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(57) **ABSTRACT**

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(63) Continuation of application No. PCT/IB2023/052538, filed on Mar. 15, 2023.

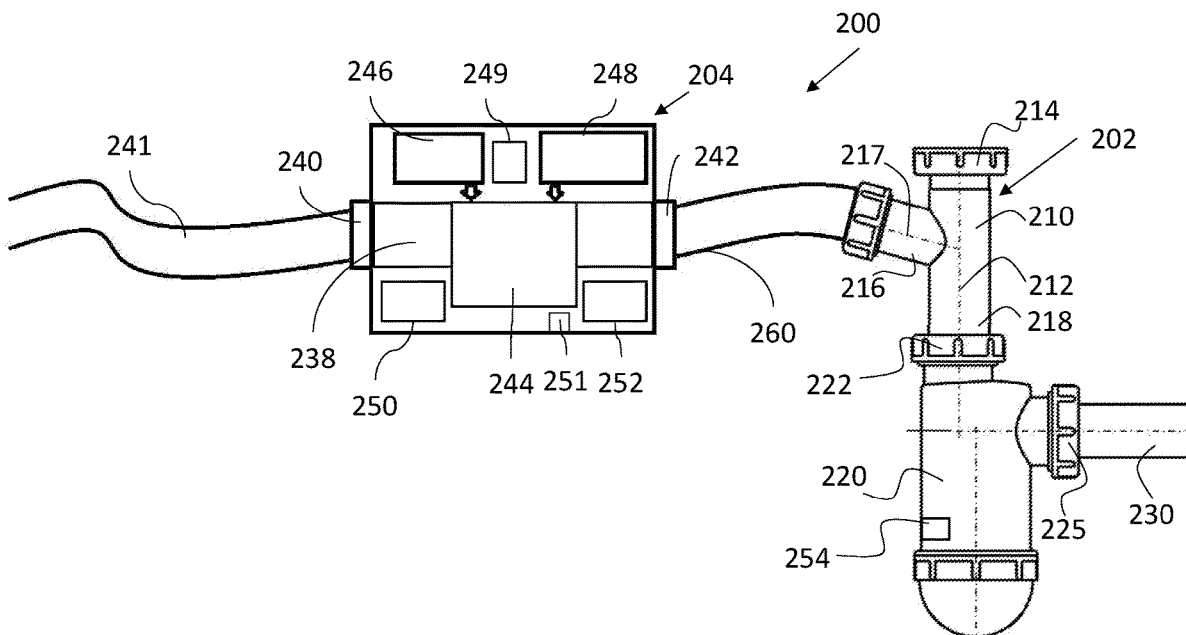
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A drain cleaning and maintenance system, including a drain trap, having a first inlet in fluid communication with a drain of a plumbing fixture, a second inlet in fluid communication with the drain trap and a cleaning and maintenance assembly. The assembly includes a maintenance-assembly inlet in fluid communication with a source of pressurized liquid, and a maintenance-assembly outlet in fluid communication with the second inlet. An electronic valve has an open state allowing flow of liquid, from the maintenance-assembly inlet to the maintenance-assembly outlet, and a closed state blocking flow of liquid from the maintenance-assembly inlet to the maintenance-assembly outlet. An electronic controller is adapted to transition the electronic valve between the open state and the closed state, to allow liquid flow from the source to the drain trap via the second inlet.



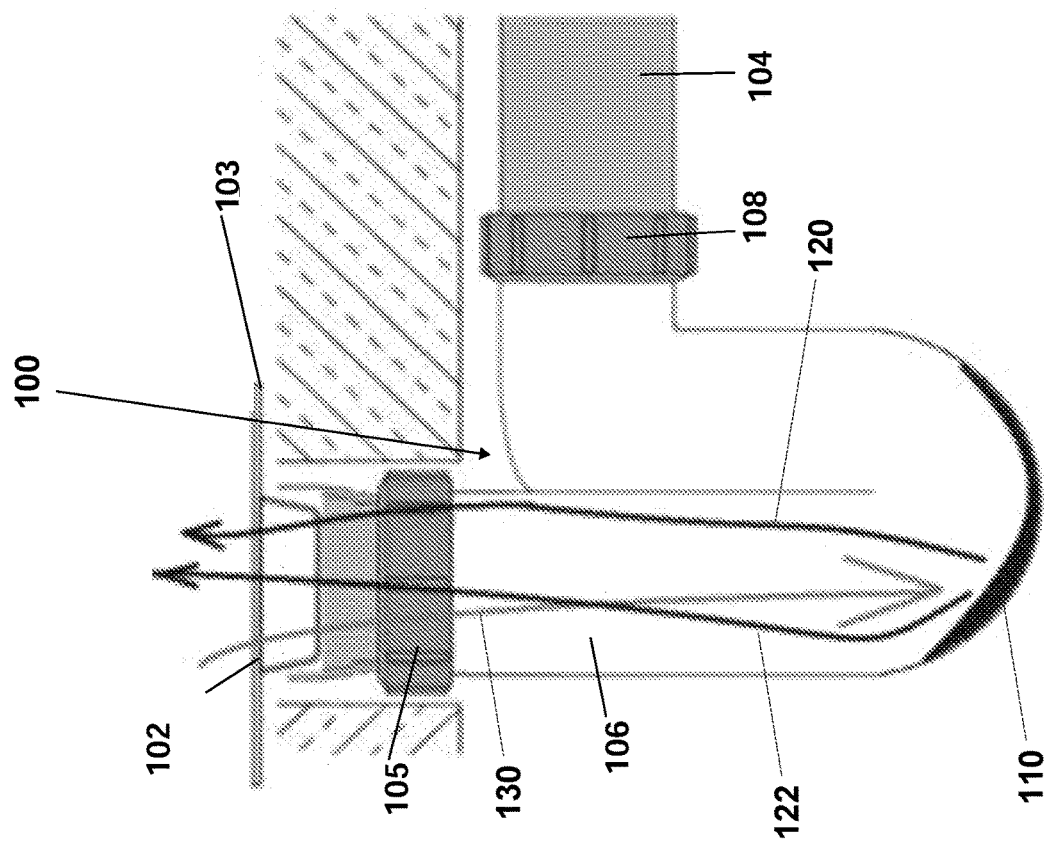


Fig. 1B (Prior art)

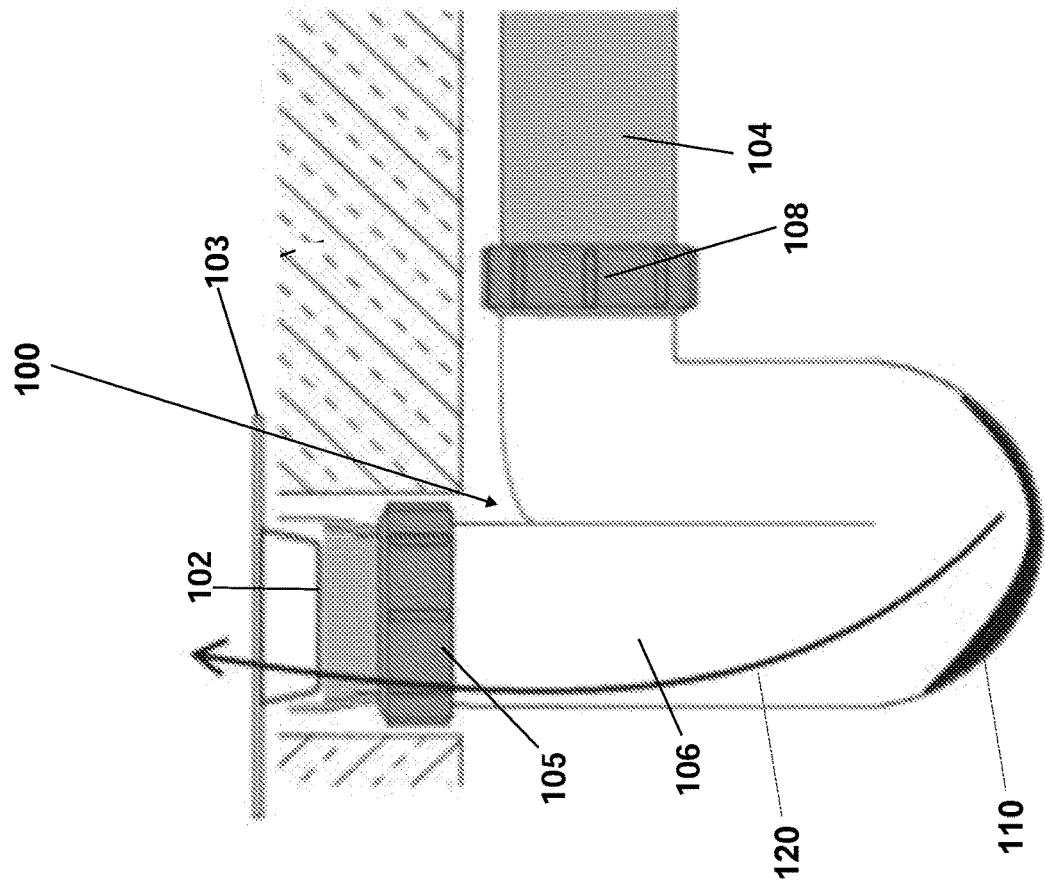


Fig. 1A (Prior art)

