



(51) International Patent Classification:
E03D 1/35 (2006.01) *F16K 33/00* (2006.01)
F16K 31/18 (2006.01)

(74) Agent: **FORDENBACHER, Paul J.**; Silicon Forest
Patent Group, 11876 NW Tyler Ct., Portland, Oregon
97229 (US).

(21) International Application Number:
PCT/US2010/043147

(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ,
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO,
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP,
KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD,
ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI,
NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD,
SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR,
TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(22) International Filing Date:
23 July 2010 (23.07.2010)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant (for all designated States except US): **WATER
CONSERVATION PROFESSIONALS LLC** [US/US];
235 Spyglass Dr., Eugene, Oregon 97401 (US).

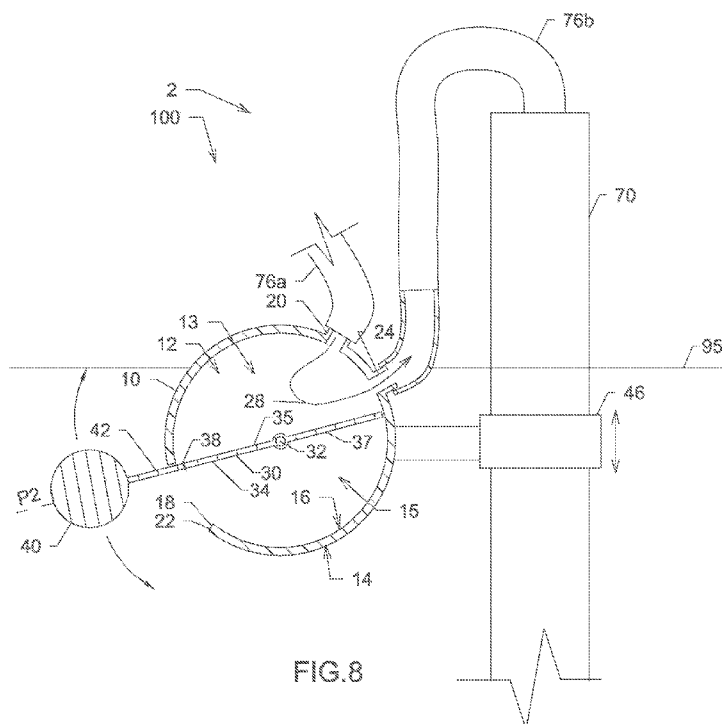
(72) Inventors; and

(75) Inventors/Applicants (for US only): **HUBER, Brandon
Anton** [US/US]; 235 Spyglass Dr., Eugene, Oregon
97401 (US). **HUBER, Richard Anton, Jr.** [US/US];
84500 Sarvis Berry Ln., Eugene, Oregon 97405 (US).
HADD, Robert Ernest [US/US]; 1600 Rhododendron
Dr., #617, Florence, Oregon 97439 (US).

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG,
ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU,
LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK,
SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: WATER SAVER TOILET CONTROL VALVE



(57) Abstract: In accordance with embodiments of apparatus and methods, a control valve suitable for use with a gravity-assisted flush toilet is presented providing means for automatically controlling the supply of mains water to the bowl. In accordance with some embodiments, the control valve supplies at least a portion of the mains water from the fill valve bowl outlet to the tank reservoir until the tank water level is at a predetermined height in the tank reservoir, at which time, the control valve diverts at least a portion of the mains water supplied by the fill valve bowl outlet to the overflow pipe, and therefore to the bowl.



Published:

— *with international search report (Art. 21(3))*

WATER SAVER TOILET CONTROL VALVE

Inventors: Brandon Anton Huber, Richard Anton Huber Jr., and Robert Ernest Hadd

5

FIELD

The embodiments presented herein are generally related to toilet tank plumbing and more particularly to valves that control the flow of water to the toilet bowl.

BACKGROUND

10

The toilet is one of the biggest users and wasters of water in the household.

15

The modern gravity-assisted flush toilet 50 is well known in the art as illustrated in FIGs. 1 and 2. The toilet 50 comprises a bowl 80 and a tank 90. The tank 90 is placed at a height that is higher than the bowl 80. The tank 90 defines a tank reservoir 92 that is coupled in fluid communication to the bowl 80. The tank reservoir 92 stores a quantity of tank water 94 so as to provide a rush of water into the bowl 80 when a flush valve 96 between the tank reservoir 92 and the bowl 80 is opened.

20

The bowl 80 provides a pool of bowl water 84 that is coupled in fluid communication to a drain 52 by a water trap 88. When the bowl water 84 reaches an overflow level 89, the bowl water 84 overflows into the drain 52 at an overflow 83 taking any waste in the bowl 80 with it. In most toilets 50 the bowl 80 is constructed such that when tank water 94 in the tank reservoir 92 is quickly released into the bowl 80, the tank water 94 is directed towards the water trap 88 and drain 52 through the bowl water 84 which creates a siphoning action assisting in draining the bowl water 84. The water trap 88 provides a water seal between the bowl 80 and the drain 52 to prevent sewer gas from entering the bowl 80 from the drain 52. The overflow level 89, defined by the top of the overflow 83, determines the maximum height of the bowl water 84 when the flush and refill is completed.

25

30

Valves and other plumbing associated with the flush toilet are well known in the art. Referring to FIGs. 1 and 2, the main plumbing components of a flush toilet 50 include a fill valve 60, an overflow pipe 70, and a flush valve 96. The fill valve 60 refers to the device in the tank reservoir 92 that controls the flow of mains water from the water main 54 to the tank reservoir 92 and bowl 80. The fill valve 60 includes a fill valve inlet 62 that is coupled in fluid communication to the water main 54. The fill

valve 60 includes a fill valve tank outlet 64 and a fill valve bowl outlet 66 which direct mains water to the tank reservoir 92 and the bowl 80, respectively, at the same time as the fill valve inlet 62 is in fluid communication with the fill valve tank outlet 64 and the fill valve bowl outlet 66. The fill valve 60 is controlled by a fill vane float 68 that is
5 coupled to the fill valve 60 in such a way that when the tank water 94 in the tank reservoir 92, and thus the fill vane float 68, is below a predetermined level, referred to as the fill vane float maximum level 69, the fill valve 60 is opened to fill the tank reservoir 92 and bowl 80 with water. When the raising water in the tank reservoir 92 raises the fill vane float 68 to the fill vane float maximum level 69, the fill valve 60 is
10 closed shutting off the flow of mains water to the tank reservoir 92 and the bowl 80. Thus, the fill valve 60 stops filling the bowl 80 when the tank reservoir 92 is filled.

The overflow pipe 70 is a vertical tube defining a lumen therethrough that is open at the overflow pipe top 72 defining an overflow pipe inlet 78. The overflow pipe 70 drains water from the tank reservoir 92 that is above the overflow pipe top 72, and
15 thus determines an overflow pipe level 74 defining the maximum height of the tank water 94 in the tank reservoir 92. The overflow pipe 70 defines an overflow pipe outlet 79 that is coupled in fluid communication to the bowl 80 such that overflow water from the tank reservoir 92 is drained to the bowl 80. The overflow pipe 70 prevents the water from overflowing the top of the tank reservoir 92 in cases where the fill valve 60
20 malfunctions and does not turn off the flow of mains water.

During a flush, the tank water 94 in the tank reservoir 92 is released into the bowl 80 via a tank conduit 97, the opening and closing of which is controlled by the flush valve 96. The flush valve 96 is commonly coupled to a handle by a chain 98. A user engages the handle to open the flush valve 96 so as to release the tank water 94
25 into the bowl 80, and thus, flushing the toilet 50. The flush valve 96 is commonly held in the open position by a buoyancy effect on the flush valve 96 by the tank water and closes, sealing the tank conduit 97, when the buoyancy effect is reduced by the lowering tank water level 95 in the tank reservoir 92 during the flush. The flush valve 96 is held closed by the water pressure of the tank water 94 during refill and inactivity.

30 After the tank water 94 is released into the bowl 80, the siphoning effect of the emptying bowl 80 into the drain 52 may leave the bowl 80 with a less than desired amount of bowl water 84 were it not for the fill valve 60 refilling the bowl 80. The fill valve 60 supplies water to the fill valve bowl outlet 66 simultaneously with supplying

mains water to the fill valve tank outlet 64. The fill valve bowl outlet 66 is coupled in fluid communication to the overflow pipe inlet 78 by a bowl refill hose 76. The fill valve 60 supplies a portion of the water from the water main 54 to the tank reservoir 92 and to the overflow pipe 70. The water supplied to the overflow pipe 70 drains into the bowl 80 through the overflow pipe outlet 79 thus refilling the bowl 80 with water.

Since the fill valve 60 supplies mains water to the fill valve bowl outlet 66 simultaneously with supplying mains water to the fill valve tank outlet 64, the timing of the tank reservoir refill and bowl refill has been a long standing problem with the modern flush toilet 50. Ideally, the bowl 80 and tank reservoir 92 will reach their predetermined fill levels simultaneously. This ideal condition is rarely, if ever, achieved. Where the bowl 80 refills with water before the tank reservoir 92 is full and the fill valve 60 is closed, excess bowl water 84 in the bowl 80 overflows the water trap 88 and is wasted down the drain 52. Where the tank reservoir 92 refills before the bowl 80 refills, a less than ideal amount of bowl water 84 will be in the bowl 80. The ideal water level in the bowl 80 is rarely achieved without wasting bowl water 84 over the water trap 88.

The timing of tank water 94 and bowl water 84 refill is influenced by many factors and variables. Such factors include, but are not limited to, the proportion of mains water divided between the fill valve tank outlet 64 and the fill valve bowl outlet 66, and the size of the tank reservoir 92 and bowl 80 of a particular model of toilet 50. Such variables also include, but are not limited to, whether a partial or full flush is used (the time that the flush valve remains open), the water pressure from the water main 54, and the effectiveness of the siphoning action which may be dependent on waste load.

The timing of tank water 94 and bowl water 84 refill is further complicated by the use of various "water-saving" devices. Many water-saving devices are directed to controlling the amount of tank water 94 used from the tank reservoir 92 to supply the bowl 80. For example, in an effort to save water, two-stage flush mechanisms have been developed where, in a first stage, or partial flush, only a portion of the tank water 94 is allowed to pass through the flush valve 96 to accommodate the flushing of liquid waste. Since less tank water 94 is released from the tank reservoir 92, tank reservoir 92 refilling is faster with less mains water used than a full flush. A second stage provides a more complete tank reservoir 92 discharge to accommodate the flushing of

solid waste. Since more tank water 94 is released from the tank reservoir 92, tank reservoir 92 refilling is slower with more mains water required than the first stage flush. Regardless of which stage is used for a particular flush, the bowl 80 is required to be refilled to a desired level. Therefore, the amount of mains water for bowl refill is commonly adjusted to be completed by the time the tank reservoir 92 is refilled for the stage one, shortest refill time, condition. Therefore, in the stage two condition, the bowl 80 is supplied with much more mains water than necessary to refill the bowl 80 wasting the overflowing water through the water trap 88 to the drain 52.

Accordingly, there is a need in the art for improved apparatus and methods for conserving water usage by controlling tank and bowl refill such that an ideal water level may be achieved in the bowl without wasting bowl water over the water trap and down the drain during the refilling of the bowl.

SUMMARY

Embodiments provided herein provide apparatus and methods suitable for use with a gravity-assisted flush toilet for automatically controlling the flow of water from a fill valve bowl outlet of a fill valve to the tank reservoir and the bowl operable to control the water level in the bowl and to substantially prevent wasting bowl water over the water trap and down the drain during the refilling of the bowl.

Embodiments are provided of a control valve for use with a toilet. The toilet includes a tank in fluid communication with a bowl. The tank defines a tank reservoir operable for storing water and housing associated plumbing including an overflow pipe and a fill valve. The overflow pipe includes a lumen therethrough defining an overflow pipe inlet at one end in fluid communication with the tank reservoir and an overflow pipe outlet at an opposite end in fluid communication with the bowl. The fill valve includes a fill valve inlet, a fill valve tank outlet in fluid communication with the tank reservoir, and a fill valve bowl outlet in fluid communication with the overflow pipe inlet. The fill valve inlet is in fluid communication with the fill valve tank outlet and the fill valve bowl outlet. The bowl is in fluid communication with a water trap and drain, The control valve comprises means for automatically controlling the flow of water from the fill valve bowl outlet to the tank reservoir and the bowl operable to control the water level in the bowl and to substantially prevent wasting bowl water over the water trap and down the drain during the refilling of the bowl.

Embodiments are provided wherein the means for automatically controlling the flow of water from the fill valve bowl outlet to the tank reservoir and the bowl is operable to communicate at least a portion of the water from the fill valve bowl outlet to the tank reservoir until the water level in the tank reservoir is at a predetermined height, at which time the means for automatically controlling the flow of water from the fill valve bowl outlet to the tank reservoir and the bowl is operable to communicate at least a portion of the water from the fill valve bowl outlet to the overflow pipe inlet and therefore to the bowl.

Embodiments are provided wherein the means for automatically controlling the flow of water from the fill valve bowl outlet to the tank reservoir and the bowl is operable to communicate at least a portion of the water from the fill valve bowl outlet to the overflow pipe inlet and therefore to the bowl until the water level in the tank reservoir is at a predetermined height, at which time the means for automatically controlling the flow of water from the fill valve bowl outlet to the tank reservoir and the bowl is operable to communicate at least a portion of the water from the fill valve bowl outlet to the tank reservoir.

Embodiments are provided wherein the means for automatically controlling the flow of water from the fill valve bowl outlet to the tank reservoir and the bowl comprises a valve body, a vane, and buoyancy means. The valve body includes a body outer surface and a body inner surface defining a valve chamber. The valve body defines an inlet, a first outlet and a second outlet. Each of the inlet, first outlet and second outlet provides fluid conduits from the body inner surface to the body outer surface such that water may flow into and out of the valve chamber. The vane is disposed within the valve chamber and is operable to substantially divide the valve chamber into a first sub-chamber and a second sub-chamber. The vane comprises a vane first side and a vane second side opposite the vane first side. The vane first side defines a portion of the first sub-chamber and the vane second side defining a portion of the second sub-chamber. The vane is operable to substantially conform to the geometry of the body inner surface of the valve body so as to establish a substantially fluid tight cooperation between the first sub-chamber and the second sub-chamber. The vane is pivotally coupled within the valve chamber about a pivot axis and operable to allow rotation of the vane between a first position and a second position. The vane and the location of the inlet, the first outlet, and the second outlet

are in cooperative arrangement to substantially restrict fluid communication from the inlet to substantially only the first outlet when the vane is in the first position and to substantially restrict fluid communication from the inlet to substantially only the second outlet when the vane is in the second position. The buoyancy means is operable to move the vane between the first position and the second position in cooperative engagement with water in the tank reservoir.

Embodiments are provided wherein the buoyancy means comprises a vane float coupled to the vane wherein the position of the vane is controlled by the buoyancy of the vane float in cooperative engagement with water in the tank reservoir. When water in the tank reservoir is disengaged from the vane float, the vane float positions the vane in the first position, and wherein when the water in the tank reservoir engages and lifts the vane float, the vane float rotates the vane to the second position.

Embodiments are provided wherein the valve body further comprises a pair of apertures aligned with the pivot axis, and an armature defining a C-shape including two armature ends operable to extend through the valve body via the apertures to couple with opposite edges of the vane intersecting the pivot axis. The cooperative arrangement of the armature ends and the apertures are operable to allow pivotal motion of the vane. The vane float is coupled to the armature.

Embodiments are provided wherein the first outlet defines an elongated slot operable to provide fluid communication between the valve chamber and the tank reservoir. The control valve further comprises a vane float stem extending from an edge of the vane and extending through the slot and coupled to the vane float.

Embodiments are provided of toilet system comprising a toilet and an control valve. The toilet includes a tank in fluid communication with a bowl. The tank defines a tank reservoir operable for storing water and housing associated plumbing including an overflow pipe and a fill valve. The overflow pipe includes a lumen therethrough defining an overflow pipe inlet at one end in fluid communication with the tank reservoir and an overflow pipe outlet at an opposite end in fluid communication with the bowl. The fill valve includes a fill valve inlet, a fill valve tank outlet in fluid communication with the tank reservoir, and a fill valve bowl outlet in fluid communication with the overflow pipe inlet. The fill valve inlet is in fluid communication with the fill valve tank outlet and the fill valve bowl outlet. The control

valve comprises a valve body, a vane, and a buoyancy means. The valve body includes a body outer surface and a body inner surface defining a valve chamber. The valve body defines an inlet, a first outlet and a second outlet. Each of the inlet, first outlet and second outlet provides fluid conduits from the body inner surface to the body outer surface such that water may flow into and out of the valve chamber. The inlet is operable for fluid communication with the fill valve bowl outlet. The first outlet is operable for fluid communication with the tank reservoir and the second outlet is operable for fluid communication with the overflow pipe inlet. The vane comprises a vane first side and a vane second side opposite the vane first side. The vane is disposed within the valve chamber and is operable to substantially divide the valve chamber into a first sub-chamber and a second sub-chamber. The vane first side defines a portion of the first sub-chamber and the vane second side defines a portion of the second sub-chamber. The vane is operable to substantially conform to the geometry of the body inner surface of the valve body so as to establish a substantially fluid tight cooperation between the first sub-chamber and the second sub-chamber. The vane is pivotally coupled within the valve chamber about a pivot axis and operable to allow rotation of the vane between a first position and a second position. The vane and the location of the inlet, the first outlet, and the second outlet are in cooperative arrangement to substantially restrict fluid communication from the inlet to substantially only the first outlet when the vane is in the first position wherein both the inlet and the first outlet are co-located within the first sub-chamber, and to substantially restrict fluid communication from the inlet to substantially only the second outlet when the vane is in the second position wherein both the inlet and the second outlet are co-located within the second sub-chamber. The buoyancy means is operable to move the vane between the first position and the second position in cooperative engagement with water in the tank reservoir for automatically controlling the flow of water from the fill valve bowl outlet to the tank reservoir and the bowl operable to control the water level in the bowl.

