United States Patent [19]

Ashley

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[45] **Dec. 2, 1975**

[54] **TOILET FLUSH SYSTEM**

[76] Inventor: **David C. Ashley,** 108 DeWitt Road, Syracuse, N.Y. 13214

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[21] Appl. No.: **396,755**

[52] **U.S. Cl.** **4/10;** 4/71; 4/80; 4/DIG. 13; 4/95

[51] **Int. Cl.²** **A47K 17/00;** E03D 11/00

[58] **Field of Search** ..... 4/1, 9, 10, 14, 17, 42, 4/45, 47, 69, 71, 76, 79, 81, 67 R, 252 A, DIG. 13, 95

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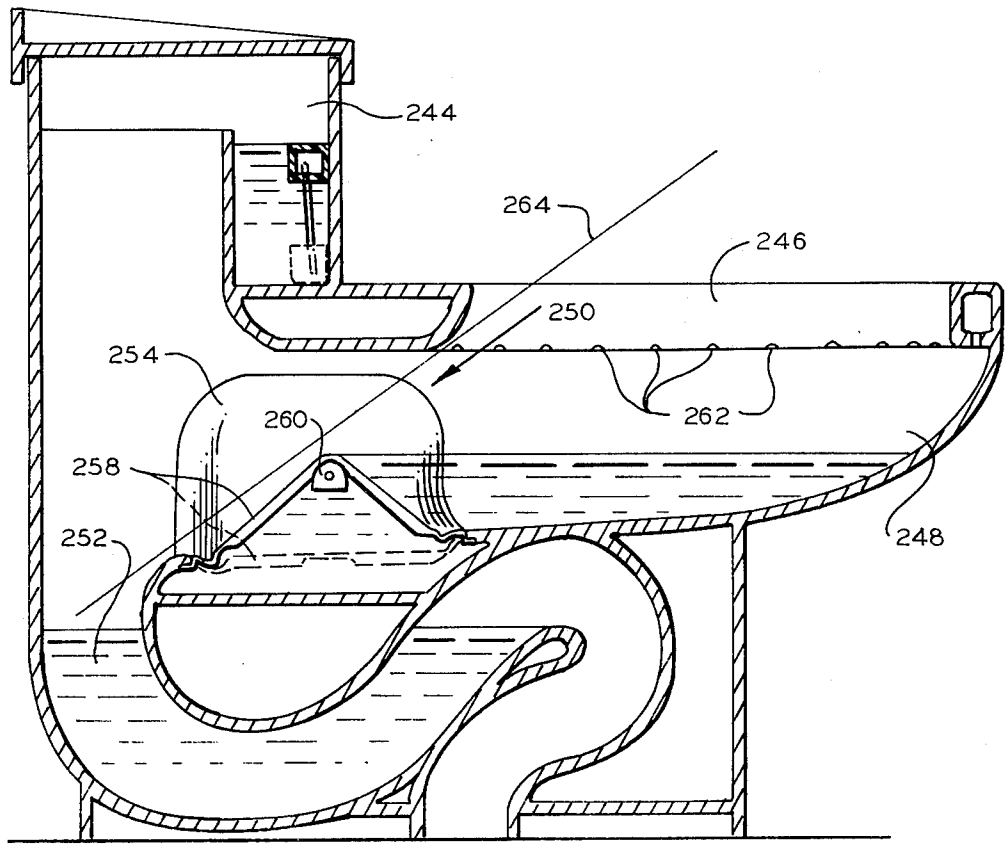
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Primary Examiner—Richard E. Aegerter
Assistant Examiner—Stuart S. Levy
Attorney, Agent, or Firm—Charles S. McGuire

[57] **ABSTRACT**

A toilet flushing system wherein water in a bowl and a conventional, change-of-direction trap, are not gravity flow communication except during flushing, although an open passageway is provided between the two for trap ventilation, cleaning and visual inspection of the trap seal. Structure higher than the bottom of the bowl prevents gravity flow until flushing, which is accomplished by relative movement of such structure and the bottom of the bowl. In the disclosed constructions the movable structure is in the form of a dam between the bowl and trap with mechanism actuated by the flush handle serving both to move the dam and to cause flushing water from an associated tank to flow through the bowl. Flushing is normally accomplished without siphon action in the trap. Tank water surrounds the element providing the dam to prevent leakage from the bowl, and to position elements of the control linkage within tank water, thereby insuring that the linkage cannot be subject to fouling or produce leakage.

10 Claims, 28 Drawing Figures



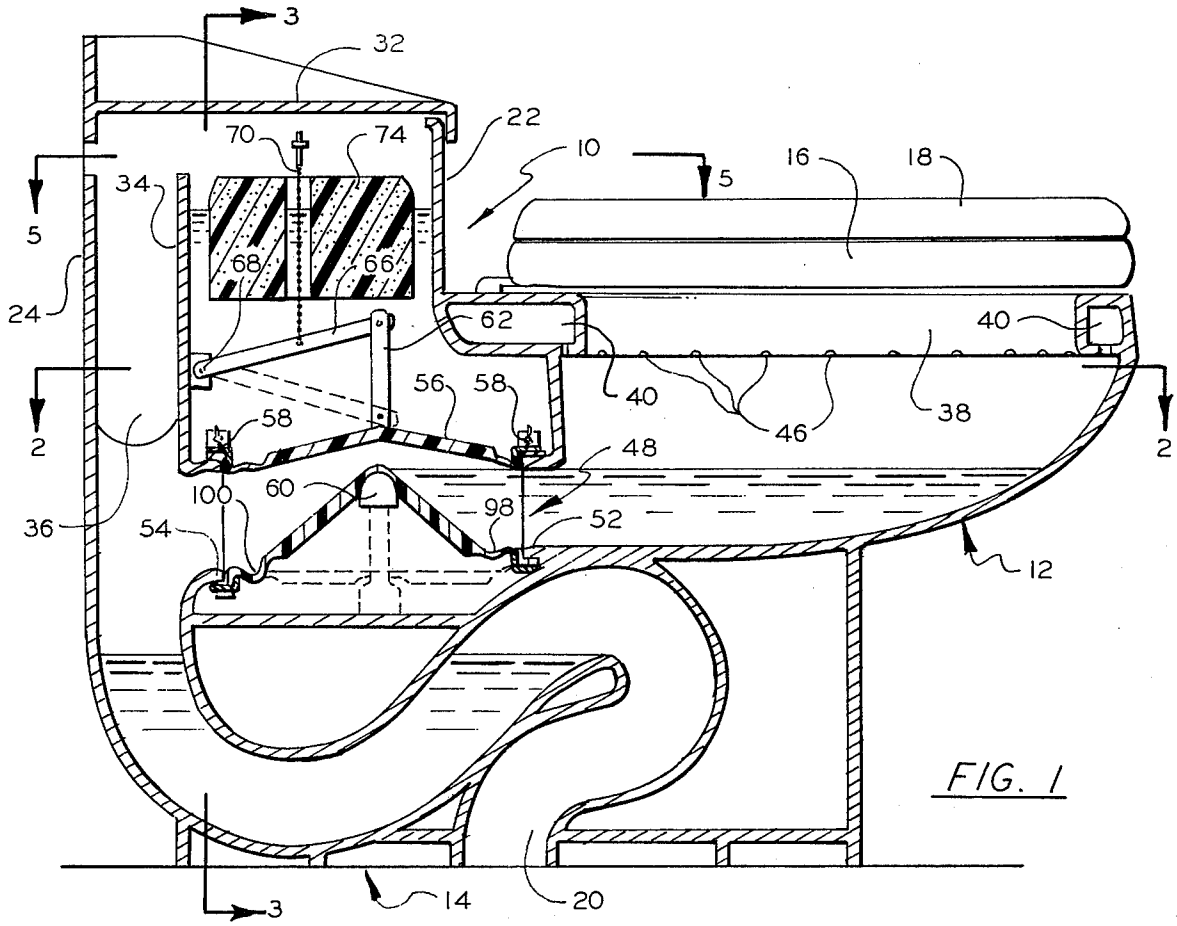

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FIG. 1

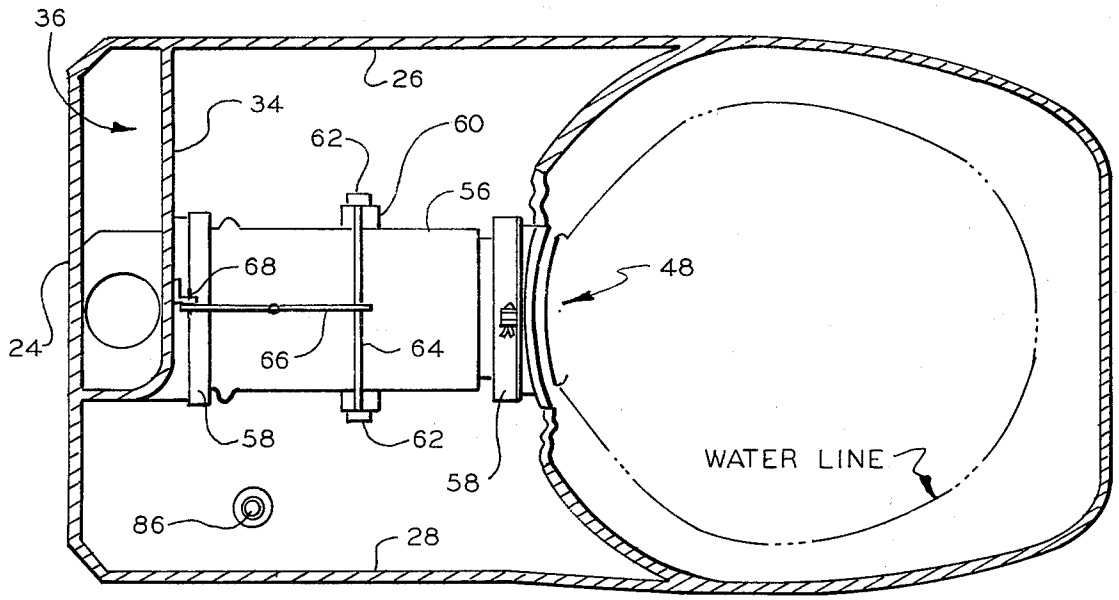

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WATER LINE
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FIG. 2