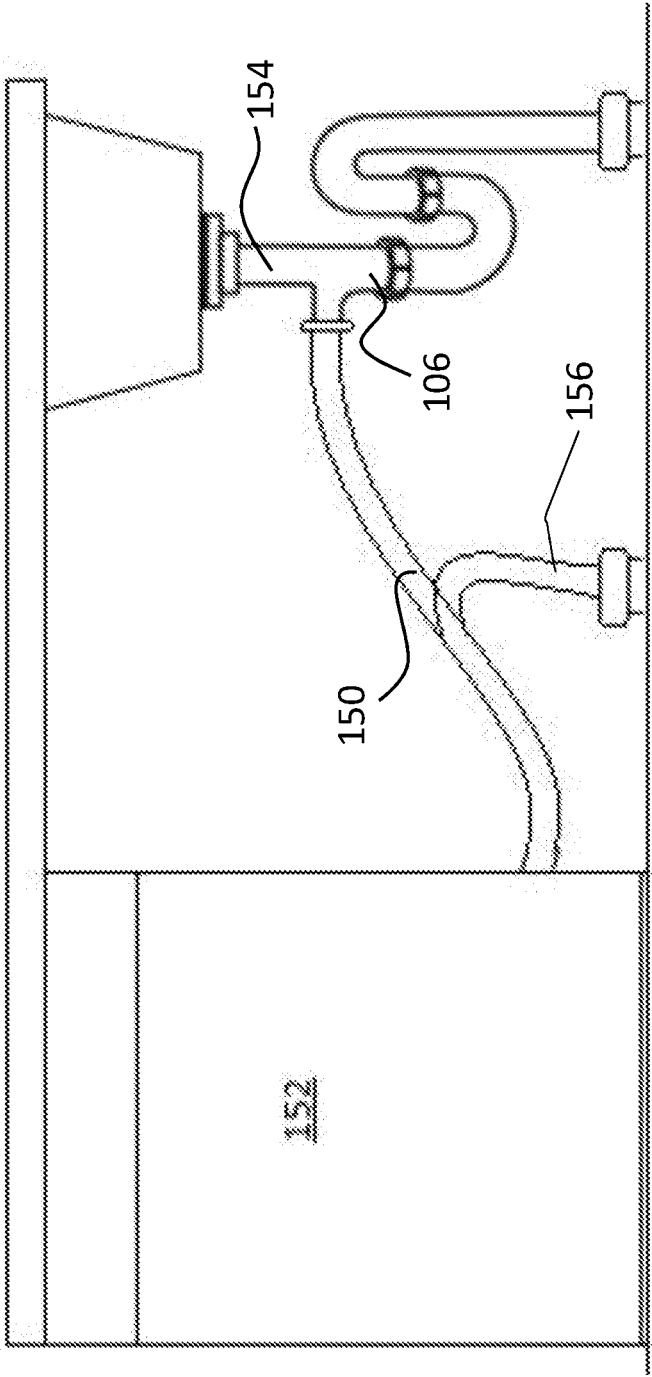


FIGURE 1C – PRIOR ART

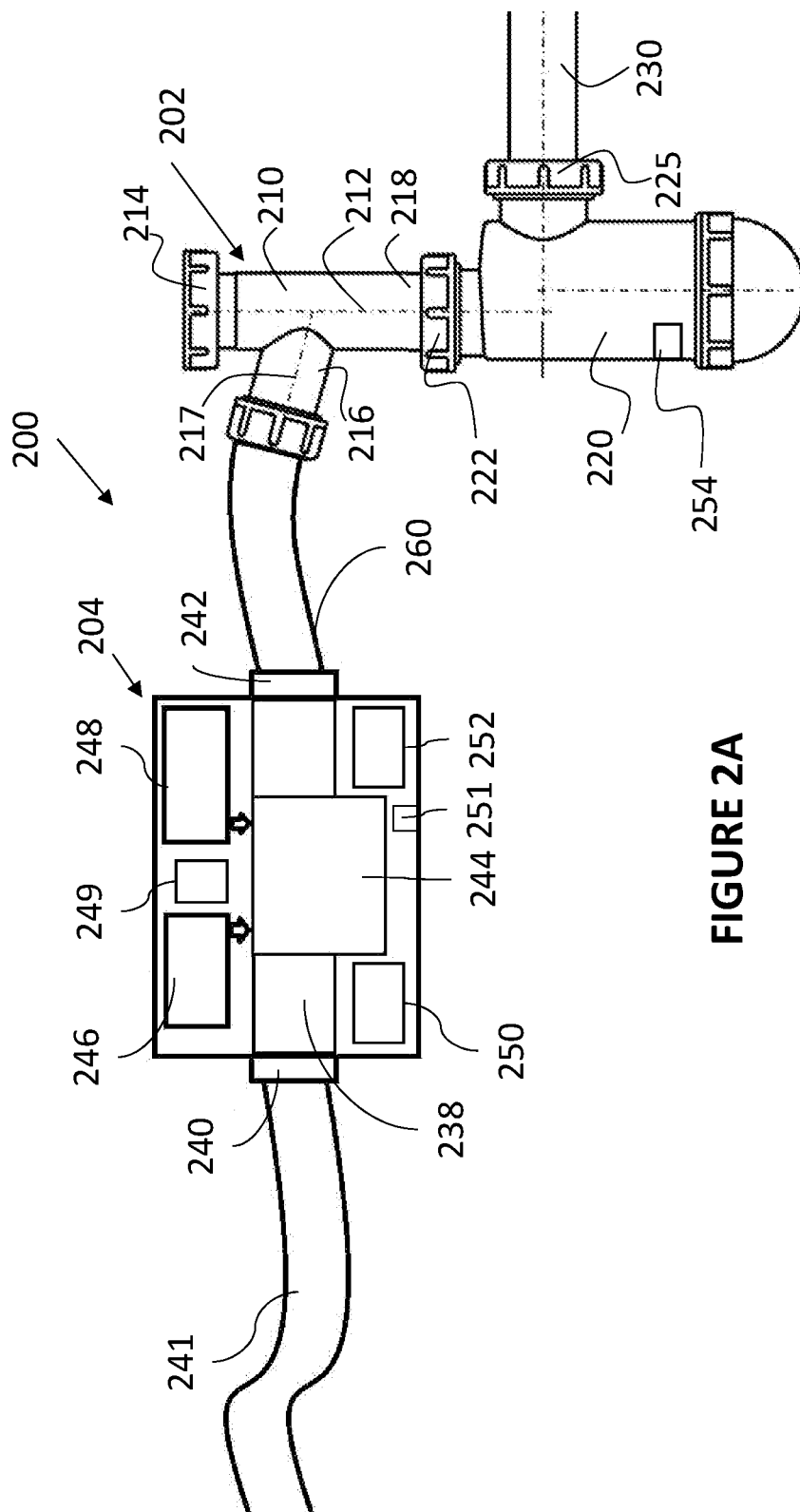


FIGURE 2A

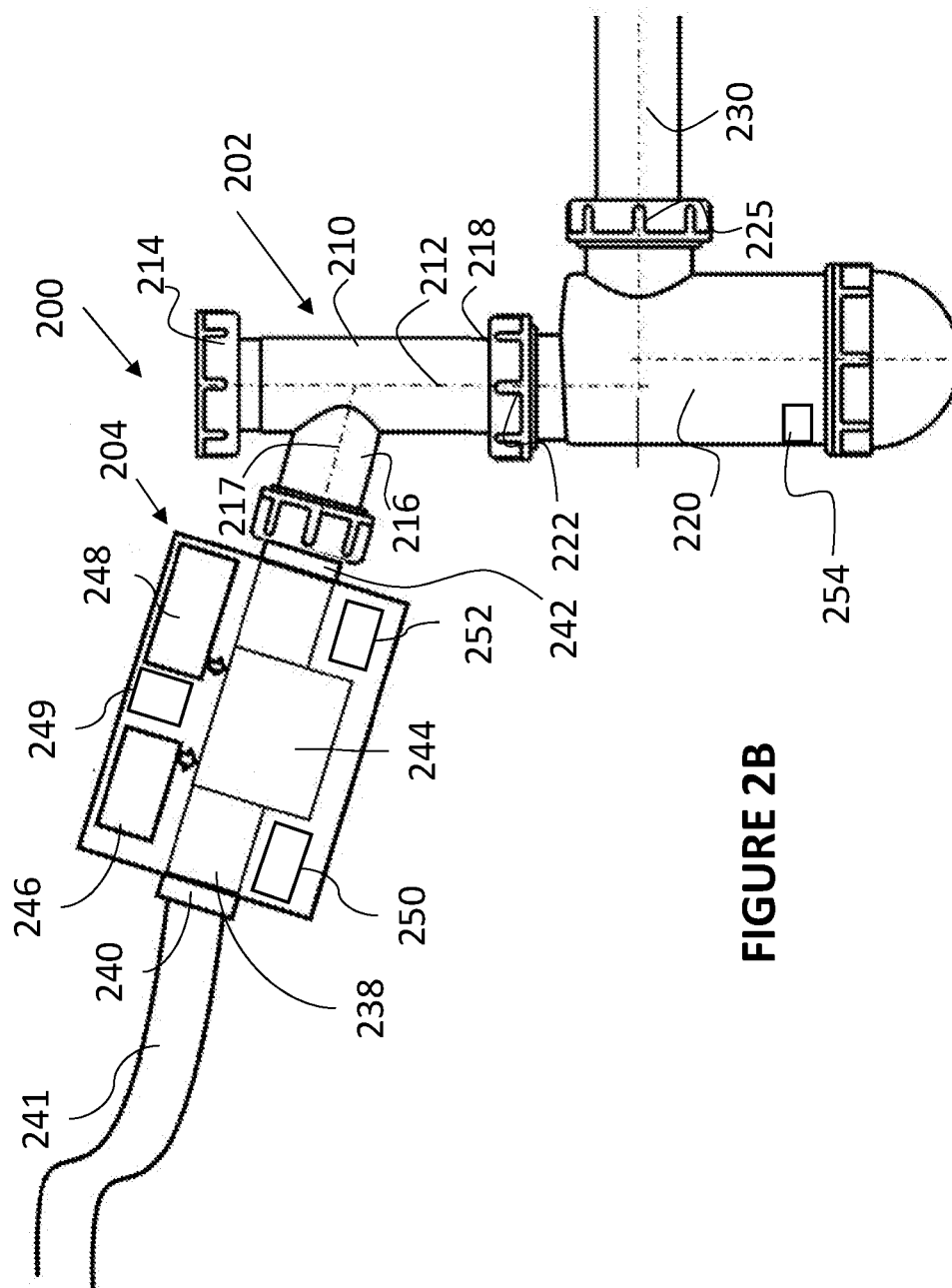


FIGURE 2B

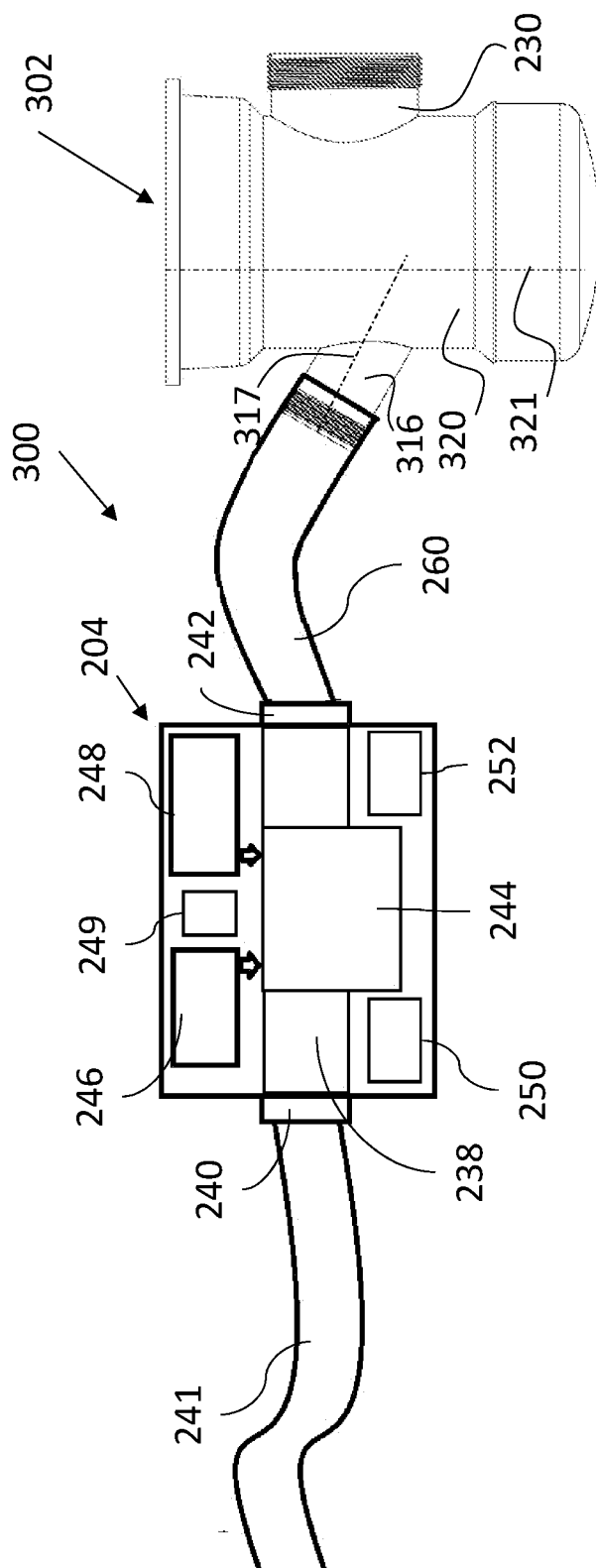


FIGURE 3

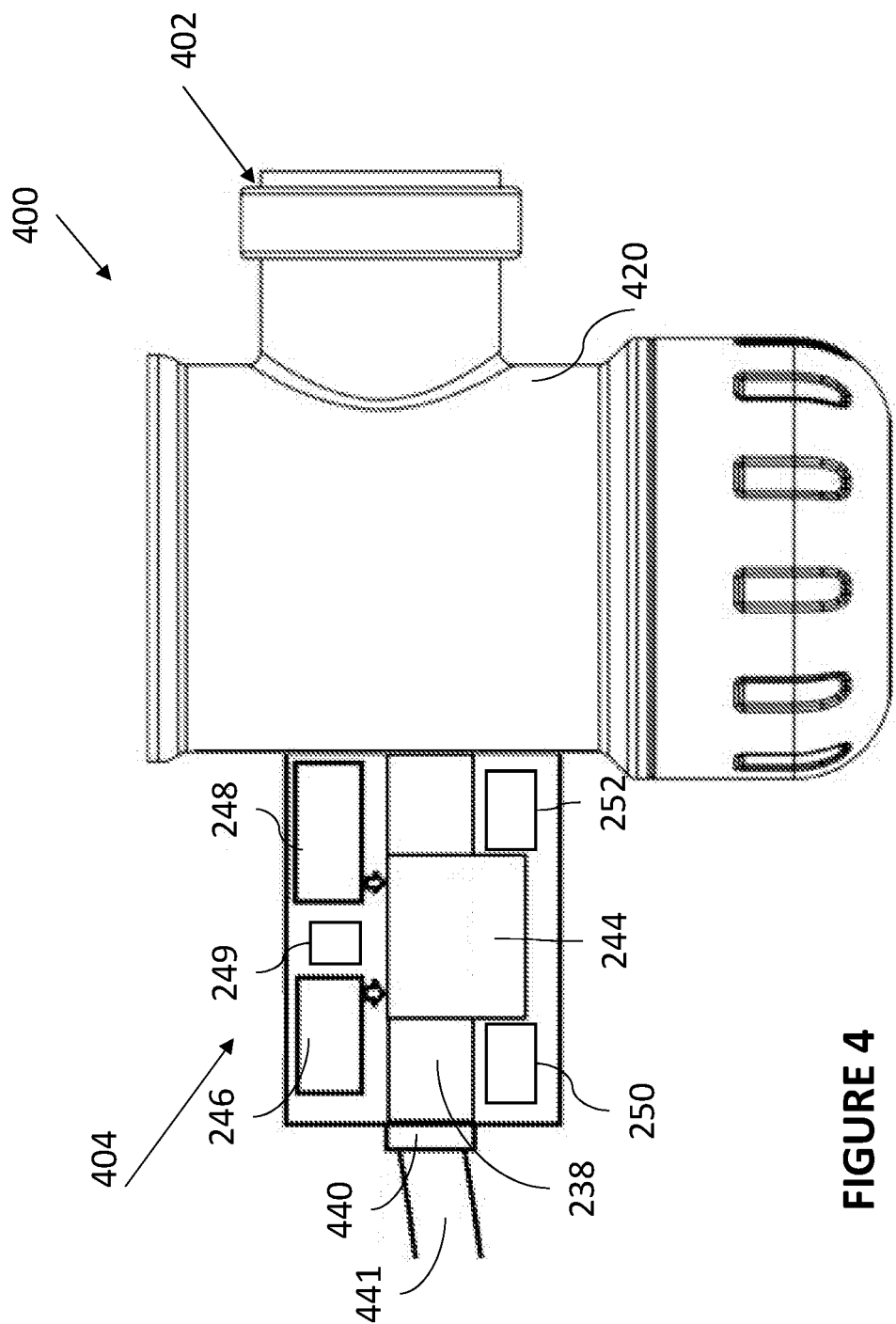


FIGURE 4

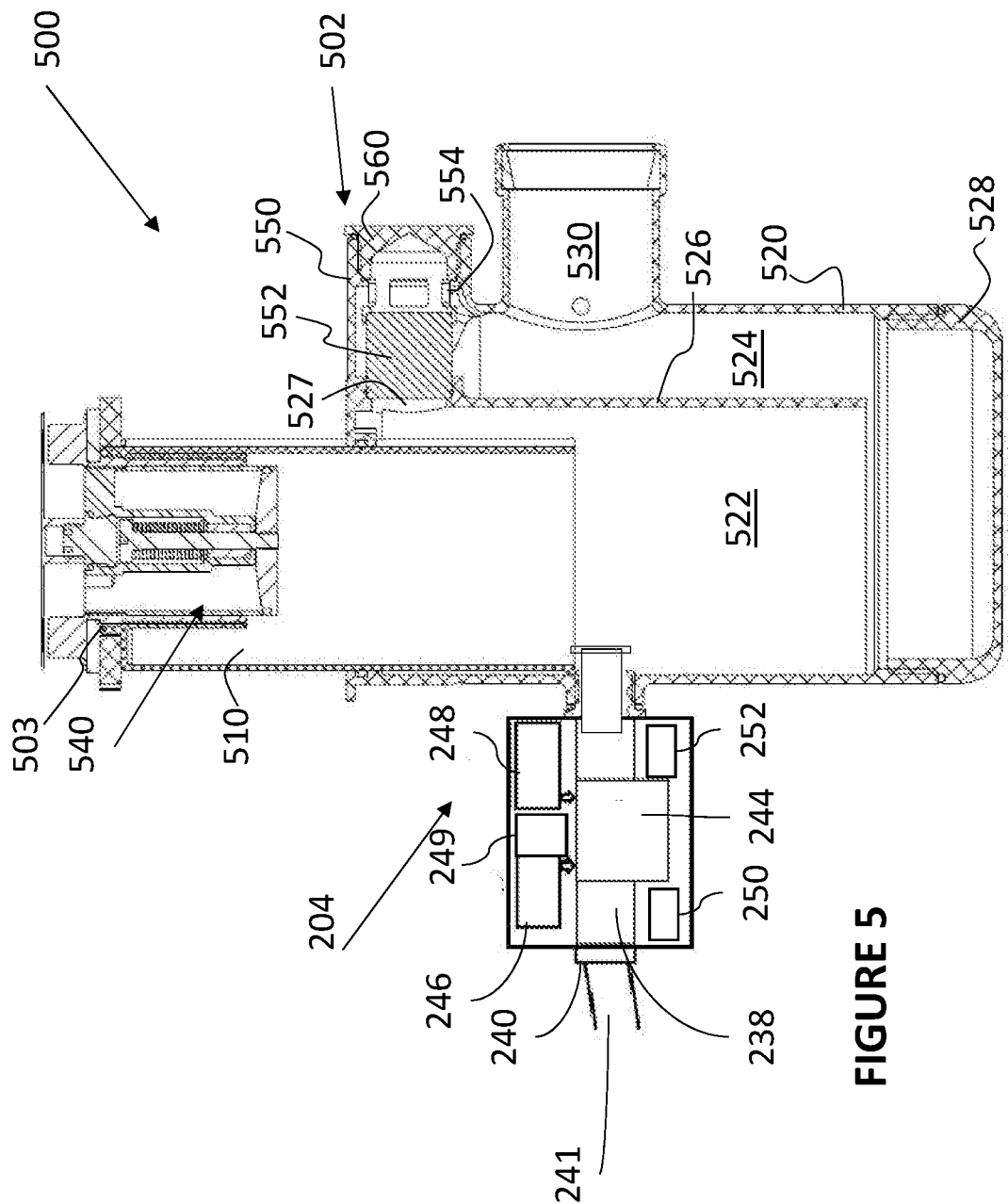
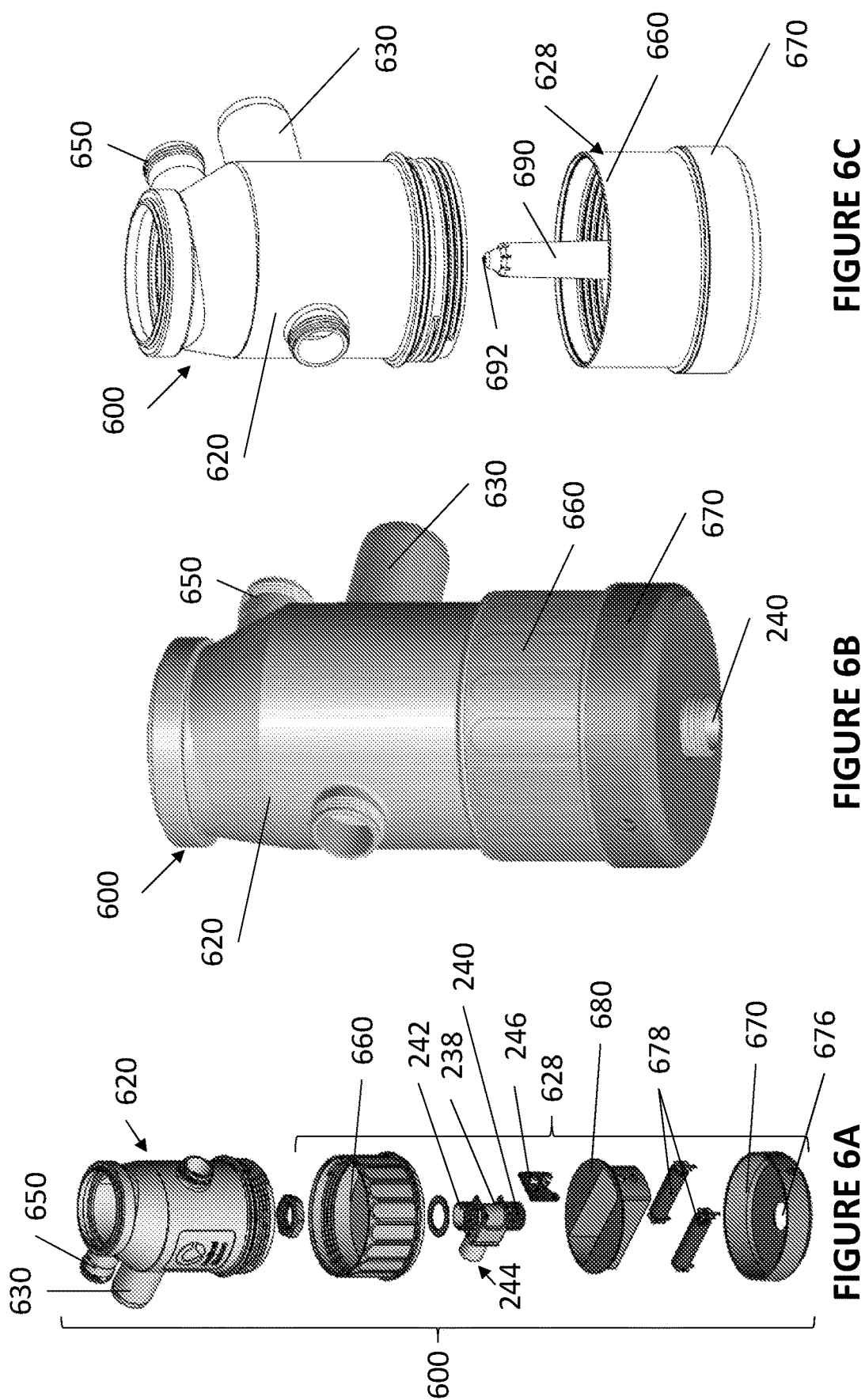
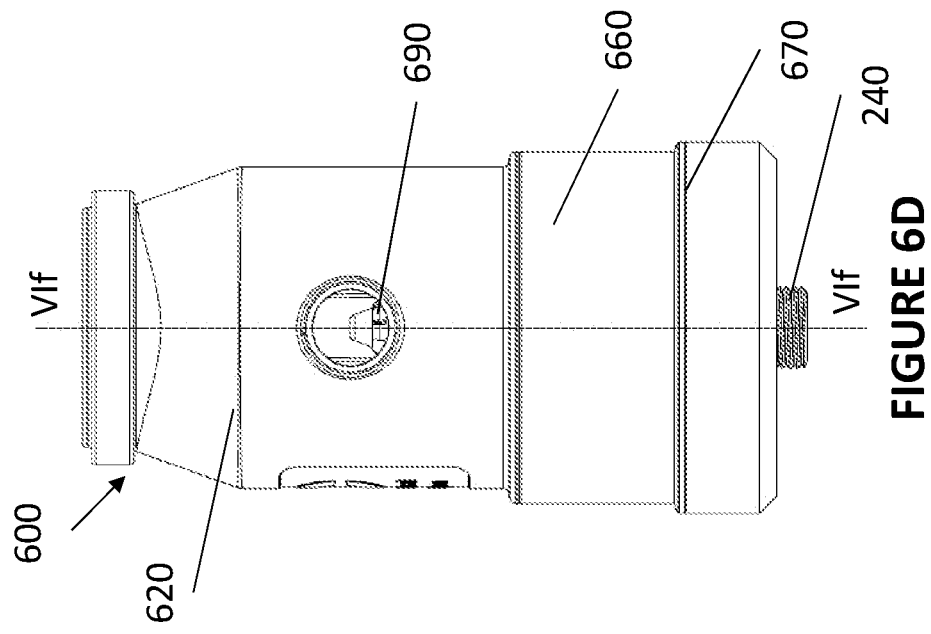
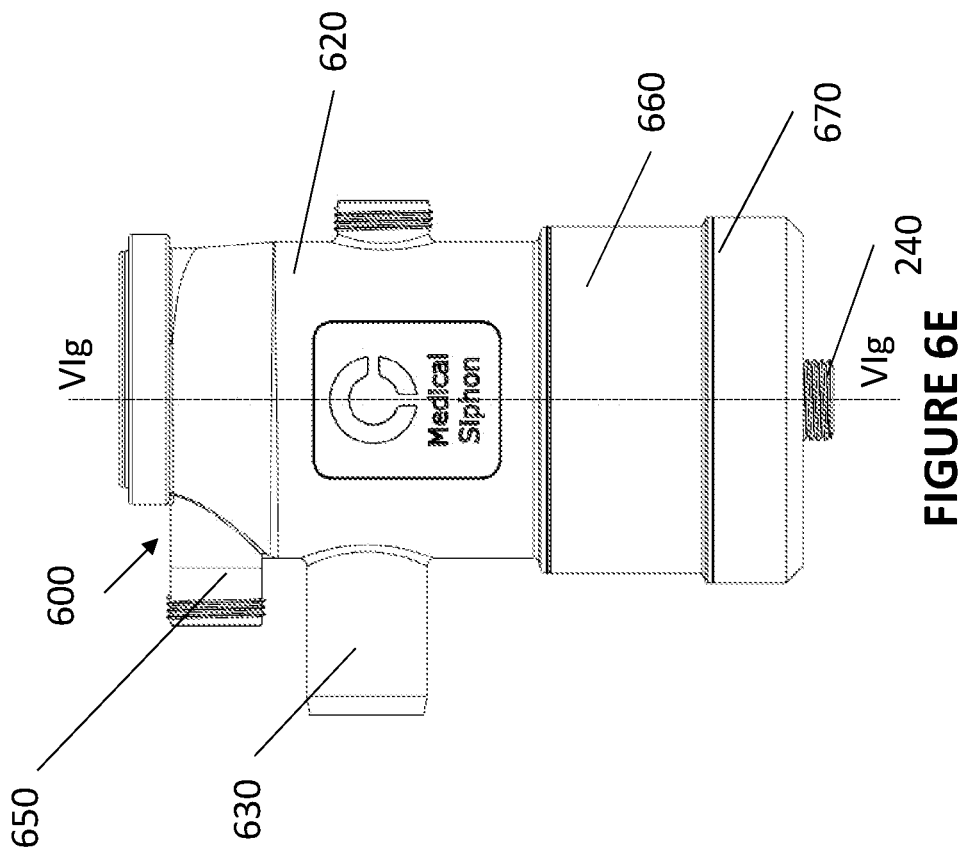
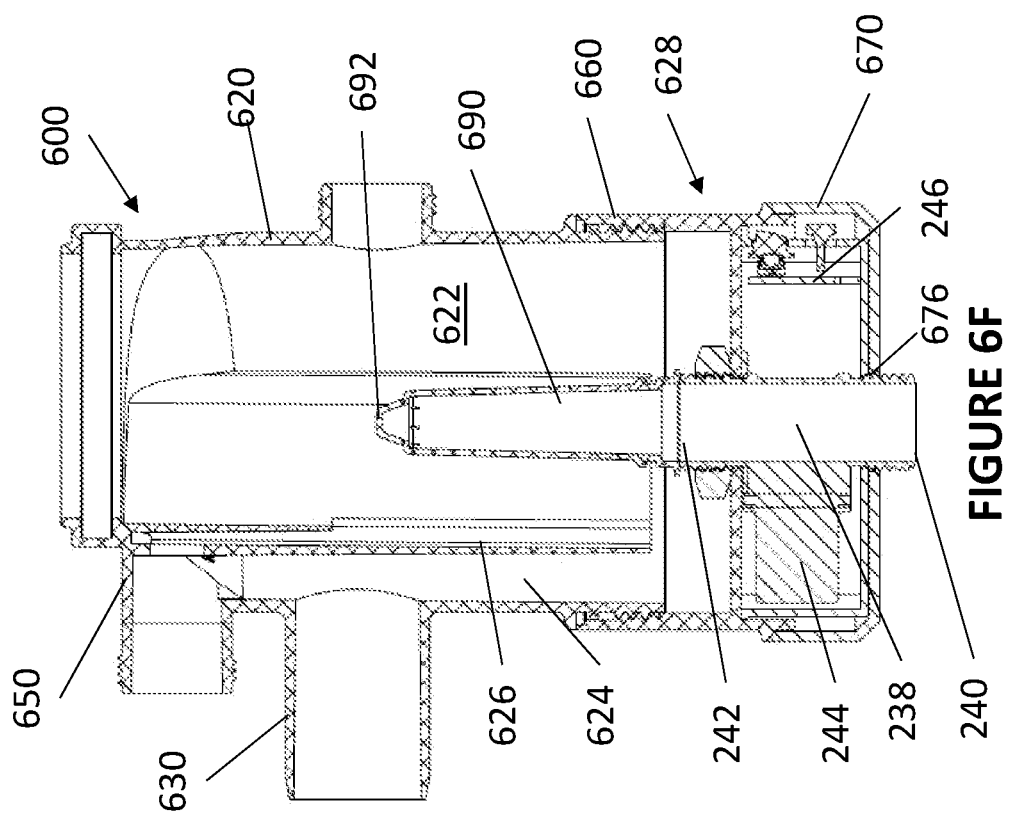
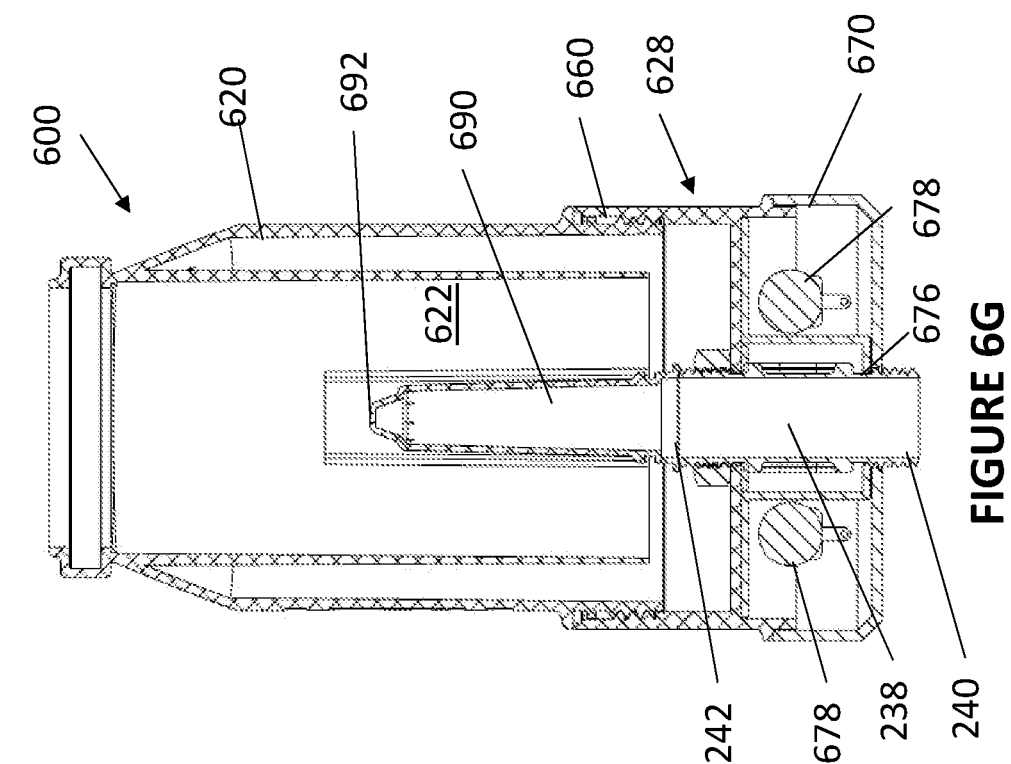
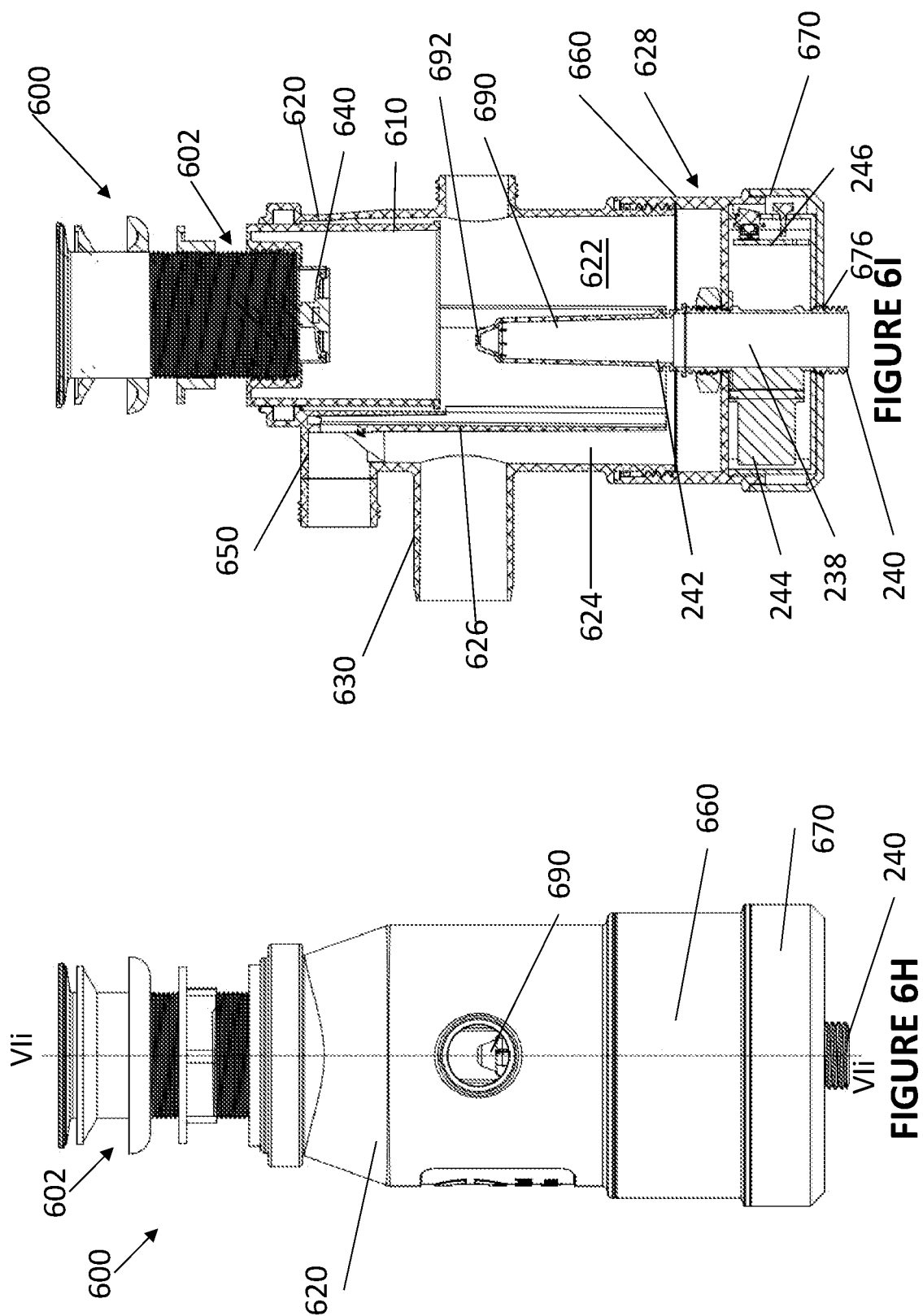


