



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
23.05.2007 Bulletin 2007/21

(51) Int Cl.:
A47K 13/10 (2006.01)

(21) Application number: **06255945.5**

(22) Date of filing: **21.11.2006**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

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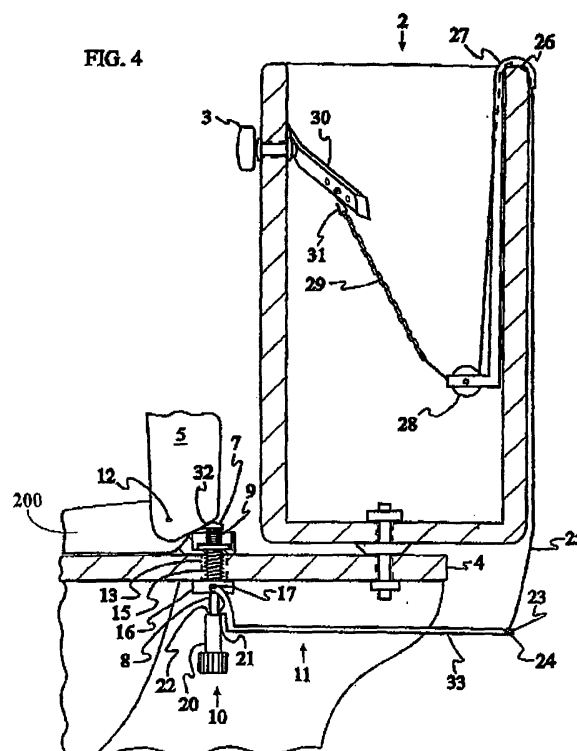
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(30) Priority: **21.11.2005 US 738630 P**

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(54) **Closure apparatus and method of installing same**

(57) A toilet assembly that includes a bowl, a toilet seat member mounted on the bowl for movement between raised and lowered positions, and a tank mounted on the bowl. The tank is adapted to contain water for flushing the toilet and has a flushing apparatus for causing the water in the tank to flow into the bowl. The toilet assembly also includes a hydraulic closure apparatus mounted on the toilet. The apparatus includes a member movable relative to the toilet and engageable with the seat member such that movement of the member in one direction moves the seat member toward the lowered position. Movement of the seat member toward the raised position moves the member in an opposite direction. The apparatus also includes a cylinder and a piston slidable inside the cylinder. The piston divides the cylinder into first and second chambers and is connected to the member such that movement of the member in the opposite direction moves the piston in the direction minimizing the volume of the second chamber. The apparatus further includes a spring positioned in the second chamber. The spring is compressed by the piston when the piston moves in the direction minimizing the volume of the second chamber. The apparatus also further includes a conduit having one end in communication with the second chamber and a second end positioned in the water in the tank. The toilet assembly further includes a valve arrangement for closing the second end of the conduit when the tank is relatively full of water and for opening the second end of the conduit when the toilet is flushed.



Description

RELATED APPUCATION

[0001] This application claims the benefit of co-pending Provisional Patent Application Serial No. 60/738,630, filed on November 21, 2005.

TECHNICAL FIELD

[0002] The present invention relates generally to toilets, and, more specifically, to devices for closing a toilet cover.

BACKGROUND ART

[0003] There are many devices in the prior art which automatically, or semi-automatically, lower a toilet seat, a toilet lid, and/or a toilet seat and lid assembly. As users often neglect to fully close a toilet lid after use, a device for automatically closing a lid upon conventional flushing of the toilet offers a numbers of advantages. Fdr example, when not in use, a fully closed toilet is safer in that it prevents children and pets from falling into the toilet bowl. In addition, a closed toilet is more sanitary in that it prevents pets from drinking from the bowl and averts cases of toilet users leaving the seat and lid assembly in an open position, thereby causing an inattentive subsequent user to sit on the actual toilet bowl instead of the toilet seat. In addition, it also helps to eliminate the situation where a male user utilizes the facility without raising the seat prior to urinating, by requiring that the male bend over and raise at least the lid, and preferably both the lid and seat, prior to urinating. Moreover, a fully closed toilet is overall more aesthetically pleasing.

[0004] However, all such known devices are believed to be relatively more obtrusive than the present invention in that they substantially detract from the usually smooth, simple appearance of the toilet or surrounding area, they make toilet cleaning more difficult, or they interfere with a conventional toilet's function, such as use of the flush handle. Most of the devices are also relatively complex and sometimes difficult to install, therefore often resulting in a rather costly device.

[0005] The devices of the prior art may be classified into several categories according to the actuation means each uses to initiate the closing of a lid and/or seat. More specifically, the actuation means used include: 1) foot pedals; 2) simple release of a user's hand, for those requiring the lid and/or seat to be held open while using the toilet; 3) sensors of various types; 4) timers of various types; 5) the toilet's existing flush handle; 6) water from either the supply line or the toilet's existing tank; 7) electric switches, which may primarily initiate flushing but also result in lid and/or seat closing; 8) the toilet's existing float or a special additional float or float/weight or float sensor; and, 9) the toilet's existing flush arm.

[0006] Unfortunately, all of these actuation means

have disadvantages, for example, with respect to how they communicate with the lid and seat of the toilet. More specifically, several devices, such as those employing foot pedals, require the use of levers and/or rods and/or cylinders and/or air tubes positioned along the side(s) of the toilet bowl and all arc believed to be highly obtrusive. For example, the devices set forth in U.S. Patent Nos. 6,112,336, 5,289,593 and 5,267,356 disclose use of a visible sheathed cable end attached to an obtrusive mechanism mounted either atop the toilet's bowl ledge or to the side of said ledge. In addition, U.S. Patent No. 5,781,938 discloses a float-actuated line which moves an obtrusive seat counter-balaucing arm which is visible over the side of said ledge. U.S. Patent No. 5,307,524 discloses an electric line over the side of the ledge to an obtrusive, expensive mechanism requiring a microprocessor atop the toilet's bowl ledge. U.S. Patent Nos. 5,754,985 and 5,222,260 disclose obtrusive apparatus mounted atop the front of the toilet's tank.

[0007] Similarly, those employing the hand-release approach are also obtrusive in that they require the user to hold the lid and/or seat open while using the toilet. In addition, those employing timers are frequently visually obtrusive because the timers are generally incorporated into sizable devices mounted atop the toilet bowl ledge. Also, the timers may initiate closing action at a time inconvenient to a particular user.

[0008] Devices that use portions of a toilet's tank to assist with automatically closing a seat and lid assembly also have some disadvantages. For example, devices employing the toilet's existing flush handle are often visually obtrusive because the chains, cables, rods or levers are attached to or interact with the flush handle and their attachment to the flush handle interferes with use of the handle to flush the toilet. In addition, devices using the toilet's existing or added float(s), floating weights or a float switch are believed to be more visually obtrusive than the present invention in that they all employ a communication means with the seat or lid which may extend over the side of the toilet bowl's ledge or be mounted to the front of the toilet's tank. Those employing special added floats also reduce the effective water capacity of the tank which is especially disadvantageous when used with smaller, lower flush volume toilets.

[0009] Although sometimes not as visually obtrusive, several other devices are difficult to install, complex in design and therefore often expensive. For example, devices employing sensors of various types and electric switches to close the lid and/or seat are believed to be considerably complex and costly. In addition, devices employing either water from the toilet's supply line or tank require additional plumbing work and therefore are relatively difficult to install. Also, these devices increase risk of water leakage.

[0010] Of all disclosed devices referred to above, only U.S. Patent No. 6,230,336 disclosed use of a direct mechanical connection to the toilet's flush arm as the actuating means. However, this direct mechanical connection

is relied upon only to, via a line or cord, activate an electrical switch in an obtrusive electro-mechanical device atop the toilet bowl's ledge that appears to be complex and costly. The reason only this one of the many prior art devices uses such a connection to the flush arm as the actuation means is believed to be that most flush arms are designed with little more strength than that required to raise the flush valve and they will not tolerate a significant additional load without breaking.

[0011] Of all the known devices to open and close a toilet seat or lid, only the following utilize the standard lid/seat assembly mounting openings provided on toilet bowl ledges as a less obtrusive method of communicating between the automatic closing actuation means and the lid and seat: U.S. Patent Nos. 6,230,336 and 6,185,754 disclose use of the mounting opening as a water conduit to an obtrusive mechanism mounted atop the toilet bowl's ledge; U.S. Patent No. 5,867,843 discloses use of the mounting opening for an air tube to an obtrusive mechanism mounted atop the toilet bowl's ledge; U.S. Patent Nos. 5,410,766 and 4,951,323 disclose use of the mounting opening as a pathway for a flexible cable to raise, rather than automatically lower, a seat or lid; while U.S. Patent 4,975,988 discloses use of the mounting opening as a pathway for a flexible cable connected to a foot pedal to lower as well as raise the seat. None of the prior art uses the mounting opening or bowl ledge in the manner provided by the present invention.

SUMMARY OF INVENTION

[0012] A closure apparatus and a method of installing the same are provided.

[0013] More specifically, in one embodiment, the closure apparatus is adapted to mount to a toilet having a cover, a bowl ledge and a flush mechanism. The closure apparatus includes a mounting bolt having an opening extending therethrough and a rod disposed within the opening of the bolt. The apparatus also includes a spring that is adapted to be deformed by the rod to thereby bias the rod and a lever movable with respect to the mounting bolt. A latch release mechanism coupled to the lever is also included. Upon flushing of the toilet when the cover is open, and when the closure apparatus is mounted on the bowl ledge, the flush mechanism causes the latch point of the lever to move with respect to the mounting bolt. This allows the spring to move the rod which pushes the cover, to thereby close the cover.

[0014] The closure apparatus may further include an adjustment mechanism that engages the rod and the latch point of the lever. The adjustment mechanism may be adjustable with respect to the lever. The adjustment mechanism may include a stop adjuster or washer.

[0015] In another embodiment, a toilet is provided that includes a toilet bowl, a bowl ledge disposed on the toilet bowl and a tank disposed on a rear portion of the bowl ledge that includes a flush mechanism. The toilet further includes a cover that is disposed on the front end of the

bowl ledge and a closure apparatus adapted to mount to the bowl ledge. The closure apparatus includes a mounting bolt having an opening extending therethrough and a spring-biased rod disposed within the opening of the bolt. The apparatus also includes a spring that is adapted to be deformed by the rod and lever movable with respect to the mounting bolt. A latch release mechanism coupled to the lever is also included. Upon flushing the toilet when the cover is open, and when the closure apparatus is mounted on the bowl ledge, the flush mechanism causes the latch point of the lever to move with respect to the mounting bolt. This allows the spring to move the rod which pushes the cover, to thereby close the cover.

[0016] In another embodiment, a toilet cover assembly adapted to mount to a toilet is provided. The toilet cover assembly includes a cover, a hinge mount adapted to mount to a bowl ledge of the toilet and a closure apparatus adapted to mount the hinge mount to the bowl ledge of the toilet. The closure apparatus includes a mounting bolt having an opening extending therethrough, a rod disposed within the opening of the mounting bolt and a spring adapted to be deformed by the rod to thereby bias the rod. The closure apparatus further includes a lever that has a latch point and is movable with respect to the mounting bolt and a latch release mechanism coupled to the lever. Upon flushing the toilet when the cover is open, and when the closure apparatus is mounted on the bowl ledge, the flush mechanism causes the latch point of the lever to move with respect to the mounting bolt. This allows the spring to move the rod which pushes the cover, to thereby close the cover.

[0017] A method of installing a closure apparatus adapted to mount to a toilet is also provided. The method includes the steps of securing a mounting bolt having a longitudinal opening therethrough to the bowl ledge of the toilet, inserting a spring-biased rod into the longitudinal opening of the mounting bolt, providing a spring and attaching a lever movable with respect to the mounting bolt. The method also includes the steps of connecting a first end of an actuating member to the lever and linking a second end of the actuating member to a flush mechanism.

[0018] In another embodiment, the invention also provides a toilet assembly including a bowl, a toilet seat member mounted on the bowl for movement between raised and lowered positions, and a tank mounted on the bowl. The tank is adapted to contain water for flushing the toilet and has a flushing apparatus for causing the water in the tank to flow into the bowl. The toilet assembly also includes a hydraulic closure apparatus mounted on the toilet. The apparatus includes a member movable relative to the toilet and engageable with the seat member such that movement of the member in one direction moves the seat member toward the lowered position. Movement of the seat member toward the raised position moves the member in an opposite direction. The apparatus also includes a cylinder and a piston slidable inside the cylinder. The piston divides the cylinder into first and

second chambers and is connected to the member such that movement of the member in the opposite direction moves the piston in the direction minimizing the volume of the second chamber. The apparatus further includes a spring positioned in the second chamber. The spring is compressed by the piston when the piston moves in the direction minimizing the volume of the second chamber. The apparatus also further includes a conduit having one end communicating with the second chamber and a second end positioned in the water in the tank. The toilet assembly further includes a valve arrangement for closing the second end of the conduit when the tank is relatively full of water and for opening the second end of the conduit when the toilet is flushed.

[0019] In another embodiment, the invention provides a toilet assembly including a bowl, a toilet seat member mounted on the bowl for movement between raised and lowered positions, and a tank mounted on the bowl. The tank is adapted to contain water for flushing the toilet and has a flushing apparatus for causing the water in the tank to flow into the bowl. The toilet assembly also includes a hydraulically actuated device for moving the seat member toward the lowered position in response to a flow of water to the device. The toilet assembly further includes a conduit having one end in communication with the device and an opposite end in the tank below the level of water in the tank. The toilet assembly also further includes a valve member movable between a first position in which the valve member seals the opposite end of the conduit and a second position in which the valve member allows water to flow into the opposite end of the conduit. The valve member moves to the first position when the tank is relatively full of water and moves to the second position when the toilet is flushed.

[0020] In another embodiment, the invention provides a hydraulic closure apparatus for a toilet seat member movable between raised and lowered positions. The toilet seat member is mounted on a toilet having a flushing apparatus. The closure apparatus includes a member movable relative to the toilet and engageable with the seat member such that movement of the member in one direction moves the seat member toward the lowered position, and movement of the seat member toward the raised position moves the member in an opposite direction. The apparatus also includes a cylinder and a piston slidable inside the cylinder. The piston divides the cylinder into first and second chambers adapted to contain fluid. The piston is connected to the member such that movement of the member in the opposite direction moves the piston in the direction minimizing the volume of the second chamber. The apparatus also includes a spring positioned in the second chamber. The spring is compressed by the piston when the piston moves in the direction minimizing the volume of the second chamber. The apparatus further includes a first conduit having one end communicating with the first chamber and having a second end, and a second conduit having one end communicating with the second chamber and having a sec-

ond end. The apparatus further includes a valve arrangement for preventing communication between the second ends of the conduits except when the toilet is flushed and for permitting communication between the second ends of the conduits when the toilet is flushed. Whereby, fluid flow between the first and second chambers is permitted when the toilet is flushed.