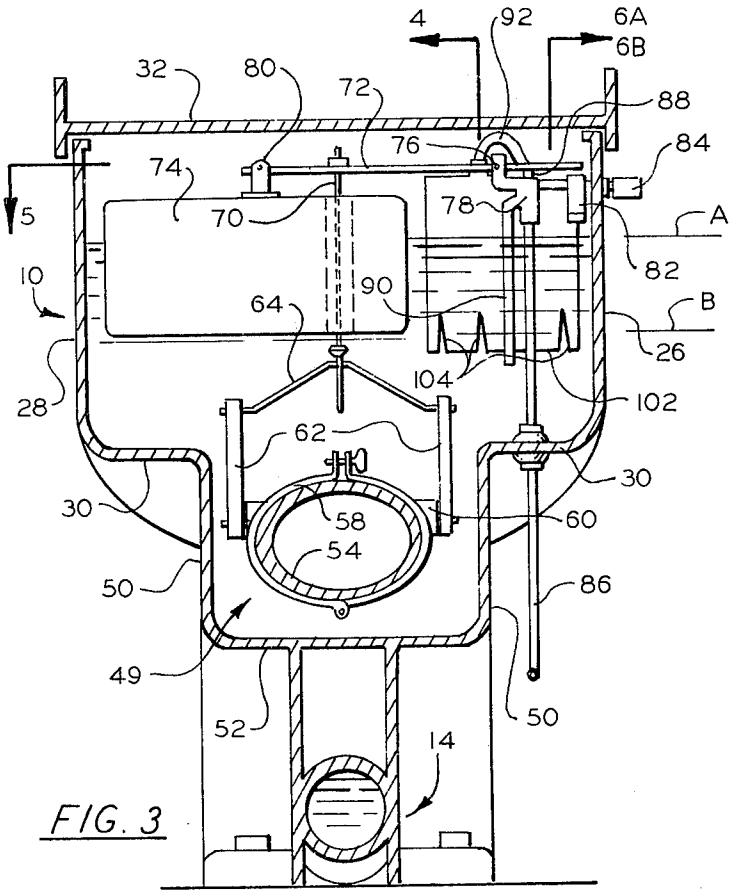


FIG. 3

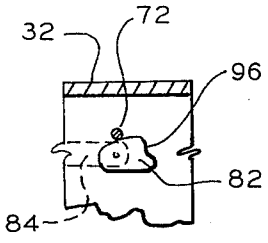


FIG. 6A

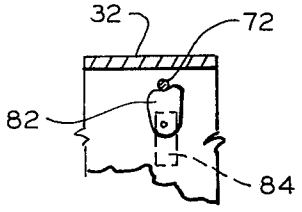


FIG. 6B

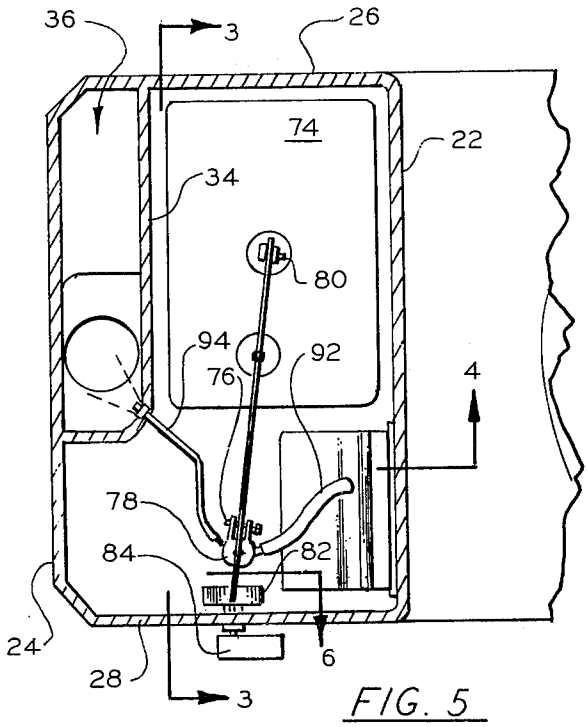


FIG. 5

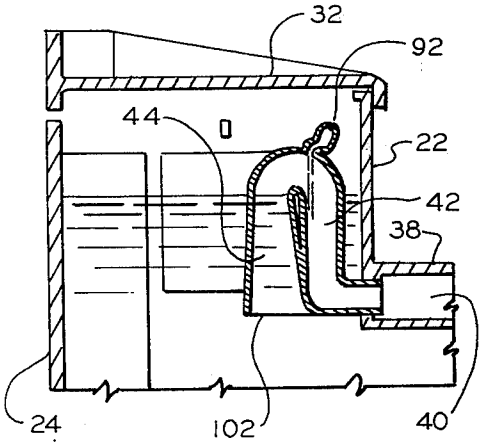


FIG. 4

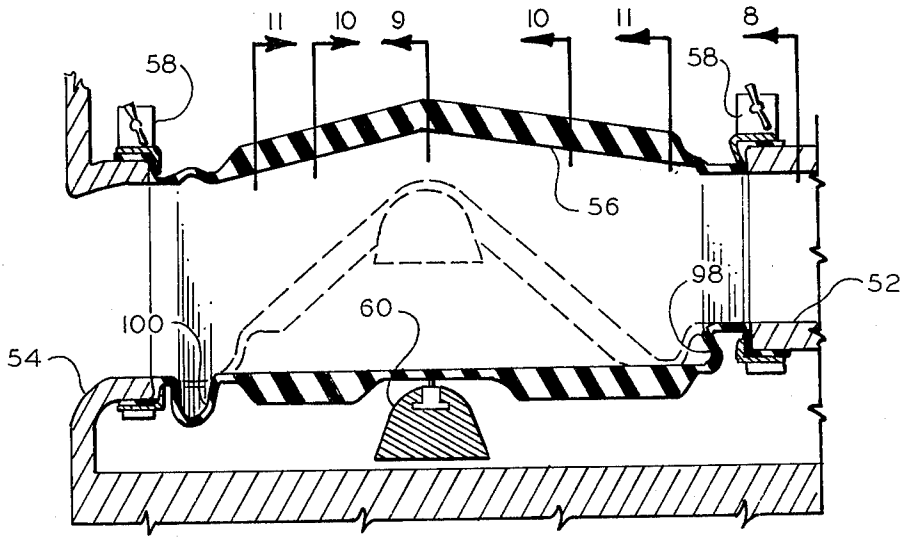


FIG. 7

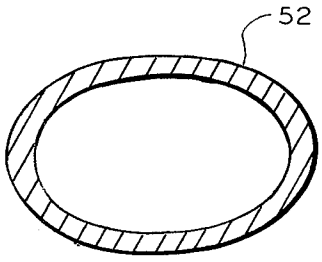


FIG. 8

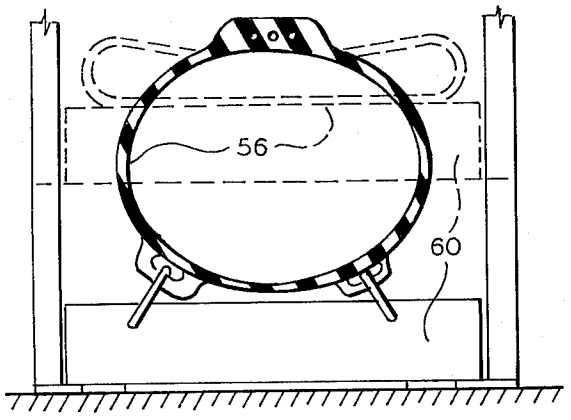


FIG. 9

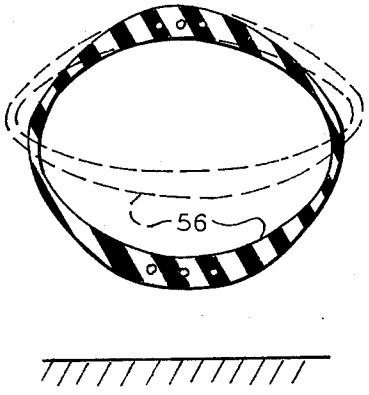


FIG. 10

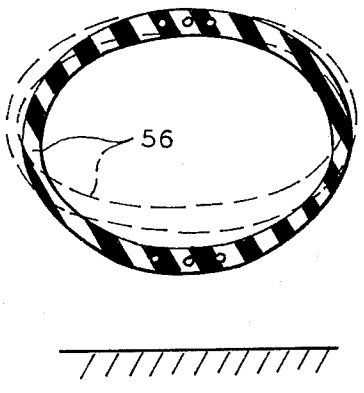