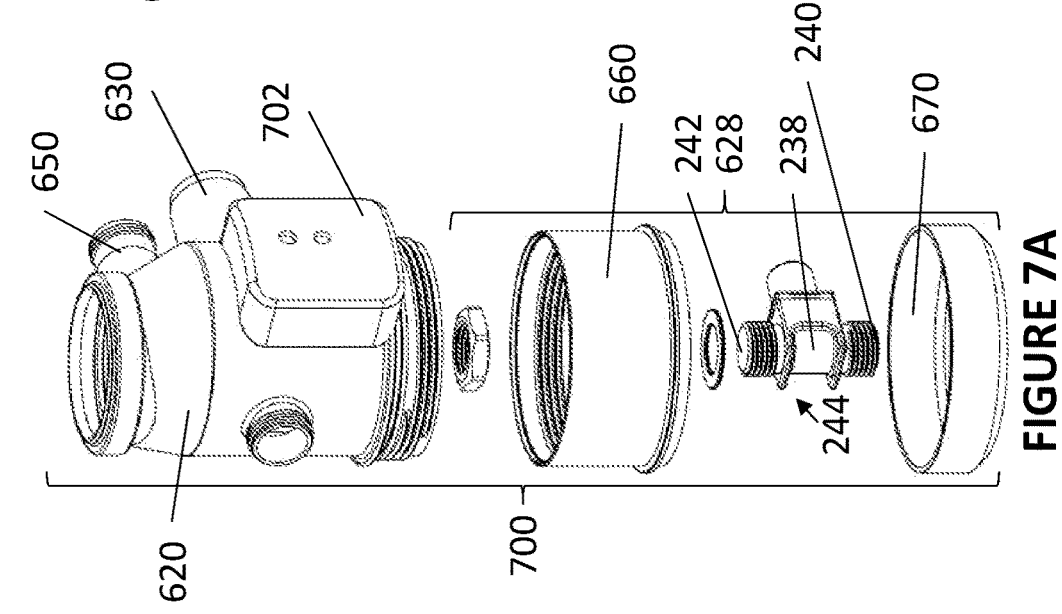
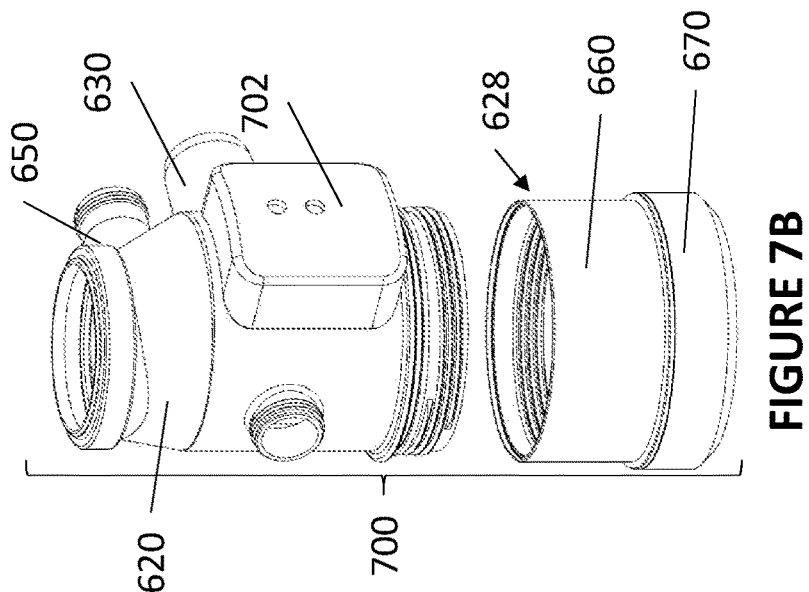
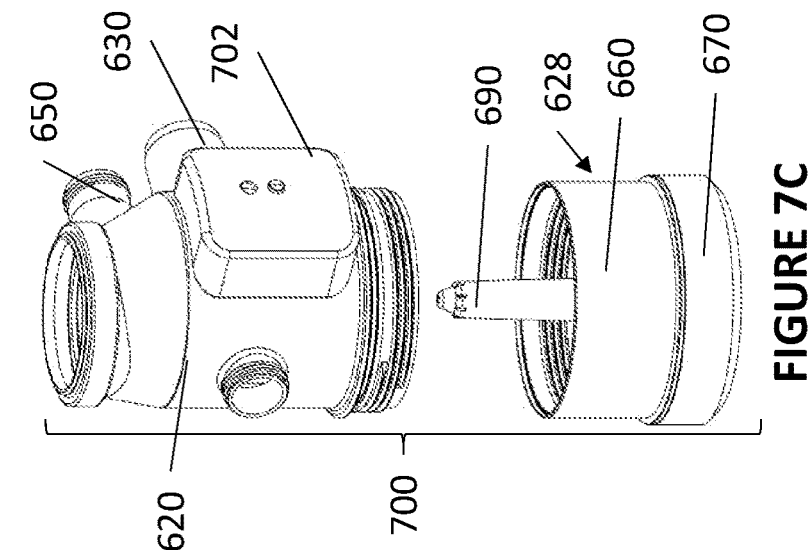
FIGURE 5











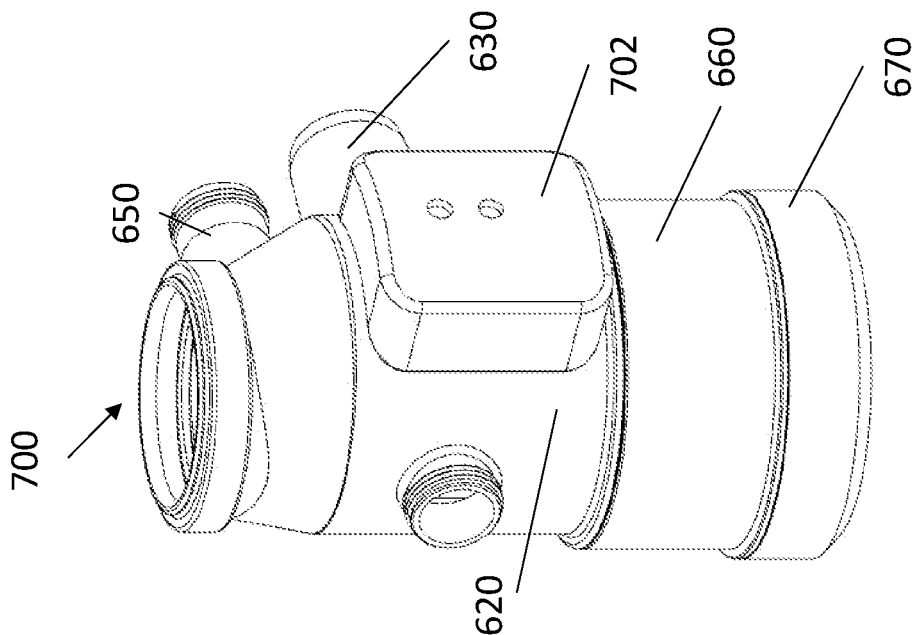


FIGURE 7D

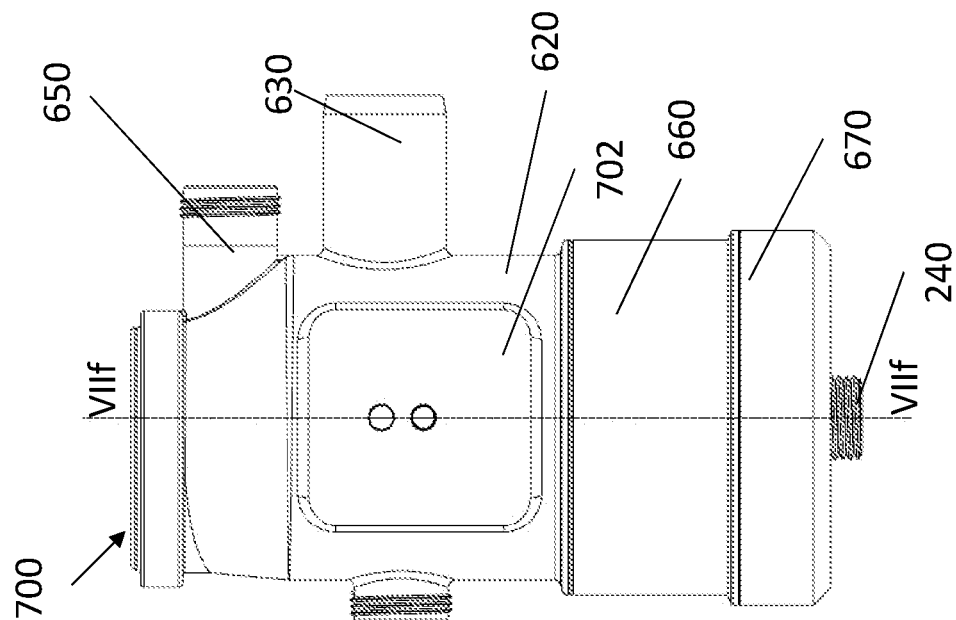


FIGURE 7E

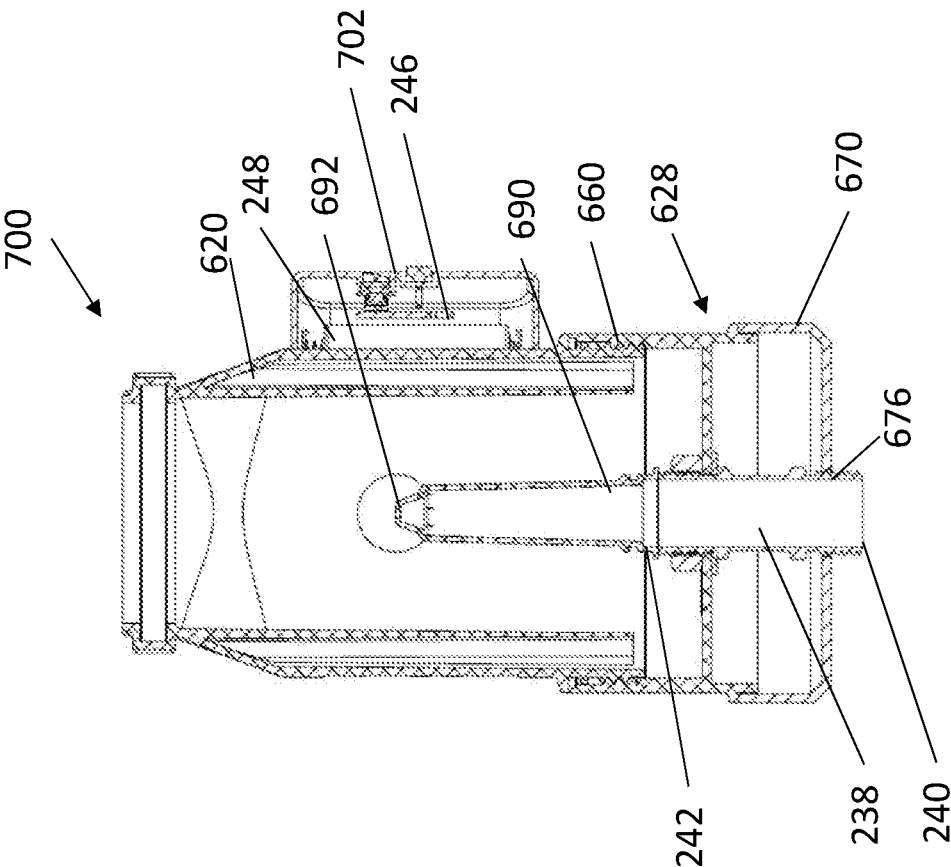
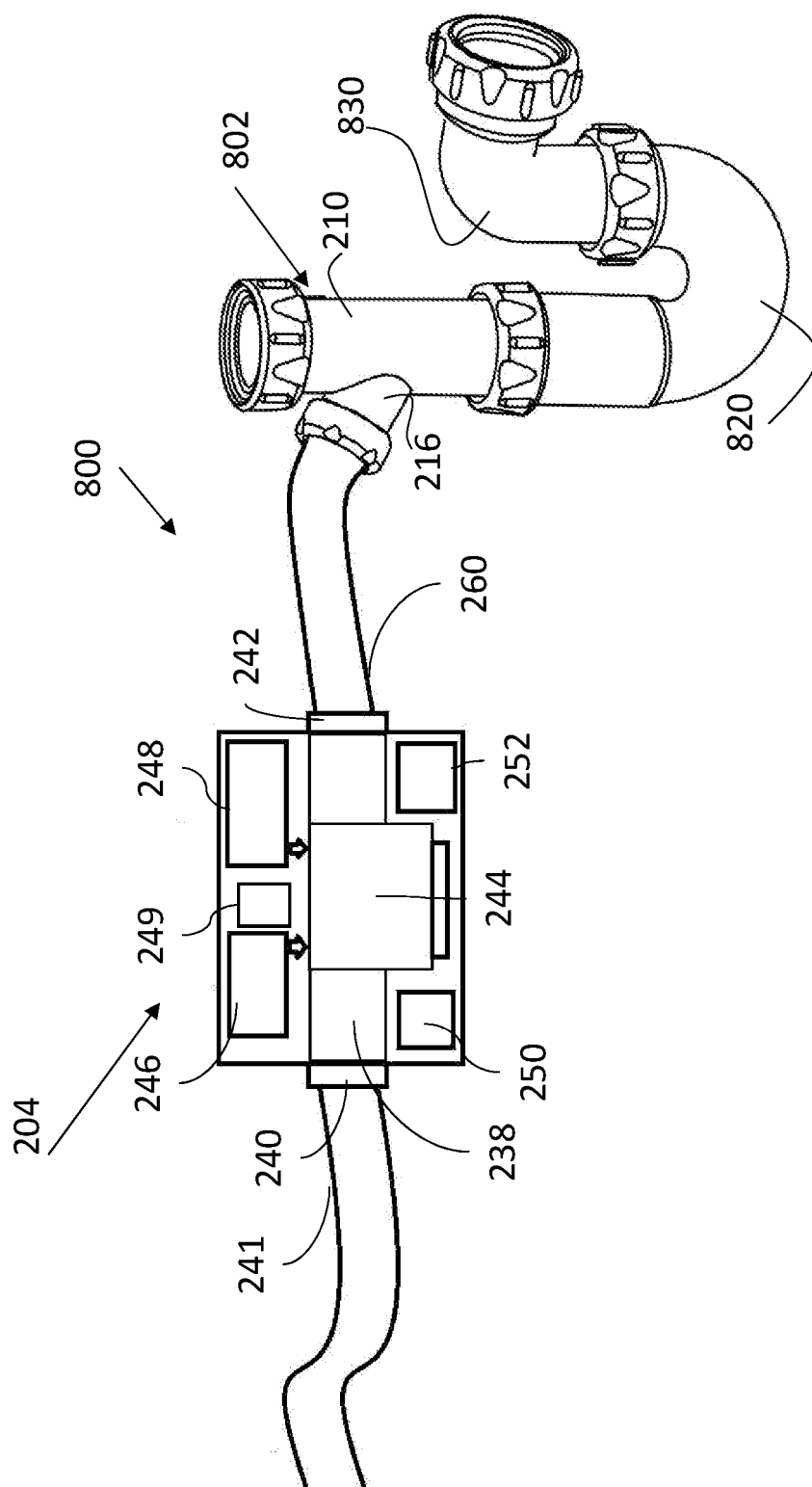