Embodiments are provided wherein the buoyancy means is a vane float. The position of the vane is controlled by the buoyancy of the vane float in cooperative engagement with water in the tank reservoir. When water in the tank reservoir is disengaged from the vane float, the vane float positions the vane in the first position.

When the water in the tank reservoir engages and lifts the vane float, the vane float rotates the vane to the second position.

Embodiments of methods are provided for automatically controlling the flow of water in a toilet from a fill valve bowl outlet to a tank reservoir and a bowl operable to control the water level in the bowl and to substantially prevent wasting bowl water over the water trap and down the drain during the refilling of the bowl. The methods comprise providing a toilet and an control valve. The toilet includes a tank in fluid communication with a bowl. The tank defines a tank reservoir operable for storing water and housing associated plumbing including an overflow pipe and a fill valve.

The overflow pipe includes a lumen therethrough defining an overflow pipe inlet at one end in fluid communication with the tank reservoir and an overflow pipe outlet at an opposite end in fluid communication with the bowl. The fill valve includes a fill valve inlet, a fill valve tank outlet in fluid communication with the tank reservoir, and a fill valve bowl outlet in fluid communication with the overflow pipe inlet. The fill valve inlet is in fluid communication with the fill valve tank outlet and the fill valve bowl outlet. The bowl is in fluid communication with a water trap and drain. The control valve comprises a valve body, a vane, a buoyancy means, and an overflow pipe coupler. The valve body includes a body outer surface and a body inner surface defining a valve chamber. The valve body defines an inlet, a first outlet and a second outlet. Each of the inlet, first outlet and second outlet provides fluid conduits from the body inner surface to the body outer surface such that water may flow into and out of the valve chamber. The inlet is operable for fluid communication with the fill valve bowl outlet. The first outlet is operable for fluid communication with the tank reservoir and the second outlet is operable for fluid communication with the overflow pipe inlet. The vane comprises a vane first side and a vane second side opposite the vane first side. The vane is disposed within the valve chamber and is operable to substantially divide the valve chamber into a first sub-chamber and a second sub-chamber. The vane first side defines a portion of the first sub-chamber and the vane second side defines a portion of the second sub-chamber. The vane is operable to substantially conform to the geometry of the body inner surface of the valve body so as to establish a substantially fluid tight cooperation between the first sub-chamber and the second sub-chamber. The vane is pivotally coupled within the valve chamber about a pivot axis and operable to allow rotation of the vane between a first

position and a second position. The vane and the location of the inlet, the first outlet, and the second outlet are in cooperative arrangement to substantially restrict fluid communication from the inlet to substantially only the first outlet when the vane is in the first position wherein both the inlet and the first outlet are co-located within the first sub-chamber, and to substantially restrict fluid communication from the inlet to substantially only the second outlet when the vane is in the second position wherein both the inlet and the second outlet are co-located within the second sub-chamber. The buoyancy means is operable to move the vane between the first position and the second position in cooperative engagement with water in the tank reservoir for automatically controlling the flow of water from the fill valve bowl outlet to the tank reservoir and the bowl operable to control the water level in the bowl and to substantially prevent wasting bowl water over the water trap and down the drain during the refilling of the bowl. The overflow pipe coupler is coupled to the valve body. The overflow pipe coupler comprises a means for removable coupling with the overflow pipe and operable for adjusting the position of the control valve along the length of the overflow pipe. The method further comprises installing the control valve in the tank reservoir by receiving the overflow pipe coupler onto the overflow pipe such that the buoyancy means may interact with the water in the tank reservoir operable to move the vane between a first position and a second position, positioning the overflow control valve higher on the overflow pipe if the bowl water level is above a predetermined level at the completion of a flush refill, and positioning the overflow control valve lower on the overflow pipe if the bowl water level is below a predetermined level at the completion of a flush refill.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features of the invention are set forth in the appended claims. However, for purpose of explanation, several embodiments of the invention are illustrated in the following Figures.

FIG. 1 is a side partially cut-away view of a flush toilet known in the art;

FIG. 2 is a front partially cut-away view of a tank of a flush toilet known in the art;

FIG. 3 is a side partially cut-away view of a flush toilet comprising a control valve in accordance with an embodiment;

FIG. 4 is a front partially cut-away view of a flush toilet comprising a control valve in accordance with an embodiment;

FIG. 5 is a perspective view of the control valve in accordance with an embodiment;

5 FIG. 6 is a cross-sectional view along cutline 6—6 of the control valve shown in FIG. 5, the cutline being substantially parallel to the vane;

FIGS. 7 and 8 are cross-sectional views along cutline 7—7 of the control valve shown in FIG. 5, the cutline being substantially perpendicular to the vane;

10 FIG. 9 is a top view of the straight-vane control valve of the embodiment of FIGs. 5-8;

FIG. 10 is a perspective view of a bent-vane control valve;

FIG. 11 is a cross-sectional view along cutline 11—11 of the control valve shown in FIG. 10, the cutline being substantially perpendicular to the bent vane;

15 FIG. 12 is a cross-sectional view along cutline 12—12 of the control valve shown in FIG. 11, the cutline being substantially parallel to a half vane

FIG. 13 is a cross-sectional view along cutline 11—11 of the control valve shown in FIG. 10, the cutline being substantially perpendicular to the bent vane;

Fig. 14 is a top view of the bent-vane control valve of the embodiment of FIGs. 10-13;

20 FIG. 15 is a flow diagram of a method of using and adjusting the control valve, in accordance with an embodiment;

FIG. 16 is a transverse cross-sectional view, of a bent-vane control valve, in accordance with an embodiment of a control valve;

25 FIG. 17 is a transverse cross-sectional view of a control valve, in accordance with another embodiment; and

FIG. 18 is a transverse cross-sectional view of a control valve, in accordance with another embodiment.

DETAILED DESCRIPTION

30 Reference throughout this specification to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of claimed subject matter. Thus, the appearances of the phrase "in one embodiment" or "an

embodiment" in various places throughout this specification are not necessarily all referring to the same embodiment. Furthermore, the particular features, structures, or characteristics may be combined in one or more embodiments.

Reference will now be made to embodiments illustrated in the drawings and specific language which will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended. Alterations and further modifications of the illustrated embodiments and further applications of the principles of the invention, as would normally occur to one skilled in the art to which the invention relates, are also within the scope of the invention.

Referring to FIGs. 3 and 4, embodiments of a control valve 2 are presented providing a means for automatically controlling the supply of mains water to the bowl 80 so as to control the level of water in the bowl, substantially prevent bowl overfilling, operable for controlling water waste and minimizing tank reservoir refill time, among other things. Embodiments of the control valve 2 are in fluid communication with a fill valve bowl outlet 66, an overflow pipe 70, and the tank reservoir 92, operable to control the mains water to the overflow pipe 70, and therefore to the bowl 80.

In accordance with some embodiments, the control valve 2 supplies at least a portion of the mains water from the fill valve bowl outlet 66 to the tank reservoir 92 until the tank water level 95 is at a predetermined height in the tank reservoir 92, at which time, the control valve 2 diverts at least a portion of the mains water supplied by the fill valve bowl outlet 66 to the overflow pipe 70, and therefore to the bowl 80.

In accordance with other embodiments, the control valve 2 comprises means for supplying mains water from the fill valve bowl outlet 66 to the overflow pipe 70, and thus the bowl 80, until the tank water level 95 reaches a predetermined height in the tank reservoir 92, at which time the control valve 2 diverts water supplied by the fill valve bowl outlet 66 to the tank reservoir 92.

FIGs. 5-8 are perspective, lateral cross-sectional, and transverse cross-sectional views, respectively, of a straight-vane control valve 100, in accordance with an embodiment of an control valve 2. The straight-vane control valve 100 comprises a valve body 10, a straight vane 34, and a vane float 40. FIG. 6 is a cross-sectional view along cutline 6—6 of the control valve 100 shown in FIG. 5, the cutline being substantially parallel to the straight vane 34. The straight vane 34 defines a

rectangular profile operable to substantially divide a valve chamber 12 into two sub-chambers as explained below. FIGs. 7 and 8 are cross-sectional views along cutline 7—7 of the control valve 100 shown in FIG. 5, the cutline being substantially perpendicular to the straight vane 34. The straight vane 34 in FIG. 7 is in a first position P1 and in FIG. 8 is in a second position P2.

The straight-vane control valve 100 comprises the valve body 10 having a body outer surface 14 and a body inner surface 16 defining a valve chamber 12. The valve body 10 is substantially hollow with the valve chamber 12 defining a substantially cylindrical shape with a substantially circular transverse cross-section as shown in FIGs. 7 and 8. The valve body 10 defines an inlet 20, a first outlet 22, and a second outlet 24, each providing fluid conduits from the body inner surface 16 to the body outer surface 14 such that fluid may flow into and out of the valve chamber 12.

The straight-vane control valve 100 further comprises a vane 30, in the embodiment of FIGs. 6-8, in the form of a straight vane 34. The straight vane 34 is operable to divide the valve chamber 12 into a first sub-chamber 13 and a second sub-chamber 15. The straight vane 34 comprises a vane first side 35 and a vane second side 37 opposite the vane first side 35, the vane first side 35 defining a portion of the first sub-chamber 13 and the vane second side 37 defining a portion of the second sub-chamber 15. The straight vane 34 is operable to substantially conform to the geometry of the body inner surface 16 of the valve body 10 so as to establish a substantially fluid tight cooperation between the first sub-chamber 13 and the second sub-chamber 15. As will be discussed below, an absolute fluid-tight separation between the first sub-chamber 13 and a second sub-chamber 15 is not required for satisfactory function of the straight-vane control valve 100. Further, freedom of rotation within the valve chamber 12 may require that the vane edge 38 have enough clearance from the body inner surface 16 to reduce any friction therebetween with the water providing lubrication therewith.

The straight vane 34 is pivotally coupled within the valve chamber 12 and is operable to present the straight vane 34 in a first position P1 and thus substantially restricting fluid communication from the inlet 20 to substantially only the first outlet 22, which is coupled in fluid communication to the tank reservoir 92, along a first flow path 26, as both the inlet 20 and the first outlet 22 are co-located within the first sub-

chamber 13. And, for presenting the straight vane 34 in the second position P2 and thus substantially restricting fluid communication from the inlet 20 to substantially only the second outlet 24, which is coupled in fluid communication to the overflow pipe 70, along the second flow path 28, as both the inlet 20 and the second outlet 24 are co-located within the second sub-chamber 15.

It is appreciated that there are many means for pivotally coupling the straight vane 34 to the valve body 10. FIG. 6 illustrates an embodiment wherein a vane pivot element 32 comprises a dimple projection 31 extending from opposite vane edges 38 operable to cooperate with corresponding divots 17 in the body inner surface 16. The divot 17 is operable to allow pivotal motion of the dimple projection 31 therein.

The inlet 20 comprises an inlet nipple 21 operable for coupling with a first refill hose 76a, which may have been the bowl refill hose 76 where the control valve 100 is retrofitted onto an existing toilet. The first refill hose 76a is operable for providing a fluid connection between the fill valve bowl outlet 66 of the fill valve 60 and the inlet 20. The second outlet 24 comprises a second outlet nipple 25 operable for coupling with a second refill hose 76b. The second refill hose 76b is operable for providing a fluid connection between the second outlet 24 and the overflow pipe 70.

In accordance with the embodiment of FIG. 5, the first outlet 22 defines an elongated slot 18 that provides, among other things, a fluid path out of the valve chamber 12 and mechanical access to the vane float 40. In accordance with other embodiments discussed below, the first outlet 22 may comprise a first outlet nipple suitable for a particular purpose.

The straight-vane control valve 100 further comprises a vane float 40 coupled to the edge 38 of the straight vane 34 by a float stem 42. The movement of the straight vane 34 from the first position P1 to the second position P2 is affected by the buoyancy of the vane float 40 operable to rotate the straight vane 34 about the vane pivot element 32 in accordance to the tank water level 95 of tank water 94 in the tank reservoir 92, as shown in FIGs. 3 and 4. The pivot axis X upon which the straight vane 34 pivots, is positioned parallel with the tank water level 95 such that when the tank water 94 raises and falls, the vane float 40 raises and falls, respectively, and thus moving the straight vane 34 between the first position P1 and the second position P2.

The position of the straight vane 34 is controlled by the cooperation of the vane float 40 with the tank water 94. When the tank water 94 is below the vane float 40, the vane float 40, and thus the straight vane 34, is in the first position P1. When the tank water 94 lifts the vane float 40 due to buoyancy affect, the straight vane 34 rotates to the second position P2.

Fig. 9 is a top view of the straight-vane control valve 100 of the embodiment of FIGs. 5-8. The straight-vane control valve 100 further comprises an overflow pipe coupler 46, in accordance with an embodiment. In accordance with an embodiment, the overflow pipe coupler 46 comprises a split ring 47 comprises a first half ring 43 and a second half ring 44 that are operable to couple with the overflow pipe 70. The split ring 47 defines an inner diameter for cooperative engagement with the outer surface of the overflow pipe 70 having a complementary diameter. A fastener 48 is operable to clamp the split ring 47 for securing engagement with the overflow pipe 70. As will be discussed further below, the overflow pipe coupler 46 is operable to allow removable coupling with the overflow pipe 70 and to allow for adjusting the position of the straight-vane control valve 100 along the length of the overflow pipe 70.

In accordance with another embodiment, a coupler pivot 49 pivotally couples the second half ring 44 of the split ring 47 to the first half ring 43. The coupler pivot 49 allows for spreading apart the second half ring 44 relative to the first half ring 43 such that the overflow pipe 70 may be positioned therebetween.

It is appreciated that the means for diverting mains water from the fill valve bowl outlet 66 to the overflow pipe 70 and tank reservoir 92 may be affected by a number of elements. The straight vane 34 discussed above is but one example of a vane 30. Further, it is appreciated that there are various means for pivoting the vane 30 within the valve chamber 12, where the vane pivot element 32 in the form of a dimple projection 31 cooperating with divots 17 in the valve chamber 12 is but one example.

FIGs. 10-14 are perspective, transverse cross-sectional, lateral cross-sectional, and top views, respectively, of a bent-vane control valve 200, in accordance with an embodiment of an control valve 2. The embodiment of FIGs. 10-14 illustrates alternative embodiments of the vane 30 and vane pivot element 32, among other things, as compared with the embodiments of FIGs. 5-8. The bent-

vane control valve 200 comprises a valve body 10, a bent vane 36, and a vane float 40. FIGs. 11 and 13 are cross-sectional views along cutline 11—11 of the control valve 200 shown in FIG. 10, the cutline being substantially perpendicular to the bent vane 36. The bent vane 36 defines a V-shaped profile operable to substantially divide the valve chamber 12 into two sub-chambers as explained below. The bent vane 36 in FIG. 11 is in a first position P1 and in FIG. 13 is in a second position P2. FIG. 12 is a cross-sectional view along cutline 12—12 of the control valve 200 shown in FIG. 11, the cutline being substantially parallel to a second half vane 36b.

The bent-vane control valve 200 comprises the valve body 10 having an outer surface 14 and a body inner surface 16 defining a valve chamber 12. The valve body 10 is substantially hollow with the valve chamber 12 defining a substantially cylindrical shape with a substantially circular transverse cross-section as shown in FIGs. 11 and 13, and defining an axis Y. The valve body 10 defines an inlet 20, a first outlet 22, and a second outlet 24, each providing fluid conduits from the body inner surface 16 to the outer surface 14 such that fluid may flow into and out of the valve chamber 12.