FIG. 11

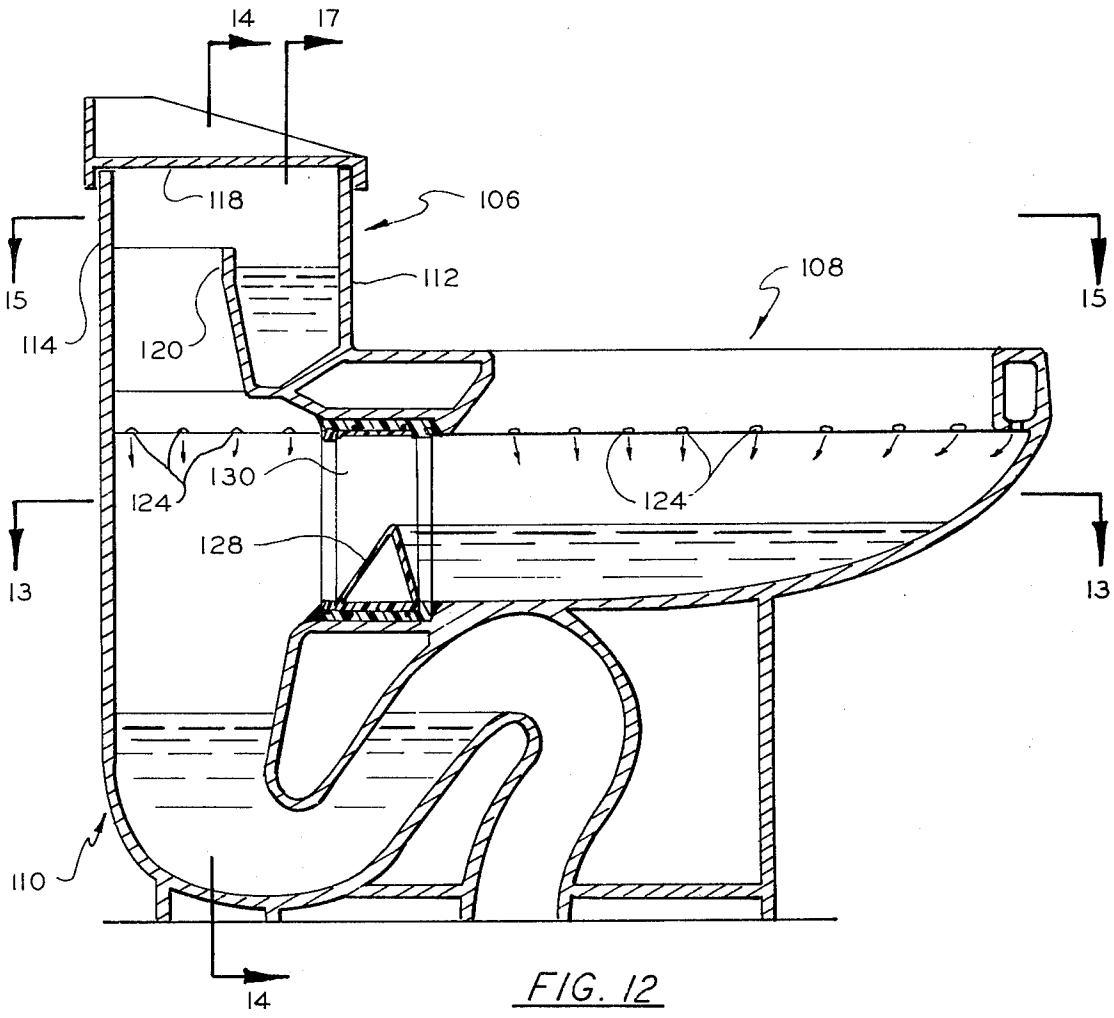

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FIG. 12

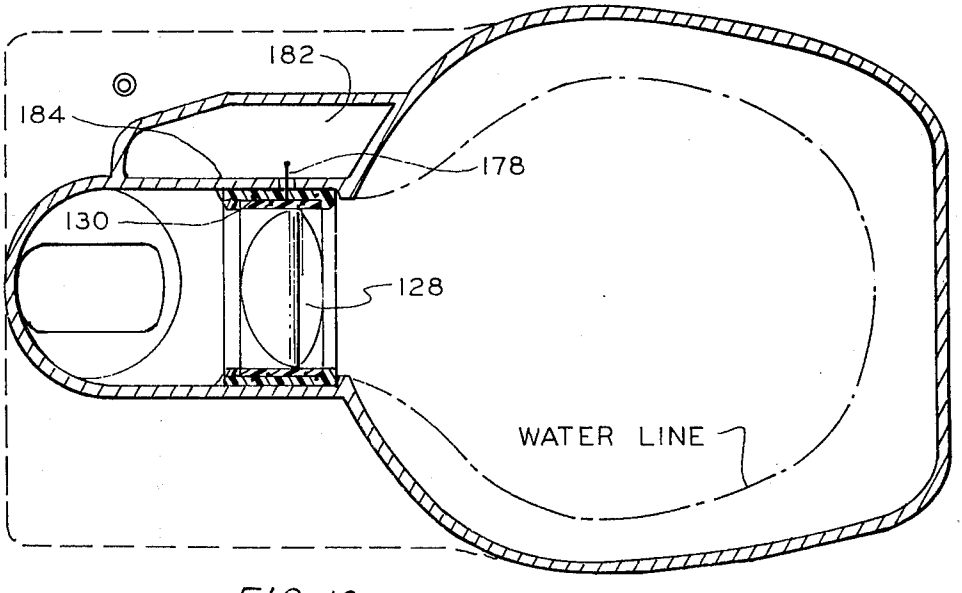

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WATER LINE

FIG. 13

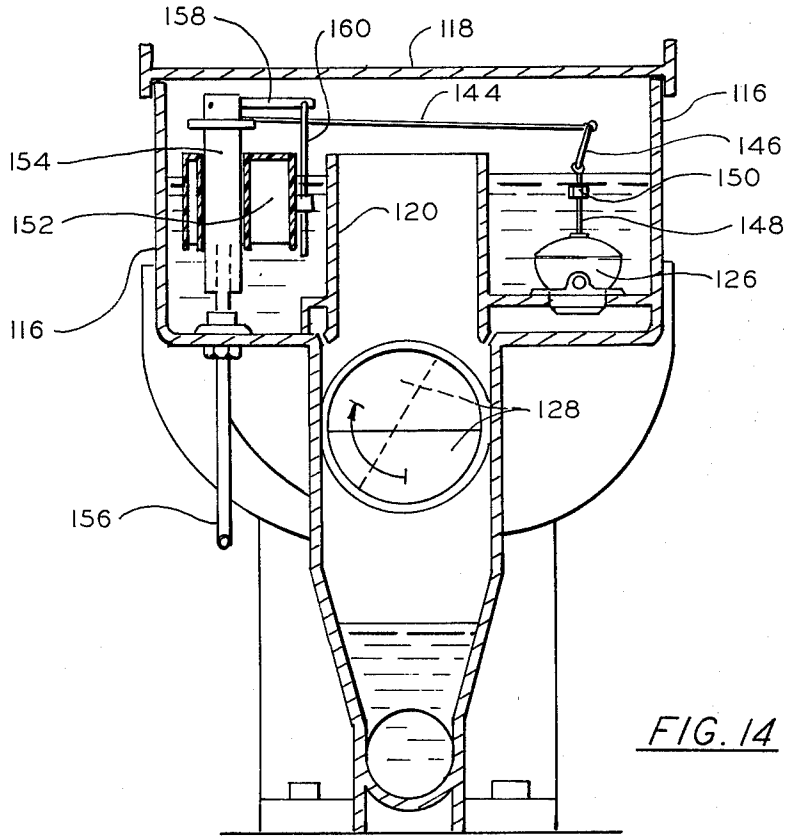

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FIG. 14

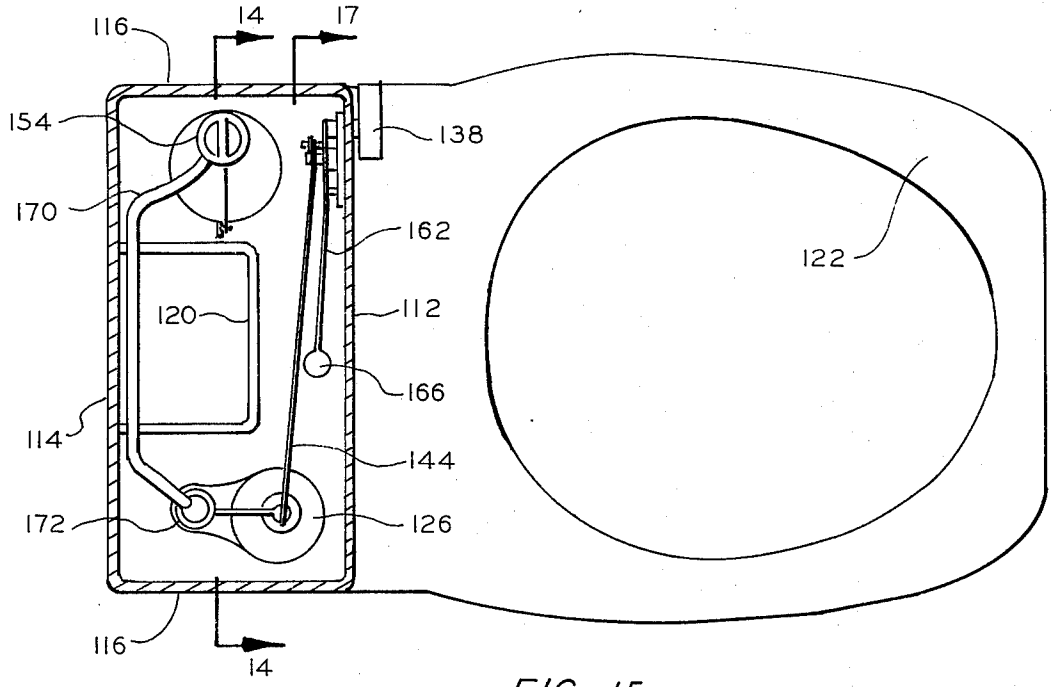

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FIG. 15

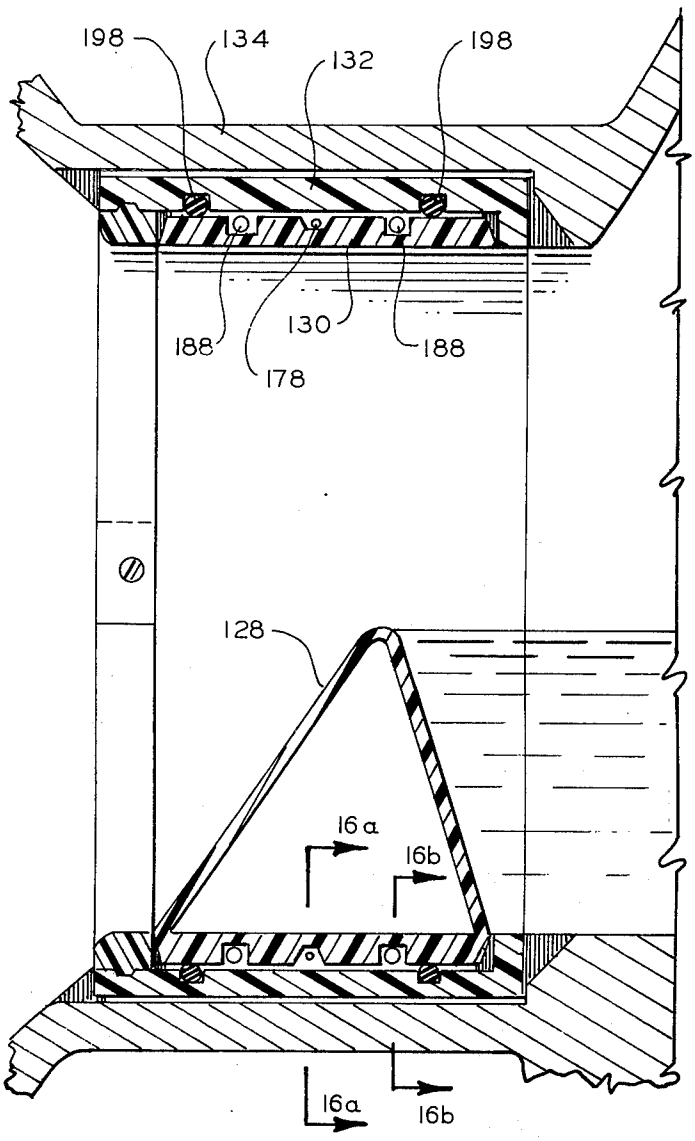