FIGURE 7F



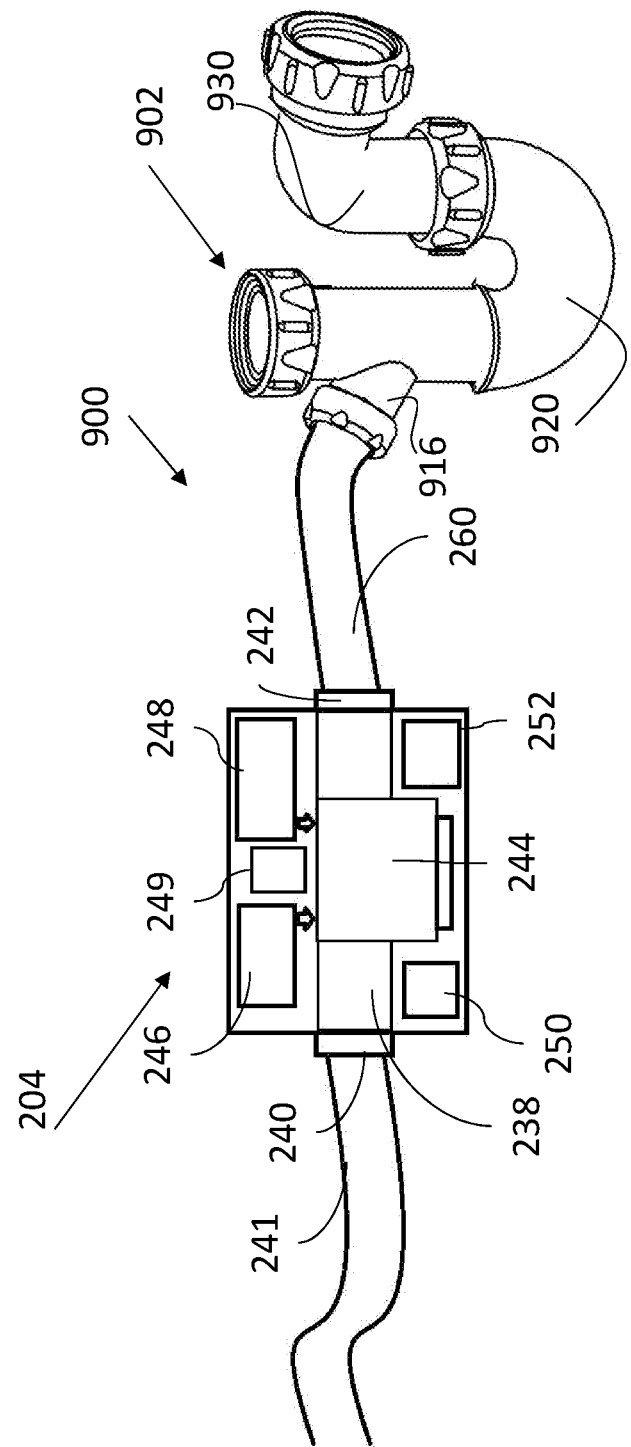


FIGURE 9

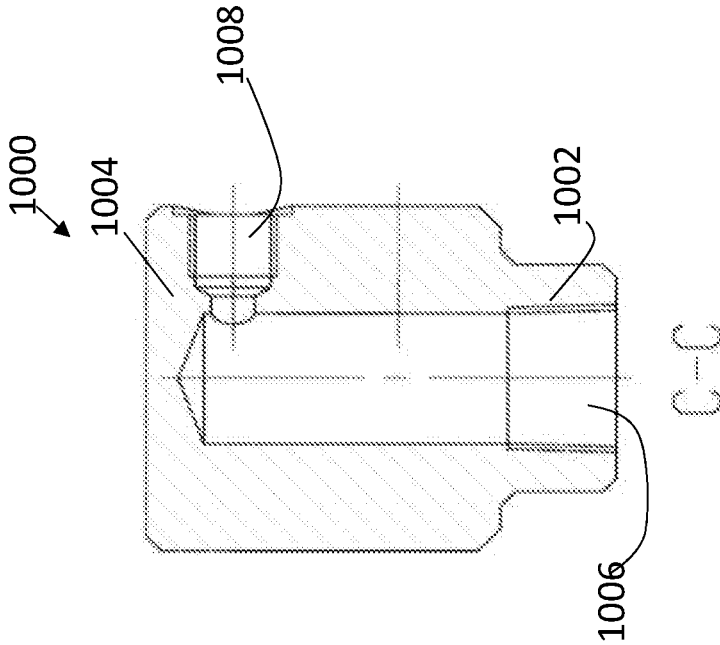


FIGURE 10B

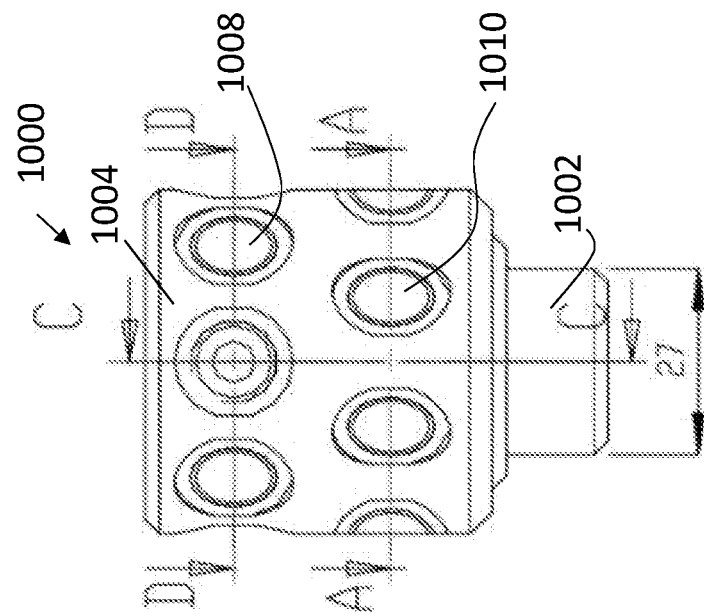


FIGURE 10A

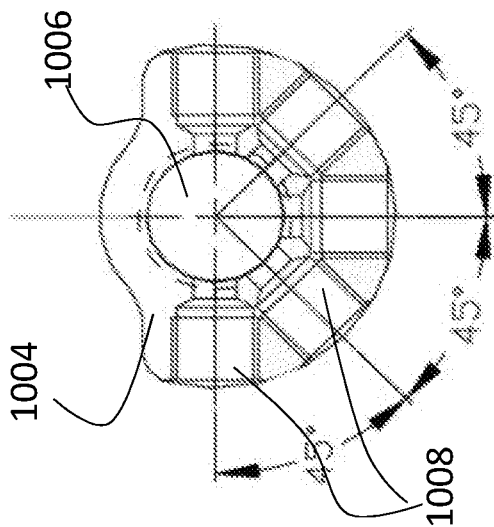


FIGURE 10D

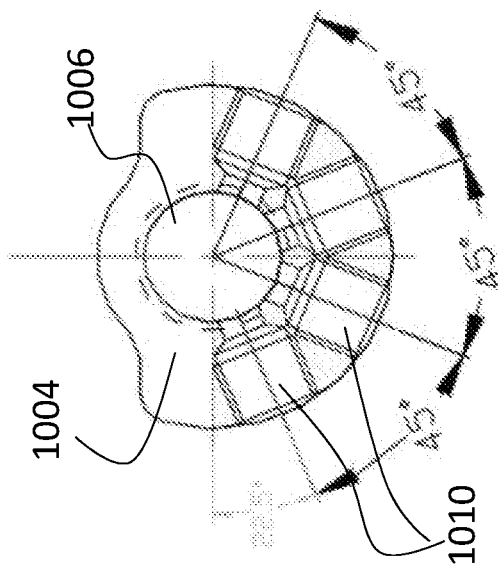


FIGURE 10C

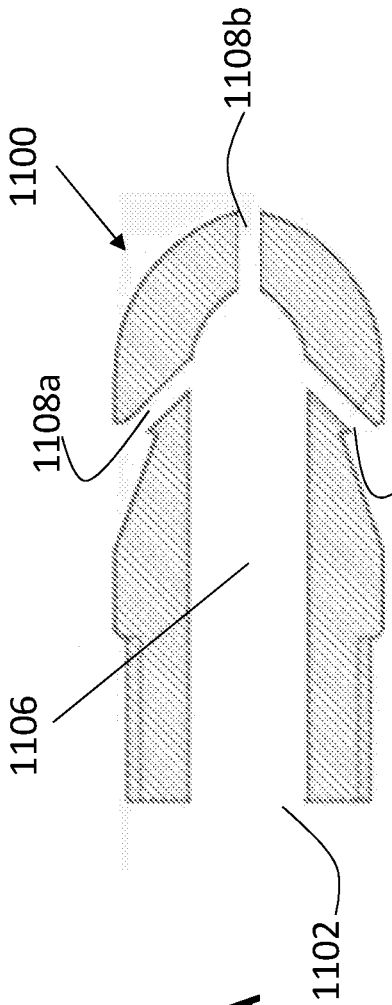


FIGURE 11A

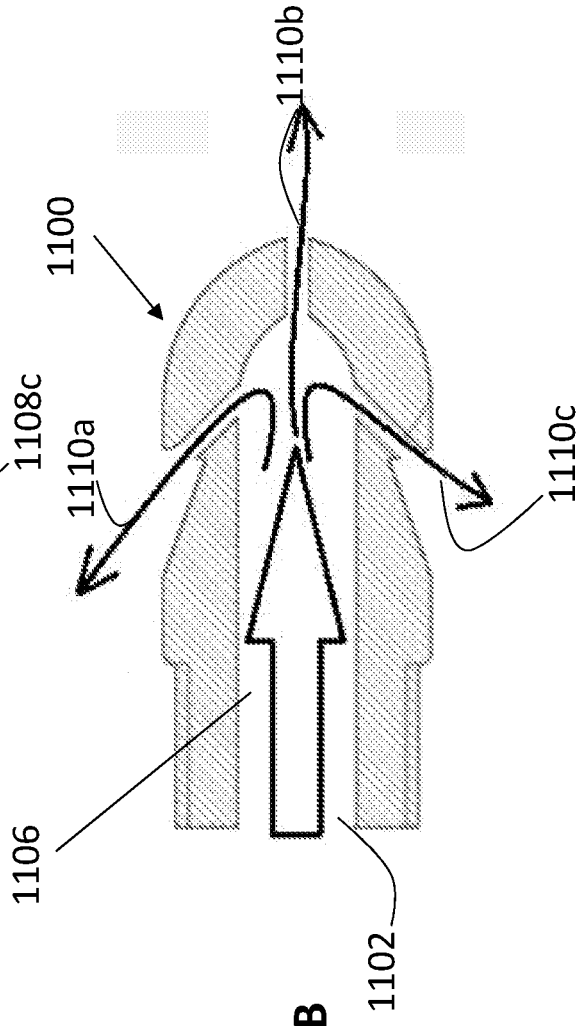


FIGURE 11B

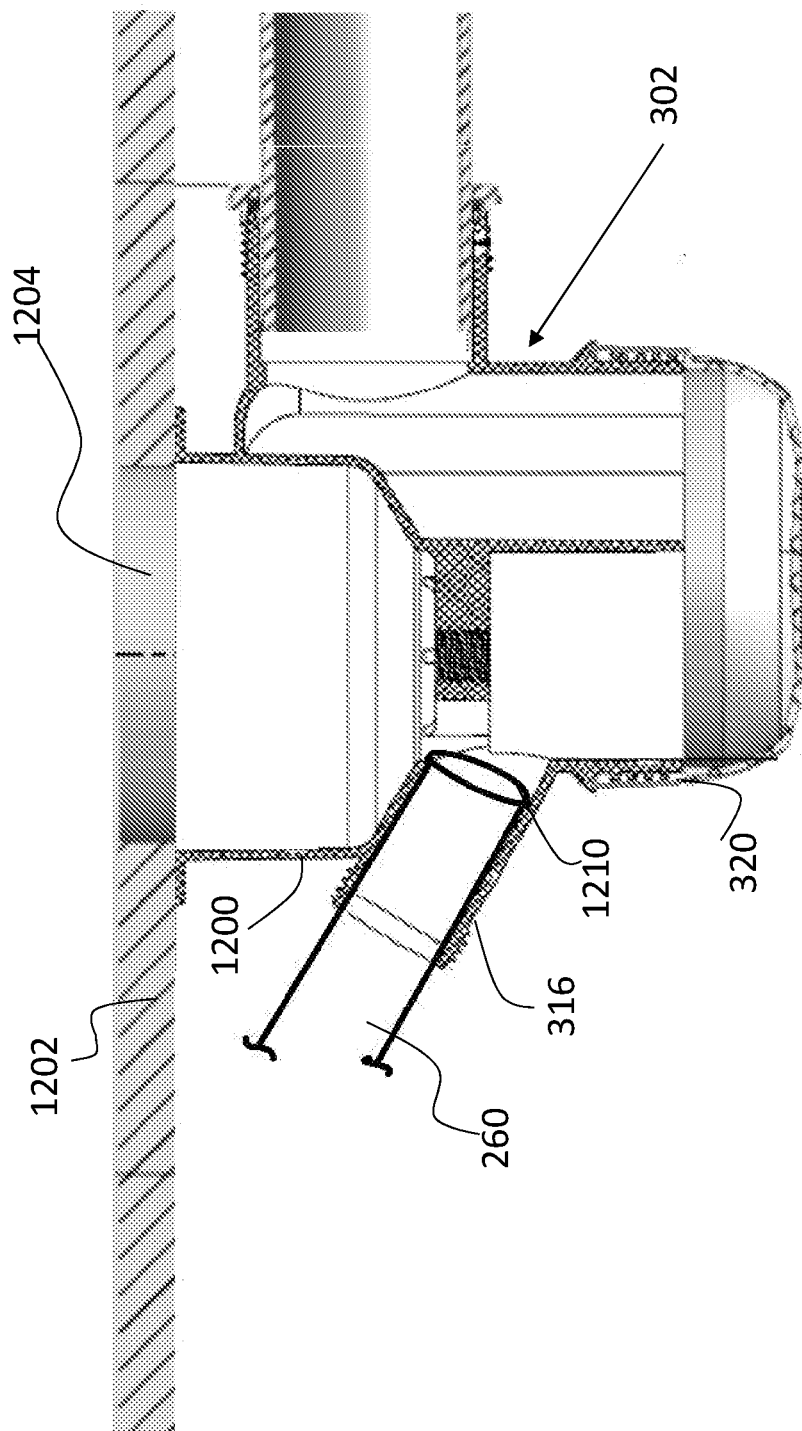
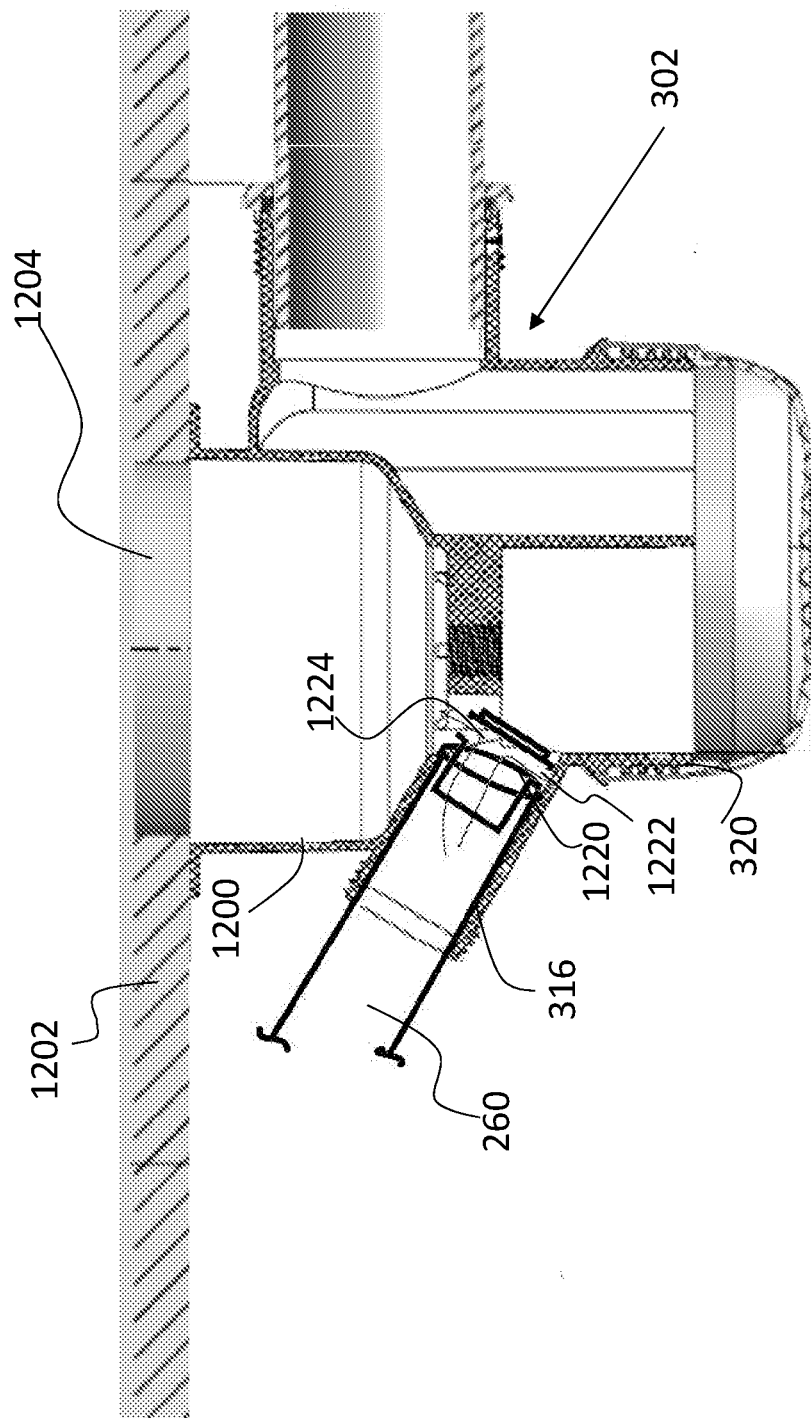
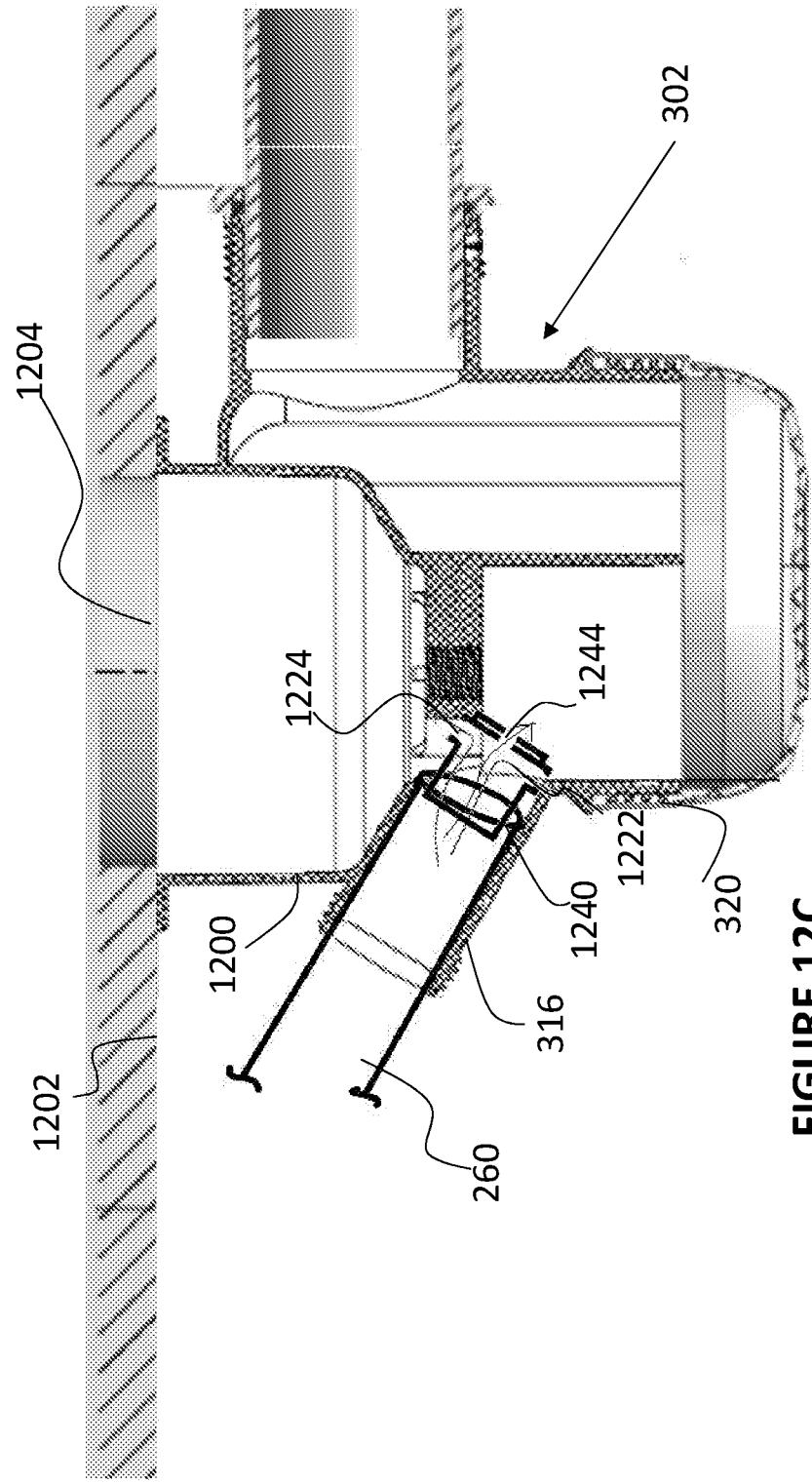