The bent-vane control valve 200 further comprises a vane 30, in the embodiment of FIGs. 10-14 in the form of a bent vane 36. The bent vane 36 is operable to divide the valve chamber 12 into a first sub-chamber 13 and a second sub-chamber 15. The bent vane 36 comprises a first half vane 36a and a second half vane 36b joined at an apex 39 defining a V-shaped profile. The bent vane 36 comprises a vane first side 35 and a vane second side 37 opposite the vane first side 35, the vane first side 35 defining a portion of the first sub-chamber 13 and the vane second side 37 defining a portion of the second sub-chamber 15. The angle between the first half vane 36a and the second half vane 36b is in cooperative arrangement with the location of the inlet 20, the first outlet 22, and the second outlet 24, operable to substantially restrict fluid communication from the inlet 20 to substantially only the first outlet 22 in a first position P1 and operable to substantially restrict fluid communication from the inlet 20 to substantially only the second outlet 24 in a second position P2.

It is appreciated that there are many means for pivotally coupling the bent vane 36 to the valve body 10. By way of example, the bent vane 36 may be pivotally coupled to the valve body 10 in substantially the same way as the embodiment of

FIGs. 5-8, with dimple/divot elements. Alternatively, but not limited thereto, the embodiment of FIGs. 10-14 comprise an armature 45 defining a C-shape, as viewed from the top in FIG. 14, having two armature ends 41 that extend through the valve body 10 via the apertures 11 to couple with either ends of the apex 39 of the bent vane 36, along the axis X of the apex 39. The armature 45 may substantially conform to the shape of the body outer surface 14 of the valve body 10. The armature ends 41 and the apertures 11 define the vane pivot element 32. The cooperative arrangement of the armature ends 41 and the apertures 11 allow pivotal motion of the bent vane 36. It is appreciated that the pivotal coupling presented above may also be utilized with the embodiment of FIGs. 5-8.

The bent-vane control valve 200 further comprises a vane float 40 coupled to the armature 45, and thus to the bent vane 36. The movement of the bent vane 36 from the first position P1 to the second position P2 is affected by the buoyancy of the vane float 40 operable to rotate the bent vane 36 about the vane pivot element 32 in accordance to a tank water level 95 of tank water 94 in the tank reservoir 92, as shown in FIGs. 3 and 4. The pivot axis X upon which the bent vane 36 pivots, is positioned parallel with the tank water level 95 such that when the tank water 94 raises and falls, the vane float 40 raises and falls, respectively, and thus moving the bent vane 36 between the first position P1 and the second position P2.

Means for restricting the rotation of the vane 30, in this embodiment bent vane 36, is provided to control the rotation of the bent vane 36 between the first position P1 and the second position P2. In accordance with an embodiment, the means for restricting the rotation of the bent vane 36 comprises first stop 19a and second stop 19b operable to control the rotation of the vane 36 between the first position P1 and the second position P2, each stop defining a projection from the body inner surface 16 into the valve chamber 12.

The angle between the first half vane 36a and the second half vane 36b, the location of the inlet 20, the first outlet 22, and the second outlet 24, and the location of the first stop 19a and second stop 19b, are in cooperative arrangement to substantially restrict fluid communication from the inlet 20 to substantially only the first outlet 22 in a first position P1 and operable to substantially restrict fluid communication from the inlet 20 to substantially only the second outlet 24 in a second position P2.

By way of example, in the embodiment of FIGs. 11 and 13, the inlet 20 is located at the 6 o'clock, or -90 degrees from axis Y, the first outlet 22 is located at the 8 o'clock position or about -30 degrees from axis Y, and the second outlet 24 is positioned at the 12 o'clock, or 90 degrees from axis Y. The angle between the first half vane 36a and the second half vane 36b is about 100 degrees. The body inner surface 16 defines a first stop 19a defining a projection at about the 9 o'clock position, or 0 degrees from axis Y, that is operable to engage the second half vane 36b so as to prevent rotation of the bent vane 36 in the counter-clockwise direction beyond the first position P1, as shown in FIG. 11. As such, the bent vane 36 substantially restricts fluid communication from the inlet 20 to substantially only the first outlet 22 along the first flow path 26, as both the inlet 20 and the first outlet 22 are co-located within the first sub-chamber 13.

The body inner surface 16 defines a second stop 19b defining a projection at about 30 degrees from axis Y that is operable to engage the second half vane 36b so as to prevent rotation of the bent vane 36 in the clockwise direction beyond the second position P2, as shown in FIG. 13. As such, the bent vane 36 substantially restricts fluid communication from the inlet 20 to substantially only the second outlet 24 along the second flow path 28, as both the inlet 20 and the second outlet 24 are co-located within the second sub-chamber 12.

It is appreciated that various mechanisms may be used for restricting the counter-clockwise rotation of the bent vane 36 when in the first position P1 and the clockwise rotation in the second position P2, with the first stop 19a and the second stop 19b, as shown in FIG. 11, as one example. Other examples include, but are not limited to, features of the valve body 10 that restrict the movement of the vane float 40, such as, but not limited to the slot 18, engaged by the float stem 42 of the embodiment of FIGs. 5-8.

FIG. 10 shows an alternative mechanism that may be used for restricting the counter-clockwise rotation of the bent vane 36 when in the first position P1 and the clockwise rotation in the second position P2. The body outer surface 14 further comprises first stop 19a and the second stop 19b as projections operable to engage the armature 45 in the first position P1 and the second position P2, respectively.

The bent vane 36 is operable to substantially conform to the geometry of the body inner surface 16 of the valve body 10 so as to establish a substantially fluid

tight cooperation between the first sub-chamber 13 and a second sub-chamber 15. As discussed previously, an absolute fluid-tight separation between the first sub-chamber 13 and a second sub-chamber 15 is not required for satisfactory function of the bent-vane control valve 200. Further, an absolute fluid-tight seal about the armature ends 41 and the apertures 11 is similarly not required as the water within the valve body 10 will simply leak into the tank reservoir 92. It is appreciated that wherein a fluid-tight seal is desired, such may be facilitated by rubber seals and o-rings and other means known in the art to affect a desired seal.

As provided for the embodiment of FIGs. 5-8, the inlet 20 comprises an inlet nipple 21 operable for coupling with a first refill hose 76a, shown in FIG. 4. The first refill hose 76a is operable for providing a fluid connection between the fill valve bowl outlet 66 of the fill valve 60 and the inlet 20. The second outlet 24 comprises a second outlet nipple 25 operable for coupling with a second refill hose 76b. The second refill hose 76b is operable for providing a fluid connection between the second outlet 24 and the overflow pipe 70. In accordance with the embodiment of FIG. 11, the first outlet 22 defines an aperture that provides a fluid path out of the valve chamber 12. In accordance with other embodiments, the first outlet 22 may comprise a first outlet nipple suitable for coupling to tubing for directing the flow of water away from the bent-vane control valve 200. One purpose, by way of example, but not limited thereto, for directing the flow of water away from the bent-vane control valve 200 is to preferentially agitate any sediment in the bottom of the tank reservoir 92 for cleaning purposes during a flush.

The position of the bent vane 36 is controlled by the cooperation of the vane float 40 with the tank water 94. When the tank water level 95 is below the vane float 40, the vane float 40, and thus the bent vane 36, is in the first position P1. When the tank water level 95 lifts the vane float 40 due to buoyancy affect, the bent vane 36 rotates to the second position P2.

Fig. 14 is a top view of the bent-vane control valve 200 of the embodiment of FIGs. 10-13. As discussed previously for the embodiment of FIG. 9, the bent-vane control valve 200 further comprises an overflow pipe coupler 46, in accordance with an embodiment.

It is appreciated that other configurations of the vane 30 besides the straight-vane 34 and bent-vane 36 provided above, may be suitably used for the intended

purpose. Further, it is appreciated that other configurations of the valve body 10, besides a cylindrical shape as provided above, may be suitably used for the intended purpose. By way of example, wherein the valve chamber 12 defines a spherical shape, the vane 30 may define a flat or bent disk.

5 In the embodiments of FIGs. 5-14, the operation of the control valve 2 is such that when the tank water level 95 is lowered below the control valve 2, the vane float 40 is in a lowered position presenting the vane 30 in the first position P1 and thus substantially restricting fluid communication from the inlet 20 to substantially only the first outlet 22, which is coupled in fluid communication to the tank reservoir 92, along
10 the first flow path 26, as both the inlet 20 and the first outlet 22 are co-located within the first sub-chamber 13. And, when the tank water level 95 is raised above the control valve 2, the vane float 40 is in a raised position presenting the vane 30 in the second position P2 and thus substantially restricting fluid communication from the inlet 20 to substantially only the second outlet 24, which is coupled in fluid
15 communication to the overflow pipe 70, along the second flow path 28, as both the inlet 20 and the second outlet 24 are co-located within the second sub-chamber 15. In this configuration, the bowl 80 will be filled with bowl water 84 even if only a portion of the tank water 94 is released, as the bowl-fill portion of the refill process is at the end of the refill process.

20 The timing of the transition of mains water being supplied to the first outlet 22, and thus the tank reservoir 92, and the second outlet 24, and thus the bowl 80, is determined, at least in part, by the location of the vane float 40 of the control valve 2 relative to the final tank water level 93, defined as the tank water level 95 at the time of closing of the fill valve 60 to the water main 54. The further below the final tank
25 water level 93 that the vane float 40 is positioned, the vane float 40 will be raised sooner by the raising tank water level 95 and the amount of mains water supplied to the overflow pipe 70, and thus the bowl 80, will be greater. By properly adjusting the location of the vane float 40 relative to the final tank water level 93, the control valve 2 may be optimized to provide the correct amount of mains water supplied to
30 the bowl 80 sufficient to fill the bowl 80 to a desired bowl water level 85 but not overfill the bowl 80 such that water overflows the overflow 83 and into the drain 52, as shown in FIG. 3.

In accordance with an embodiment, the control valve 2 may be raised and lowered relative to the final tank water level 93 by raising and lowering, respectively, the overflow pipe coupler 46 along the length of the overflow pipe 70.

FIG. 15 is a flow diagram of a method of using and adjusting the control valve 2, in accordance with an embodiment. A mark is made in the toilet bowl that is about the desired bowl water level 1502, such as, but not limited to, 0.25 inches below the bowl water level of a maximally-filled bowl. Placing the mark at the bowl water level might lead to bowl overflowing as the bowl water level might be representing the level of overflow into the drain. Placing the mark below the bowl water level ensures that the mark is below the overflow level. The first fill hose is coupled in fluid communication to the inlet nipple and the fill valve bowl outlet 1504. The control valve is installed in the tank reservoir by slidingly receiving the overflow pipe coupler onto the overflow pipe 1506. A second refill hose is coupled in fluid communication to the second outlet and to the overflow pipe so as to direct the flow of mains water into the overflow pipe and thus into the bowl 1508. The first outlet should be pointing in a downward direction. Position the overflow control valve about 4 inches below the final tank water level, that tank water level of a maximally-filled tank reservoir. Secure the overflow control valve to the overflow pipe. The toilet is flushed and filled. If the bowl water level is above the mark after the fill valve shuts off, the control valve is moved higher on the overflow pipe such that the float is raised later in the fill process and less mains water is supplied to the bowl. If the bowl water level is below the mark after the fill valve shuts off, the control valve is moved lower on the overflow pipe such that the float is raised sooner in the fill process and more mains water is supplied to the bowl. If the bowl water level is at the mark after the fill valve shuts off, the control valve is properly positioned on the overflow pipe, at which point no bowl water is wasted by overflowing into the drain 1510.

In accordance with another embodiment, the vane float 40 may be adjusted along the length of the shaft operable to fine tune the bowl water level.

Alternatively, it is appreciated that the bowl-fill portion of the refill process may come at the beginning of the refill process. FIG. 16 is a transverse cross-sectional view of a bent-vane control valve 300 in accordance with an embodiment of an control valve 2 that provides wherein the bowl-fill portion of the refill process comes at the beginning of the refill process. Comparing with the embodiment of FIG. 11,

the location of the first outlet 22 and the second outlet 24 are switched. The first outlet 22 is provided with a first nipple 23 such that it may be coupled in fluid communication to the second refill hose 76b to direct the mains water to the overflow pipe 70. The second outlet nipple 25 maybe be coupled in fluid communication to a
5 hose directed into the tank reservoir 92.

Therefore, when the tank water level 95 is below the vane float 40, the vane float 40, and thus the vane 30, is in the first position P1 substantially restricting fluid communication from the inlet 20 to substantially only the second outlet 24, which is coupled in fluid communication to the overflow pipe 70, along the first flow path 26,
10 as both the inlet 20 and the second outlet 24 are co-located within the first sub-chamber 13. When the tank water level 95 is above the vane float 40, the vane float 40, and thus the vane 30, is in the second position P2 substantially restricting fluid communication from the inlet 20 to substantially only first outlet 22, coupled in fluid communication to the tank reservoir 92, along the first flow path 26, as both the inlet
15 20 and the first outlet 22 are co-located within the second sub-chamber 12.

It is important to understand that the mains water coming out of the fill valve tank outlet 64 is unaffected by the control valve 2. The control valve 2 diverts mains water being supplied through the fill valve bowl outlet 66 to either the tank reservoir 92 or the bowl 80. With the control valve 2 installed, the tank reservoir 92 may be
20 filled with mains water faster than without the control valve 2 as the water that would have been wasted into the drain by overfilling the bowl 80 if the overfill valve 2 is not used, is diverted to the tank reservoir 92.

It is appreciated that any suitable element may be used as a vane float 40. The buoyancy property of the vane float 40 may be provided by any suitable means,
25 including, but not limited to, the material property of the vane float 40 and the construction of the vane float 40. Elements exhibiting buoyancy suitable for use as a vane float 40 are well known in the art. The vane float 40 may comprise a material that is buoyant in water. Such material includes, but is not limited to, cork, expanded polystyrene, and some closed-cell foams. The vane float 40 may define geometry so
30 as to impart buoyancy, such as, but not limited to, a fluid-tight hollow element, an upward-facing cup, and a downward-facing cup that may trap air when exposed to raising water.

It is appreciated that the vane float 40 may be coupled to the vane 30 in such a way that the vane float 40 is inside the valve chamber 12. FIG. 17 is a transverse cross-sectional view of a control valve 400, in accordance with an embodiment of a control valve 2 comprising the vane float 40 coupled to a surface of the vane second side 37 of the vane 30 so as to impart the desired functionality as described above. The control valve 400 further comprises a second inlet 99 operable to allow tank water to enter the second sub-chamber 15 as the water level 95 reaches the control valve 400. In this way, as the tank water enters and exits the second sub-chamber 15 from the tank reservoir 92, the buoyancy of the vane float 40 will rotate the vane 30 between the first position P1 and the second position P2.

It is also appreciated that the vane 30 may comprise integral float functionality. FIG. 18 is a transverse cross-sectional view of a control valve 500, in accordance with an embodiment of a control valve 2 comprising a vane 130 comprising integral buoyancy means, so as to impart the desired functionality as described above. In the embodiment of FIG. 18, the integral buoyancy means is a hollow portion 101. The control valve 500 further comprises a second inlet 99 operable to allow tank water to enter the second sub-chamber 15 as the water level 95 reaches the control valve 500. In this way, as the tank water enters and exits the second sub-chamber 15 from the tank reservoir 92, the buoyancy of the hollow portion 101 will rotate the vane 130 between the first position P1 and the second position P2 .

It is appreciated that other means for positioning the control valve 2 within the tank reservoir 92 may be used. By way of example, but not limited thereto, the control valve 2 may be provided with a free-standing element that is not coupled to the overflow pipe 70. Another embodiment comprises an adhesive coupling for coupling to a surface within the tank reservoir 92. In yet another embodiment, a cross-brace is provided that spans across two opposing surfaces of the tank reservoir 92 upon which the control valve 2 may be coupled.

It is appreciated that the control valve 2 may be an integral part of the plumbing provided with the toilet. By way of example, but not limited thereto, the control valve 2 may be permanently coupled to or an integral part of the overflow tube 70. The toilet manufacturer may determine the ideal bowl water level for a

particular toilet system and therefore, adjustability of the control valve 2 on the overflow tube 70 may not be required.

Embodiments of the control valve 2 are provided herein that automatically controls the flow of mains water to the bowl 80 so as to establish an ideal water level in the bowl 80 without overfilling the bowl 80. Embodiments of the control valve 2 control valve 2 controls the flow of mains water to the bowl 80 irrespective of a specific tank 90 or bowl 80 design. Embodiments of the control valve 2 may be part of the plumbing system of a new toilet as well as used for retrofitting to an existing toilet.

While there has been illustrated and described what are presently considered to be example embodiments, it will be understood by those skilled in the art that various other modifications may be made, and equivalents may be substituted, without departing from claimed subject matter. Additionally, many modifications may be made to adapt a particular situation to the teachings of claimed subject matter without departing from the central concept described herein. Therefore, it is intended that claimed subject matter not be limited to the particular embodiments disclosed, but that such claimed subject matter may also include all embodiments falling within the scope of the appended claims, and equivalents thereof.