[0021] In another embodiment, the invention provides a toilet assembly including a bowl having therein a bore for mounting of a toilet seat hinge and a hinge mounted on the bowl. The hinge having therein a bore that aligns with the bore in the bowl. The toilet assembly also includes a seat member pivotally supported by the hinge for movement between raised and lowered positions and a tank mounted on the rear of the bowl. The tank is adapted to contain water for flushing the toilet and has a flushing apparatus for causing the water in the tank to flow into the bowl. The toilet assembly also includes a mounting bolt extending through the hinge bore and the bowl bore. The mounting bolt has a central bore and a lower end. The toilet assembly further includes an upper rod movable in the bore of the mounting bolt. The rod is engageable with the toilet seat member such that upward movement of the rod moves the toilet seat member from its raised position toward its lowered position. Movement of the toilet seat member from its lowered position to its raised position moves the rod downward. The toilet assembly further includes a mounting nut threaded onto the mounting bolt to secure the hinge to the bowl, a cylinder connected to the lower end of the mounting bolt, and a piston slidably housed in the cylinder. The piston divides the cylinder into upper and lower chambers. The piston includes a piston body and a piston rod extending from the piston body and through the upper chamber. The piston rod couples to the upper rod such that the piston rod and the upper rod move vertically together. The piston also includes a plate surrounding the piston rod and a seal positioned around the piston rod between the piston body and the plate. The plate is capable of moving relative to the piston body and to the seal such that the seal changes shape with the relative positioning of the plate. The seal permits water flow around the piston when the piston moves downward and prevents water flow around the piston when the piston moves upward. The toilet assembly also includes a spring positioned in the lower chamber of the cylinder to bias the piston upward. The spring is adapted to be compressed by downward movement of the piston. The toilet assembly also includes an inflow tube communicating between the tank and the lower chamber of the cylinder. A first end of the inflow tube communicates with the water in the tank and a second end of the inflow tube communicates with the lower chamber. The toilet assembly further includes an outflow tube communicating between the upper chamber of the cylinder and the tank. A first end of the outflow tube communicates with the upper chamber and a second end of the outflow tube communicates with the tank at a point above the water in the tank. The toilet assembly further

includes a weighted float positioned in the tank and a nipple coupled to the weighted float. The nipple is movable between a seated position in which the nipple seals the first end of the inflow tube and an open position in which the nipple is unseated from the first end of the inflow tube so that the water can enter the first end of the inflow tube. The nipple is moved by the float to the seated position when the tank is relatively full of water and is moved to the open position when the toilet is flushed. Wherein, movement of the toilet seat member from its lowered position to its raised position moves the rod downward, thereby moving the piston downward against the force of the spring to a lower position. Also wherein, when the tank is relatively full of water, the nipple is in the seated position, in combination with the seal, to substantially prevent water flow into the lower chamber, thereby locking the piston in its lower position. Also wherein, upon flushing the toilet with the seat member in its raised position, the weighted float lowers in response to flushing of the toilet to cause the nipple to move to its open position, allowing water in the tank to flow through the inflow tube into the lower chamber, thereby allowing the spring to move the piston and the rod upward to move the seat member to its closed position, with water in the upper chamber flowing into the tank via the outflow tube.

BRIEF DESCRIPTION OF DRAWINGS

[0022]

FIG. 1 is a top plan view of a conventional toilet, showing a portion of a first embodiment of a seat and lid assembly closure apparatus.

FIG. 2 is a perspective view of the toilet, wherein several portions of the first embodiment of the closure apparatus are shown.

FIG. 3 is a side elevational view of the first embodiment of the closure apparatus, wherein a tank and a bowl ledge of the toilet are shown in section and a lid is in a closed position.

FIG. 4 is a side elevational view of the first embodiment of the closure apparatus, wherein the tank and the bowl ledge are shown in section and the lid is in an open position.

FIG. 5 is a side elevational view of the first embodiment of the closure apparatus, wherein the tank and bowl ledge are shown in section and a flush handle of the toilet has been actuated.

FIG. 6A is a top plan view of a portion of the first embodiment of the closure apparatus shown in FIGS. 3-5.

FIG. 6B is a cross-sectional view of a portion of the

first embodiment of the closure apparatus taken along line 6B-6B of FIG. 6A.

FIG. 7 is a perspective view of a lever used in the first, second and third embodiments of the closure apparatus.

FIG. 8A is a top plan view of a bracket used in the first, second and third embodiments of the closure apparatus.

FIG. 8B is a cross-sectional view of the bracket taken along line 8B-8B of FIG. 8A.

FIG. 9 is a side elevational view of the rod used in the first, second and third embodiments of the closure apparatus.

FIG. 10A illustrates a portion of a second embodiment of the closure apparatus.

FIG. 10B is a cross-sectional view of the second embodiment of the closure apparatus taken along line 10B-10B of FIG. 10A.

FIG. 11 is a perspective view of a washer used in the second embodiment of the closure apparatus.

FIG. 12 is a side elevational view of the second embodiment of the closure apparatus, wherein the toilet ledge is shown in section.

FIG. 13 is a side elevational view of the second embodiment of the closure apparatus, wherein the toilet ledge is shown in section and a lever is disposed at a bottom portion of a spring holder.

FIG. 14 is a side elevational view of a third embodiment of the closure apparatus, wherein the toilet ledge is shown in section.

FIG. 15 is a side elevational view of the rod used in the preferred embodiment of the closure apparatus.

FIG. 16 is a cross-sectional view of a portion of the preferred embodiment of the closure apparatus, wherein the rod is in the extended position.

FIG. 17 is a cross-sectional view of a portion of the preferred embodiment of the closure apparatus, wherein the rod is in the depressed position.

FIG. 18 is a side elevational view of the preferred embodiment of the closure apparatus, wherein the tank, bowl ledge and hinge mount are shown in section and the rod is in the extended position.

FIG. 19 is a cross-sectional view of a portion of an-

other embodiment of the closure apparatus.

FIG. 20 is a partial cross-sectional view of a first embodiment of an in-tank portion of the closure apparatus for use with the portion illustrated in FIG. 19.

FIG. 21 is a partial cross-sectional view of a second embodiment of an in-tank portion of the closure apparatus for use with the portion illustrated in FIG. 19.

FIG. 22 is a partial cross-sectional view of a third embodiment of an in-tank portion of the closure apparatus for use with the portion illustrated in FIG. 19.

FIG. 23 is a cross-sectional view of a portion of another embodiment of the closure apparatus.

FIG. 24 is a partial cross-sectional view of an in-tank portion of the closure apparatus for use with the portion illustrated in FIG. 23.

MODES FOR CARRYING OUT THE INVENTION

[0023] Referring now to FIGS. 1-5, a first embodiment of a seat and lid assembly closure apparatus is shown in combination with a conventional toilet 1. As shown, the conventional toilet includes a tank 2, having a flush handle 3 attached thereto, mounted on a bowl ledge 4. A cover, such as a seat or ring 200 (see Fig. 4), a lid 5 or a seat and lid assembly, is attached to a hinge mount 6 disposed on the bowl ledge 4. As shown, for example, in FIG. 3, the cover or lid 5 pivots at pivot point 12. In addition, the ledge 4 has a mounting opening 13 for mounting a hinge mount 6 of a toilet seat and lid 5.

[0024] As shown in FIG. 1, when viewing the toilet and closure apparatus from a top view, only an enlarged head 7 of a rod 8 of the apparatus is visible.

[0025] As shown in FIG. 2, when viewing the toilet and closure apparatus from a side perspective view, only the head 7 of the rod 8 and the spring 9 are visible above ledge 4 and only a portion of an adjustment mechanism, such as a stop adjuster 10, and a lever 11 are partially visible below ledge 4.

[0026] Referring now to FIGS. 3-5, the closure apparatus includes a rod 8 having a first end disposed above the ledge 4 and a second end disposed below the ledge 4. As shown in FIG. 9, the rod 8 includes a head 7 disposed at its first end and a series of male threads 18 at its second end. A spring, such as a compression spring 9, is disposed around the rod at its first end. The rod 8 may be constructed of plastic or non-corrosive metal, and other like materials.

[0027] The closure apparatus also includes a mounting bolt 15 having an opening, such as a longitudinal guide opening 14, for receiving a portion of the rod 8. The longitudinal guide opening 14, as shown in FIG. 6B, which is of only slightly larger inside diameter than the outside diameter of rod 8, serves as a guide to maintain

the rod 8 in a vertical position as it moves up and down. More specifically, the rod 8 first extends through the compression spring 9 and then through the longitudinal guide opening 14 of the mounting bolt 15. The mounting bolt 15 is inserted through a mounting opening 13 disposed on the ledge 4 and is fastened to the ledge by a mounting nut 16 having pins 17. The mounting bolt 15 and the mounting nut 16 together fasten hinge mount 6 of the toilet seat and lid assembly to the toilet ledge 4. The mounting bolt 15 may be constructed of plastic or non-corrosive metal, and other like materials. The mounting nut 16 is preferably constructed of plastic, as are most conventional toilet seat and lid assembly mounting nuts.

[0028] FIGS. 6A and 6B illustrate the arrangement of the rod 8, the compression spring 9, the mounting bolt 15 with the longitudinal guide opening 14 inserted through opening 13 in ledge 4 (shown in FIGS. 3-5), the mounting nut 16 and a portion of a lever 11, which is discussed in more detail below. In addition, a slot 34 is provided on the top of mounting bolt 15 to permit said bolt to be screwed down into mounting nut 16.

[0029] The closure apparatus also includes an adjustment mechanism, such as a stop adjuster 10. As shown in FIG. 6B, the stop adjuster 10 includes a top portion having female threads 19 for engaging the male threads 18 disposed on the second end of the rod 8. The stop adjuster 10 also includes a smooth side surface area 20 and a top surface 22. The stop adjuster 10 is of larger diameter than rod 8 and may be constructed of plastic or a non-corrosive metal, and other like materials.

[0030] The closure apparatus further includes a lever 11, as shown in FIGS. 3-5, and most specifically, in FIG. 7. The lever 11 includes a front end 46 having at least one opening for receiving a pin 17 of the mounting nut 16 and a latch point 21 for engaging the adjustment mechanism. More specifically, the latch point 21 engages the top surface 22 of the stop adjuster 10. The lever 11 also includes a rearward extension 33 and rearward end 23 having an opening 24. It is mounted on the pins 17 of the mounting nut 16 and pivots about the pins 17. The lever 11 is preferably constructed of non-corrosive metal, and may be constructed of other like materials.

[0031] In FIG. 3, the lever 11 is shown with its rearward end slightly elevated because the side surface area 20 of the stop adjuster 10 is preventing latch point 21 of latch lever 11 from moving inward toward the rod 8. This condition exists when the lid 5 is in the closed position and the rod 8 is in an extended or elevated position.

[0032] When rod 8 and stop adjuster 10 are sufficiently depressed, the latch point 21 of latch lever 11 typically engages the top surface 22 of the stop adjuster 10. When the rod 8 and stop adjuster 10 are not sufficiently depressed, the latch point 21 of the latch lever 11 may slide on the side surface 20 of stop adjuster 10. The threaded engagement of stop adjuster 10 with rod 8 allows the stop adjuster 10 to be adjusted to control the point at which latching will occur to accommodate different thickness of ledge 4 on which the closure apparatus may be

mounted as well as variations in toilet configurations which require the seat and lid to latch at somewhat different elevation angles.

[0033] The closure apparatus further includes a latch release mechanism. The latch release mechanism may include an actuating member, such as a cable 25 or nylon line, having a first end 25a and a second end 25b. The first end 25a is attached to the lever 11 and the second end 25b is linked to a flush mechanism, or a device that is actuated in response to flushing the toilet, such as a flush arm 30 or a float arm, disposed within tank 2 of the toilet 1. More specifically, the first end 25a of the cable 25 is attached to the rearward end 23 of the lever 11 through the opening 24 of the lever 11. The actuating member may also comprise any electric or electro-mechanical device.

[0034] The latch release mechanism may further include a bracket 27 for receiving the cable 25 that is adapted to be mounted on a rear wall of the tank 2 and includes a groove 26. As illustrated in FIG. 8A, a pulley 28 is mounted to the bracket 27 at a lower end, and the groove 26 is included in a top portion of bracket 27. FIG. 8B shows the top portion of the bracket 27. More specifically, the cable 25 proceeds through opening 24 of latch lever 11 upward behind the toilet's tank 2 and through the groove 26 provided in the bracket 27. The bracket 27, which is preferably constructed of plastic, preserves a small gap between the cable 25, and the underside and flanges of a tank top when fitted on tank 2. This assures free movement back and forth of the cable 25 through the groove 26. The cable 25 then proceeds from the groove 26 downward under the pulley 28 provided at the lower end of the bracket 27 and then upward where it attaches to an adjusting chain 29, similar to those commonly used to attach flush valve flaps to flush arms. The adjusting chain 29 in turn attaches to the toilet's flush arm 30 by a fastener, such as a S-hook 31.

[0035] Alternatively, the latch release mechanism may include a solenoid mounted at a bottom rear of the toilet tank 2 and connected to the rearward end 23 of the lever 11. The solenoid may be activated, for example, by a switch mechanism disposed on the flush arm 30 or float arm instead of cable 25.

[0036] FIG. 4 shows lid 5 raised to its full upright position, pivoting about its pivot point 12. Its rearward edge 32 has engaged and depressed rod 8 which has stressed compression spring 9 and moved side surface area 20 of stop adjuster 10 below latch point 21 of latch lever 11. As shown, when this occurs the weight of rearward extension 33 of latch lever 11, relative to its pivot point at pins 17, rotates latch lever 11 clockwise. This results in the engagement of latch point 21 with the top surface 22 of stop adjuster 10, and the latching of the rod 8 in its depressed position with its associated compression spring 9 deformed. In this state the interface of latch point 21 with top surface 22 of stop adjuster 10, and the pivot point of the lever 11 at pins 17 are both approximately vertically aligned with rod 8, permitting the interface to

be small, yet still securely latch rod 8 with the energy stored in deformed spring 9.

[0037] FIG. 5 illustrates the toilet being flushed, with the flush handle 3 depressed and the flush arm 30 raised. By pulling the adjusting chain 29 and the adjusting side of the cable 25 upward, the cable 25 on the opposite side of the pulley 28 moves downward and the cable 25 behind tank 2 moves upward, thereby generating a pulling force that is applied to lever 11. More specifically, the force is applied at the opening 24 near the rear end of 23 of latch lever 11 where the cable 25 is attached. Because the previously described interface of latch point 21 and top surface 22 (shown in FIG. 4) of stop adjuster 10 is small, the interface presents only a small amount of friction to overcome to release the latch condition. In addition, because the rearward extension 33 of latch lever 11 relative to its pivot point at pins 17 provides substantial leverage, only a few ounces (less than 100 grams) of pulling force need be applied by cable 25 at its attachment point to opening 24 of latch lever 11 to release the latch point 21. Accordingly, just a slight pull by the cable 25 at the opening 24 of the latch lever 11 results in an upward movement of the rearward end 23 of latch lever 11, causing latch lever 11 to pivot counter-clockwise about pins 17 and disengaging latch point 21 from the top surface 22 (shown in FIG. 4) of stop adjuster 10.

[0038] When disengaged, deformed compression spring 9 forces the rod 8 upward. The top portion 7 of rod 8 then pushes the rearward edge 32 of lid 5, resulting in the lid 5 being tilted forward about its pivot point 12 to a point at which lid 5 will continue to close of its own weight and momentum to a fully-closed position. In some toilet configurations the cover may softly close instead of sometimes forcefully and loudly closing due to its own weight and momentum. In any case, when a user wishes to flush a toilet while sitting on the seat, although the closure apparatus does initiate closure of the cover, there is insufficient force to discomfort a user seated on the toilet. By simply leaning gently backward, the user may relatch the cover or lid 5 into an open position. In addition, the closure apparatus does not interfere with manual closing of the cover or lid 5 before flushing, if desired.