FIGURE 12A





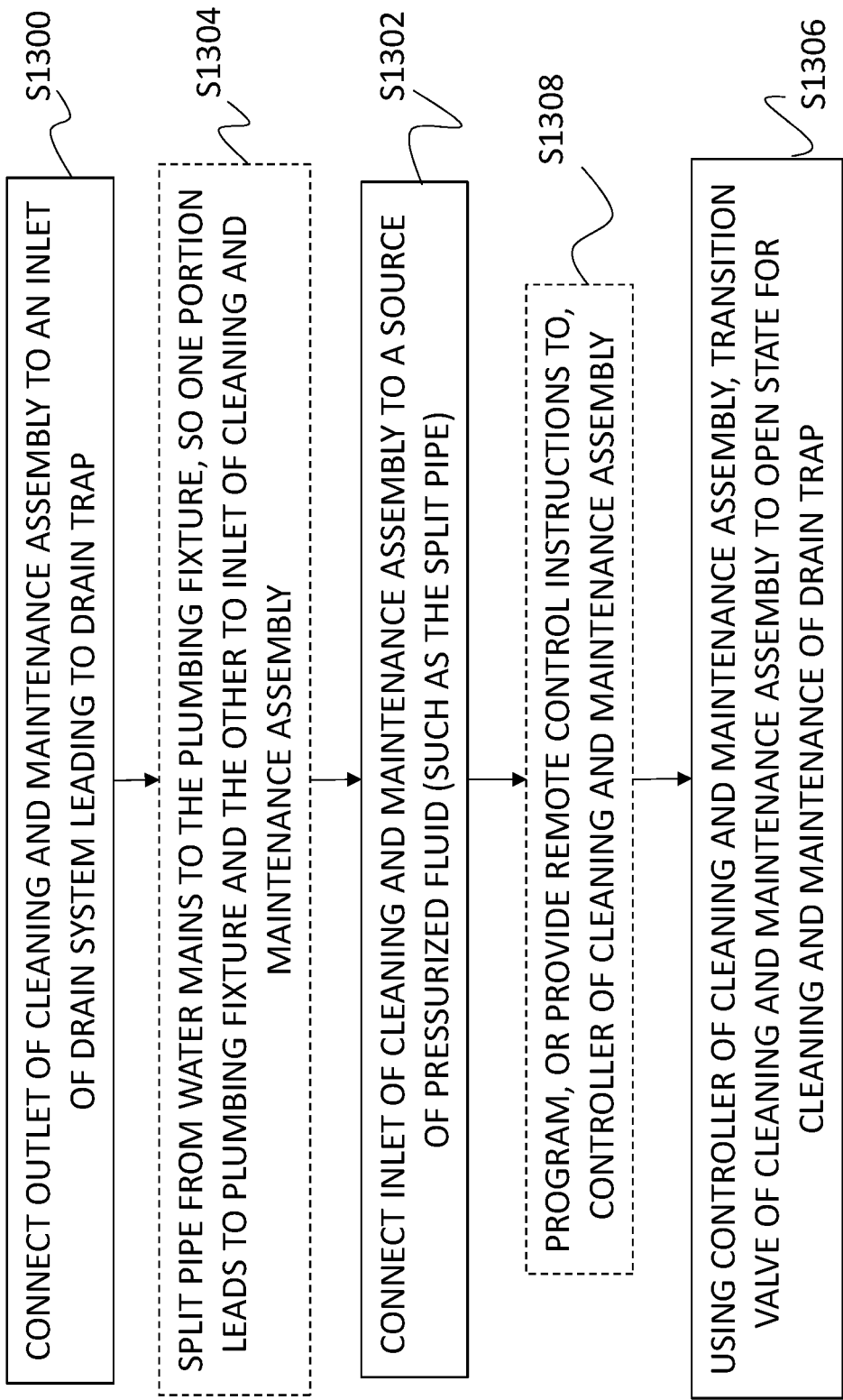


FIGURE 13

DRAIN CLEANING AND MAINTENANCE SYSTEM AND METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a continuation of PCT/IB2023/052538 filed on Mar. 15, 2023, which is incorporated by reference in its entirety.

FIELD AND BACKGROUND OF THE INVENTION

[0002] The present invention generally relates to drain systems, and specifically to systems and methods for maintenance and cleaning of drain systems from debris, biofilm formation, and/or bacterial or fungal growth within the drain system.

[0003] In typical plumbing, a drain trap, also known as a siphon, is disposed below or within a plumbing fixture, and is shaped and configured to prevent sewer gases from entering buildings. Typically, the drain trap is formed as a U-shaped bend in the drain pipe. Due to its shape, a typical drain trap retains a small amount of liquid therein at all times, and particularly after use of the plumbing fixture. This trapped liquid seals the remainder of the drain pipe leading to the sewage, thereby preventing sewer gases from reentering the environment via back-flow through the drain pipe. Essentially all plumbing fixtures, including sinks, bathtubs, and toilets, are equipped with either an internal or external trap.

[0004] Prior art FIGS. 1A and 1B show an exemplary conventional drain pipe connector 100, which connects a drain portal 102 disposed in a plumbing fixture 103 such as a sink or bathtub to a drain pipe 104 leading to the sewage. Drain pipe connector 100 includes a first connector ring 105 connecting drain portal 102 to a U-shaped drain trap 106, and a second connector ring 108, connecting the trap 106 to drain pipe 104.

[0005] Because drain traps are a local low-point in the plumbing, heavy objects, such as jewelry that is inadvertently dropped into the fixture 103, as well as hair, sand, and other debris, tend to be collected in drain traps, such as trap 106. This limits the size of objects that flow through the trap into pipe 104. As such, typical drain traps are designed such that they can be disassembled for removal of objects captured therein, or have another cleaning mechanism.

[0006] In addition to capturing debris and objects that inadvertently enter the plumbing, drain traps and drain pipe connectors also encourage the formation of biofilm and the accumulation of bacteria. This is, in part, the result of use of tap water which is not sterile, and due to the fact that sinks are used to wash contaminated objects, for example when people wash their hands after going to the bathroom, or wash dirty dishes. Such formation of bacteria or biofilm is illustrated in FIGS. 1A and 1B as layer 110 disposed at the lower end of trap 106, where the trap bends.

[0007] As seen in FIG. 1A, bacteria from the trap 106 may “climb” up the drain pipe, for example by air flow out of the drain trap via the drain portal 102, as indicated by arrow 120. Such backflow of bacteria may contaminate the fixture 103 drained by drain portal 102, and may also contaminate the air, or open space, of the room in which the plumbing fixture 103 is disposed.

[0008] The problem of bacteria backflow is further compounded by the fact that water draining from the fixture, via drain portal 102 and into trap 106, impinges upon the biofilm 110 formed in the trap 106, as indicated by arrow 130 in FIG. 1B. The water impinging on the biofilm causes contaminated aerosol from the biofilm 110 to be released into the air in the trap 106, facilitating backflow of such aerosol out of trap 106 via drain portal 102 and into the fixture 103 and the room in which it is disposed, as indicated by arrow 122 in FIG. 1B.

[0009] Various mechanisms have been proposed in the prior art for removing the bacteria or dirt from the drain trap. According to some methods, clean water, which may include a sterilizing, antibacterial or antifungal substance, is poured down the drain portal (e.g. 102 in FIG. 1A) into the trap, in an attempt to remove at least part of the bacteria growth or dirt. However, the water pressure of water flowing from the drain portal is relatively low, and the direction of flow is such, that the sterilizing water does not impinge directly on the bacteria growth or dirt to break it up. Additionally, the flow of sterilizing water or liquid may be insufficient to replace all the liquid within the trap, leaving stagnant liquid in the trap to develop new, or additional, bacteria growth.

[0010] Prior art FIG. 1C shows another exemplary solution that has been proposed, in which water from a drain hose 150 of a water based appliance, such as a dishwasher 152, is fed into the drain pipe 154 upstream of drain trap 106. In some cases, the appliance may have a second drain hose 156, connected directly to the sewage. In this arrangement, liquid from the appliance reaches the drain trap, and theoretically could rinse, or remove, the dirt or bacteria growth from the drain trap. However, the problems mentioned above occur in this case as well—the pressure of the liquid from the appliance is low, so that the liquid does not impinge directly on the dirt layer to break it up, and may be insufficient to replace all the liquid within the trap.

[0011] There is thus a need in the art for a system for draining a plumbing fixture, which prevents formation of a dirt layer or bacteria growth on a drain trap of the plumbing fixture, and is capable of removing or cleaning a dirt layer or bacteria growth already formed.

SUMMARY OF THE INVENTION

[0012] In accordance with an embodiment of the present invention, there is provided a drain cleaning and maintenance system, including a drain trap, having a first inlet in fluid communication with a drain of a plumbing fixture, a second inlet, in fluid communication with the drain trap; and a cleaning and maintenance assembly, disposed on an inlet line leading to the second inlet. The cleaning and maintenance assembly includes a maintenance-assembly inlet, adapted to be in fluid communication with a source of pressurized liquid, a maintenance-assembly outlet in fluid communication with the second inlet, and a pipe disposed between the maintenance-assembly inlet and the maintenance-assembly outlet. An electronic valve has an open state allowing flow of liquid, from the maintenance-assembly inlet to the maintenance-assembly outlet, through the pipe, and a closed state blocking flow of liquid from the maintenance-assembly inlet to the maintenance-assembly outlet. An electronic controller is adapted to transition the electronic valve between the open state and the closed state, wherein, when the maintenance-assembly inlet is connected

to the source of pressurized liquid and the electronic valve is in the open state, liquid flows from the source to the drain trap via the second inlet.

[0013] In accordance with another embodiment of the present invention, there is provided a drain device, including a drain trap, having a first inlet, adapted to be in fluid communication with a drain of a plumbing fixture and a second inlet and a cleaning and maintenance assembly, integrally formed with the drain trap. The cleaning and maintenance assembly includes a maintenance-assembly inlet, adapted to be in fluid communication to a source of pressurized liquid, a maintenance-assembly outlet in fluid communication with the second inlet, and a pipe disposed between the maintenance-assembly inlet and the maintenance-assembly outlet. An electronic valve having an open state allowing flow of liquid, from the maintenance-assembly inlet to the maintenance-assembly outlet, through the pipe, and a closed state blocking flow of liquid from the maintenance-assembly inlet to the maintenance-assembly outlet. An electronic controller is adapted to transition the electronic valve between the open state and the closed state, and a power source adapted to power the electronic valve and the electronic controller, wherein, when the maintenance-assembly inlet is in fluid communication to the source of pressurized fluid and the electronic valve is in the open state, liquid flows from the source to the drain trap via the second inlet to clean the drain trap.

[0014] In accordance with another embodiment of the present invention, there is provided a method of cleaning and maintaining a drain trap of a drain, the drain trap having first inlet. The method includes providing a cleaning and maintenance assembly, which includes a maintenance-assembly inlet, a maintenance-assembly outlet, a pipe disposed between the maintenance-assembly inlet and the maintenance-assembly outlet, a electronic valve having an open state allowing flow of liquid, from the maintenance-assembly inlet to the maintenance-assembly outlet, through the pipe, and a closed state blocking flow of liquid from the maintenance-assembly inlet to the maintenance-assembly outlet, and an electronic controller adapted to transition the electronic valve between the open state and the closed state. The method further includes connecting the maintenance-assembly outlet of the cleaning and maintenance assembly to a second inlet in fluid communication with the drain trap, and while the electronic valve is in the closed state, connecting the maintenance-assembly inlet of the maintenance assembly to a source of pressurized liquid. The method also includes, using the electronic controller, transitioning the electronic valve from the closed state to the open state, thereby to enable liquid from the source to flow through the pipe and the second inlet into the drain trap and to impinge on interior walls of the drain trap to clean the walls of the drain trap.

BRIEF DESCRIPTION OF THE FIGURES

[0015] The foregoing discussion will be understood more readily from the following detailed description of the invention, when taken in conjunction with the accompanying FIGS. 1-12), in which:

[0016] FIGS. 1A, 1B, and 1C (PRIOR ART) are schematic illustrations of prior art drain pipe connectors, including a drain trap;

[0017] FIGS. 2A, and 2B are schematic illustrations of a drain cleaning and maintenance system according to embodiments of the present invention;

[0018] FIG. 3 is a schematic illustration of another drain cleaning and maintenance system according to embodiments of the present invention;

[0019] FIG. 4 is a schematic illustration of an integrally-formed drain cleaning and maintenance system according to embodiments of the present invention;

[0020] FIG. 5 is a schematic illustration of another integrally-formed drain cleaning and maintenance system according to embodiments of the present invention;

[0021] FIGS. 6A, 6B, 6C, 6D, 6E, 6F, and 6G are, respectively, an exploded perspective view illustration, an assembled perspective view illustration, a partly assembled perspective view illustration, a side view planar illustration, a front view planar illustration, and two cross-sectional illustrations of another integrally-formed drain cleaning and maintenance system according to embodiments of the present invention;

[0022] FIGS. 6H and 6I are a side view planar illustration and a cross-sectional illustration of the integrally formed drain cleaning and maintenance system of FIGS. 6A to 6G, including a unidirectional valve at a drain outlet leading into the system;

[0023] FIGS. 7A, 7B, 7C, 7D, 7E and 7F are, respectively, an exploded perspective view illustration, two partially assembled perspective view illustrations, an assembled perspective view illustration, a side view planar illustration, and a cross-sectional illustration of another integrally-formed drain cleaning and maintenance system according to embodiments of the present invention;

[0024] FIG. 8 is a schematic illustration of yet another drain cleaning and maintenance system according to embodiments of the present invention;

[0025] FIG. 9 is a schematic illustration of a further drain cleaning and maintenance system according to embodiments of the present invention;

[0026] FIGS. 10A, 10B, 10C, and 10D are, respectively, a front view planar illustration and three sectional illustrations of a nozzle for connecting a drain cleaning and maintenance assembly of any one of FIGS. 2A to 9 to a drain assembly;

[0027] FIGS. 11A and 11B are, schematic sectional illustrations of another nozzle for connecting a drain cleaning and maintenance assembly of any one of FIGS. 2A to 9 to a drain assembly, in a rest state and in a flow state;

[0028] FIGS. 12A, 12B, and 12C are schematic illustrations of embodiments of connections of any of the cleaning and maintenance assemblies of FIGS. 2A to 9 to a drain assembly using different nozzles as in FIGS. 10A to 11B, according to embodiments of the present invention; and

[0029] FIG. 13 is a schematic flow chart of a method of installing the cleaning and maintenance system of any one of FIGS. 2A to 9 according to embodiments of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0030] The principles of the inventive systems and methods for maintenance and cleaning of drain systems, may be better understood with reference to the drawings and the accompanying description.

[0031] Before explaining at least one embodiment of the invention in detail, it is to be understood that the invention

is not limited in its application to the details of construction and the arrangement of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments or of being practiced or carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein is for the purpose of description and should not be regarded as limiting.

[0032] In the context of the present application and claims, the term “downstream” relates to a pipe or element, which would be reached by a liquid passing through the drain, at a later time. As such, pipe segment A is downstream of pipe segment B if water draining through the plumbing system would reach pipe segment A after passing through pipe segment B.

[0033] In the context of the present application and claims, the term “upstream” relates to a pipe or element, which would be reached by a liquid passing through the drain, at an earlier time. As such, pipe segment A is upstream of pipe segment B if water draining through the plumbing system would reach pipe segment A before passing through pipe segment B.

[0034] In the context of the present application and claims, the term “drain trap” relates to any device connecting between a drain and a sewage pipe, which retains liquid therein. The term “drain trap” includes, for example, a U-trap, a P-trap, a Q-trap, an S-trap, a gully trap, a floor trap or nahni trap, a bottle trap, a siphon, and an intercepting trap.

[0035] In the context of the present application and claims, the term “pressurized liquid” relates to a liquid having a pressure of at least 2 bar.

[0036] In some embodiments, the present invention provides a solution to the formation of a dirt layer and/or bacterial or fungal growth in a drain trap or siphon.

[0037] In some embodiments, the present invention includes an electronically controllable valve which controls flow of water or another liquid from a high-pressure source directly into a drain pipe connector or directly into a drain trap, downstream of the drain, for cleaning of the drain trap and for replacing all the liquid held within the drain trap. For example, the control may be by a computerized controller.

[0038] Reference is now made to FIGS. 2A and 2B, which are schematic illustrations of an electronically-operated drain cleaning and maintenance system 200 according to embodiments of the present invention.

[0039] As seen in FIGS. 2A and 2B, drain cleaning and maintenance system 200 includes a drain assembly 202, and a cleaning and maintenance assembly 204.

[0040] Drain assembly 202 includes a linear pipe segment 210 having a longitudinal axis 212. An inlet-end 214 of linear pipe segment 210 is adapted to be connected to a drain portal of a plumbing fixture, such as a sink. Linear pipe segment 210 includes a second inlet 216, the second inlet having a longitudinal axis 217 angled relative to longitudinal axis 212, such that, when fluid flows from second inlet 216 into linear pipe segment 210, the fluid will turn at an obtuse angle α . The angle at which liquid flows from second inlet 216 into linear pipe segment 210 ensures that the fluid flowing through the second inlet impinges on walls of the linear pipe segment, and/or on walls of additional components of drain assembly 202 downstream of second inlet 216, for cleaning thereof.