CLAIMS

What is claimed is:

1. An control valve for use with a toilet, the toilet including a tank in fluid communication with a bowl, the tank defining a tank reservoir operable for storing water and housing associated plumbing including an overflow pipe and a fill valve, the overflow pipe including a lumen therethrough defining an overflow pipe inlet at one end in fluid communication with the tank reservoir and an overflow pipe outlet at an opposite end in fluid communication with the bowl, the fill valve including a fill valve inlet, a fill valve tank outlet in fluid communication with the tank reservoir, and a fill valve bowl outlet in fluid communication with the overflow pipe inlet, the fill valve inlet in fluid communication with the fill valve tank outlet and the fill valve bowl outlet, the bowl in fluid communication with a water trap and drain, the control valve comprising:

means for automatically controlling the flow of water from the fill valve bowl outlet to the tank reservoir and the bowl operable to control the water level in the bowl and to substantially prevent wasting bowl water over the water trap and down the drain during the refilling of the bowl.

2. The control valve of claim 1, wherein the means for automatically controlling the flow of water from the fill valve bowl outlet to the tank reservoir and the bowl is operable for coupling in fluid communication with the fill valve bowl outlet, the overflow pipe inlet, and the tank reservoir, operable to control communication of the water from the fill valve bowl outlet to the overflow pipe inlet and the tank reservoir.

3. The control valve of claim 2, wherein the means for automatically controlling the flow of water from the fill valve bowl outlet to the tank reservoir and the bowl is operable to communicate at least a portion of the water from the fill valve bowl outlet to the tank reservoir until the water level in the tank reservoir is at a predetermined height, at which time the means for automatically controlling the flow of water from the fill valve bowl outlet to the tank reservoir and the bowl is operable to

communicate at least a portion of the water from the fill valve bowl outlet to the overflow pipe inlet and therefore to the bowl.

4. The control valve of claim 2, wherein the means for automatically controlling the flow of water from the fill valve bowl outlet to the tank reservoir and the bowl is operable to communicate at least a portion of the water from the fill valve bowl outlet to the overflow pipe inlet and therefore to the bowl until the water level in the tank reservoir is at a predetermined height, at which time the means for automatically controlling the flow of water from the fill valve bowl outlet to the tank reservoir and the bowl is operable to communicate at least a portion of the water from the fill valve bowl outlet to the tank reservoir.

5. The control valve of claim 1, the means for automatically controlling the flow of water from the fill valve bowl outlet to the tank reservoir and the bowl comprising:

a valve body including a body outer surface and a body inner surface defining a valve chamber, the valve body defining an inlet, a first outlet and a second outlet, each of the inlet, first outlet and second outlet providing fluid conduits from the body inner surface to the body outer surface such that water may flow into and out of the valve chamber;

a vane disposed within the valve chamber and operable to substantially divide the valve chamber into a first sub-chamber and a second sub-chamber, the vane comprising a vane first side and a vane second side opposite the vane first side, the vane first side defining a portion of the first sub-chamber and the vane second side defining a portion of the second sub-chamber, the vane being operable to substantially conform to the geometry of the body inner surface of the valve body so as to establish a substantially fluid tight cooperation between the first sub-chamber and the second sub-chamber, the vane being pivotally coupled within the valve chamber about a pivot axis and operable to allow rotation of the vane between a first position and a second position, wherein the vane and the location of the inlet, the first outlet, and the second outlet are in cooperative arrangement to substantially restrict fluid communication from the inlet to substantially only the first outlet when the vane is in the first position and to substantially restrict fluid communication from

the inlet to substantially only the second outlet when the vane is in the second position; and

buoyancy means operable to move the vane between the first position and the second position in cooperative engagement with water in the tank reservoir.

6. The control valve of claim 5, the buoyancy means comprising a vane float coupled to the vane wherein the position of the vane is controlled by the buoyancy of the vane float in cooperative engagement with water in the tank reservoir, wherein when water in the tank reservoir is disengaged from the vane float, the vane float positions the vane in the first position, and wherein when the water in the tank reservoir engages and lifts the vane float, the vane float rotates the vane to the second position.

7. The control valve of claim 5, further comprising means for restricting the rotation of the vane between the first position and the second position.

8. The control valve of claim 7, the means for restricting the rotation of the vane between the first position and the second position comprising a first stop and a second stop operable to control the rotation of the vane between the first position and the second position, each of the first stop and second stop define a projection from the body inner surface into the valve chamber upon which the vane may abut at the respective first and second positions.

9. The control valve of claim 8, wherein the location of the inlet, the first outlet, the second outlet, the first stop and the second stop, are in cooperative arrangement to substantially restrict fluid communication from the inlet to substantially only the first outlet when the vane is in the first position and to substantially restrict fluid communication from the inlet to substantially only the second outlet when the vane is in the second position.

10. The control valve of claim 8, wherein the first stop is operable to engage the vane so as to prevent rotation of the vane in a counter-clockwise direction about the pivot axis beyond the first position wherein the vane substantially restricts fluid

communication from the inlet to substantially only the first outlet wherein both the inlet and the first outlet are co-located within the first sub-chamber, and wherein the second stop is operable to engage the vane so as to prevent rotation of the vane in a clockwise direction about the pivot axis beyond the second position wherein the vane substantially restricts fluid communication from the inlet to substantially only the second outlet wherein both the inlet and the second outlet are co-located within the second sub-chamber.

11. The control valve of claim 8, the valve body further comprising a pair of apertures aligned with the pivot axis, an armature defining a C-shape including two armature ends operable to extend through the valve body via the apertures to couple with opposite edges of the vane intersecting the pivot axis, the cooperative arrangement of the armature ends and the apertures being operable to allow pivotal motion of the vane.

12. The control valve of claim 11, the means for restricting the rotation of the vane between the first position and the second position comprising a first stop and the second stop each defining a projection from the body outer surface operable to abut the armature in the first position and the second position, respectively.

13. The control valve of claim 7, wherein the first outlet defines an elongated slot operable to provide fluid communication between the valve chamber and the tank reservoir, the control valve further comprising a vane float stem extending from an edge of the vane and extending through the slot and coupled to the vane float.

14. The control valve of claim 13, wherein the slot defines a slot first end and a slot second end opposite the slot first end, wherein the means for restricting the rotation of the vane between the first position and the second position comprises the slot wherein abutment of the float stem against the slot first end in the first position and abutment of the float stem against the slot second end in the second position restricts the rotation of the vane between the first position and the second position.

15. The control valve of claim 5, wherein the first outlet is operable to be in fluid communication with the tank reservoir and the second outlet is operable to be in fluid communication with the overflow pipe inlet.
16. The control valve of claim 5, wherein the second outlet is operable to be in fluid communication with the tank reservoir and the first outlet is operable to be in fluid communication with the overflow pipe inlet.
17. The control valve of claim 5, wherein the valve chamber defines a substantially cylindrical shape, wherein the vane is a straight vane defining a rectangular profile.
18. The control valve of claim 5, wherein the valve chamber defines a substantially spherical shape, wherein the vane defines a disk shape.
19. The control valve of claim 5, wherein the vane is a bent vane defining a V-shaped profile, the bent vane comprising a first half vane and a second half vane joined at an apex.
20. The control valve of claim 5, the vane further comprising a dimple projection extending from opposite vane edges and aligned with the pivot axis and operable to cooperate with corresponding divots in the body inner surface, the divots being operable to allow pivotal motion of the dimple projection therein.
21. The control valve of claim 5, the inlet comprising an inlet nipple operable for coupling with a first refill hose operable for providing a fluid connection between the fill valve bowl outlet of the fill valve and the inlet, wherein the second outlet comprises a second outlet nipple operable for coupling with a second refill hose, the second refill hose being operable for providing a fluid connection between the second outlet and the overflow pipe.
22. The control valve of claim 1, further comprising means for coupling the control valve within the tank reservoir.

23. The control valve of claim 5, further comprising an overflow pipe coupler coupled to the valve body, the overflow pipe coupler comprising means for removable coupling with the overflow pipe and operable for adjusting the position of the control valve along the length of the overflow pipe.

24. The control valve of claim 5, further comprising an overflow pipe coupler coupled to the valve body, the overflow pipe coupler comprising a split ring including a first half ring and a second half ring, the split ring defining an inner diameter for cooperative engagement with the outer surface of the overflow pipe having a complementary diameter, and including a fastener operable to clamp together the first half ring and the second half ring for removable engagement with the overflow pipe, the overflow pipe coupler being operable to allow for adjusting the position of the overflow pipe coupler along the length of the overflow pipe.

25. The control valve of claim 24, the overflow pipe coupler further comprising a coupler pivot pivotally coupling the second half ring to the first half ring, the coupler pivot operable for spreading apart the second half ring relative to the first half ring such that the overflow pipe may be positioned therebetween.

26. An control valve for use with a toilet, the toilet including a tank in fluid communication with a bowl, the tank defining a tank reservoir operable for storing water and housing associated plumbing including an overflow pipe and a fill valve, the overflow pipe including a lumen therethrough defining an overflow pipe inlet at one end in fluid communication with the tank reservoir and an overflow pipe outlet at an opposite end in fluid communication with the bowl, the fill valve including a fill valve inlet, a fill valve tank outlet in fluid communication with the tank reservoir, and a fill valve bowl outlet in fluid communication with the overflow pipe inlet, the fill valve inlet in fluid communication with the fill valve tank outlet and the fill valve bowl outlet, the control valve comprising:

a valve body including a body outer surface and a body inner surface defining a valve chamber, the valve body defining an inlet, a first outlet and a second outlet, each of the inlet, first outlet and second outlet providing fluid conduits from the body inner surface to the body outer surface such that water may flow into and out of the

valve chamber, the inlet being operable for fluid communication with the fill valve bowl outlet, the first outlet being operable for fluid communication with the tank reservoir, and the second outlet being operable for fluid communication with the overflow pipe inlet;

a vane disposed within the valve chamber and operable to substantially divide the valve chamber into a first sub-chamber and a second sub-chamber, the vane comprising a vane first side and a vane second side opposite the vane first side, the vane first side defining a portion of the first sub-chamber and the vane second side defining a portion of the second sub-chamber, the vane being operable to substantially conform to the geometry of the body inner surface of the valve body so as to establish a substantially fluid tight cooperation between the first sub-chamber and the second sub-chamber, the vane being pivotally coupled within the valve chamber about a pivot axis and operable to allow rotation of the vane between a first position and a second position, wherein the vane and the location of the inlet, the first outlet, and the second outlet are in cooperative arrangement to substantially restrict fluid communication from the inlet to substantially only the first outlet when the vane is in the first position wherein both the inlet and the first outlet are co-located within the first sub-chamber, and to substantially restrict fluid communication from the inlet to substantially only the second outlet when the vane is in the second position wherein both the inlet and the second outlet are co-located within the second sub-chamber; and

buoyancy means operable to move the vane between the first position and the second position in cooperative engagement with water in the tank reservoir for automatically controlling the flow of water from the fill valve bowl outlet to the tank reservoir and the bowl operable to control the water level in the bowl.

27. The control valve of claim 26, wherein the buoyancy means comprises a vane float coupled to the vane wherein the position of the vane is controlled by the buoyancy of the vane float in cooperative engagement with water in the tank reservoir, wherein when water in the tank reservoir is disengaged from the vane float, the vane float positions the vane in the first position, and wherein when the water in the tank reservoir engages and lifts the vane float, the vane float rotates the vane to the second position.

28. The control valve of claim 27, further comprises means for restricting the rotation of the vane between the first position and the second position.

29. The control valve of claim 28, wherein the means for restricting the rotation of the vane between the first position and the second position comprises a first stop and a second stop operable to control the rotation of the vane between the first position and the second position, each of the first stop and second stop define a projection from the body inner surface into the valve chamber upon which the vane may abut at the respective first and second positions.

30. The control valve of claim 28, the valve body further comprising a pair of apertures aligned with the pivot axis, an armature defining a C-shape including two armature ends operable to extend through the valve body via the apertures to couple with opposite edges of the vane intersecting the pivot axis, the cooperative arrangement of the armature ends and the apertures being operable to allow pivotal motion of the vane.

31. The control valve of claim 30, wherein the means for restricting the rotation of the vane between the first position and the second position comprises a first stop and a second stop each defining a projection from the body outer surface operable to abut the armature in the first position and the second position, respectively.

32. The control valve of claim 28, wherein the first outlet defines an elongated slot operable to provide fluid communication between the valve chamber and the tank reservoir, the control valve further comprising a vane float stem extending from an edge of the vane and extending through the slot and coupled to the vane float.

33. The control valve of claim 32, wherein the slot defines a slot first end and a slot second end opposite the slot first end, wherein the means for restricting the rotation of the vane between the first position and the second position comprises the slot wherein abutment of the float stem against the slot first end in the first position and

abutment of the float stem against the slot second end in the second position restricts the rotation of the vane between the first position and the second position.

34. The control valve of claim 26, wherein the valve chamber defines a substantially cylindrical shape, wherein the vane is a straight vane defining a rectangular profile.

35. The control valve of claim 26, wherein the valve chamber defines a substantially spherical shape, wherein the vane defines a disk shape.

36. The control valve of claim 26, wherein the vane is a bent vane defining a V-shaped profile, the bent vane comprising a first half vane and a second half vane joined at an apex.

37. The control valve of claim 26, further comprising:

an overflow pipe coupler coupled to the valve body, the overflow pipe coupler comprising means for removable coupling with the overflow pipe and operable for adjusting the position of the control valve along the length of the overflow pipe.

38. The control valve of claim 26, further comprising:

an overflow pipe coupler coupled to the valve body, the overflow pipe coupler comprising a split ring including a first half ring and a second half ring, the split ring defining an inner diameter for cooperative engagement with the outer surface of the overflow pipe having a complementary diameter, and including a fastener operable to clamp together the first half ring and the second half ring for removable engagement with the overflow pipe, the overflow pipe coupler being operable to allow for adjusting the position of the overflow pipe coupler along the length of the overflow pipe.

39. A toilet system, comprising:

a toilet including a tank in fluid communication with a bowl, the tank defining a tank reservoir operable for storing water and housing associated plumbing including an overflow pipe and a fill valve, the overflow pipe including a lumen therethrough defining an overflow pipe inlet at one end in fluid communication with the tank

reservoir and an overflow pipe outlet at an opposite end in fluid communication with the bowl, the fill valve including a fill valve inlet, a fill valve tank outlet in fluid communication with the tank reservoir, and a fill valve bowl outlet in fluid communication with the overflow pipe inlet, the fill valve inlet in fluid communication with the fill valve tank outlet and the fill valve bowl outlet; and

an control valve comprising a valve body, a vane, and a buoyancy means, the valve body including a body outer surface and a body inner surface defining a valve chamber, the valve body defining an inlet, a first outlet and a second outlet, each of the inlet, first outlet and second outlet providing fluid conduits from the body inner surface to the body outer surface such that water may flow into and out of the valve chamber, the inlet being operable for fluid communication with the fill valve bowl outlet, the first outlet being operable for fluid communication with the tank reservoir, and the second outlet being operable for fluid communication with the overflow pipe inlet,

the vane comprising a vane first side and a vane second side opposite the vane first side, the vane being disposed within the valve chamber and operable to substantially divide the valve chamber into a first sub-chamber and a second sub-chamber, the vane first side defining a portion of the first sub-chamber and the vane second side defining a portion of the second sub-chamber, the vane being operable to substantially conform to the geometry of the body inner surface of the valve body so as to establish a substantially fluid tight cooperation between the first sub-chamber and the second sub-chamber, the vane being pivotally coupled within the valve chamber about a pivot axis and operable to allow rotation of the vane between a first position and a second position, wherein the vane and the location of the inlet, the first outlet, and the second outlet are in cooperative arrangement to substantially restrict fluid communication from the inlet to substantially only the first outlet when the vane is in the first position wherein both the inlet and the first outlet are co-located within the first sub-chamber, and to substantially restrict fluid communication from the inlet to substantially only the second outlet when the vane is in the second position wherein both the inlet and the second outlet are co-located within the second sub-chamber, and

the buoyancy means being operable to move the vane between the first position and the second position in cooperative engagement with water in the tank

reservoir for automatically controlling the flow of water from the fill valve bowl outlet to the tank reservoir and the bowl operable to substantially prevent overfilling the bowl with water.

40. The toilet system of claim 39, wherein the buoyancy means comprises a vane float coupled to the vane wherein the position of the vane is controlled by the buoyancy of the vane float in cooperative engagement with water in the tank reservoir, wherein when water in the tank reservoir is disengaged from the vane float, the vane float positions the vane in the first position, and wherein when the water in the tank reservoir engages and lifts the vane float, the vane float rotates the vane to the second position.

41. The toilet system of claim 40, further comprises means for restricting the rotation of the vane between the first position and the second position.

42. The toilet system of claim 41, wherein the means for restricting the rotation of the vane between the first position and the second position comprises a first stop and a second stop operable to control the rotation of the vane between the first position and the second position, each of the first stop and second stop define a projection from the body inner surface into the valve chamber upon which the vane may abut at the respective first and second positions.