[0039] Referring again now to FIG. 3, when the flush handle 3 is released, the pull of flush arm 30 on the adjusting chain 29 and cable 25 is released and the weight of rearward extension 33 of latch lever 11 is free to pull the cable 25 downward. This allows for immediate resetting of the lever 11 when the lid is next raised. This is advantageous in several circumstances, for example, when another user wishes to use the toilet immediately after a first user and before the toilet's tank has filled entirely with water as well as when a user wishes to flush a toilet while seated on the toilet seat.

[0040] Referring now to FIGS. 10-12, a second embodiment of the closure apparatus is shown. Like the first embodiment of the closure apparatus, the closure apparatus shown in FIGS. 10 and 12 includes a rod 8 having a first end disposed above the ledge 4 and a second end

disposed below the ledge 4. The rod 8 also includes a head 7 disposed at its first end and a series of male threads at its second end. A mounting bolt 15 is also included which has an opening, such as a longitudinal guide opening 14, for receiving the rod 8.

[0041] This closure apparatus, however, differs from the first embodiment of the closure apparatus. For example, this second embodiment of the closure apparatus does not include a compression spring disposed around the rod 8 above the ledge 4 like the first embodiment. Rather, as shown in FIGS. 10A, 10B and 12, a spring holder 38 is disposed below the ledge 4 and a compression spring 9 is disposed therein. The spring holder 38 further includes a threaded top portion for engaging the bolt 15. The top portion of the spring holder 38 functions in a manner similar to a mounting nut. The spring holder 38 is preferably constructed of plastic.

[0042] In addition, as shown in FIG. 11, the adjustment mechanism of the second embodiment of the closure apparatus is a washer 35. The washer 35 is disposed within the spring holder 38 and may engage the latch point 21 of the lever 11. The washer 35 includes a female threaded center opening 36 suitable for threading onto the lower end of rod 8 and ears 37, and is preferably constructed of non-corrosive metal.

[0043] As shown in FIG. 12, the spring holder 38 further includes side openings 39 through which the ears 37 of washer 35 extend, thereby allowing the latch point 21 of lever 11 to engage the ears 37 and prevent rotational movement of the washer 35 when rod 8 is threaded into it. Rod 8 is adjustably threaded into the washer 35, which sits on compression spring 9 within the spring holder 38.

[0044] As illustrated in FIG. 10A, enlarged head 7 of rod 8 (shown in FIG. 10B) sits above the mounting bolt 15 having a slot 34 and the top portion of the spring holder 38 is provided with pins 17 for mounting the lever 11 (shown in FIGS. 3-6).

[0045] Alternatively, as illustrated in FIG. 13, the lever 11 may be mounted to a bottom portion of the spring holder 38. More specifically, the lever 11 may have a pivot point at 17a which may be connected to the spring holder 38 below the spring. Here the lever 11 may also have a latch point 21a for engaging the ears 37.

[0046] The latching and unlatching operation of this closure apparatus is essentially the same as that of the previously described first embodiment of the closure apparatus, except that compression spring 9 is compressed by washer 35 instead of the head 7 of rod 8. In addition, latch point 21a of latch lever 11 latches upon ears 37 of washer 35 instead of latching upon the top surface 22 of stop adjuster 10 (shown in FIGS. 3-6) to latch and unlatch rod 8. The threaded interface of rod 8 and washer 35 provides a mechanism for adjusting the height of rod 8 at which latching will occur to accommodate different thicknesses of ledge 4 on which this embodiment of the closure apparatus may be mounted.

[0047] Referring now to FIG. 14, a third embodiment of the closure apparatus is provided. Like the first and

second embodiments of the closure apparatus, and as shown in FIG. 14, the third embodiment of the closure apparatus includes a rod 8 having a first end disposed above the ledge 4 and a second end disposed below the ledge 4. The rod 8 also includes a head 7 disposed at its first end and a series of male threads at its second end. A mounting bolt 15 is also included which has an opening, such as a longitudinal guide opening 14, for receiving the rod 8.

[0048] The third embodiment of the closure apparatus, however, differs from the first and second embodiments of the closure apparatus. For example, the third embodiment of the closure apparatus includes a set of expansion springs 40 that are positioned below the ledge 4, instead of a compression spring 9 as used in the second embodiment of the closure apparatus. Each expansion spring 40 includes a first end 40a and a second end 40b.

[0049] In addition, the adjustment mechanism of this closure apparatus includes a washer 43 similar to washer 35 (shown in FIG. 11) of the second embodiment. The washer 43 has a threaded center opening suitable for threading onto rod 8 and ears 44 suitable to interface with latch point 21 of latch lever 11. The washer 43 also provides, at a 90 degree differential from the ears 44, arms 45 adapted to be attached to the second ends 40b of the expansion springs 40. The washer 43 is preferably constructed of non-corrosive metal, and the like.

[0050] In this embodiment, a mounting nut 41 is provided which, in addition to pins 17 upon which latch lever 11 may be mounted, provides arms 42 to which the first ends 40a of expansion springs 40 may be attached at a 90 degree differential from said pins 17.

[0051] The operation of this third embodiment of the closure apparatus is essentially the same as that of the second embodiment of the closure apparatus, except that the closure apparatus of this embodiment stresses its expansion springs 40 by expanding them, instead of by compression. This closure apparatus may be adjusted in the same manner as the closure apparatus of the second embodiment.

[0052] Each of the foregoing embodiments of the closure apparatus may be relatively simply installed. Mounting bolt 15, with rod 8 inserted in it, is installed and tightened in the same manner as a conventional toilet lid and seat mounting bolt except that it threads into one of the combination mounting nut and latch lever mounting apparatus described instead of into a standard mounting nut. For example, the mounting nut 16 may then be attached to the mounting bolt 15, such that the mounting nut fastens the mounting bolt to the bowl ledge 4. Rod 8 is then inserted through the longitudinal guide opening 14 of mounting bolt 15 and threaded into the adjustment mechanism, such as the stop adjuster 10 or washer 35 or 43 as described.

[0053] A spring is also provided, for example around the rod 8 or below the bowl ledge 4, depending on the preferred embodiment. More specifically, in the first embodiment of the closure apparatus a compression spring

9 is disposed around the rod 8. In the second embodiment of the closure apparatus, a compression spring 9 is disposed below the bowl ledge 4 and is disposed within the spring holder 38. In the third embodiment, at least one expansion spring 40 is positioned below the ledge 4 and each spring 40 is attached at one end to a mounting nut 41 and at a second end to a washer 43.

[0054] A lever 11 movable with respect to the mounting bolt is also provided. More specifically, the lever 11 may be attached to the mounting nuts 16 or 41 or a portion of the spring holder 38.

[0055] The first end of the actuating member, such as a cable 25, is then connected to the lever 11 and the second end of the actuating member is linked to the flush mechanism. More specifically, a toilet tank cover is first removed and the bracket 27 having a groove 26 is mounted to the toilet tank 2, for example, to a top portion of the toilet tank 2. The actuating member, for example the cable 25, is then pulled upward and around the back portion of the tank 2, and placed in the groove 26 of the bracket 27.

[0056] After the actuating member is placed in the groove 26, it is then attached to the flush mechanism. More specifically, the actuating member may be disposed around a pulley 28 disposed within the tank 2 and then attached to an adjusting chain 29. The adjusting chain 29 may then be connected to the toilet's existing flush arm 30, with any slack removed, and the top of the tank 2 may be replaced. Alternatively, the actuating member may be attached to a flush arm 30 or a float arm, or other device disposed within a toilet tank 2.

[0057] Referring now to FIGS. 15-18, a preferred embodiment of the closure apparatus is provided. Like the foregoing embodiments of the closure apparatus, and as shown in FIGS. 16-17, the preferred embodiment of the closure apparatus includes a rod 47 having a first end disposed above the ledge 4 and a second end disposed within the longitudinal opening 14 in the mounting bolt 15.

[0058] The preferred embodiment of the closure apparatus, however, differs from the foregoing embodiments of the closure apparatus. For example, as shown in FIG. 15, the rod 47 lacks the head 7 disposed at the first end of the rod 8, as used in the foregoing embodiments, and at its second end, rod 47 of the preferred embodiment is provided with a slot 48 and, at a 90 degree differential, an opening 49, instead of the series of male threads 18 as used in the foregoing embodiments.

[0059] In addition, as shown in FIGS. 16 and 17, a compression spring 9 adapted to be inserted into the longitudinal opening 14 of the mounting bolt 15 is provided.

[0060] In addition, it may be seen that the mounting bolt 15 of the preferred embodiment of the closure apparatus lacks a bolt head at its top end, as provided in the prior embodiments. Instead, a cap nut 50 having female threads and adapted to be threaded onto the top end of the mounting bolt 15 is provided. In addition, the mounting bolt 15 of the preferred embodiment is provided with, for example, one or more indentations 52 which

constrict the inside diameter of the longitudinal opening 14 of the mounting bolt 15 at a desired point, such that they may provide a seat upon which the bottom end of the compression spring 9 may rest when the compression spring 9 is inserted in the longitudinal opening 14 of the mounting bolt 15.

[0061] In addition, the preferred embodiment provides a mounting nut 51 similar to a conventional toilet lid and seat assembly mounting nut.

[0062] The preferred embodiment of the closure apparatus also includes a lever 53 having an opening 55 disposed at the top of its front end 54, which is adapted to be insertable through the spring 9 and into the slot 48 provided at the second end of the rod 47 and pivotally attached to rod 47 by a pin 56 provided. The pin 56 is adapted to be inserted through the opening 49 of the rod 47 and the opening 55 of the lever 53. The lever 53 also includes a latch point 57.

[0063] Referring now to FIG. 18, it may be seen that lever 53, like lever 11 of the prior embodiments, extends rearwardly and is provided at its rearward end 23 with an opening 24.

[0064] In addition, the preferred embodiment also includes a bracket 58 having a groove 59 at its top end and a forward extension 60 with at least one opening 61 therein at its lower end, instead of the pulley 28 as used in the foregoing embodiments.

[0065] In addition, the preferred embodiment of the closure apparatus also includes a lever 62 adapted to be pivotally mounted to the at least one opening 61 in the forward extension 60 of the bracket 58 and extend forwardly from its pivot point over the flush arm 30 of the toilet and rearwardly to just inside the rear wall of the tank 2. The lever 62 is provided near its rearward end with an opening 63.

[0066] This embodiment is further provided with a cord lock 64, for example of one of the types commonly used on clothing having drawstrings.

[0067] As shown in FIG. 18, an actuating means, such as cable 25, is attached at its second end 25b to the opening 63 in the lever 62, proceeds through groove 59 in bracket 58 and downward through opening 24 near the rearward end of lever 53 and then through cord lock 64. Cord lock 64 may then be squeezed and moved to adjust the length of the actuating means, such as cable 25, to accommodate toilets with tanks of different heights and hinge mounts of different thicknesses.

[0068] The latching operation of this preferred embodiment of the closure apparatus is similar to that of the foregoing embodiments of the closure apparatus, except that, as shown in FIGS. 16 and 17, the compression spring 9 of this embodiment is compressed by the second end of the rod 47, instead of by the head 7 of the rod 8 or by washers 35 or 43 as used in the first, second and third embodiments, respectively. In addition, and as shown in FIG 17, because of its previously described pivotal attachment to rod 47, lever 53 of this preferred embodiment moves downward as rod 47 is depressed

and, once latch point 57 of lever 53 is below the bottom end of the mounting bolt 15, the lever 53 may rotate clockwise such that the latch point 57 of the lever 53 latches upon the bottom edge of the mounting bolt 15. The lever 53 may also engage a slotted cap (not shown) threaded onto the bottom of the mounting bolt 15.

[0069] The latch releasing operation of this preferred embodiment of the closure apparatus is also similar to that of the foregoing embodiments of the closure apparatus, except that, when the toilet is flushed and the flush arm 30 is raised, the flush arm 30 raises the forward extension of the lever 62 upward, which moves the rearward extension of lever 62 downward and the cable 25 behind the tank and cord lock 64 attached thereto upward. When the cord lock contacts the rear end 23 of lever 53, it raises the rear end 23 of the lever 53 causing the lever to rotate counter-clockwise, releasing the latch condition between the latch point 57 of the lever 53 and the bottom end of the mounting bolt 15.

[0070] This preferred embodiment of the closure apparatus may be provided fully assembled except for the cap nut 50 in order to make it easy to install. It may be installed by inserting the mounting bolt 15 upward through the bottom of the mounting opening 13 in the bowl ledge 4 and through the hinge mount 6 of a toilet seat and lid assembly, threading the cap nut 50 onto the top of the mounting bolt 15 and then tightening the mounting nut 51 under the bowl ledge 4 by hand. After removing the top from the tank 2, the bracket 58 may be mounted atop the rear wall of the tank 2 with the forward extension of the lever 62 resting atop the flush arm 30 and the top of the tank 2 may be replaced. With the lid 5 lifted (as shown in FIG. 4) to latch the closure apparatus in the latched position, which corresponds to the lowest position of the rear end 23 of the lever 53, the cord lock may be squeezed and moved to just below the opening 24 near the rear end 23 of lever 53.

[0071] From the foregoing, it may be seen that a relatively simple and inexpensive mechanical closure apparatus has been provided that automatically closes a toilet cover upon flushing a toilet, for example, in a conventional manner using a flush handle. The closure apparatus may be easily installed without the need for tools. It may be used by anyone capable of raising the lid and flushing the toilet using the flush handle.

[0072] From the foregoing, it may also be seen that a relatively unobtrusive closure apparatus has been provided. In order to be minimally obtrusive as to user interaction, the rod 8 or 47, for example, is placed through the hinge mount opening only about one inch (2.54 centimeters) behind the cover, such as lid 5, and the seat pivot axis 12 as opposed to a point ten to 14 inches (25.4 to 35.6 centimeters) in front of the axis at which a user would ordinarily grasp a cover, such as a lid 5, a seat, or a lid and seat assembly. This configuration provides such substantial mechanical advantage to the user that the additional force required of a user to depress the rod 8 or 47 and stress the associated spring or springs, as well

as lift the cover is minimal. Additionally, the latch mechanism is so constructed that minimal force is required to release the latch point 21, 21a, or 57. The latch lever 11 or 53 is positioned directly below the ledge's mounting opening, pivots at a point above or below its latch point 21 or 57 and extends rearward about 9 inches (22.9 centimeters) toward the rear of the toilet's tank 2. At the rear of the toilet's tank 2 it attaches to the latch releasing mechanism.

[0073] This configuration enables utilization of a small latch interface with minimal friction, eliminates the need for a latch-biasing spring whose resistance must be overcome to release the latch point 21 or 57, provides a substantial mechanical advantage to the latch releasing mechanism, and eases the path of the latch releasing mechanism by avoiding obstacles such as toilet tank mounting bolts and a sharply-angled pull around the rear bottom corner of the tank. Accordingly, the latch release mechanism requires a minimal force, such as only a few ounces (less than 100 grams), to move the rearward end of the latch lever 11 or 53. Therefore, the latch releasing mechanism can be actuated, for example, by a direct mechanical connection to a flush mechanism, such as a toilet's existing float arm or flush arm 30, without over stressing the flush mechanism and with only minimal added force being required to be applied to the flush handle 3 by the user.