FIG. 16

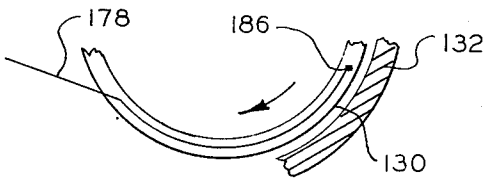


FIG. 16a

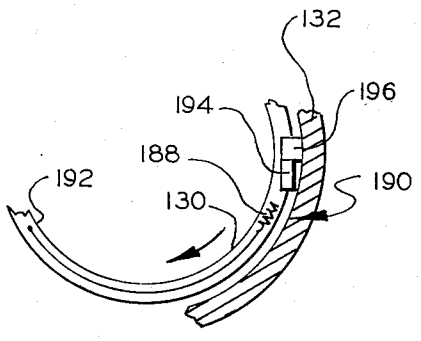


FIG. 16b

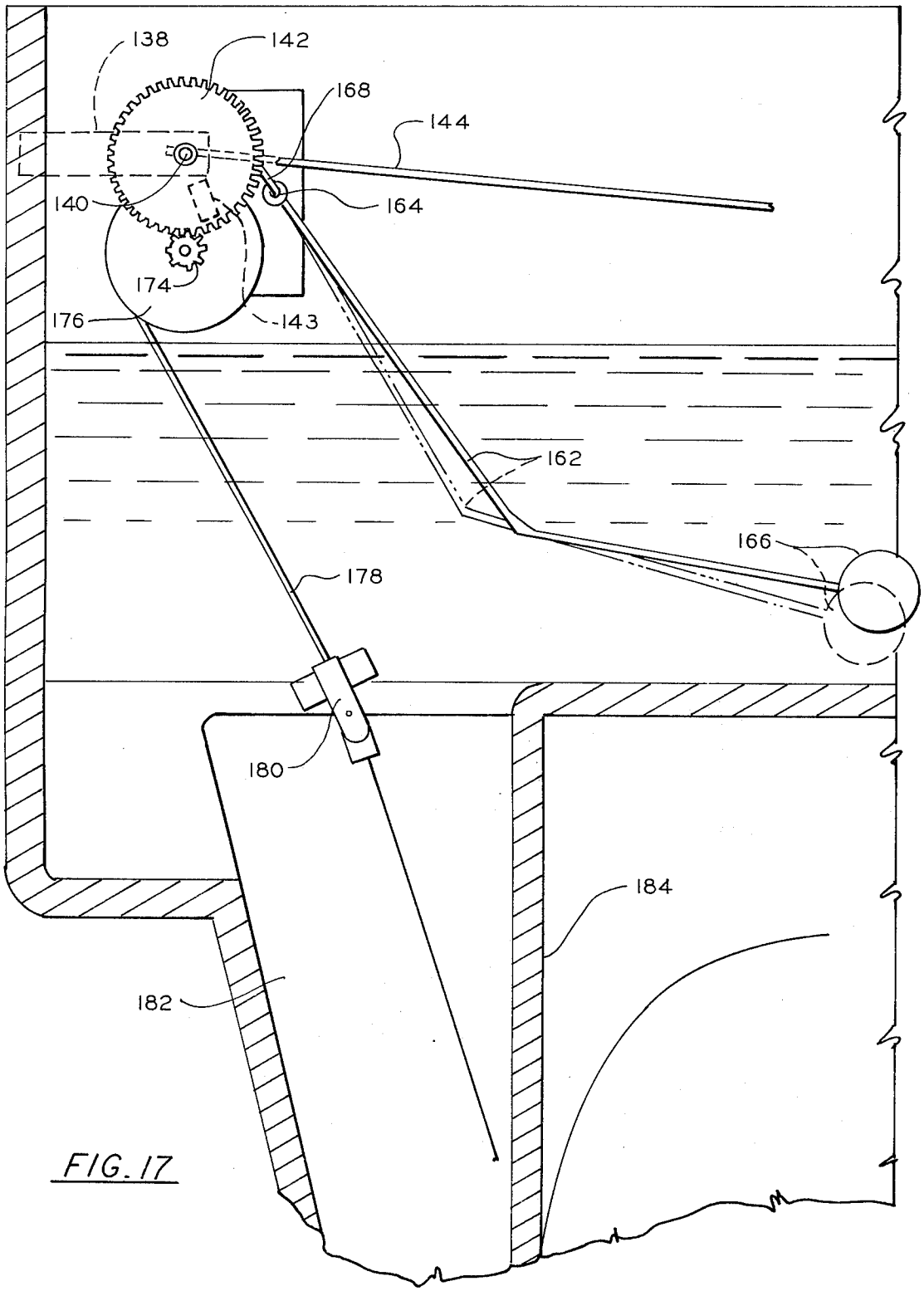


FIG. 17

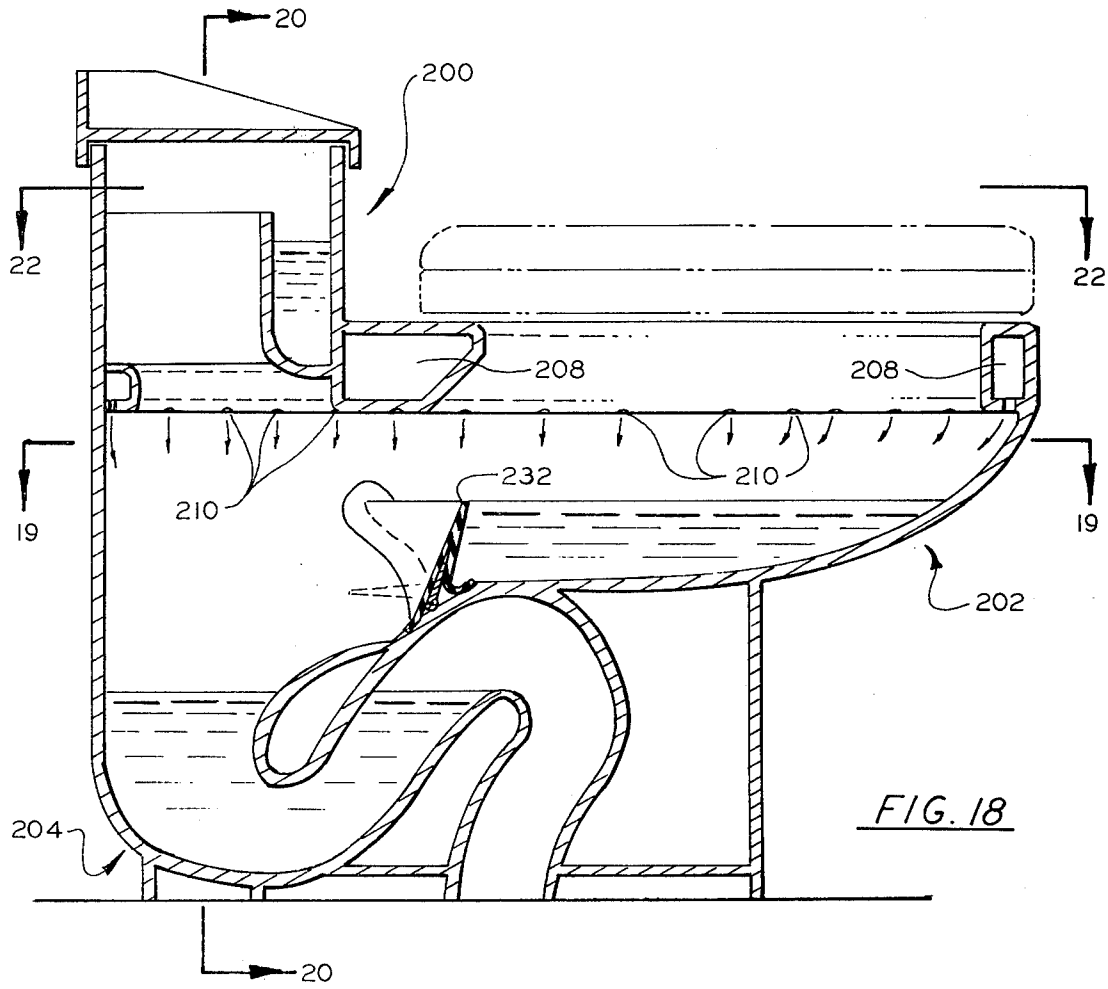

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FIG. 18

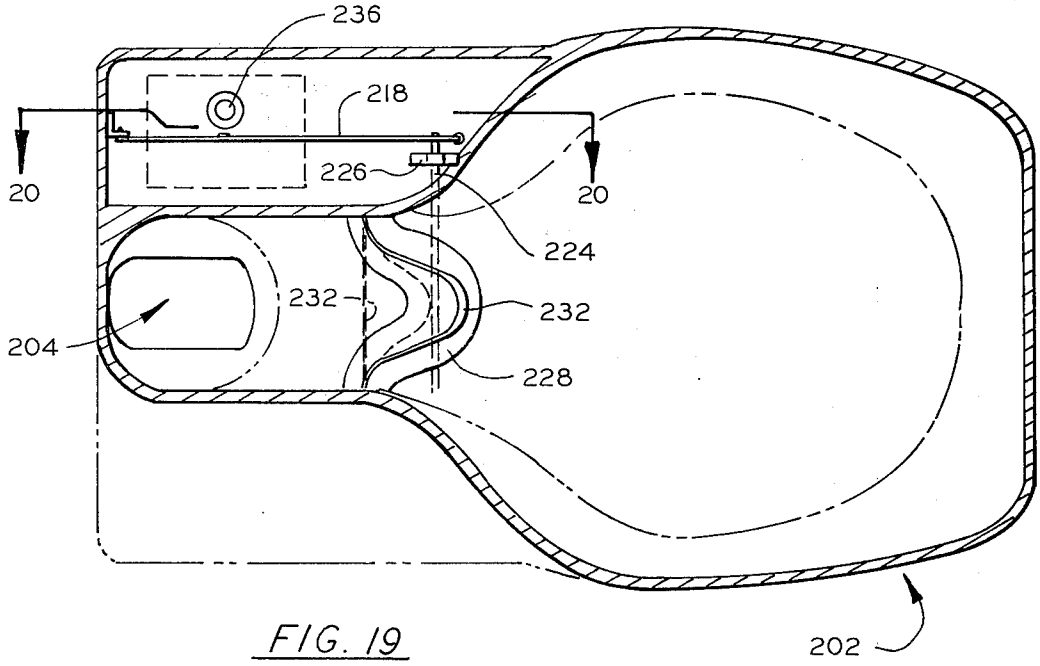

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FIG. 19

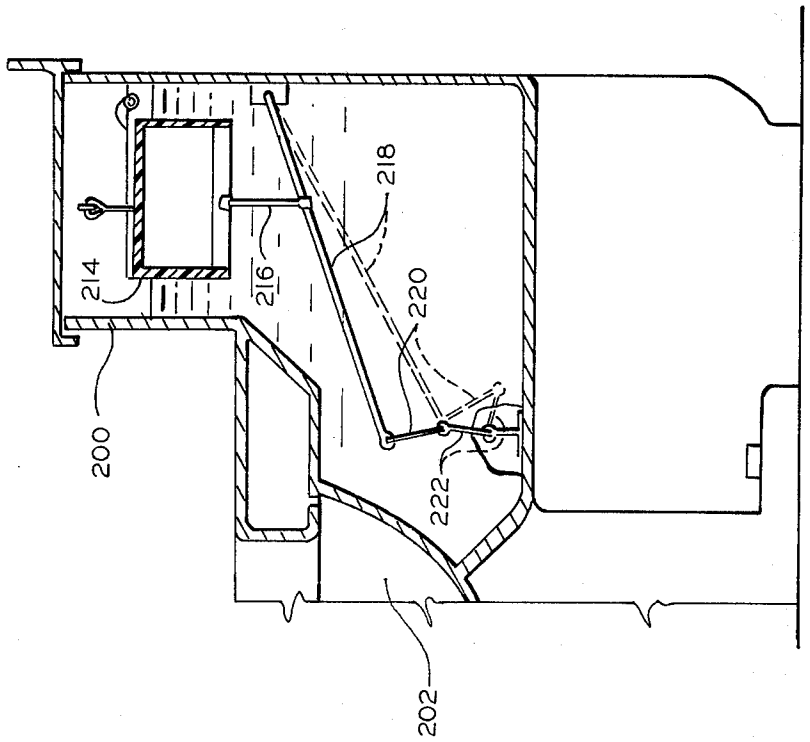

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FIG. 21