43. The toilet system of claim 41, the valve body further comprising a pair of apertures aligned with the pivot axis, an armature defining a C-shape including two armature ends operable to extend through the valve body via the apertures to couple with opposite edges of the vane intersecting the pivot axis, the cooperative arrangement of the armature ends and the apertures being operable to allow pivotal motion of the vane.

44. The toilet system of claim 43, wherein the means for restricting the rotation of the vane between the first position and the second position comprises a first stop and a second stop each defining a projection from the body outer surface operable to abut the armature in the first position and the second position, respectively.

45. The toilet system of claim 42, wherein the first outlet defines an elongated slot operable to provide fluid communication between the valve chamber and the tank reservoir, the control valve further comprising a vane float stem extending from an edge of the vane and extending through the slot and coupled to the vane float.

46. The toilet system of claim 45, wherein the slot defines a slot first end and a slot second end opposite the slot first end, wherein the means for restricting the rotation of the vane between the first position and the second position comprises the slot wherein the abutment of the float stem against the slot first end in the first position and abutment of the float stem against the slot second end in the second position restricts the rotation of the vane between the first position and the second position.

47. The toilet system of claim 39, wherein the valve chamber defines a substantially cylindrical shape, wherein the vane is a straight vane defining a rectangular profile.

48. The toilet system of claim 39, wherein the valve chamber defines a substantially spherical shape, wherein the vane defines a disk shape.

49. The toilet system of claim 39, wherein the vane is a bent vane defining a V-shaped profile, the bent vane comprising a first half vane and a second half vane joined at an apex.

50. The toilet system of claim 39, further comprising:

an overflow pipe coupler coupled to the valve body, the overflow pipe coupler comprising means for removable coupling with the overflow pipe and operable for adjusting the position of the control valve along the length of the overflow pipe.

51. The toilet system of claim 39, further comprising:

an overflow pipe coupler coupled to the valve body, the overflow pipe coupler comprising a split ring including a first half ring and a second half ring, the split ring defining an inner diameter for cooperative engagement with the outer surface of the overflow pipe having a complementary diameter, and including a fastener operable

to clamp together the first half ring and the second half ring for removable engagement with the overflow pipe, the overflow pipe coupler being operable to allow for adjusting the position of the overflow pipe coupler along the length of the overflow pipe.

52. A method for automatically controlling the flow of water in a toilet from a fill valve bowl outlet to a tank reservoir and a bowl, comprising:

providing a toilet including a tank in fluid communication with a bowl, the tank defining a tank reservoir operable for storing water and housing associated plumbing including an overflow pipe and a fill valve, the overflow pipe including a lumen therethrough defining an overflow pipe inlet at one end in fluid communication with the tank reservoir and an overflow pipe outlet at an opposite end in fluid communication with the bowl, the fill valve including a fill valve inlet, a fill valve tank outlet in fluid communication with the tank reservoir, and a fill valve bowl outlet in fluid communication with the overflow pipe inlet, the fill valve inlet in fluid communication with the fill valve tank outlet and the fill valve bowl outlet;

providing a control valve comprising:

a valve body including a body outer surface and a body inner surface defining a valve chamber, the valve body defining an inlet, a first outlet and a second outlet, each of the inlet, first outlet and second outlet providing fluid conduits from the body inner surface to the body outer surface such that water may flow into and out of the valve chamber, the inlet being operable for fluid communication with the fill valve bowl outlet, the first outlet being operable for fluid communication with the tank reservoir, and the second outlet being operable for fluid communication with the overflow pipe inlet;

a vane disposed within the valve chamber and operable to substantially divide the valve chamber into a first sub-chamber and a second sub-chamber, the vane comprising a vane first side and a vane second side opposite the vane first side, the vane first side defining a portion of the first sub-chamber and the vane second side defining a portion of the second sub-chamber, the vane being operable to substantially conform to the geometry of the body inner surface of the valve body so as to establish a substantially fluid tight cooperation between the first sub-chamber and the second sub-chamber, the vane being pivotally coupled within the valve

chamber about a pivot axis and operable to allow rotation of the vane between a first position and a second position, wherein the vane and the location of the inlet, the first outlet, and the second outlet are in cooperative arrangement to substantially restrict fluid communication from the inlet to substantially only the first outlet when the vane is in the first position wherein both the inlet and the first outlet are co-located within the first sub-chamber, and to substantially restrict fluid communication from the inlet to substantially only the second outlet when the vane is in the second position wherein both the inlet and the second outlet are co-located within the second sub-chamber;

buoyancy means operable to move the vane between the first position and the second position in cooperative engagement with water in the tank reservoir; and

an overflow pipe coupler coupled to the valve body, the overflow pipe coupler comprising means for removable coupling with the overflow pipe and operable for adjusting the position of the control valve along the length of the overflow pipe;

installing the control valve in the tank reservoir by receiving the overflow pipe coupler onto the overflow pipe such that the buoyancy means may interact with the water in the tank reservoir operable to move the vane between a first position and a second position;

positioning the control valve higher on the overflow pipe if the water in the bowl is above a predetermined level at the completion of a flush refill; and

positioning the control valve lower on the overflow pipe if the water in the bowl is below a predetermined level at the completion of a flush refill.

53. Apparatus with the inventive features shown and described.

54. Methods with the inventive features shown and described.

1/18

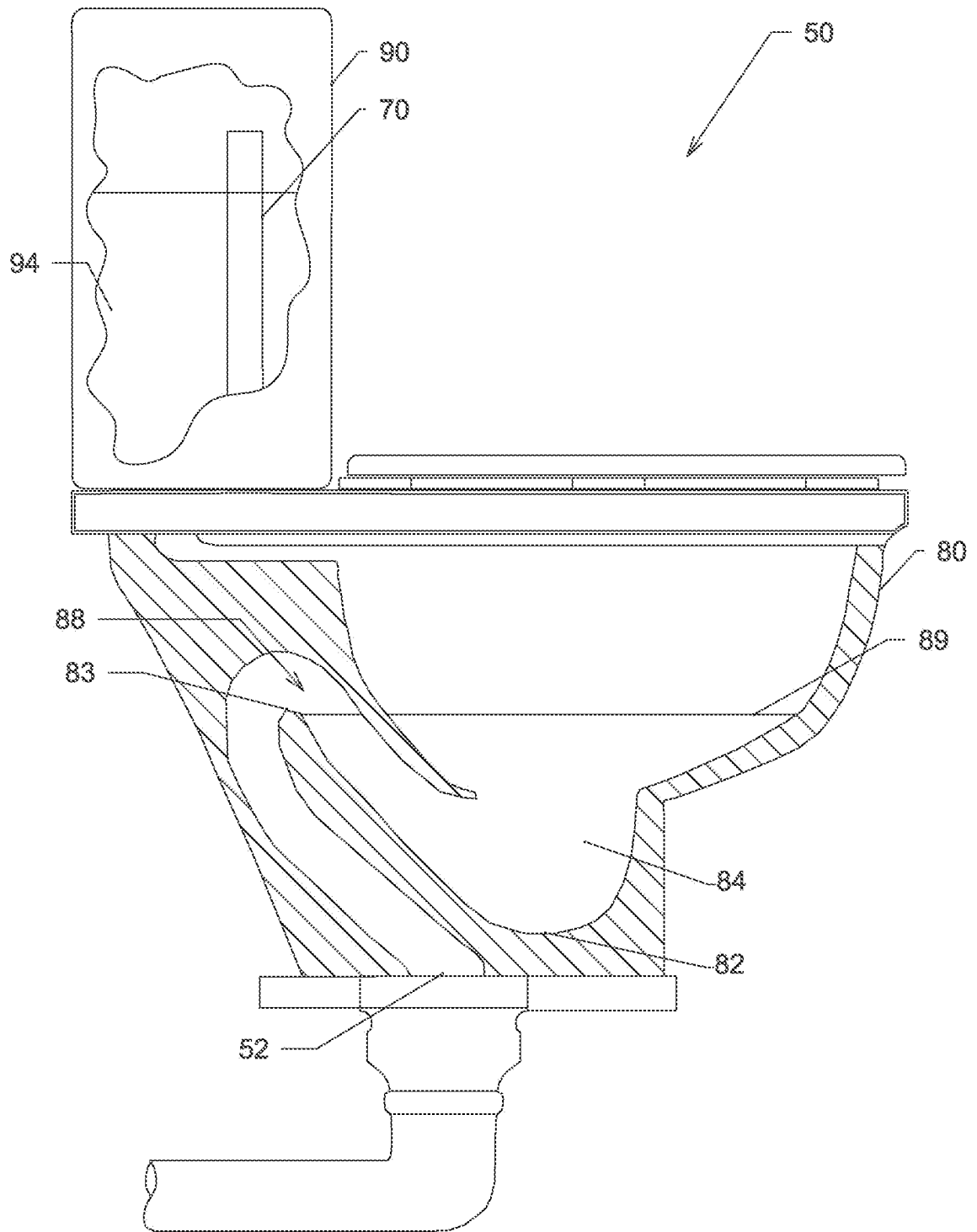


FIG.1 (PRIOR ART)

2/18

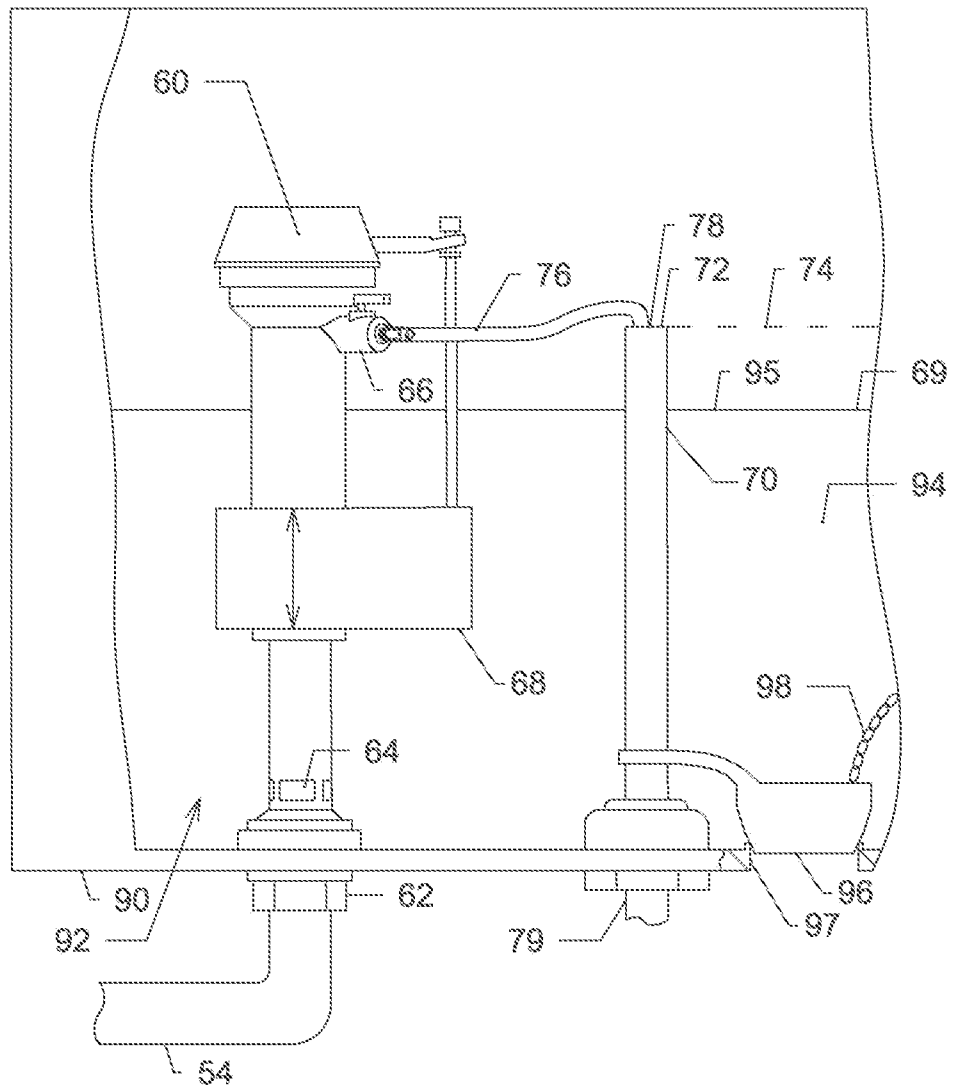


FIG.2 (PRIOR ART)