[0074] Utilizing the flush mechanism, such as the flush arm 30, in this manner allows the latch lever 11 or 53 to be reset immediately upon release of the flush handle 3 by a user, which is advantageous, for example, when another user wishes to use a toilet 1 immediately after a prior user and before the toilet's tank 2 has refilled with water or a user flushes the toilet 1 while still seated thereon.

[0075] While the closure apparatus has been described with reference to specific examples, which are intended to be illustrative only and not limiting, it will be apparent to those of ordinary skill in the art that changes, additions or deletions may be made to the disclosed embodiments without departing from the spirit and scope of the invention. For example, rod 8 or 47 could be a rigid tubular structure instead of a solid rod structure and either form could be a square or rectangular in shape rather round, provided longitudinal guide opening 14 in mounting bolt 15 was compatibly configured to guide such alternative constructions of rod 8 or 47. In addition, cable 25 could also be a line, cord or strap and, the latch release mechanism could be actuated by connection of cable 25 to the toilet's float arm or an added float/weight instead of to the toilet's flush arm, without departing from the spirit of the present invention.

[0076] The following describes improvements and additions to the foregoing. While the disclosed apparatus has been described with reference to specific examples, which are intended to be illustrative only and not limiting, it will be apparent to those of ordinary skill in the art that changes, additions or deletions may be made to the dis-

closed embodiments without departing from the spirit and scope of the invention. For example, the weighted float valve assembly shown could be replaced with the type of float valve commonly used in furnace-mounted humidifiers, or be a ball valve or needle valve. Further, the valve mechanism could be associated with an existing float or flush arm or flush handle. Similarly the portion of the pushrod extending through the hollow bolt could be a slender metal rod instead of the full inside diameter of the hollow bolt to permit the hollow bolt to be made of plastic instead of metal. In addition, while the apparatus has been described as closing the lid 5 (and thereby the seat 200 too), it should be understood that the apparatus may alternatively be configured to close just the ring or seat 200. As used hereinafter, the term "toilet seat member" is considered to be either the ring 200 or the lid 5.

[0077] Figs. 19-24 illustrate additional embodiments of the invention. Fig. 19 illustrates a hydraulic closure apparatus 65 for use with one of the in-tank valve arrangements illustrated in Figs. 20-22. As shown in Fig. 19, the hydraulic closure apparatus 65 includes a rod 66, a mounting bolt 67, a housing or cylinder 68, and a spring 69. The mounting bolt 67 has a central opening 70 for receiving a portion of the rod 66. The central opening 70, which is of only slightly larger inside diameter than the outside diameter of the rod 66, serves as a guide to maintain the rod 66 in a vertical position as it moves up and down. Similar to the previous embodiments, the mounting bolt 67 is inserted through the mounting opening 13 disposed on the ledge 4 of the toilet 1 and is fastened to the ledge 4 by a mounting nut 71. A cap nut 72 is provided on top of the mounting bolt 67 and functions like the head of a bolt.

[0078] An adapter 73 is positioned on the lower end of the mounting bolt 67, the end opposite from the cap nut 72. The mounting bolt 67 and the adapter 73 may include opposing male and female threads suitable for threading or they may include molded projections such that the adapter 73 is force fit onto the mounting bolt 67. Other known attachment means can be used. The adapter 73 receives the upper end of the cylinder 68 to fasten the cylinder 68 to the mounting bolt 67. The cylinder 68 has an outside diameter similar to the inside diameter of the adapter 73 so that the cylinder 68 tightly seals with the adapter 73. In addition, a projection may be molded on the cylinder 68 to engage the adapter 73. Glue, caulk, threading or other fastening means may also be used to help fasten and seal the interface between the cylinder 68 and the adapter 73.

[0079] A one-way valve assembly or piston 74 slidably received inside the cylinder 68 divides the cylinder 68 into a lower chamber 75 and an upper chamber 76. The spring 69 is positioned in the lower chamber 75 of the cylinder 68 and is compressed by the piston 74 when the lid 5 is lifted and pushes the rod 66 downward.

[0080] The piston 74 includes a piston body 77, a plate 78, an annular elastomeric seal 79, and a central projection or piston rod 80. The piston rod 80 couples to the

rod 66 so that the piston 74 and rod 66 move together. The elastomeric seal 79 surrounds the piston rod 80 and is sized to interface tightly with the cylinder 68, absent conditions described below. The piston body 77 and the plate 78 have diameters slightly smaller than the inside diameter of the cylinder 68 to allow water or other fluid to flow past. The plate 78 has a central aperture through which the piston rod 80 extends in a manner that allows some relative movement between the plate 78 and the elastomeric seal 79. When the rod 66 is depressed and the piston 74 moves downward, the plate 78 trails behind the elastomeric seal 79, allowing the elastomeric seal 79 to expand upward and shrink horizontally so that water can pass by the perimeter of the elastomeric seal 79. Thus, when the piston 74 is pushed downward by the rod 66, water from the lower chamber 75 can flow around the piston body 77, the seal 79 and the plate 78 and into the upper chamber 76. This allows the piston 74 to freely move downward against the force of the spring 69, reducing the volume of the lower chamber 75. When downward pressure on the rod 66 ceases and the spring 69 attempts to bias the piston 74 upward, pressure exerted on the plate 78 by water in the upper chamber 76 causes the elastomeric seal 79 to contract vertically and expand horizontally, thereby sealing against the cylinder 68. In this sealed state, the water cannot move around the piston 74 from the upper chamber 76 to the lower chamber 75. Because, for reasons explained below, water cannot enter the lower chamber 75 until the toilet is flushed, the piston 74 is effectively locked in place until the toilet is flushed.

[0081] In another construction (not shown) of the hydraulic closure apparatus 65, a conduit is positioned on the cylinder 68 to communicate between the upper chamber 76 and the lower chamber 75. The conduit includes a one-way valve (e.g., a check valve) that allows water to flow from the lower chamber 75 to the upper chamber 76, but not from the upper chamber 76 to the lower chamber 75. Therefore, when the piston 74 is pushed downward, water flows through the conduit to the upper chamber 76, rather than around the piston 74.

[0082] The hydraulic closure apparatus 65 also includes an inflow tube 81 and an outflow tube 82. Both the inflow tube 81 and the outflow tube 82 extend between the hydraulic closure apparatus 65 and the tank 2. The inflow tube 81 connects to the cylinder 68 via a first stem 83, bringing the lower chamber 75 of the cylinder 68 into fluid communication with the water in the tank 2. The cylinder 68 further includes a bracket 84 to help position the inflow tube 81 relative to the cylinder 68 for aesthetic purposes. The outflow tube 82 connects to the adapter 73 via a second stem 85, bringing the upper chamber 76 of the cylinder 68 into fluid communication with the tank 2, as further described below. The inflow tube 81 and the outflow tube 82 are made of a flexible material so that both can be easily concealed around the toilet 1.

[0083] Fig. 20 illustrates an in-tank valve arrangement

90 for use with the hydraulic closure apparatus 65 of Fig. 19. The inflow tube 81 of the hydraulic closure apparatus 65 is situated in the tank 2 such that the open end 91 of the inflow tube 81 is under water. The valve arrangement 90 closes the end 91 of the tube 81 when the tank 2 is relatively full of water and opens the end 91 of the tube 81 when the toilet is flushed. As explained below, various suitable valve arrangements can be employed. The outflow tube 82 of the hydraulic closure apparatus 65 is situated in the tank 2 such that the open end 92 of the outflow tube 82 is positioned above the water. Therefore, water in the upper chamber 76 of the cylinder 68 can flow through the outflow tube 82 into the tank 2, but water in the tank 2 cannot flow through the outflow tube 82 into the upper chamber 76 of the cylinder 68.

[0084] A weighted float 93 surrounds the inflow tube 81 and is coupled to an elastomeric nipple or valve member 94 by way of a chain, string, rod, or other connecting element 95. In another construction (not shown), the connecting element 95 couples the valve member 94 directly to the flush arm 30 of the toilet 1. The elastomeric nipple 94 is movable relative to the open end 91 of the inflow tube 81 between an upper seated or sealing position shown in Fig. 20 and a lower unseated position (not shown). When the tank 2 is full of water, the float 93 pulls the nipple upward to its seated position in which the nipple 94 creates a seal to prevent water from entering the inflow tube 81. The nipple 94 may be weighted such that the elastomeric nipple 94 naturally sinks toward the bottom of the tank 2 and the float 93 must pull on the connecting element 95 to raise the nipple 94 to its seated position. Alternatively, the connecting element 95 may be an incompressible member such that the distance between the float 93 and the nipple 94 is constant. Therefore, when the float 93 moves in response to the water level in the tank 2, the nipple 94 likewise moves the same distance. A flange or shoulder 96 is formed on the inflow tube 81 so that the weighted float 93 can not move too low and allow the nipple 94 to become unaligned with the end 91 of the inflow tube 81. When the nipple 94 is unseated, water can flow through the end 91 of the tube 81.

[0085] As the lid 5 is raised and the rod 66 is depressed, the piston 74 slides downward, deforming the spring 69 and permitting water to move from the lower chamber 75 of the cylinder 68 to the upper chamber 76. As soon as downward pressure on the rod 66 ceases, the piston 74 seals, prohibiting a reverse flow from the upper portion 76 of the cylinder 68 back to the lower portion 75. Since, by virtue of the in-tank valve arrangement 90 shown in Fig. 20, water cannot flow through the inflow tube 81 into the lower chamber 75 of the cylinder 68 when the tank 2 is full, the lower chamber 75 is prevented from increasing in volume. As a result, the rod 66 and piston 74 are held in a lower or depressed position, against the force of the spring 69, even when the lid stops pushing the rod downward.

[0086] When the toilet 1 is flushed and the water level in the tank 2 drops, the weighted float 93 also moves

downward, allowing the elastomeric nipple 94 to unseal the end 91 of the inflow tube 81 and permit water to flow through the inflow tube 81 into the lower chamber 75 of the cylinder 68. The flow of water into the lower chamber 75 permits the spring 69 to move the piston 74 and the rod 66 upward to close the seat 200 and lid 5. As this happens, water in the upper chamber 76 of the cylinder 68 is ejected out the outflow tube 82 and back into the tank 2. An O-ring 97 is provided (see Fig. 19) to seal around the rod 66 and prevent a gravity-induced backflow from the outflow tube 82 from exiting upward around the rod 66.

[0087] Fig. 21 illustrates another in-tank valve arrangement 100. Like the previous arrangement, the in-tank valve arrangement 100 includes the inflow tube 81 and the outflow tube 82 from the hydraulic closure apparatus 65. In this embodiment, both the open end 101 of the inflow tube 81 and the open end 102 of the outflow tube 82 are under water in the tank 2. A weighted float 103 is positioned in the tank 2 and surrounds both the inflow tube 81 and the outflow tube 82. The float 103 is coupled to a first elastomeric nipple 104 and to a second elastomeric nipple 105 by way of a connecting element 106 similar to that of the previous embodiment. The first elastomeric nipple 104 moves with the float 103 to seal and unseal the end 101 of the inflow tube 81. The second elastomeric nipple 105 moves with the float 103 to seal and unseal the end 102 of the outflow tube 82. A flange 107 is formed on the inflow tube 81 and the outflow tube 82 so that the weighted float 103 cannot move too low and allow either of the elastomeric nipples 104, 105 to become unaligned with the respective open ends 101, 102.

[0088] Fig. 22 illustrates another in-tank valve arrangement 110. In this embodiment, the inflow tube 81 and the outflow tube 82 are in direct fluid communication with each other, as further described below, forming a closed system. A weighted float 111 is positioned in the tank 2 and surrounds both the inflow tube 81 and the outflow tube 82. The float 111 is coupled to a pin or needle valve 112 by way of a connecting element 113 similar to the previous embodiments. The valve 112 is located in the junction 114 between the inflow tube 81 and the outflow tube 82. When the tank 2 is full of water, the weighted float 111 holds the valve 112 in an upper or closed position to prevent water from flowing between the inflow tube 81 and the outflow tube 82. When the toilet 1 is flushed, the float 111 lowers, thereby allowing the valve 112 to slide downward to an open position such that water can flow from the outflow tube 82 to the inflow tube 81, and consequently into the lower chamber 75 of the piston 68. A flange 115 formed at the junction 114 prevents the weighted float 111 from sliding off the inflow tube 81 and outflow tube 82 and, likewise, the valve 112 from sliding entirely out of the junction 114.

[0089] In another embodiment of the invention (not shown), the inflow tube 81 and the outflow tube 82 are again in direct fluid communication with each other, form-

ing a closed system, but the fluid is a hydraulic fluid rather than water. Any suitable fluid can be used. Hydraulic fluid eliminates the hardness buildup on the valve 112 and seal 79 (Fig. 19) that can occur when water is used. Regardless of the fluid used, the tubes 81 and 82 need not be submerged in the water in the tank. Any valve arrangement can be employed, as long as it prevents flow between the tubes 81 and 82 except when the toilet is flushed. Such a valve arrangement could be activated, for example, by a Boat or by the flushing mechanism of the toilet.

[0090] Fig. 23 illustrates a hydraulic closure apparatus 120 that is another embodiment of the invention. Except as described below, the hydraulic closure apparatus 120 is substantially identical to the apparatus 65 of Fig. 19, and common elements have been given the same reference numerals.

[0091] The apparatus 120 has an adapter 128 positioned on the lower end of the mounting bolt 67. Unlike the adapter 73 shown in Fig. 19, the adapter 128 is not connected to an outflow tube. A piston 129 is connected to the lower end of the rod 66 and is slidably received in the cylinder 68. Unlike the piston 74, the piston 129 is a simple piston integrally formed with the rod 66. However, in other embodiments the piston 129 may be a separate component coupled to the rod 66. The piston 129 includes an O-ring 132 along the outside perimeter, such that the O-ring 132 seals against the inside of the cylinder 68. When the rod 66 is depressed, the piston 129 moves downward, reducing the volume of the lower chamber 75. Air enters the upper chamber 76 through spaces between the mounting bolt 67, the rod 66, and the adapter 128 to fill the increased volume of the upper chamber 76. In some embodiments, the adapter 128 or the cylinder 68 may include a bore to allow air to enter the upper chamber 76. The O-ring 132 forms a seal between the piston 129 and the cylinder 68 so that air, water, and other fluid cannot pass between the upper chamber 76 and the lower chamber 75.

[0092] The hydraulic closure apparatus 120 also includes a tube 133 communicating between the lower chamber 75 and the tank 2. The tube 133 connects to the cylinder 123 via a stem 134, bringing the lower chamber 75 of the cylinder 123 into fluid communication with the water in the tank 2. The tube 133 allows water to flow in both directions to and from the tank 2, Fig. 24 illustrates an in-tank valve arrangement 140 for use with the hydraulic closure apparatus 120 of Fig. 23. The tube 133 of the hydraulic closure apparatus 120 is situated in the tank 2 such that the open end 141 of the tube 133 is under water. A weighted float 142 surrounds the tube 133 and is coupled to an elastomeric nipple 143 by way of a connecting element 144. The float 142 and the nipple 143 function in the same manner with respect to the tube 133 as do the float 93 and the nipple 94 with respect to the tube 81 of Fig. 20.