[0041] An outlet-end 218 of linear pipe segment 210, downstream of second inlet 216, is connected to a drain trap,

or siphon, 220 via a first connector 222. Drain trap 220 is connected to a sewage drain pipe 230 via a second connector 225. In some embodiment, first connector 222 and/or second connector 225 may be drain trap nuts as commonly used in the art of plumbing. However, any other suitable connection mechanism is considered to be within the scope of the present invention.

[0042] Cleaning and maintenance assembly 204 includes a pipe 238 having a maintenance-assembly inlet 240, adapted to be connected, via a maintenance inlet pipe 241, to the water mains or to another source of water flowing at a high pressure, and a maintenance-assembly outlet 242 connected or connectable to second inlet 216 of the drain assembly 202. The source of water flowing at a high pressure has an absolute pressure of at least 2 bar, and in some embodiments has an absolute pressure in the range of 3 to 5 bar.

[0043] Cleaning and maintenance assembly 204 further includes an electronic valve 244, having an open operative state in which liquid can flow through pipe 238 between maintenance-assembly inlet 240 and maintenance-assembly outlet 242, and a closed operative state in which fluid flow through pipe 238, e.g. from maintenance-assembly inlet 240 to maintenance-assembly outlet 242, is blocked. An electronic controller 246 is adapted to control transitioning of electronic valve 244 between the open and closed operative states. A power source 248, such as one or more suitable batteries, are adapted to power electronic valve 244 and electronic controller 246.

[0044] In the embodiment shown in FIG. 2A, the maintenance-assembly outlet 242 of cleaning and maintenance assembly 204 is connected to second inlet 216 of drain assembly 202 by a pipe 260.

[0045] In the embodiment shown in FIG. 2B, the maintenance-assembly outlet 242 of cleaning and maintenance assembly 204 is connected directly to second inlet 216 of drain assembly 202, without requiring an intervening pipe.

[0046] It is a particular feature of the present invention that maintenance inlet pipe 241 may be connected to a split portion of a hose or pipe leading to the plumbing fixture, as explained in further detail hereinbelow. However, as explained hereinbelow, cleaning and maintenance assembly 204 ensures that liquid flowing out of maintenance-assembly outlet 242 retains the water pressure present in that hose or pipe, as opposed to water flowing into the drain through the plumbing fixture, in which the water pressure is greatly reduced. For example, the dimensions of pipe 238, maintenance inlet pipe 241, and, where relevant, pipe 260, may be selected to maintain the fluid pressure within pipe 238 substantially equal to the pressure emanating from the water mains or from the source of the liquid. As such, pipes 238, 241 and 260 may have similar diameters, and/or may be substantially linear to avoid significant loss of pressure by the liquid following curves and turns. In other embodiments, the dimensions of pipe 238, maintenance inlet pipe 241, and, where relevant, pipe 260, may be selected to increase the fluid pressure within pipe 238 relative to the pressure emanating from the water mains or from the source of the liquid, for example by using pipes having decreasing diameters, and the like.

[0047] In some embodiments, cleaning and maintenance assembly 204 may further include, or be associated with, a communication interface 250, such as a transceiver, for communication with a remote control unit, or with a device of a controlling operator. In such embodiments, electronic

controller **246** may receive control inputs from the remote control unit, via communication interface. For example, electronic controller **246** may receive a control input to transition electronic valve **244** to the open state at a specific time of day, or after a specific event. In some embodiments, the remote control unit may be part of a “smart house” control module, for example operable by a user via a suitable application running on a computing device, such as a mobile phone.

[0048] As another example, electronic controller **246** may send output messages, via communication interface **250**, to the remote control unit or to the device of the controlling operator. For example, electronic controller **246** may provide periodic maintenance reminders (e.g. replace battery, clean or replace filters or valves) or may provide indications when the system malfunctions. In some such embodiments, cleaning and maintenance assembly **204** may further include on or more sensors **251** adapted to sense conditions in the vicinity of assembly **204**, to identify whether it is operating correctly. For example, assembly **204** may include an audio sensor adapted to sense sounds made by the flow of water through pipe **238**, and the electronic controller is adapted to provide a malfunction notification when the electronic controller transitions electronic valve **244** to be open, but sensor **251** does not provide to the electronic controller a signal indicating that it senses the sound of water flowing through pipe **238**.

[0049] In some embodiments, electronic controller **246** may be programmable. For example, the electronic controller may be programmed to transition electronic valve **244** to the open state at a first set of specific times of day, and to transition electronic valve **244** back to the closed state a predetermined duration after each of the specific times of day. In some such embodiments, electronic controller **246** may further be associated with a clock or timer **249**.

[0050] In some such embodiments, programming of electronic controller **246** may be accomplished from the remote control unit, communicating the programmed times of day and duration to electronic controller **246** via transceiver **250**. In other embodiments, programming of electronic controller **246** may be accomplished directly, for example via a user interface **252** forming part of maintenance assembly **204** and functionally associated with electronic controller **246**. User interface **252** may include one or more input interfaces, such as a keyboard, touch pad, mouse, or suitable buttons. User interface **252** may further include one or more output interfaces, such as a screen or display, or an audio output such as a speaker.

[0051] In some embodiments, electronic controller **246** may be functionally associated with, or may receive input from, one or more sensors **254**. The sensor(s) **254** may be disposed within drain assembly **202** and may provide input indicative of the need for maintenance and/or cleaning of siphon **220**, such as input indicating the formation of biofilm within the siphon.

[0052] A user would install cleaning and maintenance assembly **204** by initially ensuring that the power source **248** is charged. The user would then connect maintenance inlet pipe **241** between maintenance-assembly inlet **240** and the water mains or other source of liquid at a high pressure, and connect maintenance-assembly outlet **242** to second inlet **216** of the linear pipe segment **210**, either directly or using intervening pipe **260**. If the user is retrofitting a drain in which the linear drain pipe does not have a second inlet,

prior to installing the cleaning and maintenance assembly **204**, the user may also replace the existing linear drain pipe with linear drain pipe **210** having the second inlet **216**.

[0053] In some embodiments, the user could program electronic controller **246** to operate at desired times, or send an activation signal to electronic controller **246** from a remote control unit, such as a suitable application on the user's mobile phone.

[0054] In other embodiments, the electronic controller **246** may be preprogrammed to transition the electronic valve **244** to the open state at specific times and for specific durations. In such embodiments, no additional programming is required, and once installed, the cleaning and maintenance assembly would operate automatically without the user needing to remember to activate the cleaning and maintenance assembly, or that maintenance/cleaning is required.

[0055] In some embodiments, when liquid flows through pipe **238** from maintenance-assembly inlet **240** to maintenance-assembly outlet **242**, the absolute pressure at maintenance-assembly outlet **242** is at least 70%, at least 75%, at least 80%, at least 85%, at least 90%, or at least 95% of the absolute pressure at maintenance-assembly inlet **240**. In some embodiments, cleaning and maintenance assembly **204** is devoid of a pumping mechanism pumping liquid toward maintenance-assembly outlet **242**, or of another mechanism for increasing the absolute pressure of water within cleaning and maintenance assembly **204**, after the liquid has entered maintenance-assembly inlet **240**. In some embodiments, the only volume of cleaning and maintenance assembly **204** suitable for water flow therethrough is the volume of pipe **238**.

[0056] Reference is now made to FIG. 3, which is a schematic illustration of another electronically-operated drain cleaning and maintenance system **300** according to an embodiment of the present invention. System **300** is substantially similar to system **200** described hereinabove with respect to FIGS. 2A and 2B. The main change between the two systems is that in FIG. 3, siphon **320** of drain assembly **302** includes second inlet **316**, such that cleaning and maintenance assembly **204** is connected directly to siphon **320**. A longitudinal axis **317** of second inlet **316** is disposed at an angle to a longitudinal axis **321** of siphon **320**, and to water flow through the siphon. In the embodiment of FIG. 3, the linear pipe segment (**210** in FIGS. 2A and 2B) may be obviated, or may be replaced by a linear pipe segment that does not include a second inlet.

[0057] In the embodiments shown in FIG. 3, maintenance-assembly outlet **242** of maintenance assembly **204** is connected to second inlet **316** of siphon **320** by pipe **260**. However, it is to be appreciated that cleaning and maintenance assembly **204** may be connected to second inlet **316** directly, substantially as shown in FIG. 2B.

[0058] The angle at which water flows into siphon **320** from second inlet **316** ensures that the fluid flowing through the second inlet impinges on walls of the siphon for cleaning thereof.

[0059] The components and functionalities of cleaning and maintenance assembly **204** of FIG. 3 are substantially identical to those shown in FIGS. 2A and 2B, and for brevity, their detailed description is not repeated herein. Similarly, cleaning and maintenance assembly **204** of FIG. 3 is designed to at least maintain, and in some embodiments also increase, the water pressure of water flowing through the cleaning maintenance assembly, and to allow the water to

impinge directly on walls of the siphon for cleaning thereof, substantially as described hereinabove.

[0060] When installing cleaning and maintenance assembly 204 in system 300, the user would ensure power supply and connect maintenance inlet pipe 241 substantially as described hereinabove with respect to FIGS. 2A and 2B. The user would connect maintenance-assembly outlet 242 of maintenance assembly 204 to second inlet 316 of siphon 320, either directly or using intervening pipe 260. If the user is retrofitting a drain in which the siphon does not have a second inlet, prior to installing the cleaning and maintenance assembly 204, the user may also replace the existing siphon with siphon 320 having the second inlet 316. Programming of cleaning and maintenance assembly 204 would be substantially as described hereinabove with respect to FIGS. 2A and 2B.

[0061] As described hereinabove with respect to FIGS. 2A and 2B, the drain cleaning and maintenance assembly of FIG. 3 may be pre-programmed, and may operated automatically at regular times or intervals, without requiring the user attention for cleaning and maintenance of the drain.

[0062] Reference is now made to FIG. 4, which is a schematic illustration of yet another electronically-operated drain cleaning and maintenance system 400 according to an embodiment of the present invention. System 400 is substantially similar to system 300 described hereinabove with respect to FIG. 3. The main change between the two systems is that in FIG. 4, cleaning and maintenance assembly 404 is integrally formed with siphon 420 as a single unit, such that water flowing through pipe 438 of cleaning and maintenance assembly 404 flows directly into siphon 420, e.g. through a wall thereof. In some embodiments, siphon 420 including cleaning and maintenance assembly 404 may be manufactured as a single unit, e.g. having a unitary plastic housing. In such embodiments, the linear pipe segment (210 in FIGS. 2A and 2B) may be obviated, or may be replaced by a linear pipe segment that does not include a second inlet.

[0063] The components and functionalities of cleaning and maintenance assembly 404 of FIG. 4 are substantially identical to those shown in FIGS. 2A and 2B, and for brevity, their detailed description is not repeated herein. Cleaning and maintenance assembly 404 of FIG. 4 is designed to at least maintain, and in some embodiments also increase, the water pressure of water flowing through the cleaning and maintenance assembly, and to allow the water to impinge on walls of the siphon for cleaning thereof, substantially as described hereinabove with respect to FIGS. 2A and 2B and to FIG. 3.

[0064] When installing cleaning and maintenance assembly 404 in system 400, the user would replace the existing siphon with siphon 420 including cleaning and maintenance assembly 404. The user would ensure power supply to components of the cleaning and maintenance assembly, and would and connect pipe 441 substantially as described hereinabove with respect to FIGS. 2A and 2B. Programming of cleaning and maintenance assembly 404 would be substantially as described hereinabove with respect to FIGS. 2A and 2B.

[0065] As described hereinabove with respect to FIGS. 2A and 2B, the cleaning and maintenance assembly of FIG. 4 may be pre-programmed, and may operated automatically at regular times or intervals, without requiring the user attention for cleaning and maintenance of the drain.

[0066] Reference is now made to FIG. 5, which is a schematic illustration of another integrally-formed electronically-operated drain cleaning and maintenance system 500 according to an embodiment of the present invention.

[0067] System 500 is substantially similar to system 400 described hereinabove with respect to FIG. 4. The main change between the two systems is in the structure of the drain assembly.

[0068] Specifically, drain assembly 502 of system 500 includes a linear pipe segment 510, slidably disposed within siphon 520, which is connected to, or integrally formed with, a sewage drain pipe 530.

[0069] Siphon 520 is a unitarily formed element, including a downward flow path 522 and an upward flow path 524, separated by a wall 526. Downward flow path 522 is in fluid communication with upward flow path 524 via a removable drain trap cap 528, sealingly arranged about a lower end of drain trap 520. Sewage drain pipe 530 is in fluid communication with upward flow path 524.

[0070] Linear pipe segment 510 is disposed within downward flow path 522. However, a diameter of linear pipe segment 510 (indicated by D1) is smaller than a diameter of downward flow path 522 (indicated by D2), such that fluid can flow from linear pipe segment 510 to the entire length of downward flow path 522.

[0071] Linear pipe segment 510 is adapted to be connected to a drain portal 503 of a plumbing fixture, such as a sink, via a unidirectional valve 540.

[0072] Because drain trap 520 is integrally formed with sewage drain pipe 530, in some embodiments, the height at which drain trap 520 is installed, relative to portal 503, may be determined by a height of the center of sewage drain pipe 530. As such, the installation conditions may require a longer linear pipe segment 510 to bridge the gap between the heights of the portal and of the sewage pipe. To facilitate different size gaps, linear pipe segment 510 is slidable relative to downward flow path 522 of drain trap 520. Additionally, in some embodiments, linear pipe segments 510 may have different longitudinal lengths. The length of linear pipe 510, and the extent to which it is disposed within trap 520, are determined once at the time of installation. It is required that the end of linear pipe 510, distal to portal 503, be disposed above the water level within the drain trap, and approximately at the vertical center of sewage drain pipe 530, to ensure that the linear pipe segment is in fluid communication with the pressure equalizing mechanism described hereinbelow.

[0073] Unidirectional valve 540 allows running water to flow, and seals the passage between the drain trap and the fixture when no water is flowing. The unidirectional valve is normally closed, such that when no water flows into/onto the unidirectional valve, the unidirectional valve is sealed to fluid flow into and/or out of drain trap 520 and linear pipe segment 510, thereby preventing back flow of bacterial and/or contaminated aerosol from pipe 510 into the plumbing fixture. As such, the unidirectional valve 540 is normally closed.

[0074] When water flows into unidirectional valve 540, it applies pressure thereto which causes the unidirectional valve to open. As such, when water drains through the portal of the plumbing fixture and into unidirectional valve 540, the weight of the water causes the unidirectional valve to open a gap through which the water can flow into linear pipe segment 510. While water is draining through the gap, the

water flow inhibits air flow through the gap in the opposing direction (out of linear pipe segment 510) and as such during that time back flow of contaminated aerosol and/or bacteria is very limited and/or inhibited.

[0075] The increased pressure in linear pipe segment 510, caused by the use of the unidirectional valve 540 is relieved by a pressure equalizing element 550. Pressure equalizing element 550 comprises a tube, or conduit, which in some embodiments may be integrally formed with drain trap 520, and is in fluid communication with downward flow path 522 via a first end thereof which extends from a bore 527 in an upper portion of wall 526, above a water level in drain trap 520. Because of the fluid flow communication between the linear pipe segment 510 and downward flow path 522, pressure equalizing element 550 is also in fluid communication with linear pipe segment 510. In some embodiments, a second unidirectional valve 552 is disposed within pressure equalizing element 550, adjacent bore 527, to prevent fluid flow from pressure equalizing element 550 to downward flow path 522. Second unidirectional valve 552 ensures that there will be no back flow of gas from the sewage to downward flow path 522, for example if pressure in the upward flow path 524 increases (e.g. because of a blockage in the sewage).

[0076] In some embodiments, pressure equalizing element 550 is in fluid communication with upward flow path 524, downstream of second unidirectional valve 552, via a pathway 554 in the conduit of pressure equalizing element 550. As such pressure equalizing element 550 is in fluid communication with sewage drain pipe 530. In some embodiments, a second end of pressure equalizing element 550 is sealed by a cap 560, such that fluid flowing from the first end of pressure equalizing element toward the second end, can exit the pressure equalizing element via pathway 554.

[0077] In use, when gas pressure accumulates in downward flow path 522 above a water level 568 of drain trap 520, the pressurized gas flows into pressure equalizing element 550 via second unidirectional valve 552 and flows toward the second end of the pressure equalizing element. Because the second end of the pressure equalizing element is sealed by cap 560, the pressurized gas flows through pathway 554 to upward flow path 524, and from there can flow to sewage drain pipe 530. As such, pressure equalizing element 550 serves to equalize the gas pressure between linear pipe segment 510 and downward flow path 524 of drain trap 520, which is fluidly connected to sewage pipe 530.

[0078] Due to the pressure differential between linear pipe segment 510 and downward flow path 522 (above the water level of trap 520) and upward flow path 524 of drain trap 520, gas will flow from bore 527, through the unidirectional valve 552 into the pressure equalizing element 550 toward the second end thereof, and from there via pathway 554 to upward flow path 524 and to sewage pipe 530, thereby relieving the pressure and enabling proper functioning of unidirectional valve 540. Furthermore, because the bacteria and/or contaminated aerosols that the invention is designed to block are disposed within linear pipe segment 510, the airborne bacteria and/or contaminated aerosol may also flow through pressure equalizing element 550 away from portal 502, and be trapped downstream of drain trap 520, thereby further reducing or eliminating the chance of contaminated backflow through portal 502. Unidirectional valve 552, and the higher pressure in downward flow path 522, prevent

backflow of gas from sewage pipe 530 to downward flow path 522 or linear pipe segment 510.

[0079] Siphon 520 includes a second inlet 566, which is disposed at an angle to downward flow path 522. Maintenance-assembly outlet 242 of cleaning and maintenance assembly 204, described in detail hereinabove with respect to FIGS. 2A and 2B, is connected directly to second inlet 566 of siphon 520 for automatic maintenance and cleaning of the siphon, substantially as described hereinabove with respect to FIG. 2B. However, in some embodiments, cleaning and maintenance assembly 204 may be connected to siphon 520 by a connecting pipe 260, as shown in FIG. 2A, or may be integrally formed with the siphon as shown in FIG. 4.

[0080] In some embodiments, sliding of linear pipe segment 510 into downward flow path 522 is limited by second inlet 566 or by a connection of cleaning and maintenance assembly 204 thereto, e.g. by maintenance-assembly outlet 242 or by pipe 260.

[0081] It is to be appreciated that the cleaning and maintenance assembly 204 may be used together with any pressure-equalizing drain trap, for example as described in U.S. Patent Application Publication No. 2021/0388589 which is incorporated by reference as if fully set forth herein.

[0082] As described hereinabove with respect to FIGS. 2A and 2B, the cleaning and maintenance assembly of FIG. 5 may be pre-programmed, and may operated automatically at regular times or intervals, without requiring the user attention for cleaning and maintenance of the drain.

[0083] Reference is now made to FIGS. 6A, 6B, 6C, 6D, 6E, 6F, and 6G, which are, respectively, an exploded perspective view illustration, an assembled perspective view illustration, a partly assembled perspective view illustration, a side view planar illustration, a front view planar illustration, and two cross-sectional illustrations of another integrally-formed drain cleaning and maintenance system 600 according to embodiments of the present invention.

[0084] System 600 is substantially similar to system 500 described hereinabove with respect to FIG. 5. One main difference between the two systems is in the location of the cleaning and maintenance assembly within the system. System 600 includes a siphon 620, which is connected to, or integrally formed with, a sewage drain pipe 630, substantially as shown in FIG. 5.

[0085] Reference is additionally made to FIGS. 6H and 6I, which are a side view planar illustration and a cross-sectional illustration of the integrally formed drain cleaning and maintenance system 600 having a drain assembly 602 including a unidirectional valve 640. Drain assembly 602 includes a linear pipe segment 610, slidably disposed within siphon 620, substantially as shown in FIG. 5.

[0086] Siphon 620 is a unitarily formed element, including a downward flow path 622 and an upward flow path 624, separated by a wall 626. Downward flow path 622 is in fluid communication with upward flow path 624 via a removable drain trap cap 628, sealingly arranged about a lower end of drain trap 620. Sewage drain pipe 630 is in fluid communication with upward flow path 624. Drain cap 628 is described in further detail hereinbelow.

[0087] As described hereinabove with respect to FIG. 5, linear pipe segment 610 may be adjusted to accommodate for different drain trap heights.

[0088] System 600 may include unidirectional valve 640 and a pressure equalizing element 650, substantially as described hereinabove with respect to FIG. 5.