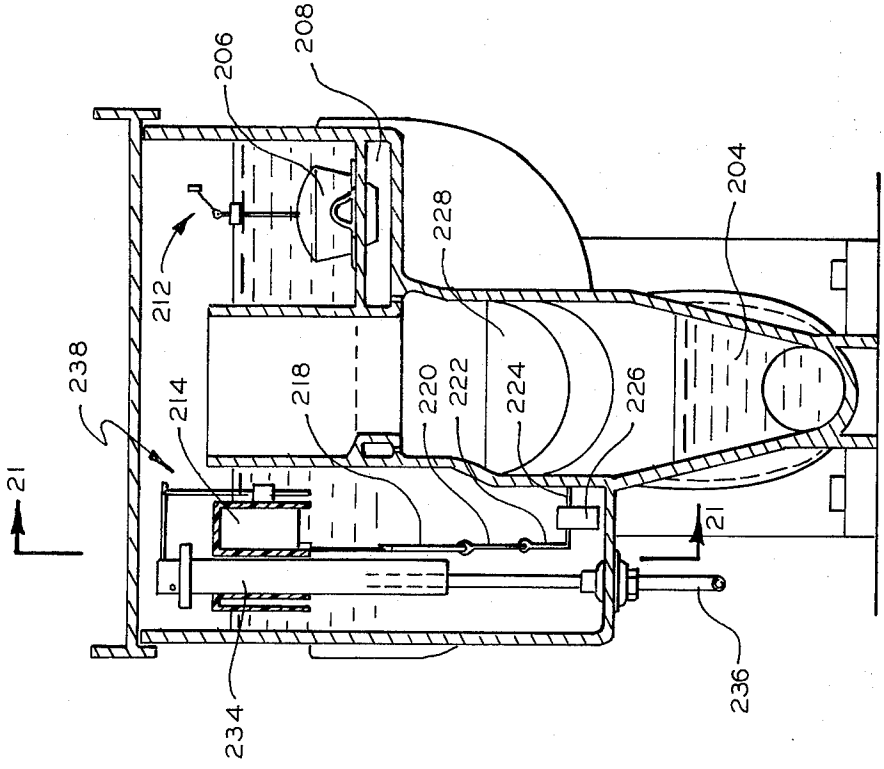

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FIG. 20

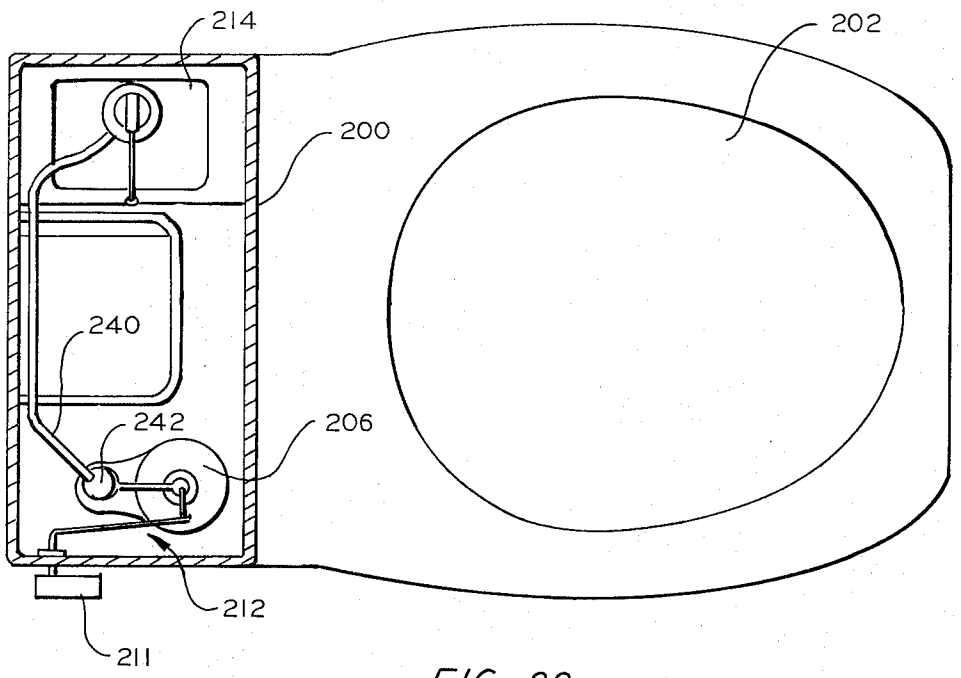


FIG. 22

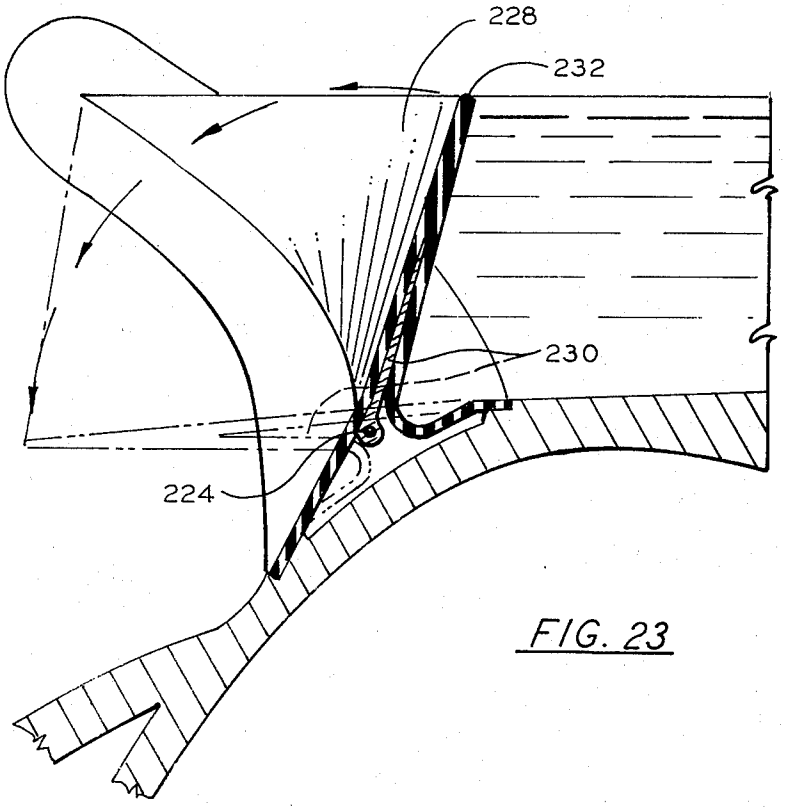


FIG. 23

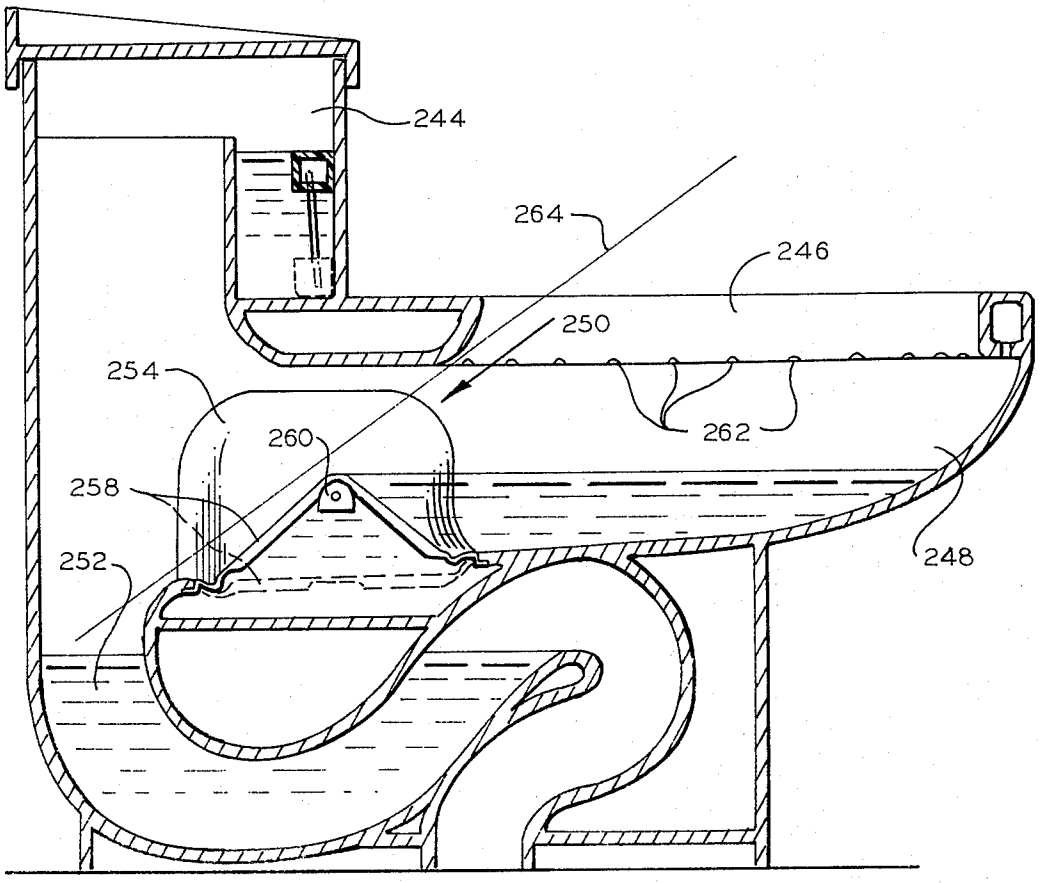


FIG. 24

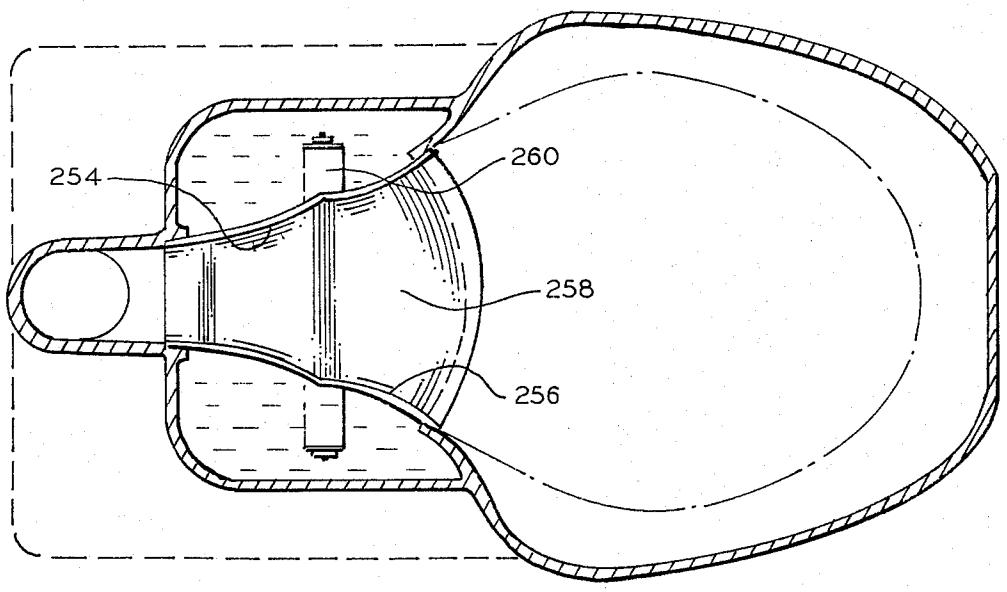


FIG. 25

TOILET FLUSH SYSTEM

BACKGROUND OF THE INVENTION

This invention relates to tank type flushing toilets, and, more particularly, to novel designs of the flushing system thereof.