[0093] As the lid 5 is raised and the rod 66 is depressed, the piston 129 slides downward, deforming the spring 69

and ejecting the water in the lower chamber 75 through the tube 133 toward the tank 2. The water pressure in the tube 133 is sufficient to push the nipple 143 out of the tube end 141 and allow water in the tube 133 to flow into the tank 2. When downward movement of the rod 66 ceases and no more water is being ejected from the lower chamber 75, the nipple 143 rises by way of the float 142 or its own buoyancy to seal the end 141 of the tube 133. At this time, no water can enter or exit the lower chamber 130 of the cylinder 123, holding the piston 129 in the depressed or lower position against the force of the spring 69.

[0094] When the toilet 1 is flushed and the water level in the tank 2 drops, the float 142 also moves downward, allowing the nipple 143 to unseal the end 141 of the tube 133 and permit water to flow through the tube 133 into the lower chamber 75 of the cylinder 68. The flow of water into the lower chamber 75 permits the spring 69 to move the piston 129 and the rod 66 upward to close the seat 200 and lid 5. As this happens, the air in the upper chamber 76 is ejected out of the cylinder 68 through the spaces between the mounting bolt 67, the rod 66, and the adapter 128 or through a bore provided in the adapter.

[0095] The hydraulic closure apparatus 65, 120 eliminate the need for a wand, cable, or rod to communicate the release action of flushing to the rod 66 from the tank 2. All that is needed is flexible tubing which can be more easily concealed and allows more flexibility in placement of the in-tank valve arrangements 90, 100, 110, and 140.

[0096] The hydraulic closure apparatus 65, 120 also allow for a substantial differential between restrained force and release force simply by having greater disparity in diameters between the cylinder 68 and the inflow tubes 81, 133. For example, to restrain a spring having a compressed force of eleven pounds, only one or two ounces of force is needed to release it. As a result, the size and movement distance of the floats can be minimized.

[0097] The release action of the hydraulic closure apparatus 65, 120 can also be made smooth, as opposed to the possibly sudden, jerky release of a mechanical trigger, by metering the flow of water in the inflow tubes 81, 133 and adjusting design details of the one-way valve assembly 74. Also mechanical friction and wear of the hydraulic closure apparatus 65, 120 are minimized. The elastomeric seal 78 interfacing tightly with the cylinder 68 is a lubricious cup seal. In addition, the elastomeric nipples 89, 104, 105, and 143 are subject to only linear in and out action and not rubbing action.

[0098] It is to be understood that the invention is not limited in its application to the details of construction and the arrangement of components set forth above or illustrated in the following drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use of "including," "comprising," or "having" and variations thereof herein is meant to encompass

the items listed thereafter and equivalents thereof as well as additional items. Unless specified or limited otherwise, the terms "mounted," "connected," "supported," and "coupled" and variations thereof are used broadly and encompass both direct and indirect mountings, connections, supports, and couplings. Further, "connected" and "coupled" are not restricted to physical or mechanical connections or couplings.

Claims

1. A toilet assembly comprising:

a bowl;
a toilet seat member mounted on the bowl for movement between raised and lowered positions;
a tank mounted on the bowl; the tank adapted to contain water for flushing the toilet and having a flushing apparatus for causing the water in the tank to flow into the bowl;
a hydraulic closure apparatus mounted on the toilet, the apparatus including

a member movable relative to the toilet and engageable with the seat member such that movement of the member in one direction moves the seat member toward the lowered position, and such that movement of the seat member toward the raised position moves the member in an opposite direction;
a cylinder;
a piston slidable inside the cylinder, the piston dividing the cylinder into first and second chambers, and the piston connected to the member such that movement of the member in the opposite direction moves the piston in the direction minimizing the volume of the second chamber;
a spring positioned in the second chamber, the spring being compressed by the piston when the piston moves in the direction minimizing the volume of the second chamber;
and
a conduit having one end communicating with the second chamber and having a second end positioned in the water in the tank;
and

a valve arrangement for closing the second end of the conduit when the tank is relatively full of water and for opening the second end of the conduit when the toilet is flushed.

2. A toilet assembly comprising:

a bowl;

a toilet seat member mounted on the bowl for movement between raised and lowered positions;

a tank mounted on the bowl, the tank adapted to contain water for flushing the toilet and having a flushing apparatus for causing the water in the tank to flow into the bowl;

a hydraulically actuated device for moving the seat member toward the lowered position in response to a flow of water to the device;

a conduit having one end in communication with the device and an opposite end in the tank below the level of water in the tank; and

a valve member movable between a first position in which the valve member seals the opposite end of the conduit and a second position in which the valve member allows water to flow into the opposite end of the conduit, the valve member moving to the first position when the tank is relatively full of water, and the valve member moving to the second position when the toilet is flushed.

3. A toilet assembly as set forth in claim 2 and further comprising a float positioned in the tank and coupled to the valve member, wherein the float lowers in response to flushing the toilet and moves the valve member to the second position.

4. A toilet assembly as set forth in claim 2 and further comprising a second conduit, the second conduit having a first end in communication with the device and a second end positioned above the level of the water in the tank.

5. A toilet assembly as set forth in claim 2 and further comprising a second conduit, the second conduit having a first end in communication with the device and a second end positioned below the level of water in the tank.

6. A toilet assembly as set forth in claim 5 and further comprising a second valve member movable between a first position in which the second valve member seals the second end of the second conduit and a second position in which the second valve member allows water to flow into the second end of the second conduit, the second valve member moving to the first position when the tank is relatively full of water, and moving to the second position when the toilet is flushed.

7. A toilet assembly as set forth in claim 2 and further comprising a second conduit, the second conduit having a first end in communication with the device and a second end in direct communication with the opposite end of the first-mentioned conduit.

8. A toilet assembly as set forth in claim 7 wherein the first position of the valve member blocks communication between the first-mentioned conduit and the second conduit, and the second position of the valve member allows communication between the first-mentioned conduit and the second conduit.
9. A hydraulic closure apparatus for a toilet seat member movable between raised and lowered positions, the toilet seat member being mounted on a toilet having a flushing apparatus, the closure apparatus comprising:
- a member movable relative to the toilet and engageable with the seat member such that movement of the member in one direction moves the seat member toward the lowered position, and such that movement of the seat member toward the raised position moves the member in an opposite direction;
 - a cylinder;
 - a piston slidable inside the cylinder, the piston dividing the cylinder into first and second chambers adapted to contain fluid, and the piston connected to the member such that movement of the member in the opposite direction moves the piston in the direction minimizing the volume of the second chamber;
 - a spring positioned in the second chamber, the spring being compressed by the piston when the piston moves in the direction minimizing the volume of the second chamber;
 - a first conduit having one end communicating with the first chamber and having a second end;
 - a second conduit having one end communicating with the second chamber and having a second end; and
 - a valve arrangement for preventing communication between the second ends of the conduits except when the toilet is flushed and for permitting communication between the second ends of the conduits when the toilet is flushed, whereby fluid flow between the first and second chambers is permitted when the toilet is flushed.
10. An apparatus as set forth in claim 1 or claim 9 wherein the piston and the member form a unitary structure.
11. An apparatus as set forth in claim 1 or claim 9 and further comprising a piston rod connected to the piston and connected to the member.
12. An apparatus as set forth in claim 1 or claim 9 and further comprising a valve arrangement for allowing water flow from the second chamber to the first chamber when the piston moves in the direction minimizing the volume of the second chamber, and for preventing water flow from the first chamber to the second chamber.
13. An apparatus as set forth in claim 12 and further comprising a second conduit, the second conduit adapted to transport water flow from the first chamber to the tank.
14. An apparatus as set forth in claim 12 wherein the piston includes a piston body, and where the valve arrangement includes a plate in the first chamber and a seal between the piston body and the plate, the plate capable of moving relative to the piston body and to the seal such that the seal changes shape with the relative positioning of the plate, the seal permitting fluid flow around the piston when the piston moves in the direction minimizing the volume of the second chamber and preventing fluid flow around the piston when the piston moves in the direction maximizing the volume of the second chamber.
15. An apparatus as set forth in claim 1 or claim 9 wherein the piston includes a seal positioned around an outer edge of the piston, the seal preventing fluid flow around the piston.
16. An apparatus as set forth in claim 1, claim 2 or claim 9 wherein the conduits are formed of flexible tubing.
17. An apparatus as set forth in claim 9 wherein the second ends of the conduits are adapted to be located in the water in the tank.
18. An apparatus as set forth in claim 9 wherein the valve arrangement includes a valve member movable between a first position in which the valve member prevents communication between the second ends of the conduits and a second position in which the valve member permits communication between the second ends of the conduits, the valve member moving to the second position when the toilet is flushed, and the valve member moving to the first position after the toilet is flushed.
19. An apparatus as set forth in claim 18 wherein the toilet has a tank adapted to contain water, and wherein the apparatus further comprises a float adapted to be positioned in the tank and coupled to the valve member to move the valve member between the first and second positions, wherein the float lowers in response to flushing the toilet and moves the valve member to the second position.