3/18

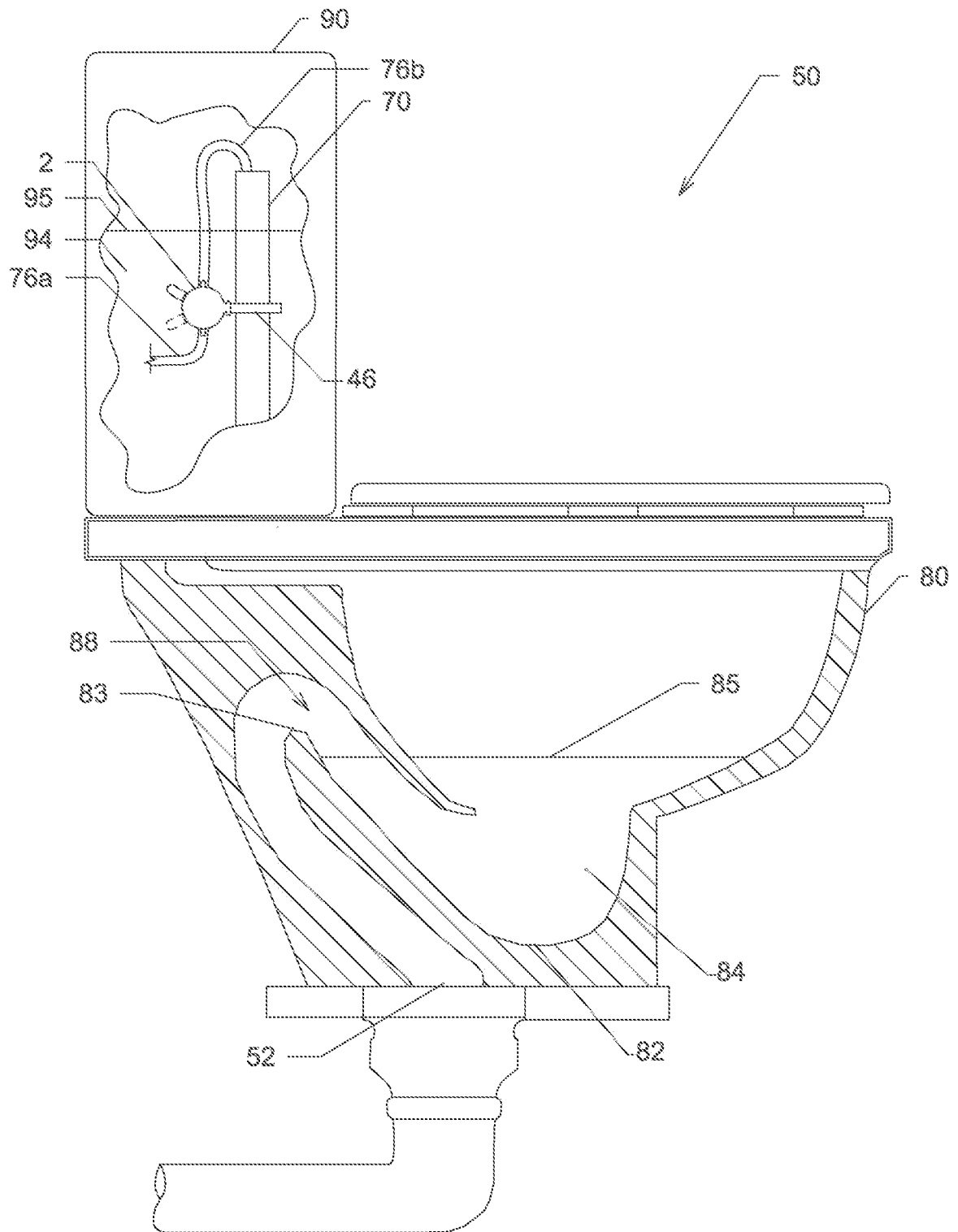


FIG.3

4/18

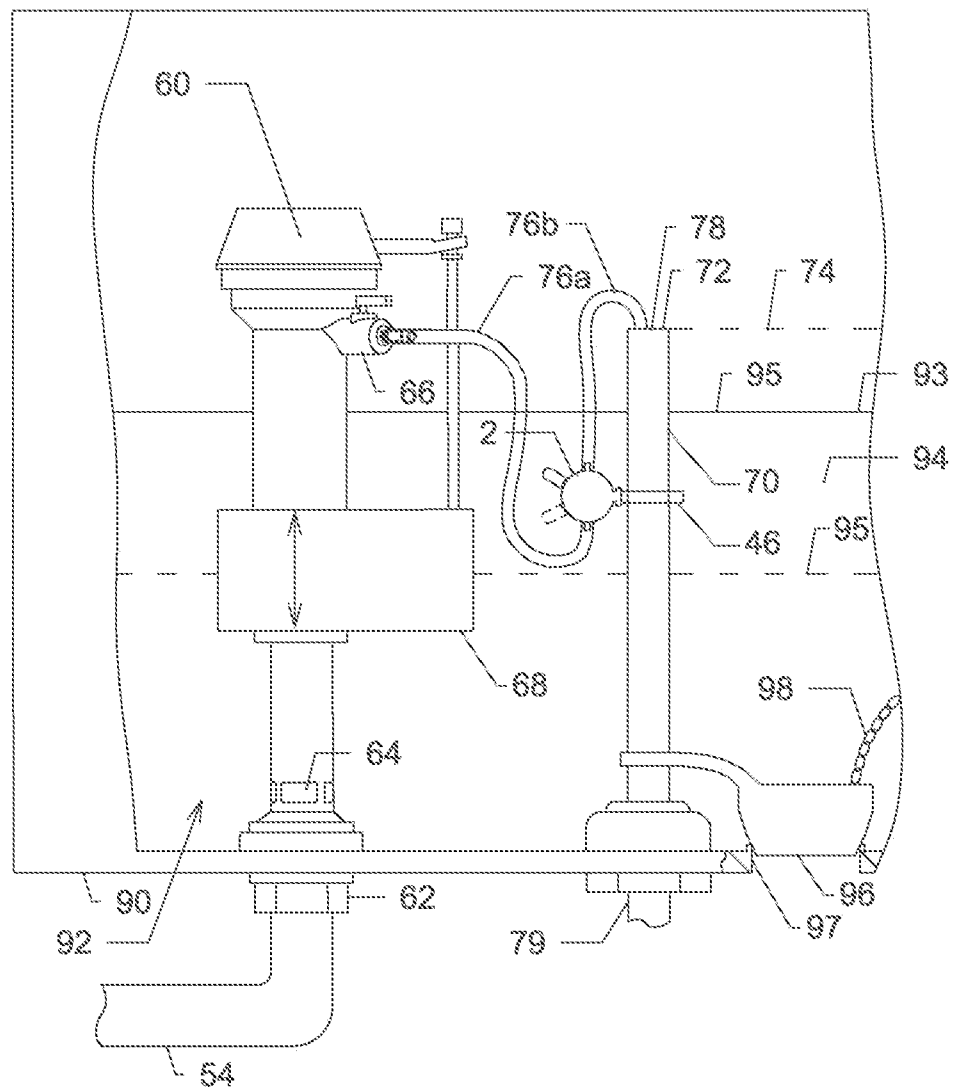


FIG.4

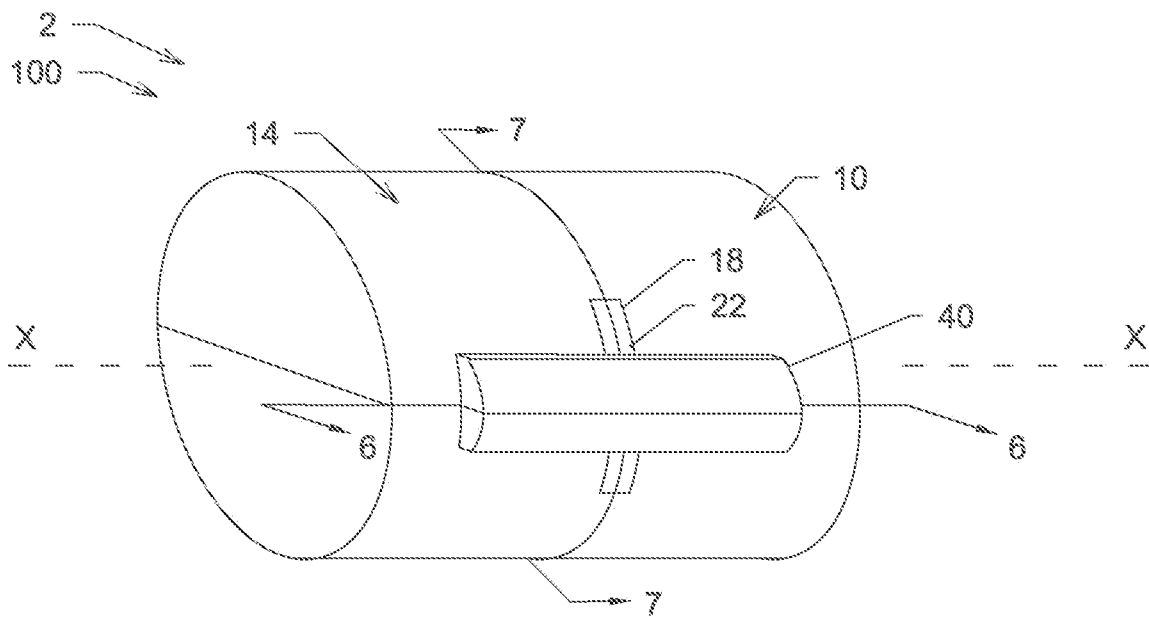


FIG.5

6/18

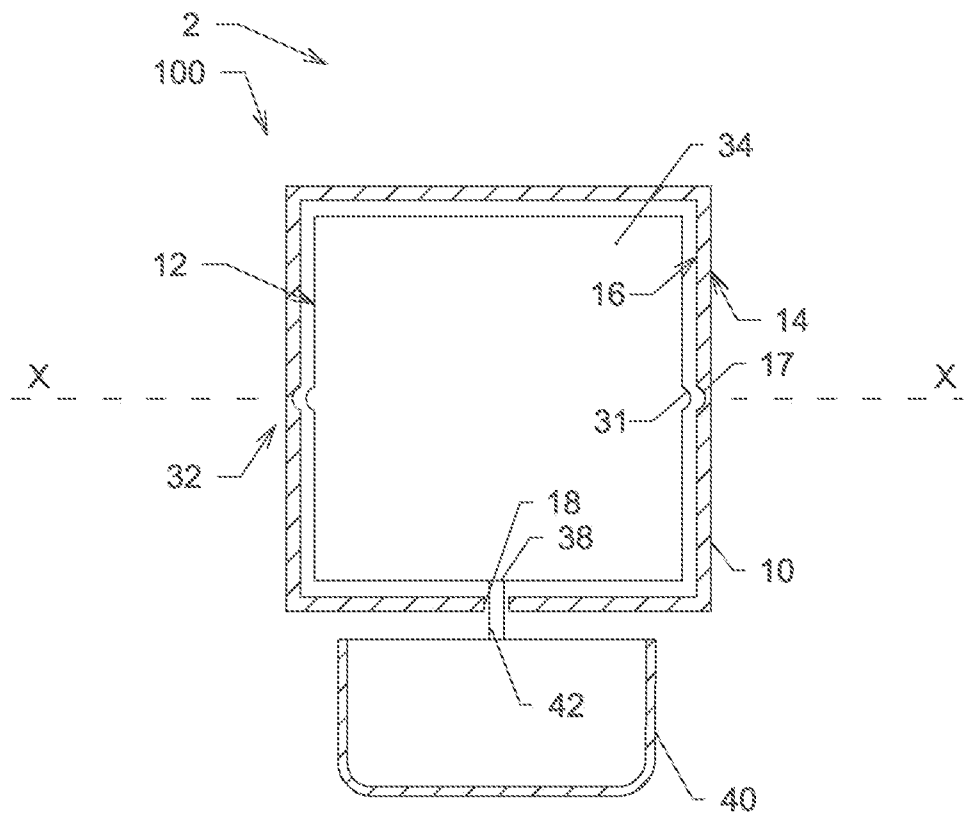


FIG.6

7/18