[0089] System 600 is distinct from the systems described hereinabove in that the cleaning and maintenance assembly 204 is disposed within cap 628 of the drain trap. Specifically, cap 628 includes a cylindrical portion 660 and a base 670, the base defining a second inlet 676 at the center thereof. The power source, here shown as batteries 678, and the electronic controller 246 are disposed within base 670, and are protected from liquid by a cover 680.

[0090] Electronic valve 244, which may be a solenoid valve, is disposed within cover 680, such that maintenance-assembly inlet 240 is disposed within second inlet 676, and maintenance-assembly outlet 242 is disposed within cylindrical portion 660 of cap 628. As such, maintenance-assembly inlet 240 of cleaning and maintenance assembly 204 is in fluid communication with a second pipe leading to the source of fluid, via the second inlet 676. Additionally, when electronic valve 244 is open and permits fluid flow from maintenance-assembly inlet 240 to maintenance-assembly outlet 242, the fluid flows from the maintenance-assembly outlet directly into the siphon 620, in a direction oriented toward the drain assembly 602.

[0091] In some embodiments, a pressure increasing tube 690 may extend from maintenance-assembly outlet 242 into siphon 620. Pressure increasing tube 690 terminates in an orifice 692 having a smaller diameter than maintenance-assembly outlet 242, thus increasing the pressure of the fluid flowing through the electronic valve (when the valve is open). Additionally, pressure increasing tube 690 ensures that fluid flow through the cleaning and maintenance assembly reaches a high enough portion of the walls of siphon 620 to facilitate cleaning thereof, substantially as described hereinabove. Furthermore, pressure increasing tube 690 may enable the fluid to be released above the water level in the siphon, and can replace the fluid within the siphon.

[0092] The components and functionalities of system 600 not explicitly mentioned herein are substantially identical to those shown in FIG. 5, and for brevity, their detailed description is not repeated herein. Similarly, the cleaning and maintenance assembly of system 600 is designed to at least maintain, and in some embodiments also increase, the water pressure of water flowing through the maintenance assembly, and to allow the water to impinge on walls of the siphon for cleaning thereof, substantially as described hereinabove.

[0093] As described hereinabove with respect to FIGS. 2A and 2B, the cleaning and maintenance assembly of FIGS. 6A to 6G may be pre-programmed, and may operated automatically at regular times or intervals, without requiring the user attention for cleaning and maintenance of the drain.

[0094] Reference is now made to FIGS. 7A, 7B, 7C, and 7D, which are, respectively, an exploded perspective view illustration, a partially assembled perspective view illustration, an assembled perspective view illustration, and a cross-sectional illustration of another integrally-formed drain cleaning and maintenance system 700 according to embodiments of the present invention.

[0095] System 700 is substantially similar to system 600 described hereinabove with respect to FIGS. 6A to 6G. The main distinction between the two systems is in the location of the electronic controller and power source of the cleaning and maintenance assembly.

[0096] In system 700, electronic valve 244, and in some embodiments also pressure increasing tube 690, are disposed within cap 628 of the siphon 620, as shown for system 600. However, electronic controller 246 and power source 248, which are more sensitive to getting wet, are disposed in a dedicated compartment 702 on the exterior of siphon 620.

[0097] As described hereinabove with respect to FIGS. 2A and 2B, the cleaning and maintenance assembly of FIGS. 7A to 7D may be pre-programmed, and may be operated automatically at regular times or intervals, without requiring the user's attention for cleaning and maintenance of the drain.

[0098] Turning now to FIG. 8, which is a schematic illustration of another electronically-operated drain cleaning and maintenance system 800 according to an embodiment of the present invention. System 800 is substantially similar to system 200 described hereinabove with respect to FIGS. 2A and 2B. The main change between the two systems is that siphon 220 (of FIGS. 2A and 2B) has been replaced by a U-shaped drain trap 820 in FIG. 8. As a result, the sewage drain pipe 830 of FIG. 8 is bent, as compared to the linear sewage drain pipe 230 of FIGS. 2A and 2B.

[0099] The components and functionalities of cleaning and maintenance assembly 204 of FIG. 8 are substantially identical to those shown in FIGS. 2A and 2B, and for brevity, their detailed description is not repeated herein. Similarly, cleaning and maintenance assembly 804 of FIG. 8 is designed to at least maintain, and in some embodiments also increase, the water pressure of water flowing through the maintenance assembly, and to allow the water to impinge on walls of the drain trap for cleaning thereof, substantially as described hereinabove.

[0100] Installation and programming of cleaning and maintenance assembly 204 in system 800 would be substantially identical to the installation described hereinabove with respect to FIGS. 2A and 2B.

[0101] As described hereinabove with respect to FIGS. 2A and 2B, the cleaning and maintenance assembly of FIG. 8 may be pre-programmed, and may operated automatically at regular times or intervals, without requiring the user attention for cleaning and maintenance of the drain.

[0102] Reference is now made to FIG. 9, which is a schematic illustration of a further electronically-operated drain cleaning and maintenance system 900 according to an embodiment of the present invention. System 900 is substantially similar to system 800 described hereinabove with respect to FIG. 8. One main difference between the two systems is that in FIG. 8, U-shaped drain trap 920 includes second inlet 916, such that cleaning and maintenance assembly 204 is connected directly to U-shaped drain trap 920, typically to a linear segment thereof. A longitudinal axis 917 of second inlet 916 is disposed at an angle to a longitudinal axis 921 of the drain trap 920 at the location of connection, and to water flow through the drain trap at that location. In the embodiment of FIG. 9, the linear pipe segment (210 in FIGS. 2A, 2B, and 8) may be obviated, or may be replaced by a linear pipe segment that does not include a second inlet.

[0103] In the embodiments shown in FIG. 9, maintenance-assembly outlet 242 of cleaning and maintenance assembly 204 is connected to second inlet 916 of drain trap 920 by pipe 260. However, it is to be appreciated that cleaning and maintenance assembly 204 may be connected to second inlet 916 directly, substantially as shown in FIG. 2B.

[0104] The components and functionalities of cleaning and maintenance assembly 204 of FIG. 9 are substantially

identical to those shown in FIGS. 2A and 2B, and for brevity, their detailed description is not repeated herein. Similarly, cleaning and maintenance assembly 204 of FIG. 9 is designed to at least maintain, and in some embodiments also increase, the water pressure of water flowing through the maintenance assembly, and to allow the water to impinge on walls of the siphon for cleaning thereof, substantially as described hereinabove.

[0105] When installing cleaning and maintenance assembly 204 in system 900, the user would ensure power supply and connect maintenance inlet pipe 241 substantially as described hereinabove with respect to FIGS. 2A and 2B. The user would connect maintenance-assembly outlet 242 of maintenance assembly 204 to second inlet 916 of drain trap 920, either directly or using intervening pipe 260. If the user is retrofitting a drain in which the drain trap does not have a second inlet, prior to installing the cleaning and maintenance assembly 204, the user may also replace the existing drain trap with drain trap 920 having the second inlet 916. Programming of cleaning and maintenance assembly 204 would be substantially as described hereinabove with respect to FIGS. 2A and 2B.

[0106] As described hereinabove with respect to FIGS. 2A and 2B, the cleaning and maintenance assembly of FIG. 9 may be pre-programmed, and may operated automatically at regular times or intervals, without requiring the user attention for cleaning and maintenance of the drain.

[0107] Reference is now made to FIGS. 10A, 10B, 10C, and 10D, which are, respectively, a front view planar illustration and three sectional illustrations of a nozzle 1000 for connecting a drain cleaning and maintenance assembly of any one of FIGS. 2A to 9 to a drain assembly. FIGS. 10B, 10C, and 10D are taken along section lines C-C, A-A, and D-D, respectively.

[0108] As seen, nozzle 1000 includes a neck portion 1002 and a head portion 1004, the head portion having a greater diameter than the neck portion. An interior pipe 1006 extends along the interior of neck portion 1002 and head portion 1004, the pipe having a nozzle inlet at neck portion 1002 and being blocked at head portion 1004. A first plurality of nozzle outlets 1008 are arranged in a first hemisphere about head portion 1004, and a second plurality of nozzle outlets 1010 are arranged in a second hemisphere about head portion 1004, beneath the first hemisphere. In the illustrated embodiment, each nozzle outlet 1010 is disposed between two nozzle outlets 1008. Each of nozzle outlets 1008 and 1010 is in fluid communication with pipe 1006.

[0109] When nozzle 1000 is disposed within a pipe, or flow path, such as within maintenance-assembly outlet 242 of the cleaning and maintenance assembly of FIG. 2B or within an outlet of intervening pipe 260 of FIG. 2A, pressurized liquid flowing from the cleaning and maintenance assembly into the second inlet flows into pipe 1006, and from there is distributed to nozzle outlets 1008 and 1010, such that the water impinges on walls of linear pipe segment 210 and/or of siphon 220 in a plurality of directions, determined by the orientation of nozzle outlets 1008 and 1010.

[0110] It is to be appreciated that nozzle 1000 may be designed and configured in accordance with a specific application, or drain assembly, in which it is installed. As such, nozzle 1000 may have more nozzle outlets or fewer nozzle outlets than those shown in the drawings. Nozzle 1000 may have nozzle outlets in one or more angular

orientations about the circumference of the head portion. Nozzle 1000 may have nozzle outlets at a single location, or at multiple locations along the longitudinal axis of pipe 1006.

[0111] In some embodiments, one or more of the nozzle outlets of nozzle 1000 may extend beyond the footprint of head portion 1004. For example, one or more of the nozzle outlets may comprise an outlet pipe or conduit.

[0112] FIGS. 11A and 11B show schematic sectional illustrations of another nozzle 1100 for connecting a drain cleaning and maintenance assembly of any one of FIGS. 2A to 9 to a drain assembly, in a rest state and in a flow state.

[0113] As seen in FIGS. 11A and 11B, nozzle 1100 includes a main pipe 1106 having a nozzle inlet 1102 and terminating at three nozzle outlets 1108a, 1108b, and 1108c, each pointing in a different angular direction. As such, as seen in FIG. 11B, when water or another liquid flows into nozzle inlet 1102, the water flows out of nozzle outlets 1108 in the directions indicated by arrows 1110a, 1110b, and 1110c, respectively.

[0114] It is to be appreciated that nozzle 1100 may be designed and configured in accordance with a specific application, or drain assembly, in which it is installed. As such, nozzle 1100 may have more nozzle outlets or fewer nozzle outlets than those shown in the drawings. Nozzle 1100 may have nozzle outlets in one or more angular orientations. Nozzle 1100 may have nozzle outlets at a single location, or at multiple locations along the longitudinal axis of pipe 1106.

[0115] In some embodiments, one or more of the nozzle outlets of nozzle 1100 may extend beyond the footprint of the nozzle. For example, one or more of the nozzle outlets may comprise a nozzle outlet pipe or conduit.

[0116] FIGS. 12A, 12B, and 12C are schematic illustrations of embodiments of nozzles for connection of any one of the cleaning and maintenance assemblies of FIGS. 2A to 9, e.g. maintenance assembly 204 of FIG. 3, to a drain assembly, e.g. drain assembly 302 of FIG. 3, according to embodiments of the present invention.

[0117] As seen in FIGS. 12A to 12C, siphon 320 of drain assembly 302 includes a second inlet 316. The maintenance-assembly outlet of maintenance assembly 204 is connected to second inlet 316 via pipe 260. In the illustrated embodiment, siphon 320 is integrally formed with a drain receptacle 1200, and is installed beneath a bottom surface 1202 of a plumbing fixture, such as a sink. Drain receptacle 1200 is in fluid communication with a drain portal 1204 of the plumbing fixture.

[0118] In the embodiment shown in FIG. 12A, end 1210 of pipe 260 disposed within second inlet 316 is open, allowing water, or another liquid, to flow freely through pipe 260 and into siphon 320, at the angle defined by second inlet 316, without any further obstructions. In this arrangement, no nozzle is used.

[0119] In the embodiment shown in FIG. 12B, a nozzle 1220 is disposed at end 1210 of pipe 260 within second inlet 316. Nozzle 1220 includes two nozzle outlets 1222 and 1224, allowing water to flow out of end 1210, and to be redirected to flow into an upstream portion and into a downstream portion of siphon 320, as indicated by arrows.

[0120] FIG. 12C shows a nozzle 1240, which is substantially similar to nozzle 1220 of FIG. 12B. However, nozzle 1240 includes a third nozzle outlet bore 1242 along a longitudinal axis of pipe 260, in addition to nozzle outlets

1222 and **1224**. As such, at least some of the flow from pipe **260** into siphon **320** continues in its original direction, through nozzle outlet **1242**.

[0121] Reference is now made to FIG. **13**, which is a schematic flow chart of a method of installing the cleaning and maintenance system of any one of FIGS. **2A** to **9** according to embodiments of the present invention.

[0122] At step **S1300**, a maintenance-assembly outlet of a cleaning and maintenance assembly, for example as described hereinabove with respect to any one of FIGS. **2A** to **9**, is connected to a drain inlet of a drain system upstream of a drain trap, or to an inlet directly into the drain trap. When the cleaning and maintenance assembly is integrally formed with the drain trap, as shown in FIG. **4**, step **S1300** may be obviated.

[0123] At step **S1302**, which typically occurs while the electronic valve (e.g. **244** of FIGS. **2A** and **2B**) of the cleaning and maintenance assembly is in a closed state, the maintenance-assembly inlet of the cleaning and maintenance assembly is connected to a source of pressurized water or another liquid. In some embodiments, the source of pressurized water may be the water mains. In some such embodiments, prior to step **S1302**, at step **S1304**, a pipe extending from the water mains to the plumbing fixture, e.g. to a faucet thereof, may optionally be split, such that one portion of the pipe is connected to the faucet, and the other section of the pipe is connected to the cleaning and maintenance assembly at step **S1302**.

[0124] At step **S1306**, the electronic valve of the cleaning and maintenance assembly is controlled to be in the open state, so that water flowing from the pressurized source through the cleaning and maintenance assembly cleans and maintains the drain trap.

[0125] Typically, the control is automatic, as described hereinabove with respect to FIGS. **2A** to **9**. In some such embodiments, prior to step **S1306**, at step **S1308**, the cleaning and maintenance assembly may be programmed to be in the open state at specific times, or may receive an input, from a remote control unit, instructing it to control the electronic valve to be in the open state.

[0126] In some embodiments, programming of the cleaning and maintenance assembly comprises applying a default program to the cleaning and maintenance assembly, and may be carried out during manufacturing of the cleaning and maintenance assembly.

[0127] In some embodiments, the cleaning and maintenance assembly may be pre-loaded with a plurality of default programs, and programming of the cleaning and maintenance assembly may include selecting one of the plurality of default programs.

[0128] It is to be appreciated that unless specifically stated otherwise, all fluid pressures mentioned in the present application and claims are absolute pressures.

[0129] It is to be appreciated that, when the pressurized washing liquid flows directly into the drain trap, at an angle relative to flow from the drain into the drain trap, cleaning of the drain trap walls is more effective than when the pressurized washing fluid flows into the drain trap together with flow from the drain into the drain trap.

[0130] Various exemplary embodiments of the present invention are provided hereinbelow: Embodiment 1: A drain cleaning and maintenance system, including:

[0131] a drain trap, having a first inlet in fluid communication with a drain of a plumbing fixture;

[0132] a second inlet, in fluid communication with the drain trap; and

[0133] a cleaning and maintenance assembly, in fluid communication with the second inlet, the cleaning and maintenance assembly including:

[0134] a maintenance-assembly inlet, adapted to be in fluid communication with a source of pressurized liquid;

[0135] a maintenance-assembly outlet in fluid communication with an interior of the drain trap;

[0136] a pipe disposed between the maintenance-assembly inlet and the maintenance-assembly outlet;

[0137] an electronic valve having an open state allowing flow of liquid, from the maintenance-assembly inlet to the maintenance-assembly outlet, through the pipe, and a closed state blocking flow of liquid from the maintenance-assembly inlet to the maintenance-assembly outlet;

[0138] an electronic controller adapted to transition the electronic valve between the open state and the closed state; and

[0139] a power source adapted to provide power to the electronic valve and the electronic controller,

[0140] wherein, when the maintenance-assembly inlet is connected to the source of pressurized liquid and the electronic valve is in the open state, liquid flows from the source of pressurized liquid to the drain trap via the electronic valve.

[0141] Embodiment 2: The drain cleaning and maintenance system of embodiment 1, wherein, when the maintenance-assembly inlet is connected to the source of pressurized liquid and the electronic valve is in the open state, an absolute output-pressure of liquid flowing out of the maintenance-assembly outlet is at least 70% of an absolute input-pressure of the liquid when it flows into the maintenance-assembly inlet.

[0142] Embodiment 3: The drain cleaning and maintenance system of embodiment 1, wherein, when the maintenance-assembly inlet is connected to the source of pressurized liquid and the electronic valve is in the open state, the absolute output-pressure is at least 75% of the absolute input-pressure.

[0143] Embodiment 4: The drain cleaning and maintenance system of embodiment 1, wherein, when the maintenance-assembly inlet is connected to the source of pressurized liquid and the electronic valve is in the open state, the absolute output-pressure is at least 80% of the absolute input-pressure.

[0144] Embodiment 5: The drain cleaning and maintenance system of embodiment 1, wherein, when the maintenance-assembly inlet is connected to the source of pressurized liquid and the electronic valve is in the open state, the absolute output-pressure is at least 85% of the absolute input-pressure.

[0145] Embodiment 6: The drain cleaning and maintenance system of embodiment 1, wherein, when the maintenance-assembly inlet is connected to the source of pressurized liquid and the electronic valve is in the open state, the absolute output-pressure is at least 90% of the absolute input-pressure.

[0146] Embodiment 7: The drain cleaning and maintenance system of embodiment 1, wherein, when the maintenance-assembly inlet is connected to the source of pressur-

ized liquid and the electronic valve is in the open state, the absolute output-pressure is at least 95% of the absolute input-pressure.

[0147] Embodiment 8: The drain cleaning and maintenance system of any one of embodiments 1 to 7, wherein when the maintenance-assembly inlet is connected to the source of pressurized liquid and the electronic valve is in the open state, a pressure differential between absolute pressure of liquid flowing into the maintenance-assembly inlet and the absolute pressure of liquid flowing out of the maintenance-assembly outlet is at most 30%.

[0148] Embodiment 9: The drain cleaning and maintenance system of any one of embodiments 1 to 7, wherein when the maintenance-assembly inlet is connected to the source of pressurized liquid and the electronic valve is in the open state, the pressure differential is at most 25%.

[0149] Embodiment 10: The drain cleaning and maintenance system of any one of embodiments 1 to 7, wherein when the maintenance-assembly inlet is connected to the source of pressurized liquid and the electronic valve is in the open state, the pressure differential is at most 20%.

[0150] Embodiment 11: The drain cleaning and maintenance system of any one of embodiments 1 to 7, wherein when the maintenance-assembly inlet is connected to the source of pressurized liquid and the electronic valve is in the open state, the pressure differential is at most 15%.

[0151] Embodiment 12: The drain cleaning and maintenance system of any one of embodiments 1 to 7, wherein when the maintenance-assembly inlet is connected to the source of pressurized liquid and the electronic valve is in the open state, the pressure differential is at most 10%.

[0152] Embodiment 13: The drain cleaning and maintenance system of any one of embodiments 1 to 7, wherein when the maintenance-assembly inlet is connected to the source of pressurized liquid and the electronic valve is in the open state, the pressure differential is at most 5%.

[0153] Embodiment 14: The drain cleaning and maintenance system of any one of embodiments 1 to 13, wherein, when the maintenance-assembly inlet is connected to the source of pressurized liquid and the electronic valve is in the open state, an absolute input pressure of liquid flowing into the maintenance-assembly inlet is at least 2 bar.

[0154] Embodiment 15: The drain cleaning and maintenance system of any one of embodiments 1 to 13, wherein, when the maintenance-assembly inlet is connected to the source of pressurized liquid and the electronic valve is in the open state, the absolute input pressure is at least 2.5 bar.

[0155] Embodiment 16: The drain cleaning and maintenance system of any one of embodiments 1 to 13, wherein, when the maintenance-assembly inlet is connected to the source of pressurized liquid and the electronic valve is in the open state, the absolute input pressure is at least 3 bar.

[0156] Embodiment 17: The drain cleaning and maintenance system of any one of embodiments 1 to 13, wherein, when the maintenance-assembly inlet is connected to the source of pressurized liquid and the electronic valve is in the open state, the absolute input pressure is at least 4 bar.