FIG. 1

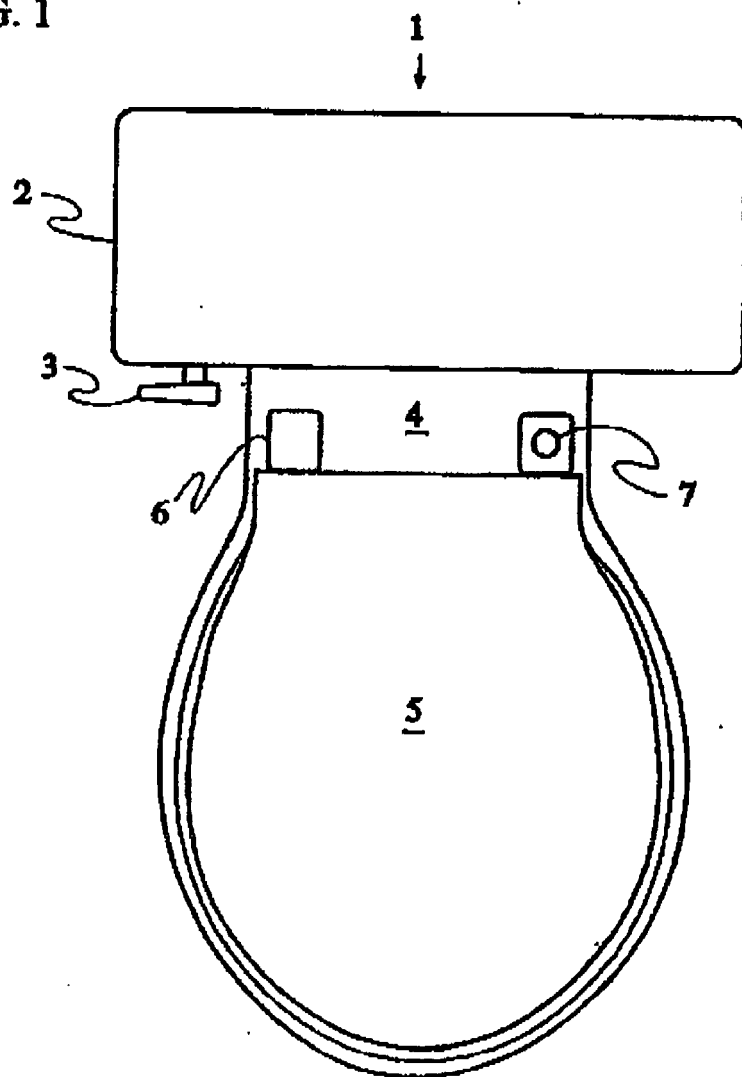


FIG. 2

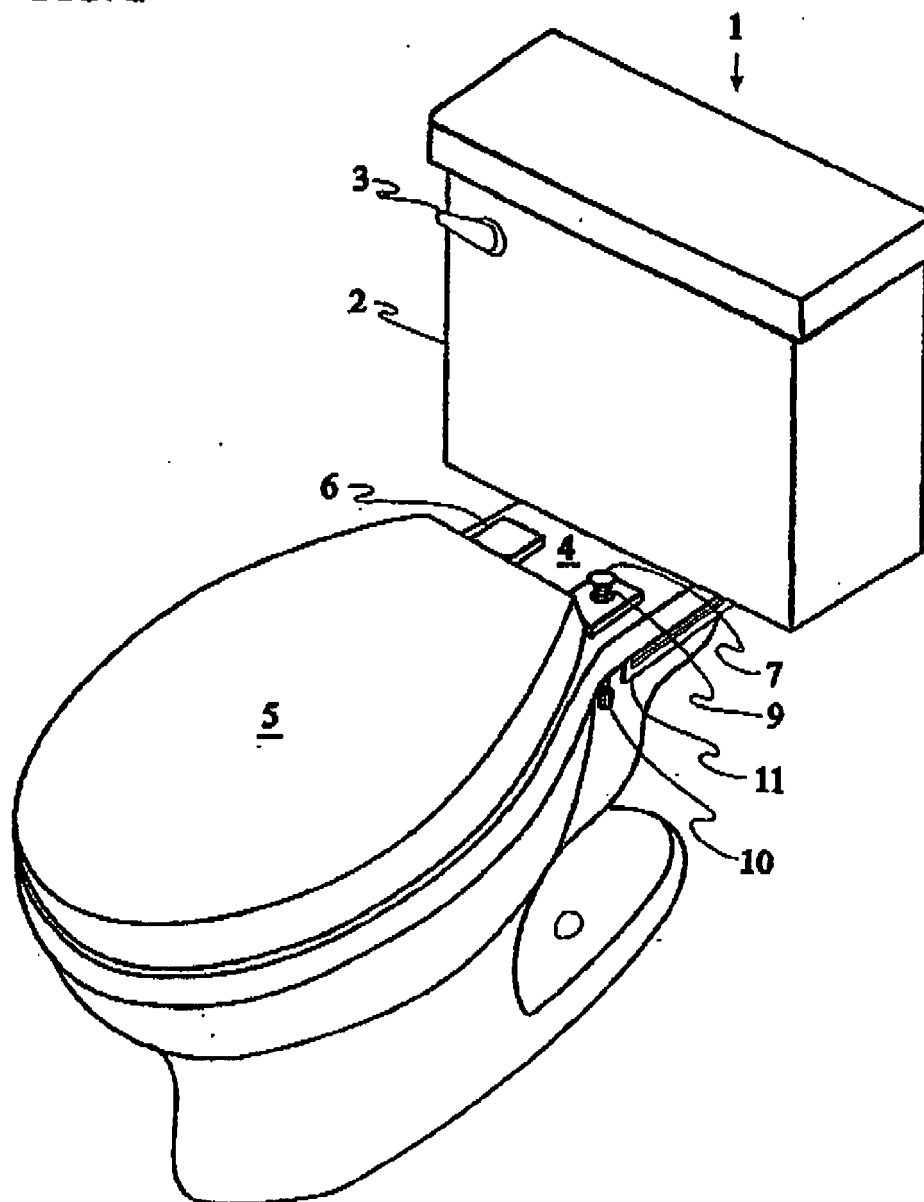


FIG. 3

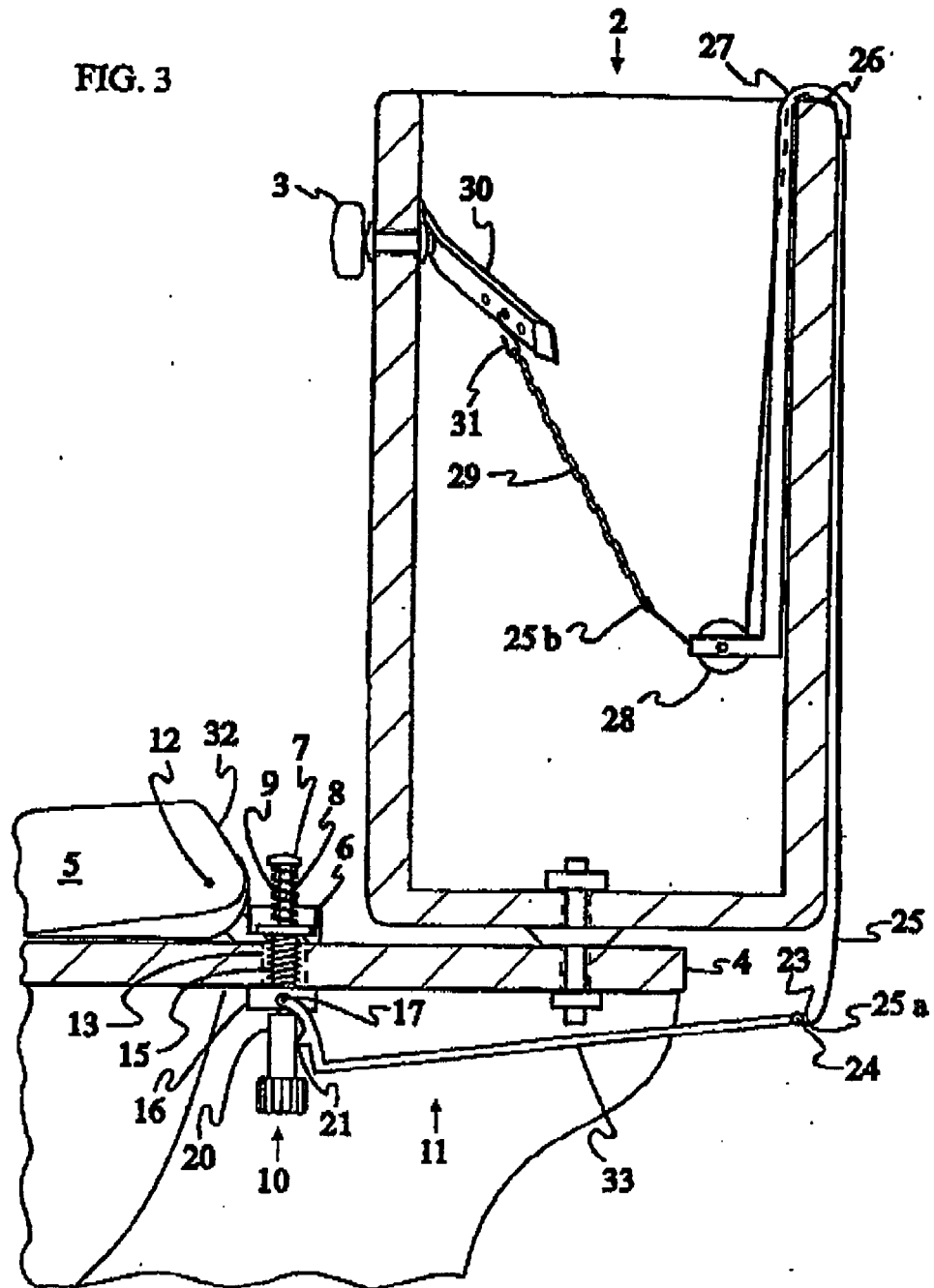
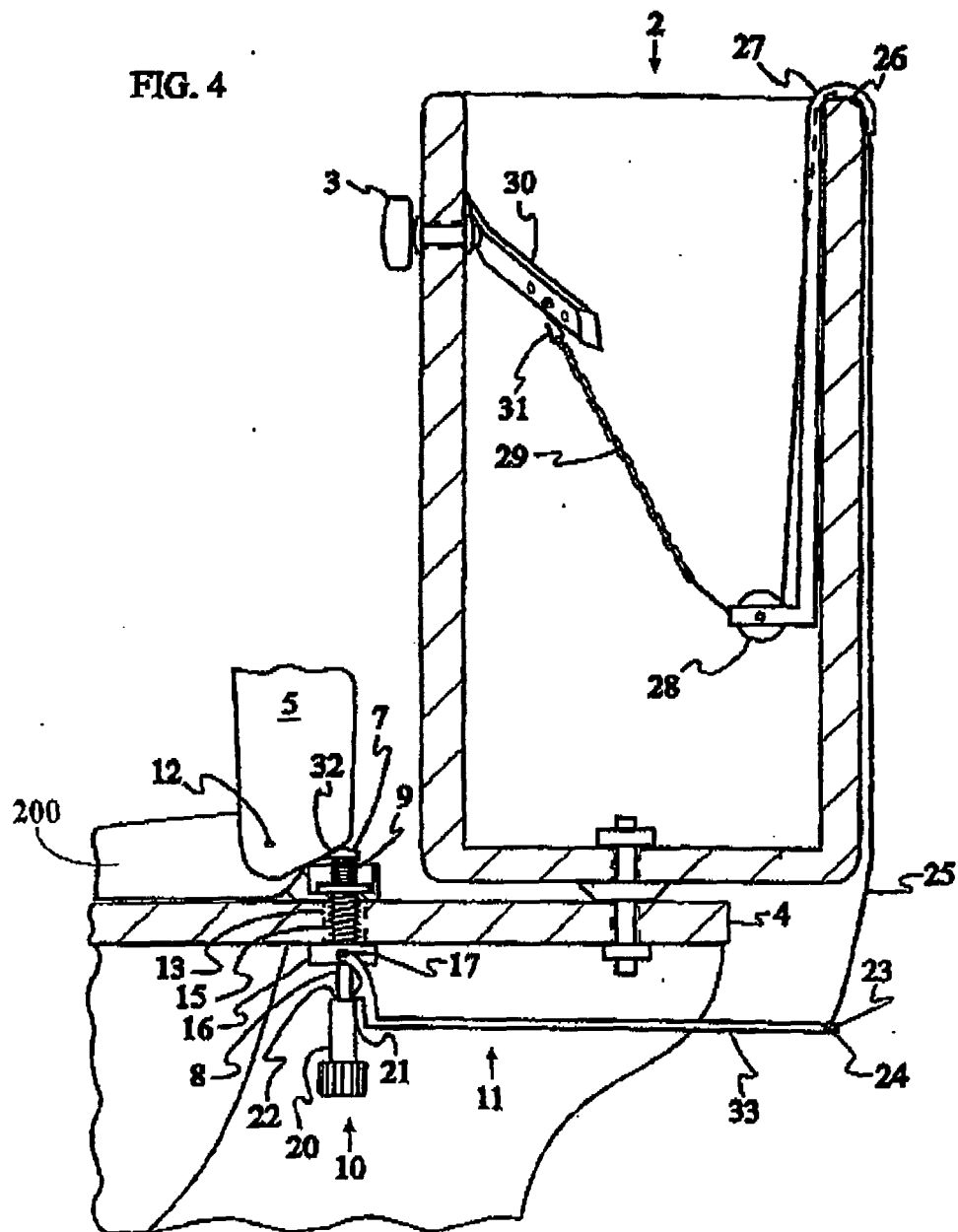