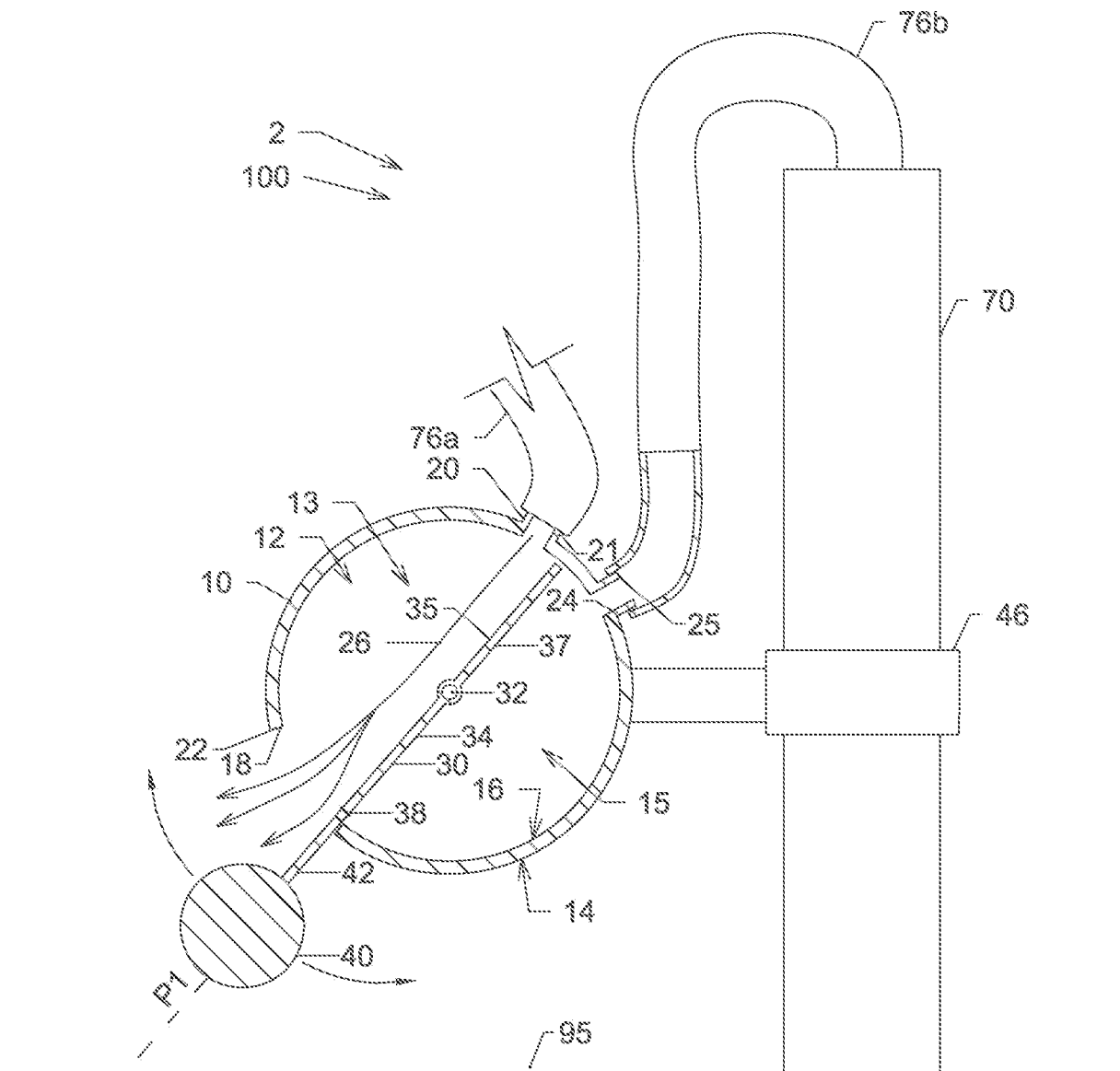


FIG. 7

8/18

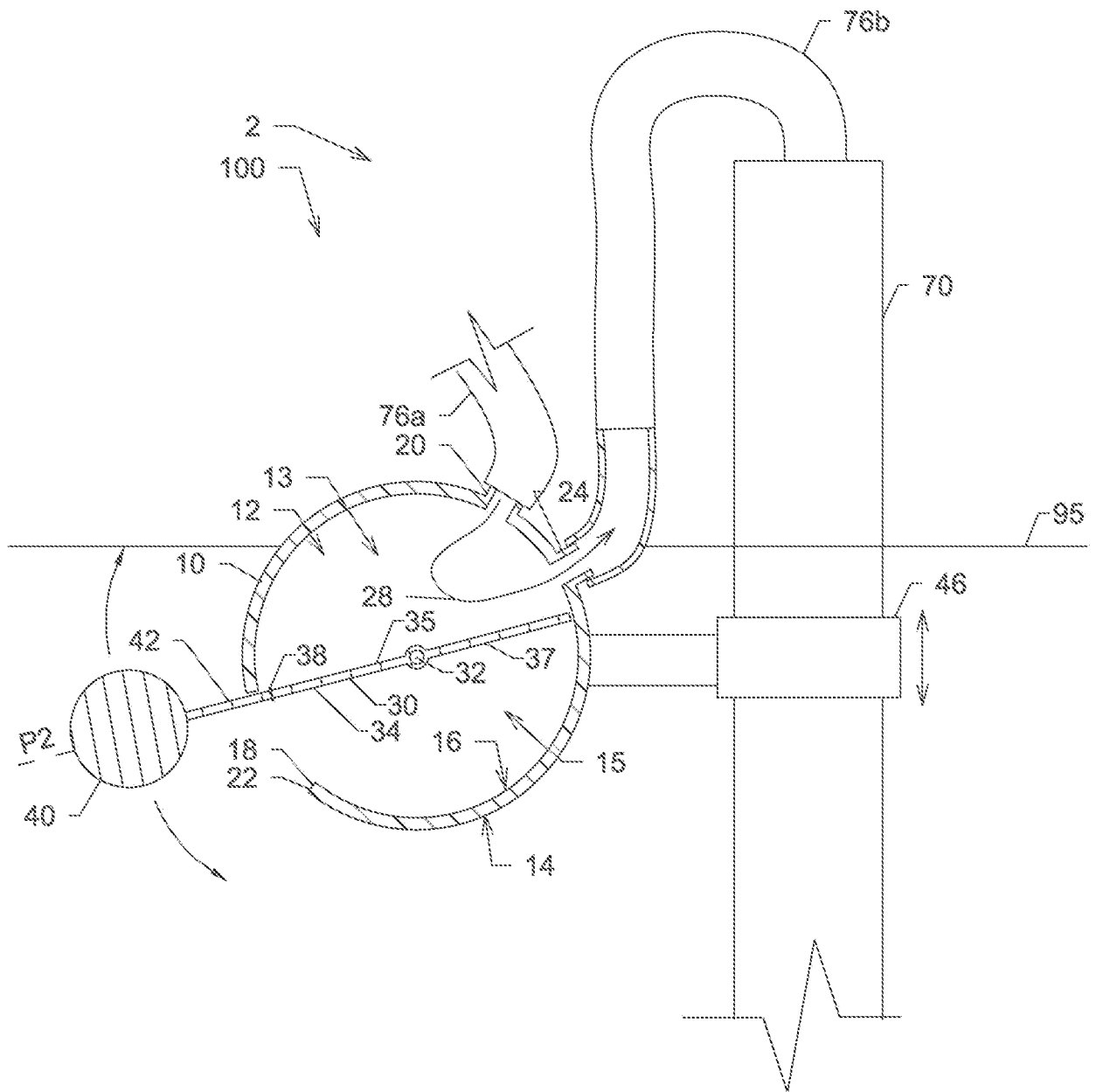


FIG. 8

9/18

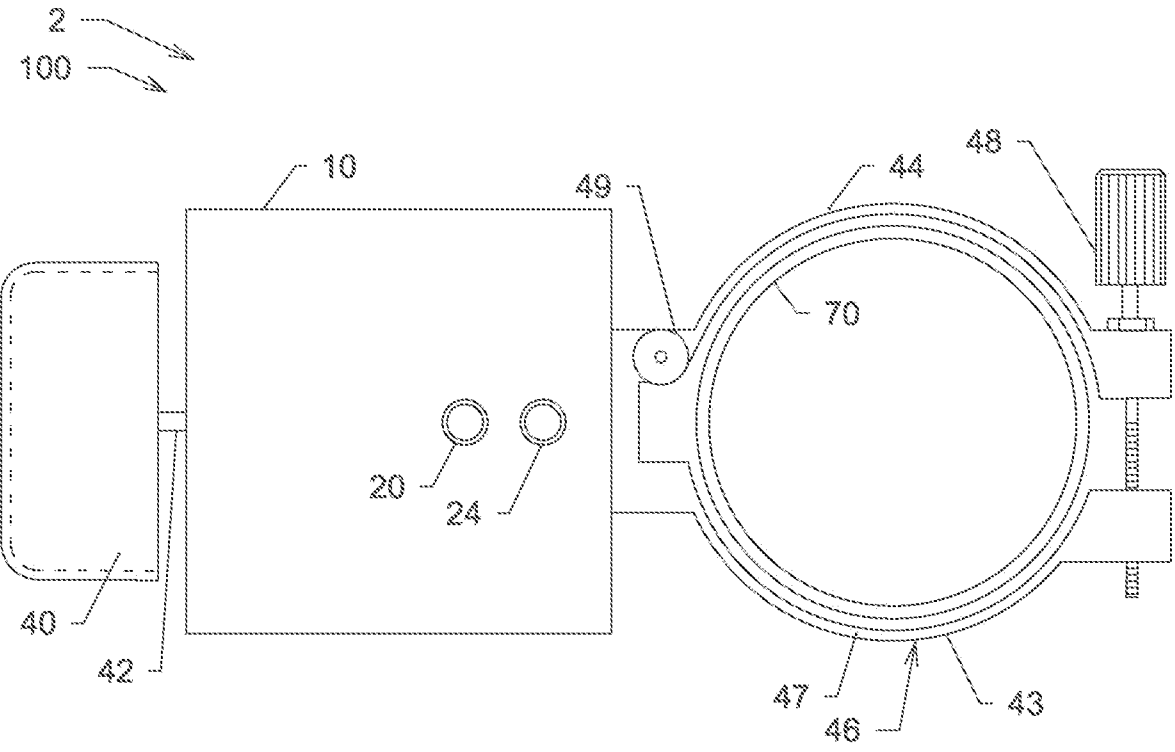


FIG.9

10/18

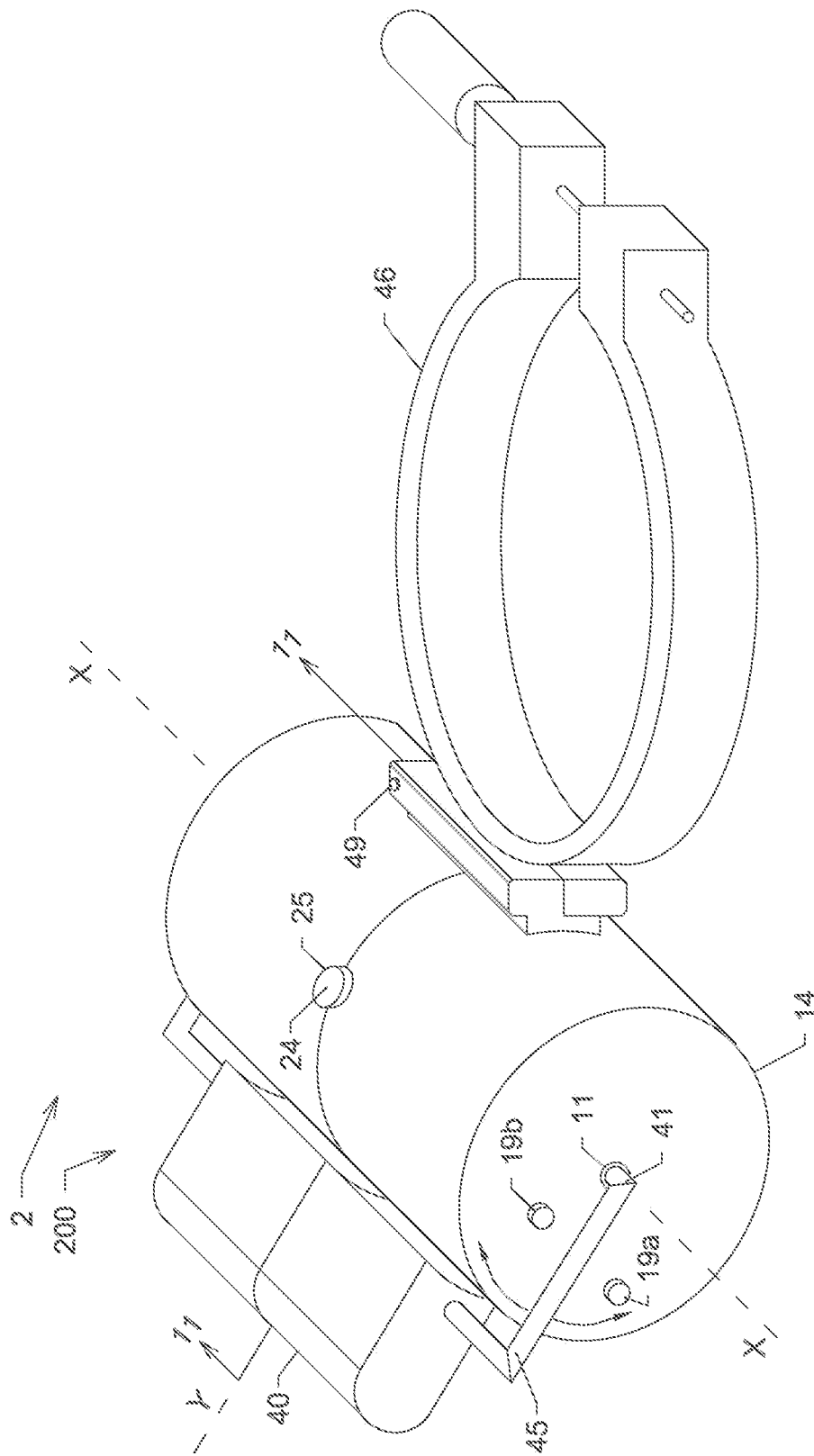
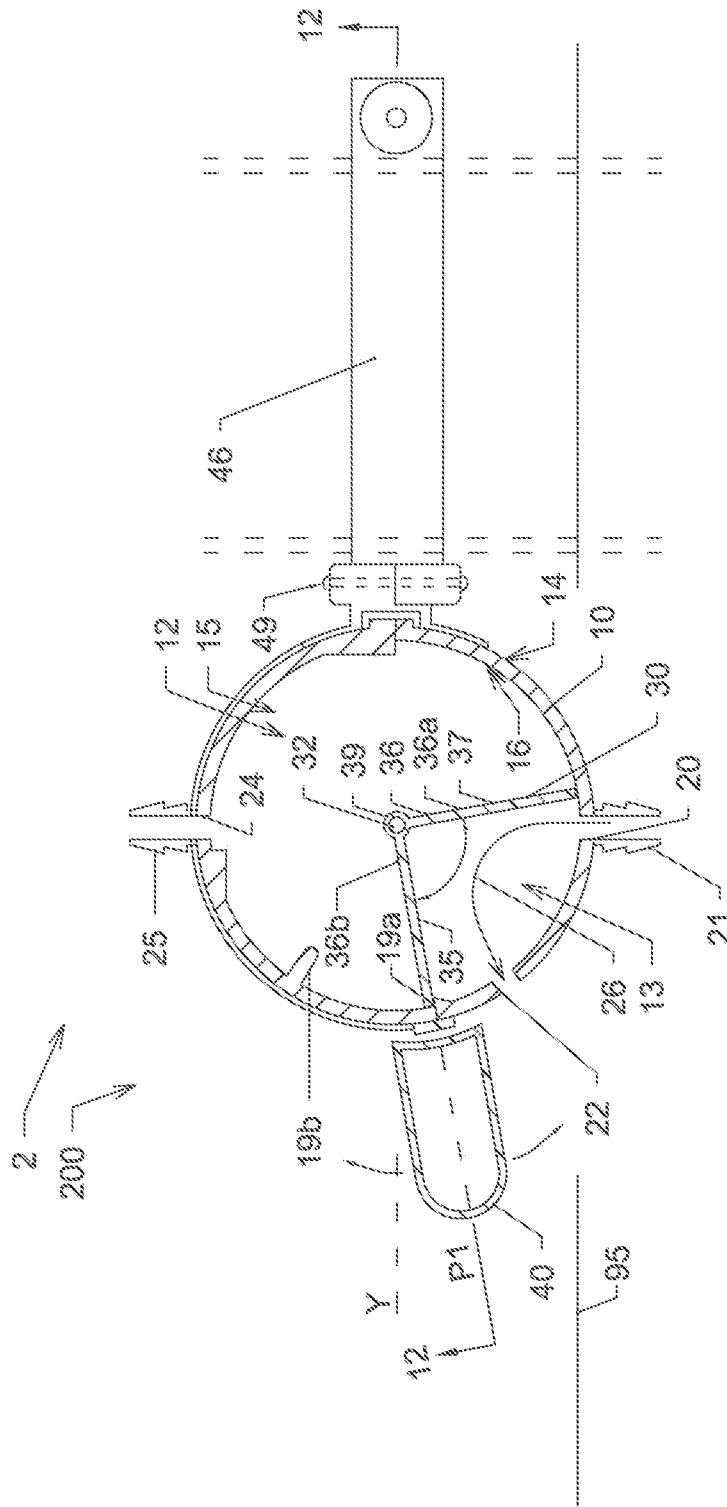