Virtually all tank type flushing toilets currently used in domestic applications operate on the siphon principle. That is, a valve is opened to allow a quantity of water (normally about 5 gallons) stored in the tank to flow into the bowl and through a trap, a siphon being created as the liquid leaves the trap, tending to pull the contents out of the bowl until the siphon is broken. The change of vertical flow direction provides both the siphon effect and the trap. The liquid contents of the bowl and trap are in direct communication, thereby insuring that the liquid trap seal is not broken as long as liquid is in the bowl.

Most residential and commercial plumbing codes currently in effect require that all flushing toilets include a visible trap. The liquid seal created in the trap prevents back flow of sewer gas from the sewage discharge line and it is, of course, essential that this seal be maintained at all times. In the conventional toilet mentioned above, it is necessary only to check visually for liquid in the bowl in order to be assured that the trap seal exists.

Although it is possible to effect flushing of a conventional tank type toilet with less than the usual five gallons or so, and many so-called water saving devices have been suggested for cutting down the amount of water used for each flush, it has generally been regarded as necessary, in order to insure starting of the siphon, to use this amount of water. At the same time, it is acknowledged that approximately one-third of all typical residential water useage is required for toilet flushing. If the average amount of water could be reduced from about 5 to 1½ gallons for each flush, estimates indicate an annual saving of 15 trillion gallons on a nationwide basis. One object of the present invention is to provide a tank type toilet complying fully in all respects with present requirements, which is satisfactorily operated on much less water than is required with present commerically available toilets of this type.

Besides using large quantities of water, present toilet designs include surfaces which cannot conveniently be visually inspected for cleanliness and which are exposed to bowl water. Thus, these surfaces may not be thoroughly cleaned and may, over a period of time, build up biologically contaminated deposits which may, in turn, contaminate the water standing in the bowl. For example, the siphon outlet of many residential toilets has a front leg approximately 3 inches high, the surface of which cannot be seen directly through the bowl. Since this surface is continually exposed to bowl water, each bowl charge may become contaminated very quickly, especially since there is always some back flow from the trap to the bowl when the siphon breaks. Another object of the present invention is to provide a flush toilet design whch substantially reduces or eliminates the liklihood of such unsanitary conditions.

Other objectionable features of the more commonly used toilet designs, improvement of which are additional objects of the present invention, are: flushing noise, especially the siphon breaking noise; tendency to become blocked or clogged up; danger of overflowing when clogged; possibility of not flushing out floating matter; tank sweating in humid weather, time required to refill the tank; and, appearance of high tank designs, or extra water pressure and larger service line size in low tank designs.

Other objects will in part be obvious and will in part appear hereinafter.

SUMMARY OF THE INVENTION

In accordance with the above-stated objects, the present invention employs a bowl and a trap which are not in direct fluid communication except during flushing. In the construction shown in the drawings, movable structure best described as a dam is provided to retain water in the bowl when in a blocking position, and is selectively moveable to an unblocking position to allow flow from the bowl to the trap while water is also flowing from the tank into the bowl.

Structure providing the dam is disclosed in three forms. In one form a flexible tube connects the bowl and the trap, a lower portion of the tube being flexed upwardly by squeezing or lifting into blocking position with respect to the bowl water. In a second form, the dam is provided by a rigid element in the passage between the bowl and trap, such element being moved between the blocking and unblocking positions, for example, by rotation of the passage. A flexible lip, normally held in the blocking position, forms the dam in the third disclosed form.

In all three forms, flushing is accomplished through gravity flow without the necessity of a siphon effect at the trap, although a siphon may be used between the tank and bowl. Also, in all disclosed configurations, the control linkage for effecting movement of the dam is surrounded by tank water, as is the passage between the bowl and trap. In one form, the trap may be visually inspected through an opening at the rear of the tank to insure that a seal exists, while in the other forms the trap water may be seen by looking directly through the bowl.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** is a side elevational view, in vertical section through the center, of a toilet construction incorporating a first form of the present invention;

FIG. **2** is a top view, in section on the line **2—2** of FIG. **1**;

FIG. **3** is a rear view, in section on the line **3—3** of FIG. **1**;

FIG. **4** is a fragmentary, side view of certain portions of the toilet structure, in section on the line **4—4** of FIGS. **3** and **5**;

FIG. **5** is a top view with a portion in section on the line **5—5** of FIGS. **1** and **3**;

FIGS. **6A** and **6B** are fragmentary, side views of a portion of the structure, taken on the line **6—6** of FIGS. **3** and **5**;

FIG. **7** is an enlarged, fragmentary, side elevation, in half-section, of a portion of the construction of FIG. **1**;

FIGS. **8–11** are sectional views of the passage between the bowl and trap, each taken on the correspondingly numbered lines of FIG. **1**;

FIG. **12** is a side elevational view, in vertical section through the center, of a toilet construction embodying a second form of the present invention;

FIG. **13** is a top view, in section on the line **13—13** of FIG. **12**;

FIg. **14** is a rear view, in section on the line **14—14** of FIG. **12**;

FIG. 15 is a top view, with a portion in section on the line 15—15 of FIG. 12;

FIG. 16 is an enlarged, fragment of a portion of FIG. 12;

FIGS. 16*a* and 16*b* are fragmentary, somewhat diagrammatic sectional views of portions of FIG. 16, taken on the lines 16*a*—16*a*, and 16*b*—16*b*, respectively, thereof;

FIG. 17 is an enlarged, fragmentary view, in section on the line 17—17 of FIG. 12;

FIG. 18 is a side elevational view, in vertical section through the center, of a toilet construction embodying a third form of the invention;

FIG. 19 is a top view, in section on the line 19—19 of FIG. 18;

FIG. 20 is a rear view, in section on the line 20—20 of FIG. 18;

FIG. 21 is a fragmentary, side view in section on the line 21—21 of FIG. 19;

FIG. 22 is a top view, with a portion in section on the line 22—22 of FIG. 18;

FIG. 23 is an enlarged fragment of a portion of FIG. 18, showing certain portions in different positions of movement; and

FIGS. 24 and 25 are side and plan views, in section, of a modified form of the construction of FIGS. 1-11.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As previously mentioned, the preferred embodiment of the invention is disclosed in three forms to illustrate a number of various designs to which the invention may be adapted. The first of these is shown in FIGS. 1–11, reference first being made especially to FIGS. 1–5. The toilet structure includes tank portion 10, bowl portion 12 and trap portion 14. The open upper side of bowl portion 12 is provided in the usual manner with hinged seat 16 and lid 18. The toilet structure is anchored to the floor with discharge opening 20 in alignment with the sewage discharge line (not shown). The walls and passages of the toilet structure are preferably constructed of earthen china, in accordance with conventional practice.

Tank portion 10 forms a reservoir of fresh water ready for use in flushing the toilet. It is formed of substantially vertical front and rear walls 22 and 24, and side walls 26 and 28, having an open top and a bottom wall 30 which, as best seen in FIG. 3, has a central opening through which the tank communicates with portions of the structure described later. The open top of tank portion 10 is normally covered by removable lid 32. Wall 34 extends from side wall 26 partially across the interior of tank portion 10 and is joined to rear wall 24 to define a space denoted generally by reference numeral 36 in FIGS. 1, 2 and 5, the purpose of which is later explained. Space 36 is isolated from the water-containing portion of tank 10.

Bowl 12 is provided around the entire periphery of its open upper side with a hollow, enclosed, annular rim 38. The interior space defined by rim 38 is designated in FIGS. 1 and 4 by the reference numeral 40. As seen in FIG. 4, space 40 communicates with the interior of tank 10 through a curved pipe having vertical front and rear legs 42 and 44, respectively. The side of rim 38 facing the interior of bowl 12 includes a plurality of openings 46 (FIG. 1) along its lower edge, through which water may flow from space 40 into bowl 12. Outlet opening 48, through which bowl 12 is emptied, is provided at the lower, rear area thereof.

A chamber 49 communicating directly with the lower interior of tank 10 is provided by side walls 50 and bottom wall 52. Tank rear wall 24 (or interior wall 34) also forms the rear wall of this chamber. At the front of chamber 49, flange 52 surrounds bowl outlet opening 48, and at the rear, flange 54 surrounds an opening communicating with trap 14, all as shown in FIG. 1. Both flanges are directed inwardly with respect to chamber 49. Opposite ends of closed tube 56 are placed over flanges 52 and 54 and secured in watertight engagement therewith by clamping rings 58. The rings are preferably of L-shaped cross-sections to provide a portion encircling the tube and flange, and a second portion holding the tube firmly against the front edge of each flange.

A central portion of the lower side of tube 56 is moveable to provide a dam blocking flow out of bowl 12 through outlet opening 48. In FIG. 1 tube 56 is shown in solid lines with the central portion in the upper, blocking position, and in dotted lines in the lower position. Movement is controlled by member 60, extending across the lower side of the tube at the longitudinal center thereof. Member 60 is connected at each end to vertical links 62 which are joined at the ends opposite member 60 by rod 64. (FIGS. 2 and 3). Link 66 is mounted at one end for pivotal movement about pin 68, and other end being connected to rod 64.

Chain 70 is connected between link 66 and rod 72, passing through an opening in float 74, preferably being adjustable in length between the two connections by any convenient means. Rod 72 is mounted at a point intermediate of its ends for rotation about pin 76, passing through a fixed extension of valve body 78. One end of rod 72 is pivotally connected at 80 to float 74, the other end being positioned for contact by rotatable cam 82. Flushing handle 84 is connected to cam 82 by a pin passing through side wall 26, whereby manual rotation of the handle will rotate the cam.

Water is provided from any convenient source under normal domestic water supply pressure through line 86 (FIGS. 2 and 3). A valve of conventional construction within valve body 78 is biased toward the open position, but is held closed by rod 72 when the latter is in the position shown in FIG. 3. Element 88 extends upwardly out of valve body 78 and is connected to the valve closure element in such a way that upward movment of element 88 opens the valve. Line water pressure provides such upward movment when rod 72 is rotated in a counterclockwise direction, as seen in FIG. 3, about pin 76.