FIG. 4



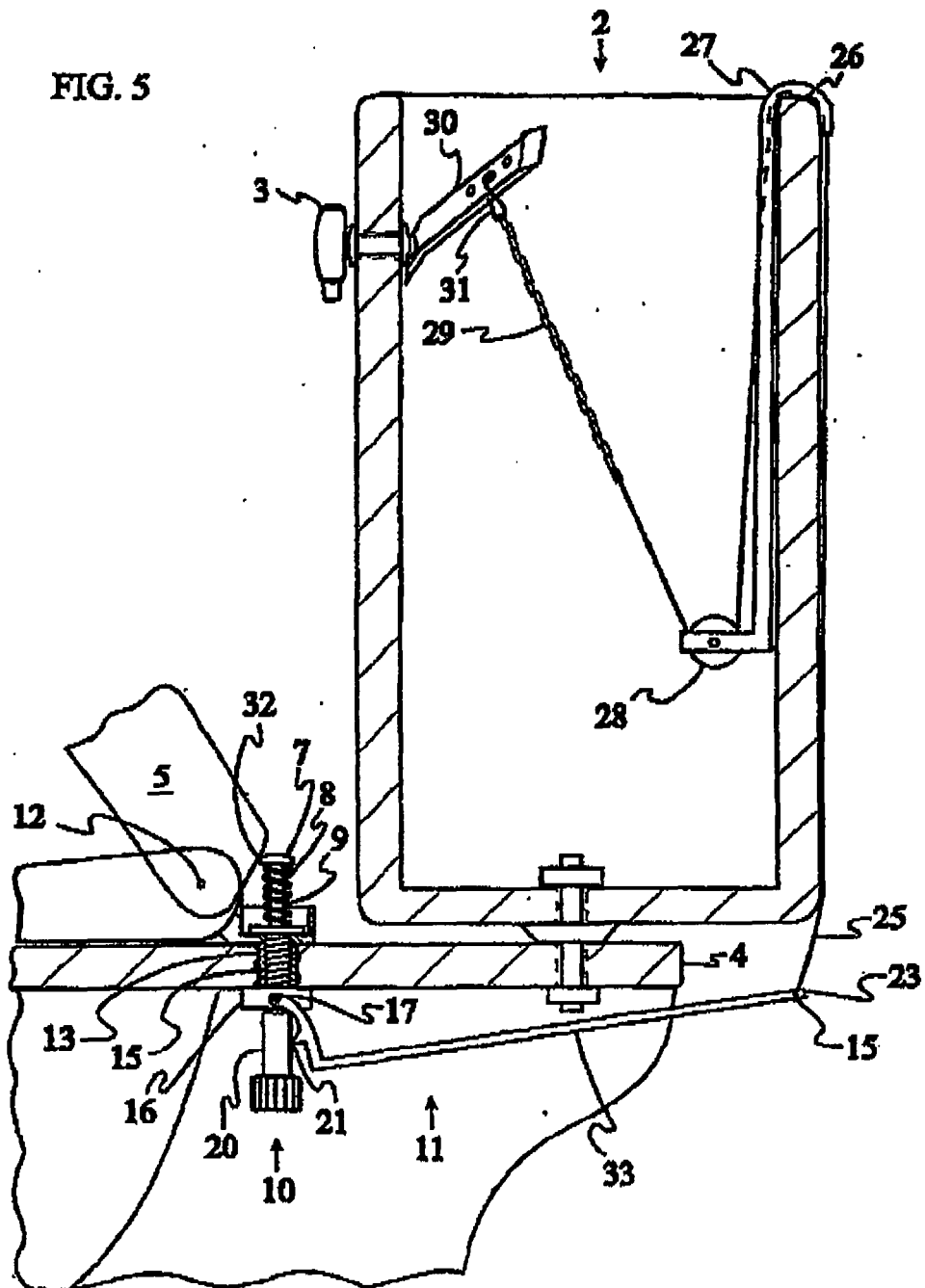


FIG. 6A

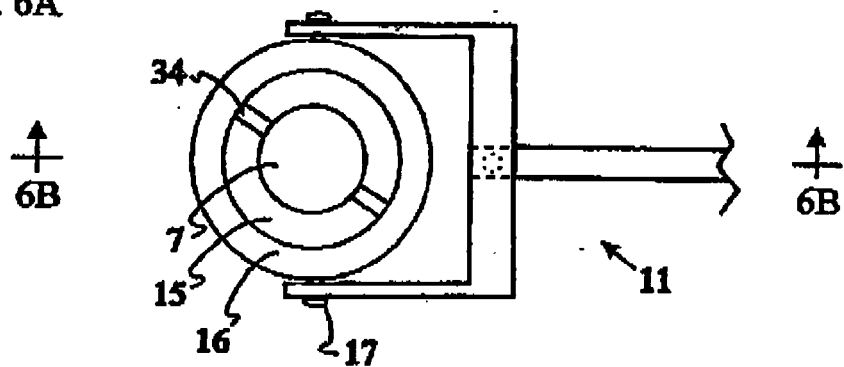


FIG. 6B

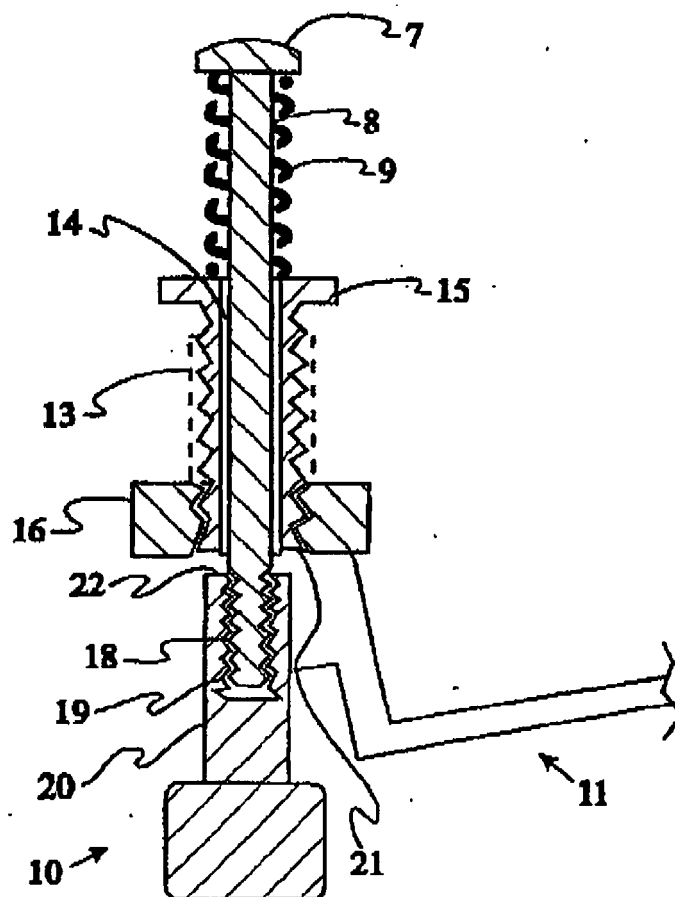


FIG. 7

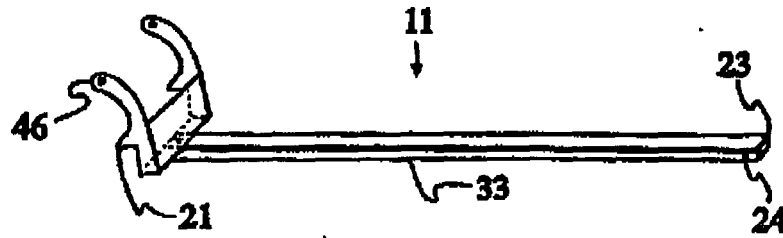


FIG. 8A

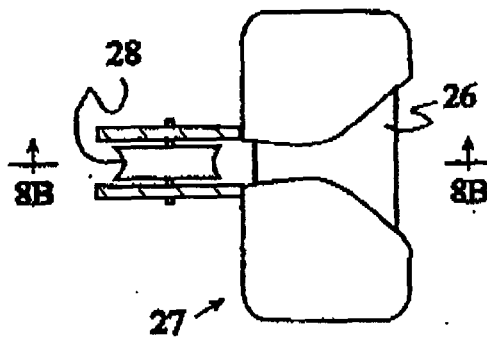


FIG. 8B

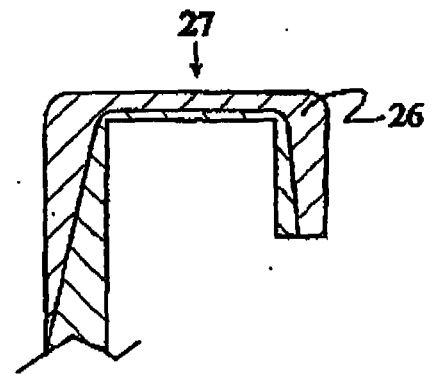


FIG 9

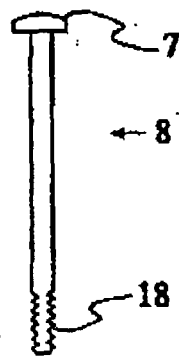


FIG. 10A

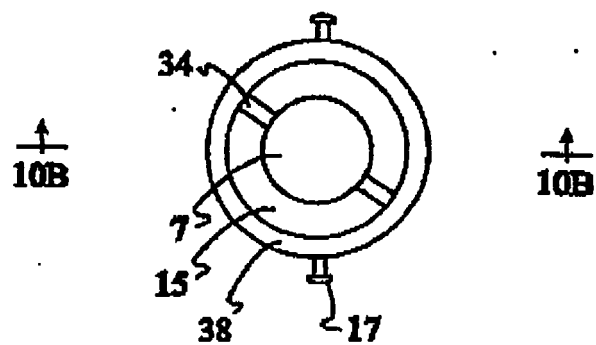


FIG. 10B

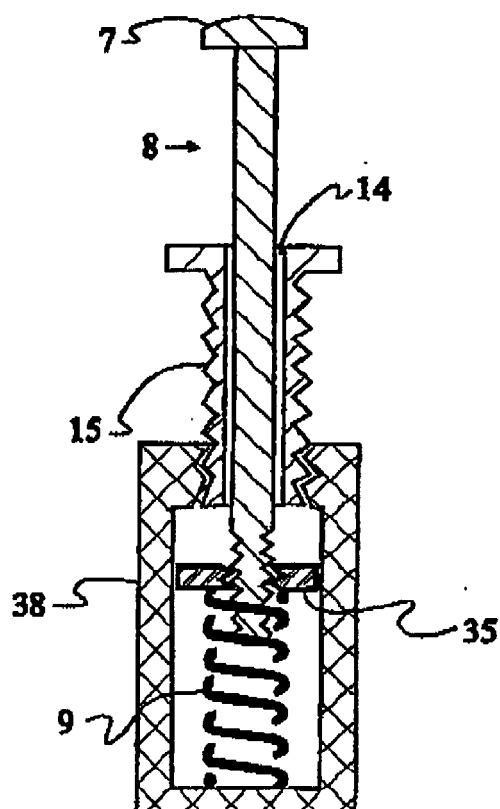


FIG. 11

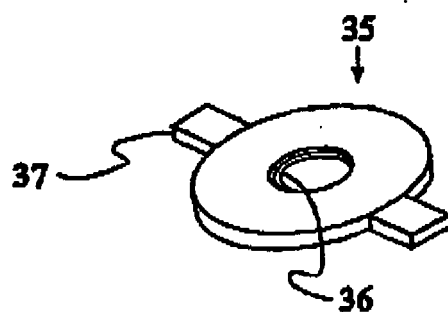


FIG. 12

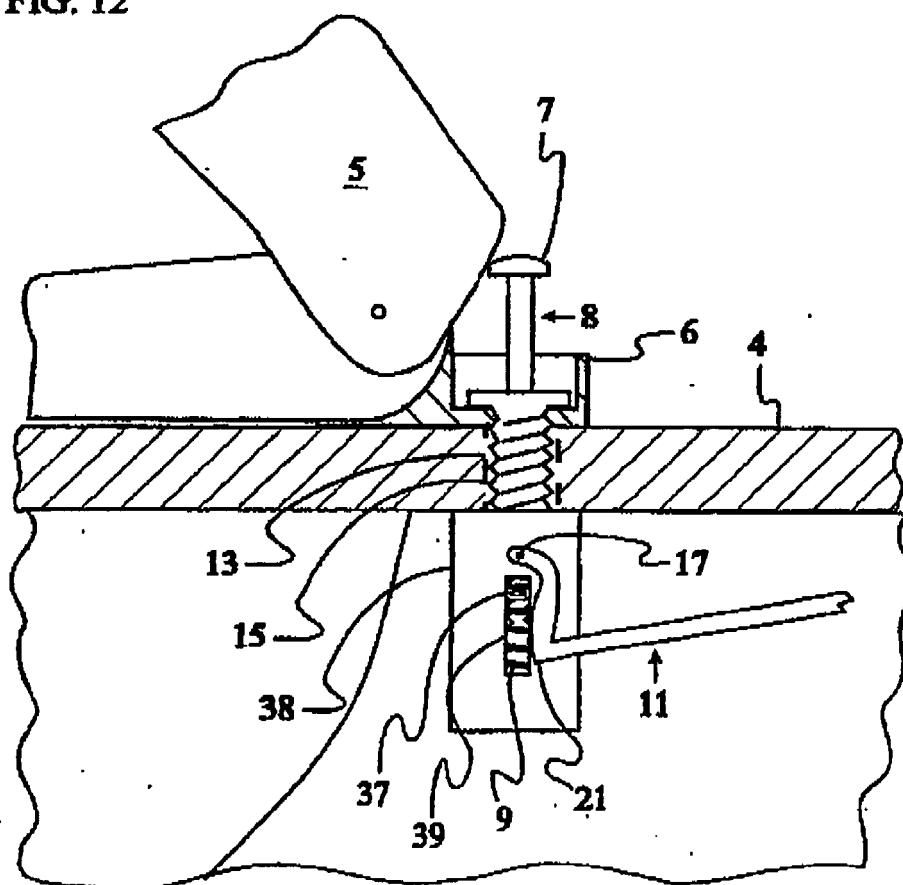


FIG. 13

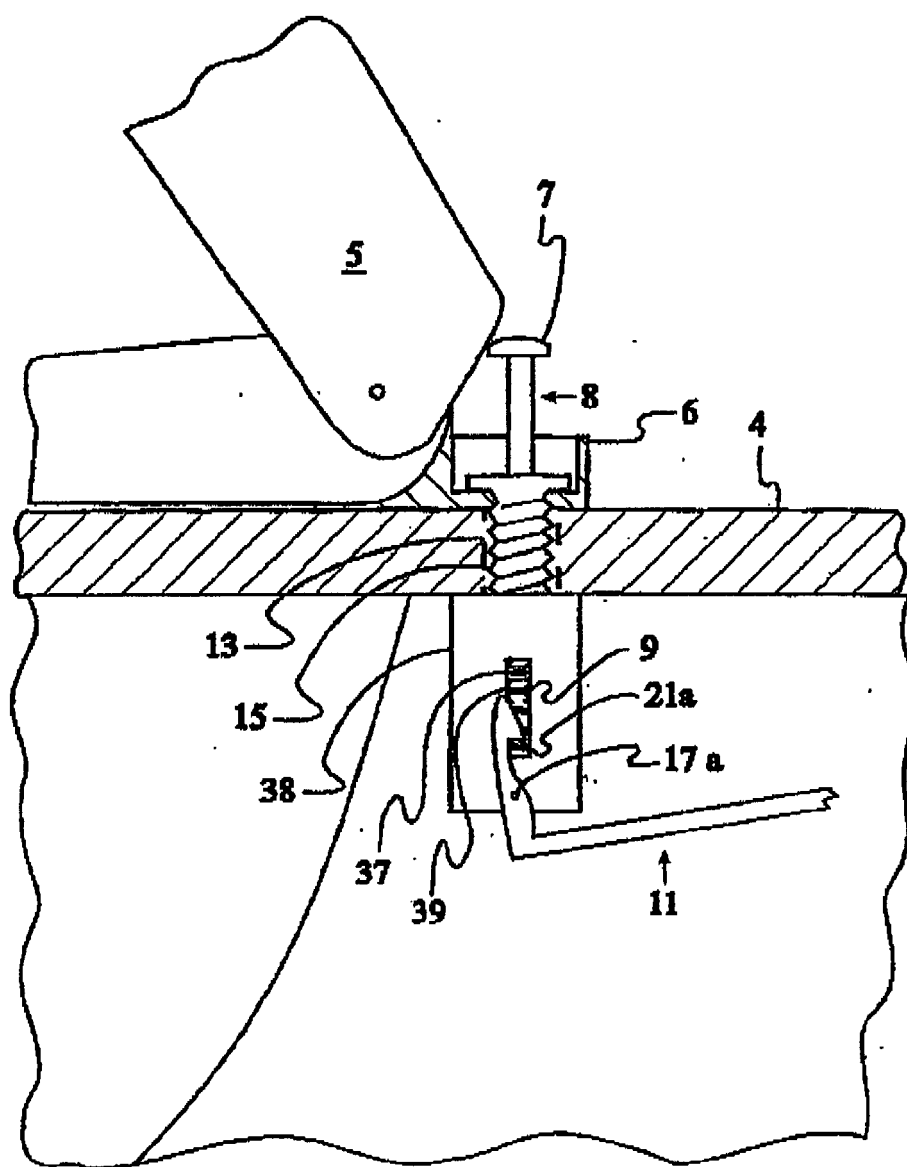


FIG. 14