FIG. 10

11/18



12/18

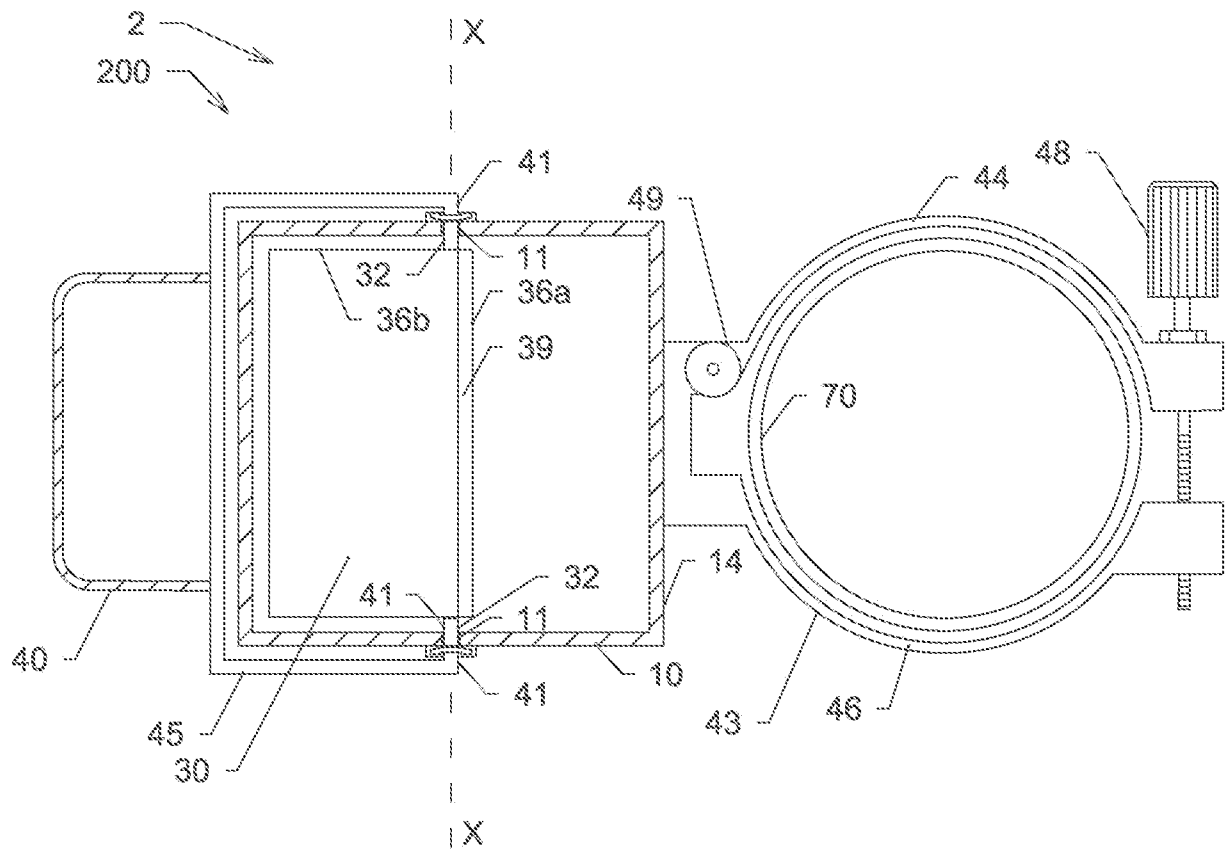


FIG. 12

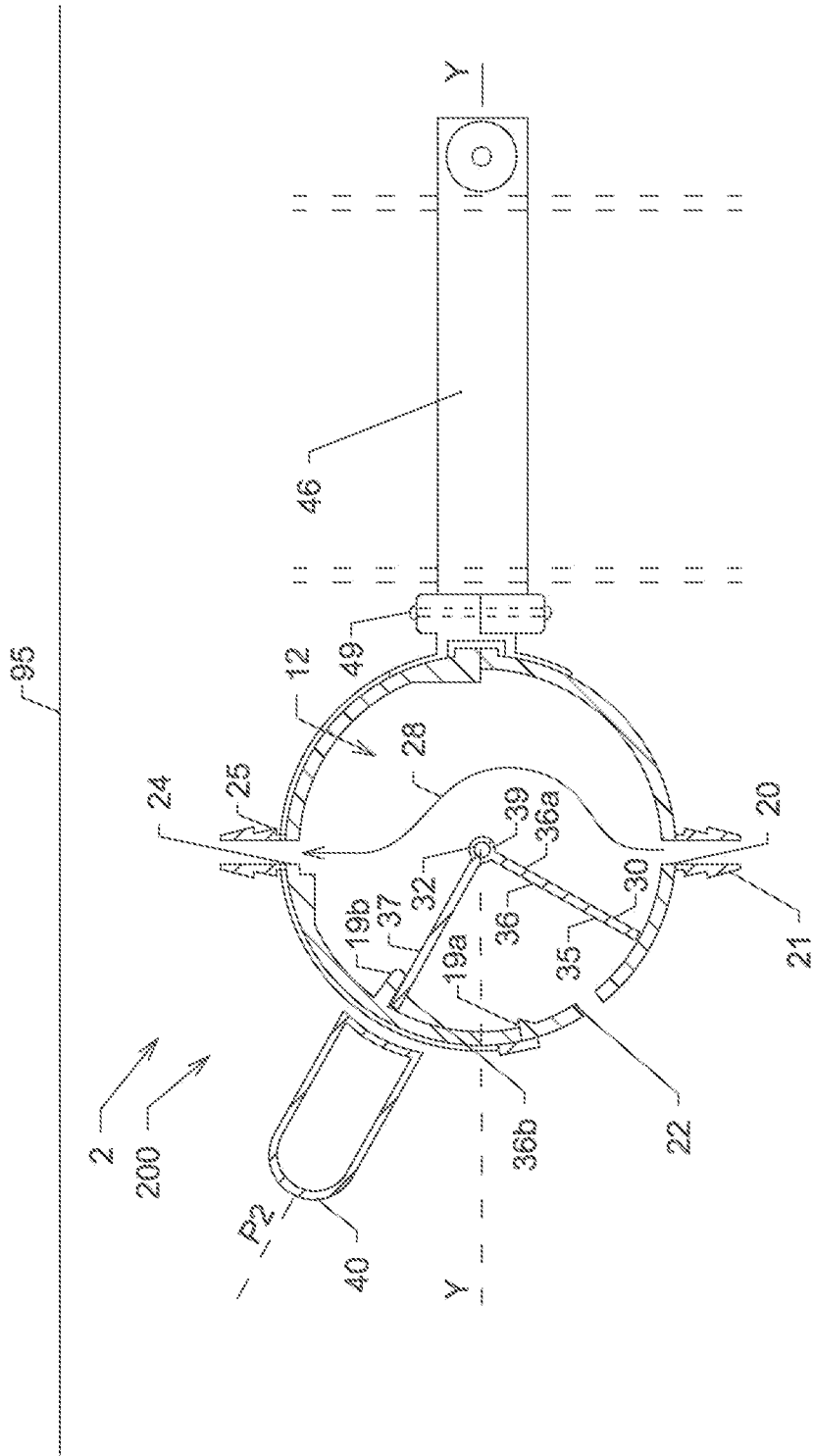


FIG.13

14/18

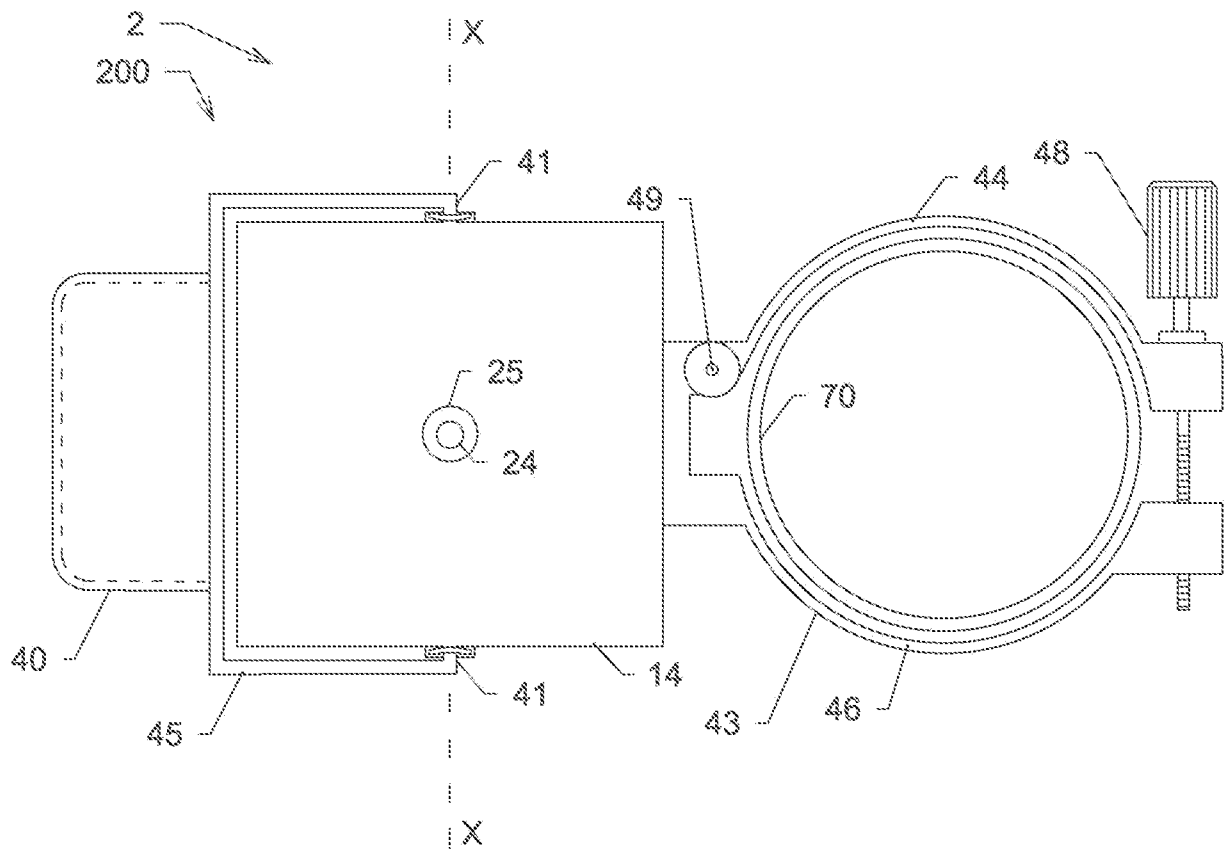


FIG. 14

15/18

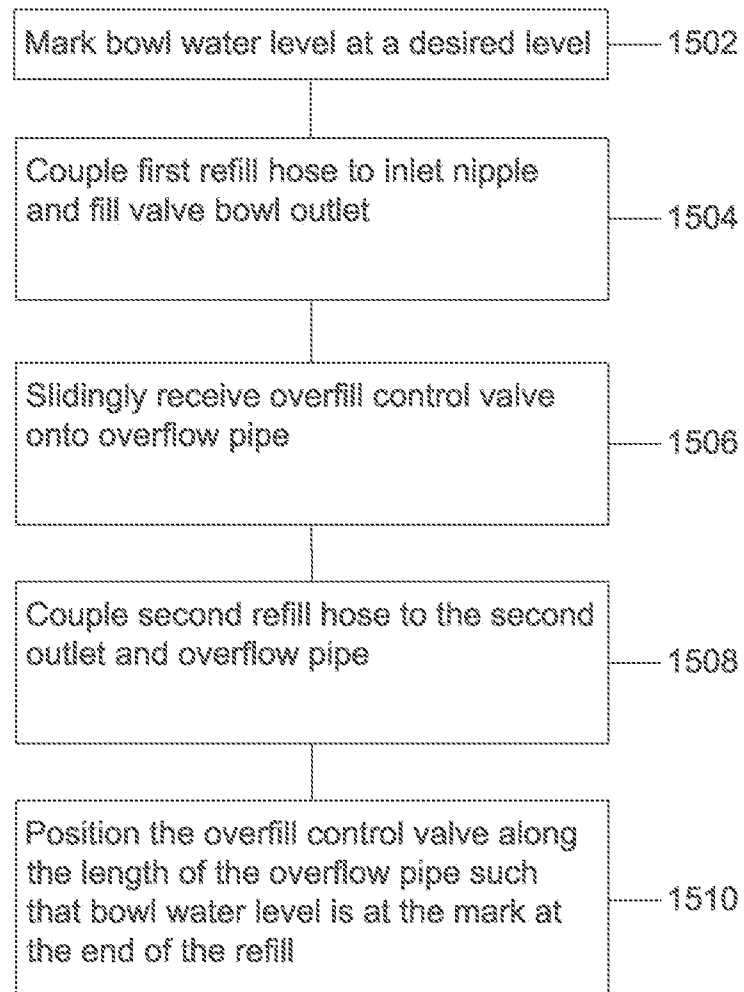


FIG.15

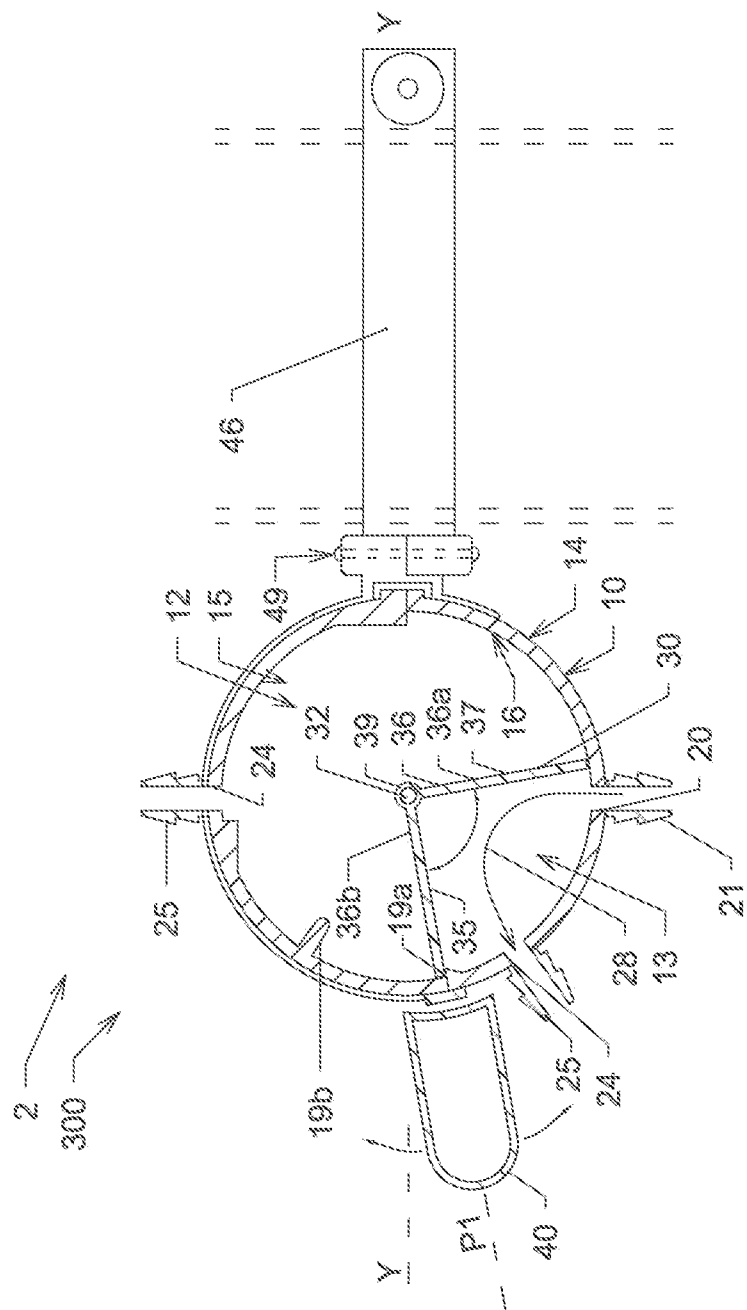


FIG. 16

17/18

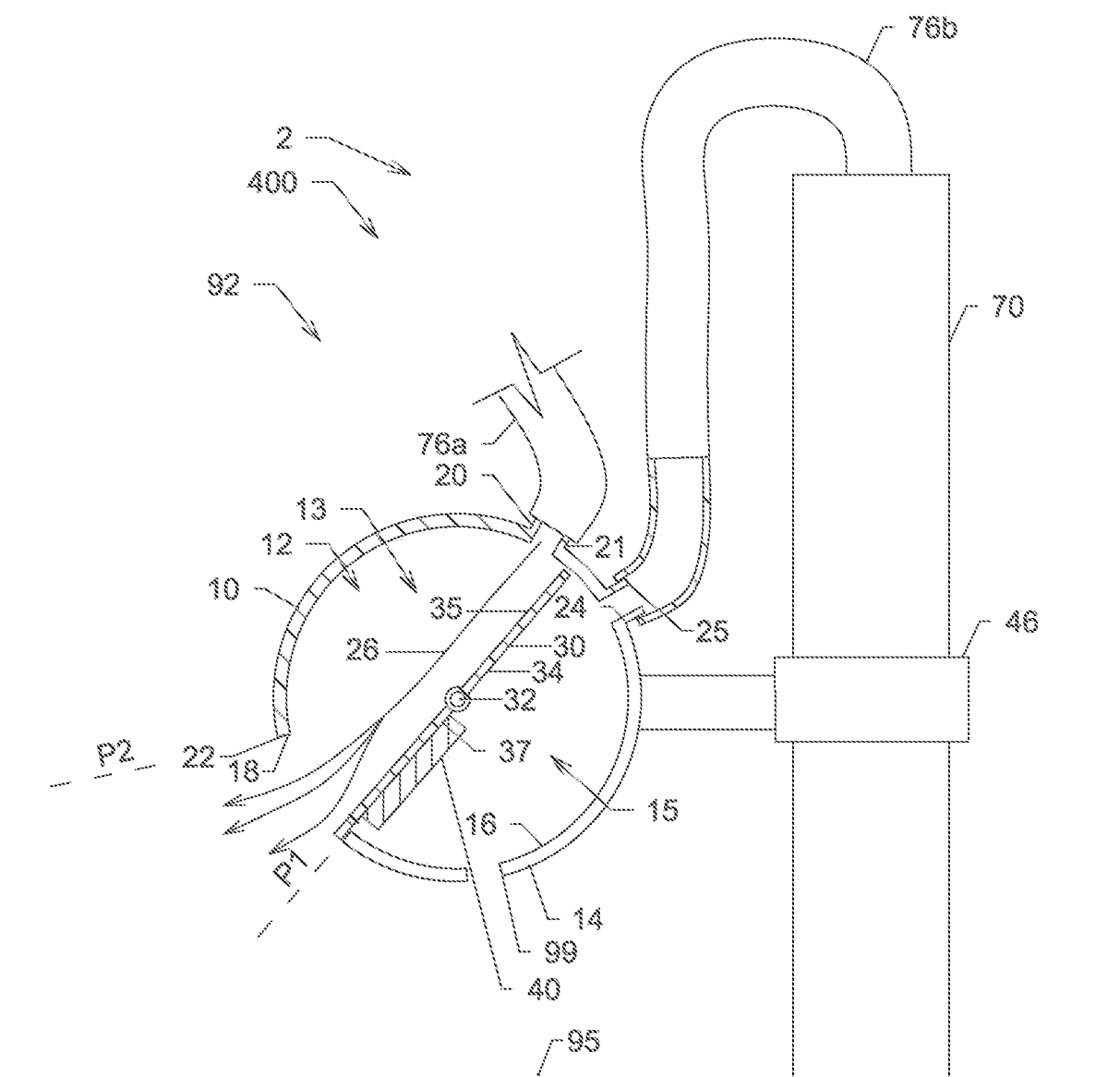


FIG. 17

18/18

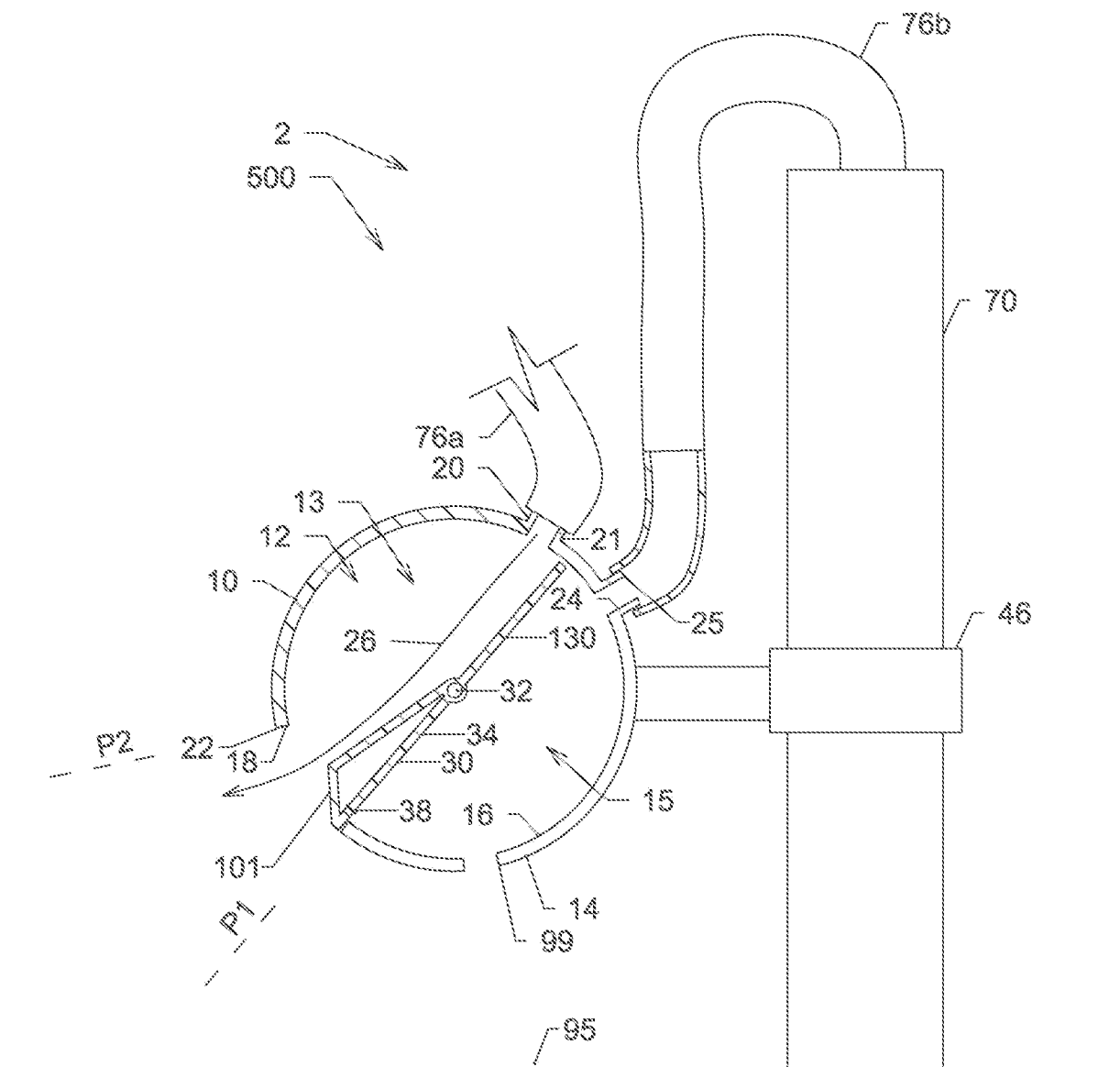


FIG. 18

A. CLASSIFICATION OF SUBJECT MATTER***E03D 1/35(2006.01)i, F16K 31/18(2006.01)i, F16K 33/00(2006.01)i***

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E03D 1/35; E03D 3/12; E03D 1/33; E03D 1/01; E03D 1/14; E03D 5/094

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: toilet, tank, bowl, valve

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP 3048310 U9 (TADAYOSHI) 18 February 1998 See figures 1-5.	1-4,22 5-21,23-52
A	KR 10-2001-0107496 A (CHOI, JONG SUNG) 07 December 2001 See figure 1.	1-52
A	JP 09-004011 A (INAX CORP) 07 January 1997 See figures 1-4.	1-52
A	JP 09-195354 A (INAX CORP) 29 July 1997 See claim 1 and figures 1-4.	1-52
A	US 5142710 A1 (OLSON; OLOF) 01 September 1992 See column 3 and figure 1.	1-52
A	US 5524297 A1 (HARRISON; JOHN S.) 11 June 1996 See abstract and figures 1-3.	1-52



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

21 APRIL 2011 (21.04.2011)

Date of mailing of the international search report

22 APRIL 2011 (22.04.2011)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
Government Complex-Daejeon, 189 Cheongsu-ro,
Seo-gu, Daejeon 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

Kim, Locbae

Telephone No. 82-42-481-8625



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2010/043147**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 53, 54
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
Claims 53 and 54 are too broad to make meaningful search possible.
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2010/043147

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 3048310 U9	18.02.1998	None	
KR 10-2001-0107496 A	07.12.2001	None	
JP 09-004011 A	07.01.1997	None	
JP 09-195354 A	29.07.1997	None	
US 5142710 A1	01.09.1992	None	
US 5524297 A1	11.06.1996	US 05924143A A	20.07.1999