When the valve is opened, water flows from supply line 86 through three lines (the function of each being expained later), tank and siphon refill line 90, (FIG. 3) bowl refill line 92 (FIGS. 3, 4 and 5) and trap cleaning and refill line 94 (FIG. 5). Line 90 discharges downwardly, directly into tank 10. Line 92 discharges into front leg 42 of the curved pipe, as best seen in FIG. 4, and thereby into space 40 and through openings 46 into bowl 12. Line 94 discharges in the form of a jet spray into space 36 directly above the rear leg of trap 14.

The operating sequence in flushig the toilet will now be described. All elements are shown in FIGS. 1-6A in their normal positions prior to initiation of a flushing cycle, with tank 10, bowl 12 and trap 14 filled. The initial step, and the only one requiring manual operation, is rotation of handle 84 through approximately 90°

from the normal position shown in FIG. 6A to the flushing position shown in FIG. 6B. This rotates cam 82, to which the handle is attached, as previously described. The shape of cam 82 is such that rotation thereof to the position of FIG. 6B lifts the end of rod 72 in contact with the cam surface upwardly. A detent or low spot 96 is provided to define the terminal flushing position of the cam.

Upward movement of the cam-contacting end of rod 72 rotates the latter about pin 76 to move the opposite end downward. Thus, float 74 is moved downward through its connection with rod 72 at 80. The displacement of tank water resulting from downward movement of float 74 causes flow from rear leg 44 to front leg 42 of the curved pipe through which bowl water is supplied. The displacement will normally be fast and great enough to fill the upper bend of this pipe and create a siphon drawing the water from the tank through rear leg 44 into front leg 42 and thence into space 40, through rim openings 46 and into bowl 12.

As the end of rod 72 opposite the cam contacting end is lowered to push float 74 downward, chain 70 is also allowed to move downward. Referring again to FIG. 1, downward movement of chain 70 allows clockwise rotation of link 66 about pin 68, with consequent downward movement of rod 64, links 62 and element 60. The lower side of flexible tube 56, which has been held in an upper, flow blocking position shown in solid lines in FIG. 1, will then move to the position shown in dotted lines, allowing flow out of bowl 12 through discharge opening 48.

In order that tube 56 be moved in the manner indicated, keeping the ends fixed, without stretching the material, it is provided with corrugations or flexible portions of reduced thickness. The tube may be formed of a suitable flexible material such as rubber or neoprene, and may be lined on the inside with a plastic such as Teflon, Tedlar, Maylar, or the like, which are at least as smooth, easy to clean, and soil resistant as the earthen china. In order that a minimum amount of force be required to move the tube between its two positions, the number or corrugations is kept to two which are, in the illustrated embodiment, adjacent each end and indicated by reference numerals 98 and 100. Also, the corrugations are as large as possible since less force is required to straighten a large corrugation than a small one, for a given wall thickness. It will be noted that the displacement of the corrugations and their configuration when the tube is in its two positions, is such as to a void trapping any contents which may flow back into bowl 12 as the tube is moved back to the blocking position. That is, corrugation 98 is essentially straight when in the lower position and cannot trap liquid or solids which would flow back into the bowl as the center of the tube is raised. Corrugation 100, although bent in a U-shape lateral cross section which may trap liquid when in the lower position, is extended to allow such liquid to flow into the trap when the center of the tube is raised.

Returning now to the operational cycle, depression of the float starts the water flowing from the tank through legs 44 and 42 with a siphon action. With the dam formed by the center of tube 56 in the lower position, the water is free to run through leg 42 and space 40, into bowl 12 through openings 46 in rim 38, out of bowl 12 through discharge opening 48, through tube 56, into and through trap 14, and finally to the sewage discharge line through opening 20. As the water flows out of the tank 10, the level therein drops toward lower edge 102 of back leg 44 (FIGS. 3 and 4). A series of tapered grooves 104 extend upwardly from lower edge 102, as seen in FIG. 3, extending through this wall of the tubing, the passage of which is seen to be somewhat wider than it is thick. When the falling water level reaches the top of grooves 104, air will begin to enter leg 44, the quantity gradually increasing as the water level continues to drop. When sufficient air has entered, the siphon will break and water will cease to flow out of tank 10. Since the rate of increase in air entry is gradual, the siphon slows gradually to a stop and is not accompanied by the usual noise associated with abrupt sipnon breaks.

Since the water supply valve opens as soon as flushing cycle is commenced, water is continually flowing through lines 90, 92 and 94 as the above-described actions occur. The flow through line 90 will serve to refill the tank after flow therefrom is stopped as just described. Flow through line 92, as best seen in FIG. 4, is delivered directly to leg 42 of the curved pipe, thus adding to the required volume in this leg to start the siphon action. Also, the water delivered through line 92 adds considerable flow momentum to the flushing water, thus assisting the starting, continuation and rate of delivery. The flow through line 94 delivered down the portion of space 36 is directly above trap 14, thereby serving as a cleansing spray on the surfaces leading to the trap, and at the same time insuring that sufficient water will be available to establish the trap seal. Although not likely, it is possible that during flushing a siphon effect may be created in the trap, tending to draw the water therefrom after most of the bowl water has been flushed, i.e., insufficient flow from the bowl would remain to seal the trap. The continued flow from line 94, in any event, would be sufficient to insure that the trap is full.

FIGS. 8-11 illustrate the cross-sectional configuration of tube 56 at various points between its ends in both the blocking (dotted lines) and unblocking (solid lines) positions.

Turning now to FIGS. 12-17, a second form of the preferred embodiment is shown, also employing a movable dam to retain water in and release it from the bowl. Rather than distorting a flexible tube as in the first form, however, the dam is provided in a rotatable tube which is turned to remove the dam from, and replace it in, blocking position with respect to the water in the bowl.

As in the earlier described form, the toilet structure includes tank, bowl and trap portions, respectively designated generally by reference numerals 106, 108 and 110. Tank portion 106 includes front and rear walls 112 and 114, respectively, and side walls 116, with an open top over which removable cover 118 is placed. Interior wall 120 cooperates with rear wall 114 to provide an enclosed space within tank 106 vertically communicating with trap portion 110.

Bowl portion 108 again is provided with hollow rim 122 having openings 124 around the lower periphery thereof. Water may flow from tank 106 into bowl 108 through an opening in the bottom of the tank which is normally closed by stopper 126 (FIGS. 14 and 15). Water is retained in bowl portion 108 prior to flushing by dam 128 which extends across cylinder 130 for about one-half the diameter thereof. Cylinder 130 is rotatably mounted in fixed casing 132 within passageway 134 between bowl portion 108 and trap portion

110. Operation of the flush mechanism, as explained later, rotates cylinder 130 about 110° so that the top of dam 128 is in the position indicated in dotted lines in FIG. 14. The contents of the bowl may then flow by gravity through cylinder 130, into and through trap 110, and out through discharge opening 136. At the same time, water is flowing from the tank into and through the bowl, and refills the bowl upon movement of dam 128 back to the blocking position at the end of the cycle.

Flush handle 138 (FIG. 15) is connected to rod 140, extending through front wall 112 of the tank. Manual rotation of handle 138 acts through rod 140 to rotate gear 142 having fixed protrusion 143 extending therefrom (FIG. 17). As handle 138 approaches 90° of rotation, protrusion 143 contacts and lifts link 144. The latter is connected, through loose pivotal connections at each end of the rod 146, (FIG. 14) to stem 148 extending upwardly from stopper 126. Thus, rotation of handle 138 will lift stopper 126 out of the opening in the bottom of the tank, stem 148 being vertically guided by fixed element 150. In accordance with conventional practice, stopper 126 is hollow and tends to float once the hydrostatic force tending to hold it in the opening is overcome and water begins to flow out of the tank. Thus, the force required on handle 138 to establish flow out of tank 106 is rather small except for the slight amount of rotation at the very beginning of movement of link 144. If desired, of course, many conventionally means are available for providing mechanical advantage between the flushing handle and stopper, the means shown merely representing one mechanical expedient for achieving the desired motion.

Float 152 surrounds tube 154, containing a normally closed shut-off valve in water supply line 156. Arm 158 is pivotally movable to open the valve upon downward movement of float 152, connected to arm 158 by link 160. Thus, as water flows out of tank 106 upon removal of stopper 126 from the opening in the bottom of the tank, float 152 moves downwardly, rotating arm 158 and opening the valve to allow water to flow back into tank 106.

Since flow out of the tank is at a higher rate than flow in through the valve, the tank will continue to empty until stopper 126 is replaced in the opening. Referring again to FIG. 17, a ratchet mechanism is provided to prevent counter-rotation of gear 142 until the tank is virtually empty. Therefore, once stopper 126 is lifted out of the opening, it will remain in such position since arm 144 cannot be lowered until gear 142 counterrotates. Arm 162 is pivotally mounted at 164 and carries float 166 at its lower end. The upper end 168 is urged into engagement with the teeth of gear 142 by virtue of the tendency of float 166 to rise. When the tank empties, removing the buoyant force on float 166, the latter drops to the position shown in dotted lines in FIG. 17, thereby moving arm 162 about its pivotal mounting at 164 to disengage upper end 168 from the teeth of gear 142.

A biasing force provides counter-rotation of gear 142, as explained in the following paragraphs, which allows stopper 126 to drop back into the opening in the bottom of the tank. Water continues to flow into the tank until the valve within tube 154 is closed by rotation of arm 158 as float 152 rises. Line 170 extends from the water supply line on the downstream side of the valve across the rear of tank 106 to an outlet within vertical tube 172. This provides refill water to bowl 108 in the usual manner of tank-type toilets. Tube 172 communicates with hollow rim 122 so that water is flowing into the bowl after the tank has emptied until the valve in the water supply line closes after refill of both tank and bowl.

Gear 142 meshes with gear 174 which is rotatably joined to pulley 176. Flexible cable 178 is wound on pulley 176 and extends therefrom through guide 180, into lower chamber 182 (FIGS. 13 and 17) of tank 106, and through an opening in wall 184 to a connection with the periphery of cylinder 130. In FIGS. 16 and 16*a*, cable 178 is shown disposed within a groove around the periphery of cylinder 130, the end of the cable being fixedly connected to the cylinder at 186. Likewise disposed in grooves in cylinder 130 are springs 188, each connected to one end to fixed casing 132 and at the other end to cylinder 130, as indicated in FIG. 16b by reference numeral 190 and 192, respectively. Cable 178 and springs 188 may encircle cylinder 130 for any required portion of the full circumference thereof, the illustrations being intended to shown only the principles of operation and not necessarily specific details of construction.

Rotation of handle 138 is transmitted through gears 142 and 174 to pulley 176, winding cable 178 on the pulley. An appropriate mechanical stop may be provided in conventional fashion at any of several places for limiting the amount of rotation of handle 138 to the flushing position. As cable 178 is would on pulley 176, it is unwound from cylinder 130, effecting rotation of the cylinder due to the fixed connection of the cable at 186. At the same time, the tension in springs 188 is increased to create a biasing force tending to counterrotate the cylinder back to the blocking position of dam 128. Such counter-rotation is prevented by the previously described engagement of end 168 of arm 162 with gear 142. When float 166 drops to allow counterrotation of gear 142, springs 188 rotate cylinder 130 which pulls cable 178 in a direction away from pulley 176, thereby counter-rotating the pulley, gears 174 and 142, and handle 138. Fixed stops are provided on each of cylinder 130 and casing 132, such as indicated in FIG. 16*b* at 194 and 196, respectively, to limit return rotation of cylinder 130 and define the location thereof with dam 128 in the blocking position. Some degree of tension is present in springs 188 in order to maintain cylinder 130 firmly in the blocking position.