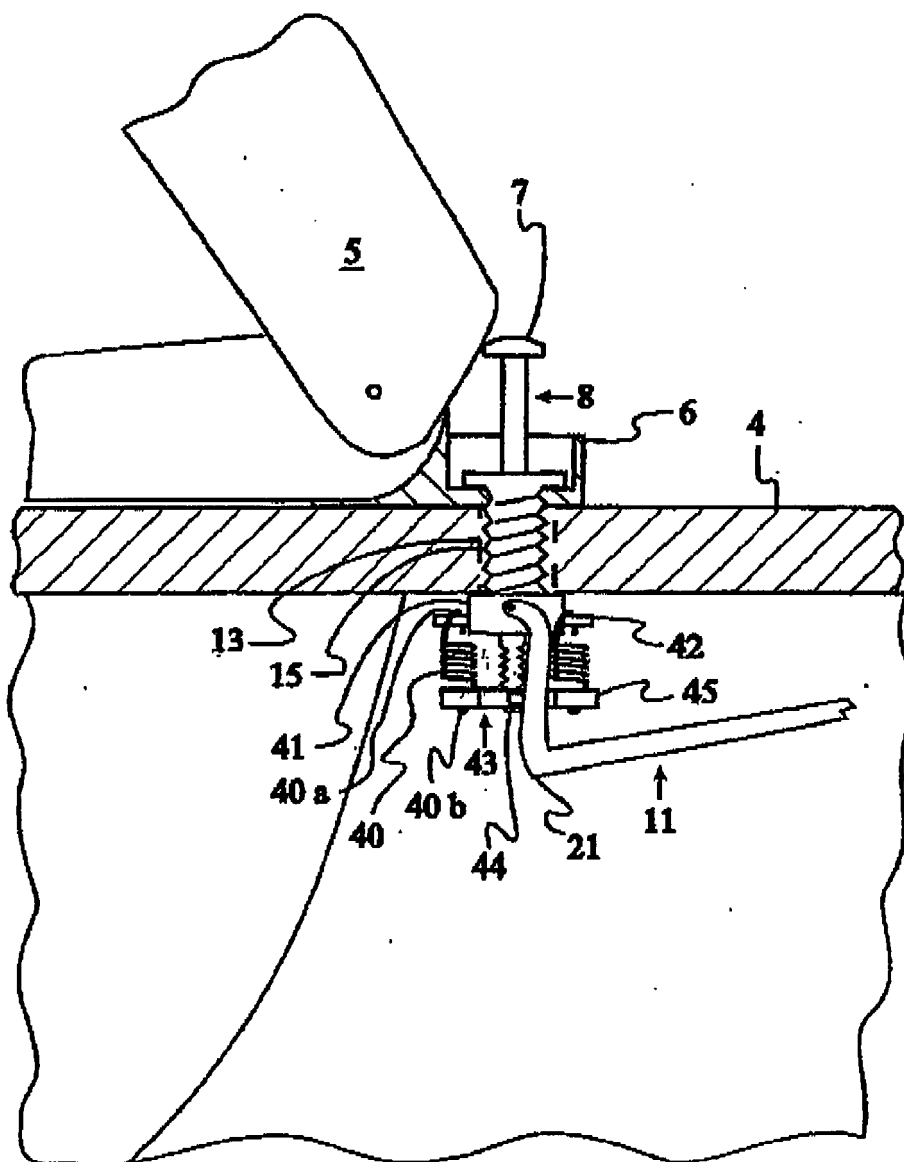


FIG. 15

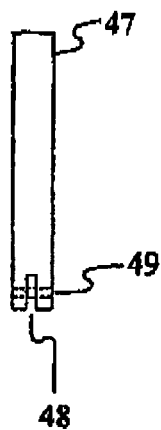


FIG. 16

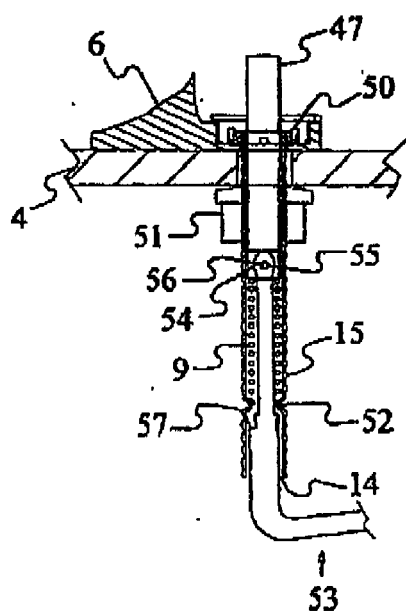


FIG. 17

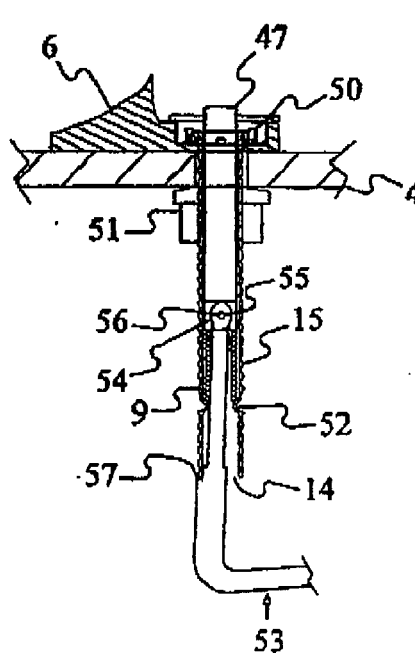


FIG. 18

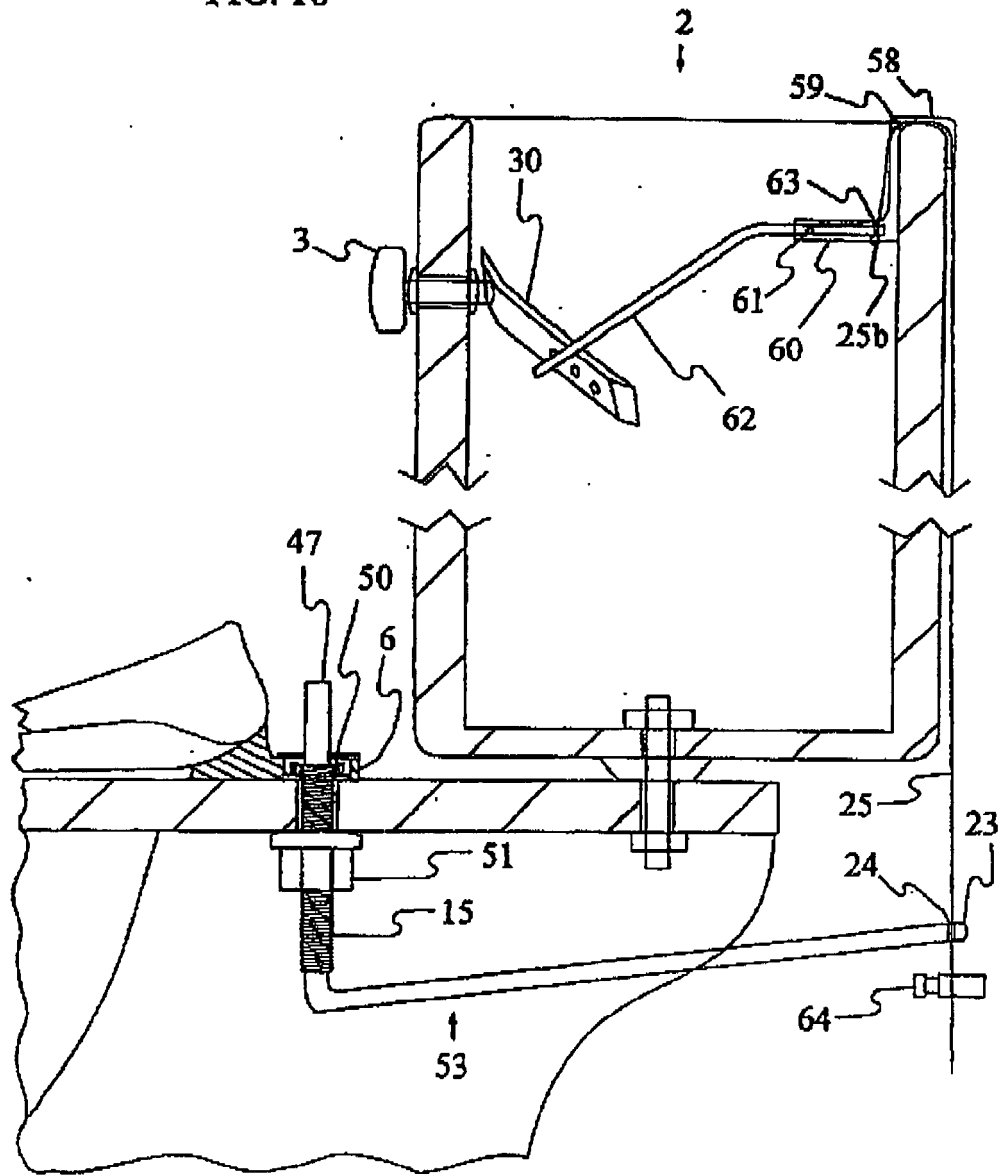


FIG. 19

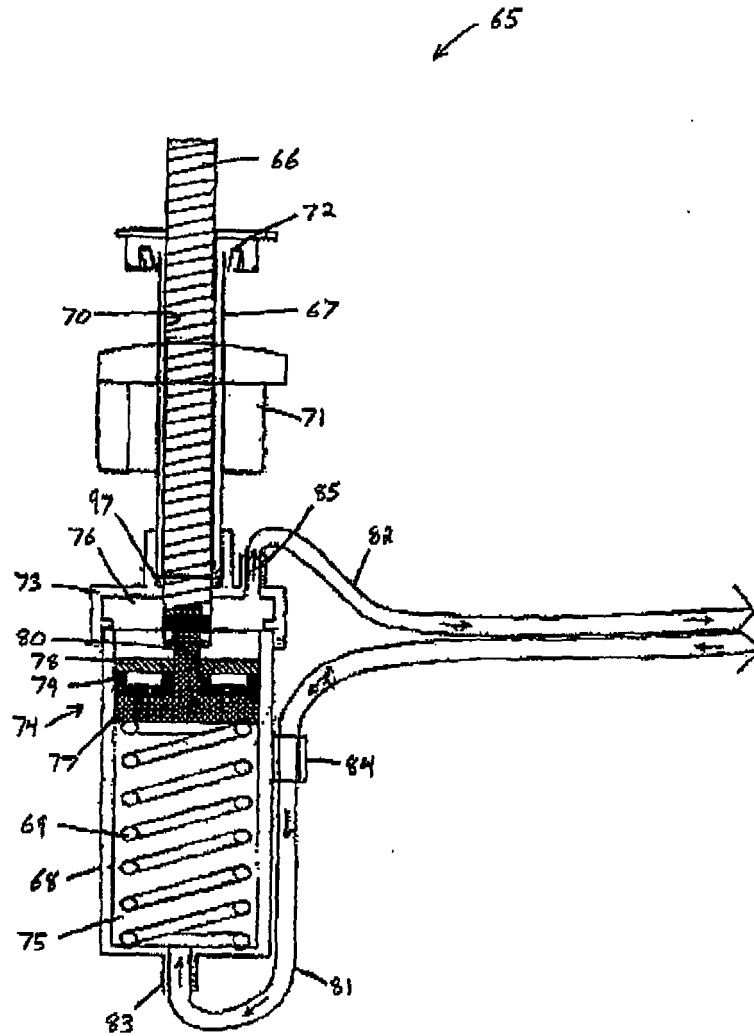


FIG. 20

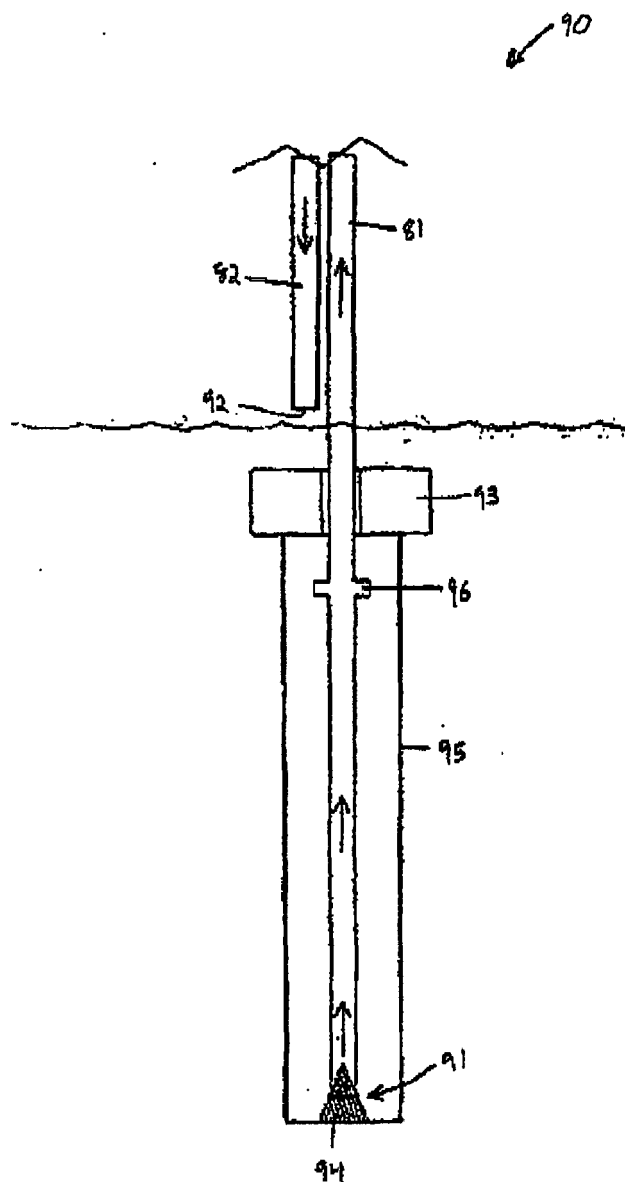


FIG. 21

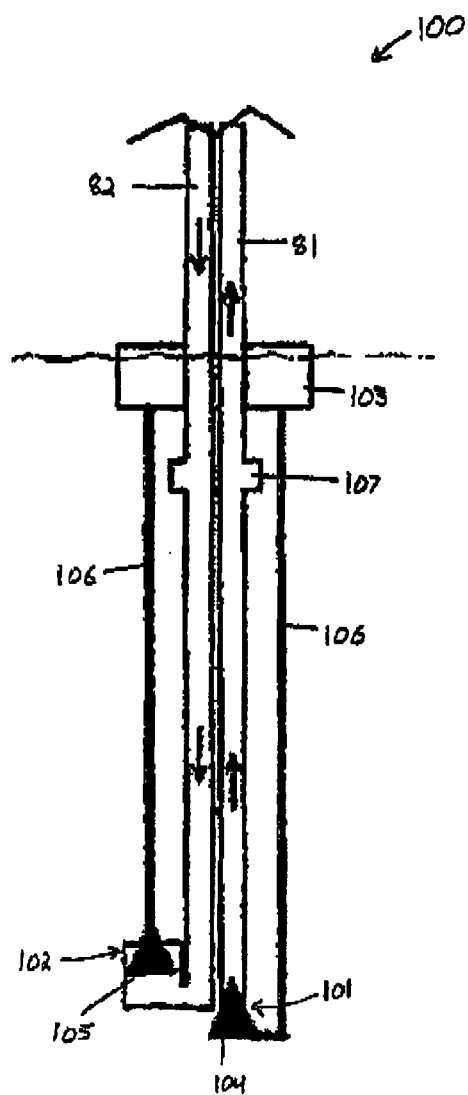


FIG. 22

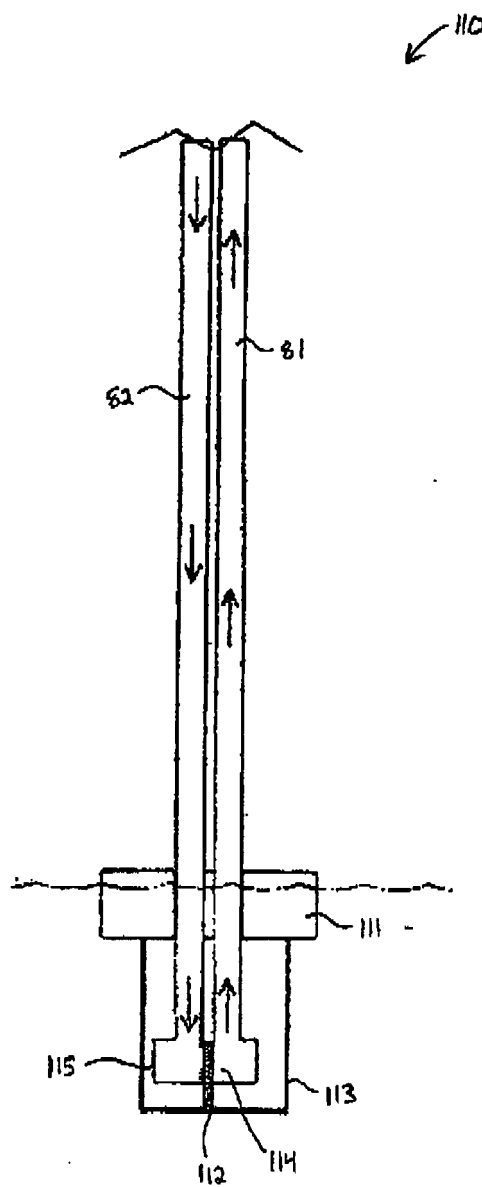


FIG. 23

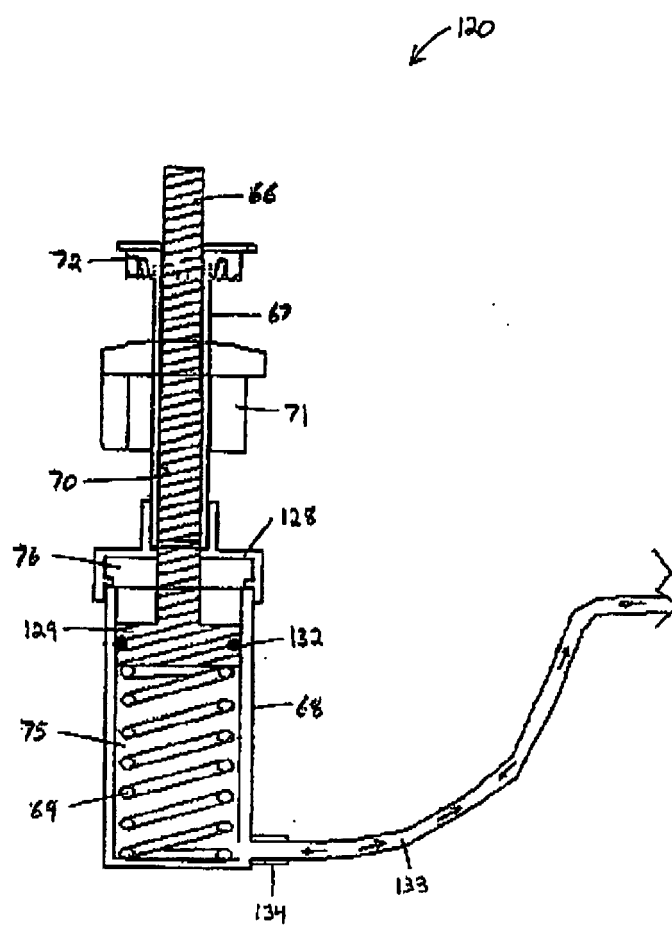
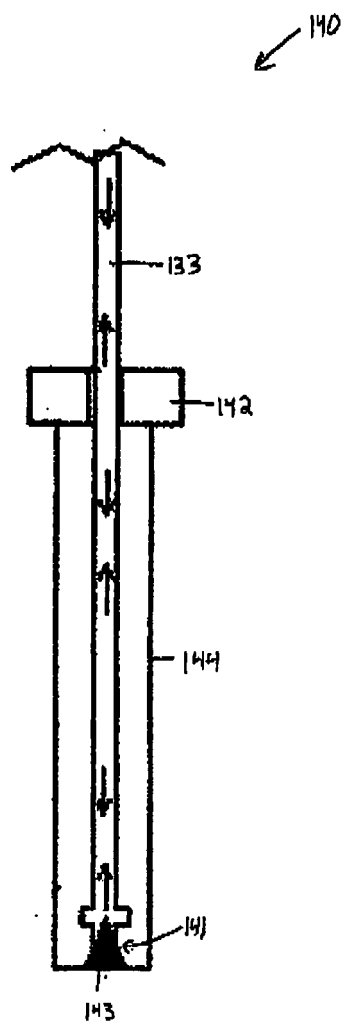


FIG. 24



REFERENCES CITED IN THE DESCRIPTION

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