Also seen in FIG. 16 are O-rings 198 which provide seals between cylinder 130 and 132. The annular space between the cylinder and casing defined on each end by the two O-rings is filled with water since it communicates, through the opening in wall 184, with chamber 182, Accordingly, the pressure of the water within this annular space will be determined by the head within tank 106. Since this is obviously greater than the head within bowl 108, any leakage past O-rings 198 will be from the tank into either the bowl or trap, thus insuring that the bowl charge will not be lost due to leakage.

Still another construction of the invention is illustrated in FIGS. 18–23. Tank 200, bowl 202 and trap 204 are provided in the same manner as previously described constructions. Flushing action is again initiated by lifting hollow stopper 206 from the opening which it normally blocks in the bottom wall of the tank, permitting flow into the chamber 208 and through opening 210 into and through both the bowl and trap portions.

Stopper 206 is lifted by rotation of handle 210; connected to the stopper through linkage 212. As water

flows out of tank **200**, float **214** drops. Link **216** connects float **214** to pivotally mounted arm **218**, rotating the latter from the solid to the dotted line position in FIG. **21** as the float moves from its upper position, when the tank is full, to its lower position, when the tank is empty. Arm **218** is connected, at the end opposite its pivotal mounted, to link **220**, which in turn is pivotally attached to link **222**. Rotation of arm **218** moves links **220** and **222** between the solid and dotted positions shown in FIG. **21**.

At the end opposite to pivotal connection to link **220**, link **222** is rigidly connected to actuator rod **224** which extends laterally through bearing support **226** and into the passageway between bowl **202** and trap **204**. Within the passageway is movable dam **228** formed of flexible material, such as Neoprene or other suitable synthetic or natural rubber, plastic, or the like. Dam **228** is sealed along a substantially semi-cylindrical edge to the china within the lower portion of the passageway. As best seen in FIG. **23**, dam **228** is formed in two layers along the sealed edge and finger **230**, of stiff material, is inserted therebetween. Actuator rod **224** is rigidly attached to finger **230** and serves to rotate the finger between solid and dotted line positions.

Due to the flexible nature of dam **228**, movement of finger **230** moves the dam from a position wherein it obstructs flow out of the bowl, to the unobstructing position shown in dotted lines in FIG. **23**. In the obstructing position, the upper level of liquid within the bowl is defined by substantially linear edge **232** of dam **228**. This edge has essentially the same, semi-circular configuration, although in opposite directions in both positions of the dam. In the disclosed configuration, dam **228** does not undergo folding or substantial deformation in moving between the two positions. This tends to minimize the force required in moving the dam, insures that no folds, or the like, which may be subject to fouling are present, and prolongs life of the dam.

Lowering of float **214** as the water flows out of the tank **200** opens a valve within housing **234** to allow water from supply line **236** to flow into the tank, linkage **238** serving to connect the float to the valve. When the tank is substantially empty, stopper **206** again seats itself in the opening through which flushing water flows from the tank to the bowl, and the tank refills. As float **214** rises, dam **228** is moved back to its obstructing position by reverse movement of the previously described linkage between the float and finger **230**. Bowl refill line **240** extends from the water supply line above the valve, across the rear of tank **200**, as shown in FIG. **22**, and empties into tube **242**. An extension of tube **242** bypasses stopper **206** to allow water to flow into the bowl after the stopper has been replaced, thus refilling the bowl as dam **228** is moved back to its position obstructing flow out of the bowl.

It is significant to note that, as in the other constructions, all elements of the operating mechanism are surrounded by tank water. In the space between the two layers of dam **228**, for example, tank water may enter through the opening in the wall for actuator rod **224**. Since the tank, when full, provides a larger hydrostatic head than the bowl, any leakage in the seal of the dam to the china cannot produce a loss of the bowl charge.

The invention may, of course, be employed in many forms other than the constructions previously described. In fact, rather than providing for flow from the bowl into the trap by moving a wall within the passageway between the two, it is possible to make the bottom of the bowl lower than the passageway and raise it to a height permitting flow to the trap. That is, the invention contemplates providing relative movement of the bowl and the wall obstructing flow therefrom in order to effect flushing in a toilet construction wherein the bowl contents are isolated from the trap prior to flushing, with an open passageway therebetween. Furthermore, an open tube extending vertically into the bowl could be employed with the trap inlet visible within the tube. The upper edge of the tube would define the maximum height of bowl water and means for lowering this edge would be provided for draining the bowl.

An alternate construction of the first-described form of the invention is shown in FIGS. **24** and **25** as an example of contemplated modifications. Rather than constructing the entire passageway between tube and trap in the form of a flexible tube, only the lower part of the pivotally is flexible. Tank **244** valve upon through an appropriate valve opening with hollow rim **246**, as in previous constructions. Bowl **248** communicates through open passageway **250** with inlet side **252** of the trap. The element providing the movable dam is constructed of flexible material and includes side portions **254** and **256**, and lower portion **258**. Side portions **254** and **256** are cemented or otherwise joined to portions of the china within passageway **250**. Lower portion **258** is likewise sealed at the front and rear, and includes corrugations of reduced thickness at the front and rear, adjacent the seals, and at the center.

Bar **260** extends across the center corrugation below lower portion **258** of the dam within chamber **262**, communicating directly with the interior of tank **244**. A suitable crank mechanism, or the like, is connected from bar **260** to movable elements of the flushing system through linkages. The mechanism for moving bar **260** and connecting it to the flushing system is not shown in FIGS. **24** and **25**, the mechanism described in previous constructions, or modifications thereof within the purview of those skilled in the art, being suitable.

When the flushing system is actuated by movement of the usual handle on the outside of tank **224**, bar **260** is lowered to allow lower portion **258** of the dam to move to the dotted line position of FIG. **24**, allowing flow from bowl **248** to trap inlet **252** through passageway **250**. At the same time, the water within tank **244** is released to flow through hollow rim **246** and openings **262** therein, into and through bowl **248**, passageway **250** and the trap. After the tank has emptied to the desired level, the stopper is replaced to allow the tank to refill through the water supply line, and bar **260** is raised to move lower portion **258** of the dam back to the obstructing position shown in solid lines in FIG. **24**. The bowl is refilled through an appropriate refill line as described in connection with the previous constructions.

It will be noted that the water forming the trap seal is visible through the bowl and open passageway, as indicated by line **264**. Furthermore, all operating elements are surrounded by tank water and any leakage due to imperfect seals around the movable dam will be from the tank and not from the bowl. Again, the open passageway and operation of the flushing system enhances sanitation, reduces liklihood of clogging and makes unclogging easier. It is also apparent that all areas above the trap inlet are directly ventilated.

Thus, there has been disclosed a toilet flushing system incorporating a number of advantages over conventional, siphon-type flushing systems wherein the

bowl and trap water are in continuous communication. Not only is complete and sanitary flushing accomplished with a great deal less water and noise, but the possibility of bowl water being contaminated by backflow from the trap or deposits on trap surfaces. The trap is visible, ventilated and easy to clean and unclog.

The possibility of the bowl water leaking out to the trap is minimized or eliminated by providing tank water, with a higher hydrostatic head, on the opposite side of any seals of flexible or movable elements to the rigid china bowl or passageway structure. In FIG. **16**, for example, casing **132** is rigidly affixed to china passageway **134** by cement, mastic, or other suitable permanent bonding material, as indicated at the ends, while packing material and O-rings provide a seal between cylinder **130** and casing **132** allowing rotational movment of the cylinder. Tank water is provided on the side of this rotary seal opposite the bowl water.

Finally, it should be noted that movement of the dam portion may be accomplished by water flow upon initiation of the flushing cycle rather than by mechanical connections of the elements in the tank to the dam structure. In the embodiments of FIGS. **1–11**, and **24** and **25**, for example, the lower side of the flexible tube would be lowered to allow flow out of the bowl by evacuating the water from the space around the tube which forms the dam. What is claimed is:

1. A toilet of the type wherein flushing water is provided to carry the bowl contents through a liquid sealed trap, said toilet comprising:

a. a bowl having an open top and a laterally disposed outlet;

b. a trap having inlet and outlet sides defined by a pipe having two vertical changes of direction, with liquid being retained to seal the trap between said inlet and outlet sides;

c. dam means between said bowl outlet and trap inlet movable between a first portion, wherein said dam means obstructs flow between said bowl outlet and trap inlet to mutually isolate the liquids in said bowl and trap, and a second position, wherein liquid may flow by gravity from said bowl outlet to said trap inlet;

d. a passageway connecting said bowl outlet and trap inlet, said dam means being disposed in said passageway and said trap being laterally disposed with respect to said bowl outlet to permit direct visibility of the liquid at said trap inlet through said bowl outlet and passageway when said dam means is in said first position;

e. first means for effecting movement of said dam means between said first and second positions;

f. second means for providing a flow of flushing liquid into said bowl; and

g. actuating means manually movable to effect cooperative actuation of both said first and second means.

2. The invention according to claim **1** wherein said dam means, when in said first position, extends from the bottom of said outlet to a predetermined height, obstructing gravity flow through said outlet of liquid within said bowl below said predetermined height, said outlet extending above said predetermined height to provide ventilation and visibility of the liquid at said trap inlet therethrough when said dam means is in said first position.

3. The invention according to claim **2** wherein said dam means comprises a flexible member disposed in said passageway, and said first means comprises means for raising and lowering a portion of said member between said first and second positions, respectively.

4. The invention according to claim **3** wherein said flexible member extends along the direction of flow from said bowl outlet to trap inlet, and a central portion thereof is raised and lowered between said first and second positions.

5. The invention according to claim **1** and further including an associated tank with a water supply line and refill valve, and wherein said second means includes communicating passageways through which water flows from said tank to said bowl upon actuation.

6. The invention according to claim **5** wherein said actuating means comprises an element movable to remove a stopper from an opening in the lower part of said tank communicating with said passageways.

7. The invention according to claim **6** and further including a siphon tube having inlet and outlet sides communicating with said tank and said bowl, respectively, and wherein said actuating means comprises an element movable within said tank to initiate a siphon through said tube.

8. The invention according to claim **5** wherein said first means includes a float in said tank operatively connected to said dam means to effect movement of the latter between said first and second positions as said float moves in response to the water level in said tank.

9. The invention according to claim **8** and further including linkage connecting said float to said dam means and positioned entirely within space communicating directly with the interior of said tank and below the lowest level reached by the tank water, whereby said linkage is positioned within water from said tank.

10. The invention according to claim **9** and further including a passageway between said bowl and said trap wherein said dam means is disposed, said passageway being at least partially surrounded by water from said tank.

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