[0157] Embodiment 18: The drain cleaning and maintenance system of any one of embodiments 1 to 13, wherein, when the maintenance-assembly inlet is connected to the source of pressurized liquid and the electronic valve is in the open state, the absolute input pressure is in the range of 2 to 5 bar.

[0158] Embodiment 19: The drain cleaning and maintenance system of any one of embodiments 1 to 13, wherein, when the assembly inlet is connected to the source of pressurized liquid and the electronic valve is in the open state, the absolute input pressure is in the range of 3 to 5 bar.

[0159] Embodiment 20: The drain cleaning and maintenance system of any one of embodiments 1 to 19, wherein, the electronic controller is adapted to maintain the electronic valve in the open state for a duration sufficient for flow of the pressurized liquid flow from the source to the drain trap to replace at least a majority of liquid within the drain trap.

[0160] Embodiment 21: The drain cleaning and maintenance system of any one of embodiments 1 to 20, wherein the cleaning and maintenance assembly is external to the drain trap and is disposed on an inlet line leading to the second inlet, wherein the maintenance-assembly outlet is in fluid communication with the drain trap via the second inlet.

[0161] Embodiment 22: The drain cleaning and maintenance system of any one of embodiments 1 to 21, further including a linear pipe segment disposed upstream of the drain trap, the linear pipe segment having a pipe-inlet adapted to be in fluid communication with the drain of the plumbing fixture and a pipe-outlet in fluid communication with the drain trap, the linear pipe segment including the second inlet.

[0162] Embodiment 23: The drain cleaning and maintenance system of any one of embodiments 1 to 21, wherein the drain trap further includes the second inlet.

[0163] Embodiment 24: The drain cleaning and maintenance system of any one of embodiments 1 to 23, wherein the second inlet is angled relative to a flow-path from the drain to the drain trap or within the drain trap.

[0164] Embodiment 25: The drain cleaning and maintenance system of any one of embodiments 1 to 24, wherein the maintenance-assembly outlet of the cleaning and maintenance assembly is connected directly to the second inlet.

[0165] Embodiment 26: The drain cleaning and maintenance system of any one of embodiments 1 to 24, wherein the maintenance-assembly outlet of the cleaning and maintenance assembly is connected to the second inlet via a connector pipe segment.

[0166] Embodiment 27: The drain cleaning and maintenance system of any one of embodiments 1 to 20, wherein the cleaning and maintenance assembly is integrally formed with the drain trap and with the second inlet, as a unitary structure.

[0167] Embodiment 28: The drain cleaning and maintenance system of embodiment 27, wherein the cleaning and maintenance assembly is disposed on or in a side wall of the drain trap, such that flow from the second inlet into the drain trap is angled relative to water flow through the drain trap.

[0168] Embodiment 29: The drain cleaning and maintenance assembly of embodiment 27, wherein at least a portion of the cleaning and maintenance assembly is disposed at a base of the drain trap.

[0169] Embodiment 30: The drain cleaning and maintenance assembly of embodiment 29, wherein the second inlet is disposed at the base of the drain trap and accommodates the maintenance-assembly inlet.

[0170] Embodiment 31: The drain cleaning and maintenance assembly of embodiment 29 or embodiment 30, wherein the maintenance-assembly outlet is in fluid communication directly with the drain trap.

[0171] Embodiment 32: The drain cleaning and maintenance assembly of any one of embodiments 29 to 31, wherein the electronic valve is disposed within the drain trap.

[0172] Embodiment 33: The drain cleaning and maintenance assembly of any one of embodiments 29 to 32, wherein the electronic controller and the power source are disposed within the drain trap.

[0173] Embodiment 34: The drain cleaning and maintenance assembly of any one of embodiments 29 to 32, wherein the electronic controller and the power source are disposed on an exterior wall of the drain trap.

[0174] Embodiment 35: The drain cleaning and maintenance system of any one of embodiments 1 to 34, wherein the drain trap includes a siphon.

[0175] Embodiment 36: The drain cleaning and maintenance system of any one of embodiments 1 to 35, wherein the drain trap includes a U-shaped drain trap.

[0176] Embodiment 37: The drain cleaning and maintenance system of any one of embodiments 1 to 36, wherein the maintenance assembly further includes a communication interface, functionally associated with the electronic controller and adapted to enable delivery of control inputs from a remote control unit to the electronic controller.

[0177] Embodiment 38: The drain cleaning and maintenance system of any one of embodiments 1 to 36, wherein the maintenance assembly further includes a communication interface, functionally associated with the electronic controller and adapted to enable delivery of maintenance outputs from the electronic controller to a remote control center.

[0178] Embodiment 39: The drain cleaning and maintenance system of any one of embodiments 1 to 38, wherein the electronic controller is programmable.

[0179] Embodiment 40: The drain cleaning and maintenance system of any one of embodiments 1 to 39, further including a user interface including at least one of an input interface enabling a user to provide input to the electronic controller and an output interface enabling a user to perceive output of the electronic controller.

[0180] Embodiment 41: The drain cleaning and maintenance system of any one of embodiments 1 to 40, wherein the cleaning and maintenance assembly further includes a timer, functionally associated with the electronic controller.

[0181] Embodiment 42: The drain cleaning and maintenance system of any one of embodiments 1 to 41, further including at least one sensor adapted to sense at least one condition in the drain trap and to provide a sensor-input to the electronic controller, the sensor-input indicative of required maintenance of the drain trap.

[0182] Embodiment 43: The drain cleaning and maintenance system of any one of embodiments 1 to 42, further including a nozzle including a nozzle-inlet and at least one nozzle-outlet, the nozzle being disposed within a flow path from the maintenance-assembly outlet to the drain trap, such that liquid flowing from the maintenance-assembly outlet flows through the nozzle-inlet and is redirected out of the at least one nozzle-outlet into the drain trap.

[0183] Embodiment 44: The drain cleaning and maintenance system of any one of embodiments 1 to 43, wherein the drain cleaning and maintenance assembly is devoid of a pumping mechanism.

[0184] Embodiment 45: The drain cleaning and maintenance system of any one of embodiments 1 to 44, wherein

the pipe is the only volume of the drain cleaning and maintenance assembly adapted to have liquid disposed therein.

[0185] Embodiment 46: A drain device, including:

[0186] a drain trap, having a first inlet, adapted to be in fluid communication with a drain of a plumbing fixture and a second inlet; and

[0187] a cleaning and maintenance assembly, integrally formed with the drain trap, and including:

[0188] a maintenance-assembly inlet, adapted to be in fluid communication to a source of pressurized liquid;

[0189] a maintenance-assembly outlet in fluid communication with the second inlet;

[0190] a pipe disposed between the maintenance-assembly inlet and the maintenance-assembly outlet;

[0191] an electronic valve having an open state allowing flow of liquid, from the maintenance-assembly inlet to the maintenance-assembly outlet, through the pipe, and a closed state blocking flow of liquid from the maintenance-assembly inlet to the maintenance-assembly outlet;

[0192] an electronic controller adapted to transition the electronic valve between the open state and the closed state; and

[0193] a power source adapted to power the electronic valve and the electronic controller,

[0194] wherein, when the maintenance-assembly inlet is in fluid communication to the source of pressurized fluid and the electronic valve is in the open state, liquid flows from the source to the drain trap via the second inlet to clean the drain trap.

[0195] Embodiment 47: The drain device of embodiment 46, wherein the second inlet is angled relative to a flow-path from the drain to the first inlet.

[0196] Embodiment 48: A drain device, including:

[0197] a drain trap, having a first inlet, adapted to be in fluid communication with a drain of a plumbing fixture and a second inlet; and

[0198] a cleaning and maintenance assembly including:

[0199] a maintenance-assembly inlet, extending through the second inlet, and adapted to be in fluid communication to a source of pressurized liquid;

[0200] a maintenance-assembly outlet in fluid communication directly with an interior of the drain trap;

[0201] a pipe disposed between the maintenance-assembly inlet and the maintenance-assembly outlet;

[0202] an electronic valve having an open state allowing flow of liquid, from the maintenance-assembly inlet to the maintenance-assembly outlet, through the pipe, and a closed state blocking flow of liquid from the maintenance-assembly inlet to the maintenance-assembly outlet;

[0203] an electronic controller adapted to transition the electronic valve between the open state and the closed state; and

[0204] a power source adapted to power the electronic valve and the electronic controller,

[0205] wherein, when the maintenance-assembly inlet is in fluid communication to the source of pressurized fluid and the electronic valve is in the open state, liquid flows from the source of pressurized fluid to the drain trap via the electronic valve to clean the drain trap.

[0206] Embodiment 49: The drain device of embodiment 48, wherein the drain trap includes a drain trap cap, disposed at a lower end thereof, and wherein the electronic valve, the pipe, and the maintenance-assembly outlet are disposed within the drain trap cap.

[0207] Embodiment 50: The drain device of embodiment 49, wherein the electronic controller is disposed within the drain trap cap.

[0208] Embodiment 51: The drain device of embodiment 49 or embodiment 50, wherein the power source is disposed within the drain trap cap.

[0209] Embodiment 52: The drain device of embodiment 49, wherein the electronic controller is disposed in a compartment on the exterior of drain trap.

[0210] Embodiment 53: The drain device of embodiment 49 or embodiment 52, wherein the power source is disposed in a compartment on the exterior of the drain trap.

[0211] Embodiment 54: The drain device of any one of embodiments 46 to 53, wherein, when the maintenance-assembly inlet is connected to the source of pressurized fluid and the electronic valve is in the open state, liquid flows from the source to the drain trap at an absolute pressure substantially equal to the absolute pressure in the source of liquid.

[0212] Embodiment 55: The drain device of any one of embodiments 46 to 54, wherein the drain trap includes a siphon.

[0213] Embodiment 56: The drain device of any one of embodiments 46 to 55, wherein the maintenance assembly further includes a communication interface, functionally associated with the electronic controller and adapted to enable delivery of control inputs from a remote control unit to the electronic controller.

[0214] Embodiment 57: The drain device of any one of embodiments 46 to 56, wherein the electronic controller is programmable.

[0215] Embodiment 58: The drain device of any one of embodiments 46 to 57, further including a user interface including at least one of an input interface enabling a user to provide input to the electronic controller and an output interface enabling a user to perceive output of the electronic controller.

[0216] Embodiment 59: The drain device of any one of embodiments 46 to 58, wherein the cleaning and maintenance assembly further includes a timer, functionally associated with the electronic controller.

[0217] Embodiment 60: The drain device of any one of embodiments 46 to 59, further including at least one sensor adapted to sense at least one condition in the drain trap and to provide a sensor-input to the electronic controller, the sensor-input indicative of required maintenance of the drain trap.

[0218] Embodiment 61: The drain device of any one of embodiments 46 to 60, further including a nozzle including a nozzle-inlet and at least one nozzle-outlet, the nozzle being disposed within the second inlet, such that liquid flowing from the maintenance-assembly outlet flows through the nozzle-inlet and is redirected out of the at least one nozzle-outlet into the drain trap.

[0219] Embodiment 62: A method of cleaning and maintaining a drain trap of a drain, the drain trap having a first inlet, the method including:

[0220] (a) providing a cleaning and maintenance assembly, including:

[0221] a maintenance-assembly inlet;

[0222] a maintenance-assembly outlet;

[0223] a pipe disposed between the maintenance-assembly inlet and the maintenance-assembly outlet;

[0224] an electronic valve having an open state allowing flow of liquid, from the maintenance-assembly inlet to the maintenance-assembly outlet, through the pipe, and a closed state blocking flow of liquid from the maintenance-assembly inlet to the maintenance-assembly outlet;

[0225] an electronic controller adapted to transition the electronic valve between the open state and the closed state; and

[0226] a power source adapted to power the electronic valve and the electronic controller;

[0227] (b) connecting the maintenance-assembly outlet of the cleaning and maintenance assembly to a second inlet in fluid communication with the drain trap;

[0228] (c) while the electronic valve is in the closed state, connecting the maintenance-assembly inlet of the maintenance assembly to a source of pressurized liquid; and

[0229] (d) transitioning the electronic valve from the closed state to the open state, by means of the electronic controller, thereby to enable liquid from the source to flow through the pipe and the second inlet into the drain trap and to impinge on interior walls of the drain trap to clean the walls of the drain trap.

[0230] Embodiment 63: The method of embodiment 62, further including:

[0231] (e) maintaining the electronic valve in the open state for a predetermined duration, sufficient to replace all the liquid in the drain trap.

[0232] Embodiment 64: The method of embodiment 62 or embodiment 63, wherein the transitioning is in response to the electronic controller receiving an input indicative of the need for the transitioning.

[0233] Embodiment 65: The method of embodiment 64, wherein the input is received from a sensor disposed in, or in the vicinity of, the drain trap.

[0234] Embodiment 66: The method of embodiment 64, wherein the input is received from a remote control unit, via a communication interface functionally associated with the electronic controller.

[0235] Embodiment 67: The method of embodiment 62 or embodiment 63, wherein the electronic controller includes a programmable electronic controller, the method further including, prior to the transitioning, programming the programmable electronic controller to carry out the transitioning step at at least one predetermined time or at a predetermined frequency.

[0236] Embodiment 68: The method of any one of embodiments 62 to 67, wherein the connecting the maintenance-assembly outlet to the second inlet of the drain trap includes connecting the maintenance-assembly outlet directly to the second inlet.

[0237] Embodiment 69: The method of any one of embodiments 62 to 68, wherein the connecting the maintenance-assembly outlet to the second inlet of the drain trap includes connecting the maintenance-assembly outlet to the second inlet via a connecting pipe.

[0238] Embodiment 70: The method of embodiment 69, wherein the second inlet is an inlet into the connecting pipe, and the connecting pipe is disposed upstream of the first inlet

of the drain trap, wherein the connecting the maintenance-assembly outlet includes connecting the maintenance-assembly outlet to the second inlet of the connecting pipe.

[0239] Embodiment 71: A method of cleaning and maintaining a drain trap of a drain, the method including:

[0240] (a) providing a drain trap integrally formed with, or having disposed therein, a cleaning and maintenance assembly, the cleaning and maintenance assembly including:

[0241] a maintenance-assembly inlet;

[0242] a maintenance-assembly outlet in fluid communication with the drain trap;

[0243] a pipe disposed between the maintenance-assembly inlet and the maintenance-assembly outlet;

[0244] an electronic valve having an open state allowing flow of liquid, from the maintenance-assembly inlet to the maintenance-assembly outlet, through the pipe, and a closed state blocking flow of liquid from the maintenance-assembly inlet to the maintenance-assembly outlet; and

[0245] an electronic controller adapted to transition the electronic valve between the open state and the closed state;

[0246] (b) while the electronic valve is in the closed state, connecting the maintenance-assembly inlet of the cleaning and maintenance assembly to a source of pressurized liquid; and

[0247] (c) transitioning the electronic valve from the closed state to the open state, by means of the electronic controller, thereby to enable pressurized liquid from the source to flow through the pipe into the drain trap and to impinge on interior walls of the drain trap to clean the walls of the drain trap, the liquid at least substantially retaining the absolute pressure it has in the source.

[0248] It will be appreciated that certain features of the invention, which are, for clarity, described in the context of separate embodiments, may also be provided in combination in a single embodiment. Conversely, various features of the invention, which are, for brevity, described in the context of a single embodiment, may also be provided separately or in any suitable sub-combination.

[0249] Although the invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, it is intended to embrace all such alternatives, modifications and variations that fall within the spirit and broad scope of the appended claims. All publications, patents and patent applications mentioned in this specification are herein incorporated in their entirety by reference into the specification, to the same extent as if each individual publication, patent or patent application was specifically and individually indicated to be incorporated herein by reference. In addition, citation or identification of any reference in this application shall not be construed as an admission that such reference is available as prior art to the present invention.

1. A drain cleaning and maintenance system, comprising:

(a) a drain trap, having a first inlet in fluid communication with a drain of a plumbing fixture;

(b) a second inlet, in fluid communication with the drain trap; and

(c) a cleaning and maintenance assembly, in fluid communication with the second inlet, the cleaning and maintenance assembly comprising:

(i) a maintenance-assembly inlet, in fluid communication with a source of pressurized liquid;

(ii) a maintenance-assembly outlet in fluid communication with an interior of the drain trap;

(iii) a pipe disposed between the maintenance-assembly inlet and the maintenance-assembly outlet;

(iv) an electronic valve having an open state allowing flow of liquid, from the maintenance-assembly inlet to the maintenance-assembly outlet, through the pipe, and a closed state blocking flow of liquid from the maintenance-assembly inlet to the maintenance-assembly outlet;

(v) an electronic controller adapted to transition the electronic valve between the open state and the closed state; and

(vi) a power source adapted to power the electronic controller and the electronic valve,

wherein, when the electronic valve is in the open state, liquid flows from the source of pressurized liquid to the drain trap via the electronic valve.

2. The drain cleaning and maintenance system of claim 1, wherein, when the maintenance-assembly inlet is connected to the source of pressurized liquid and the electronic valve is in the open state, an absolute output-pressure of liquid flowing out of the maintenance-assembly outlet is at least 70% of an absolute input-pressure of the liquid when it flows into the maintenance-assembly inlet.

3. The drain cleaning and maintenance system of claim 1, wherein when the maintenance-assembly inlet is connected to the source of pressurized liquid and the electronic valve is in the open state, a pressure differential between an absolute pressure of liquid flowing into the maintenance-assembly inlet and an absolute pressure of liquid flowing out of the maintenance assembly outlet is at most 30%.

4. The drain cleaning and maintenance system of claim 1, wherein, when the maintenance-assembly inlet is connected to the source of pressurized liquid and the electronic valve is in the open state, an absolute pressure of liquid flowing into the maintenance-assembly inlet is at least 2 bar.

5. The drain cleaning and maintenance system of claim 1, wherein, the electronic controller is adapted to maintain the electronic valve in the open state for a duration sufficient for flow of the pressurized liquid flow from the source of pressurized fluid to the drain trap to replace at least a majority of liquid within the drain trap.

6. (canceled)

7. The drain cleaning and maintenance system of claim 1, further comprising a linear pipe segment disposed upstream of the drain trap, the linear pipe segment having a pipe-inlet adapted to be in fluid communication with the drain of the plumbing fixture and a pipe-outlet in fluid communication with the drain trap, the linear pipe segment including the second inlet.

8. The drain cleaning and maintenance system of claim 1, wherein the drain trap further includes the second inlet.

9. The drain cleaning and maintenance system of claim 1, wherein the second inlet is angled relative to a flow-path from the drain to the drain trap or within the drain trap.

10. The drain cleaning and maintenance system of claim 1, wherein the maintenance-assembly outlet of the cleaning and maintenance assembly is connected directly to the second inlet.

11. The drain cleaning and maintenance system of claim 1, wherein the maintenance-assembly outlet of the cleaning and maintenance assembly is connected to the second inlet via a connector pipe segment.

12. The drain cleaning and maintenance system of claim 1, wherein the cleaning and maintenance assembly is integrally formed with the drain trap and with the second inlet, as a unitary structure.

13. (canceled)

14. (canceled)

15. (canceled)

16. (canceled)

17. (canceled)

18. (canceled)

19. (canceled)

20. (canceled)

21. (canceled)

22. The drain cleaning and maintenance system of claim 1, wherein the maintenance assembly further includes a communication interface, functionally associated with the electronic controller and adapted to enable delivery of control inputs in at least one direct between a remote control unit and the electronic controller.

23. (canceled)

24. The drain cleaning and maintenance system of claim 1, wherein the electronic controller is programmable.

25. The drain cleaning and maintenance system of claim 1, further comprising a user interface including at least one of an input interface enabling a user to provide input to the electronic controller and an output interface enabling a user to perceive output of the electronic controller.

26. The drain cleaning and maintenance system of claim 1, wherein the cleaning and maintenance assembly further comprises a timer, functionally associated with the electronic controller.

27. The drain cleaning and maintenance system of claim 1, further comprising at least one sensor adapted to sense at least one condition in the drain trap and to provide a sensor-input to the electronic controller, the sensor-input indicative of required maintenance of the drain trap.

28. The drain cleaning and maintenance system of claim 1, further comprising a nozzle including a nozzle-inlet and at least one nozzle-outlet, the nozzle being disposed within a flow path from the maintenance-assembly outlet to the drain trap, such that liquid flowing from the maintenance-assembly outlet flows through the nozzle-inlet and is redirected out of the at least one nozzle-outlet into the drain trap.

29. The drain cleaning and maintenance system of claim 1, wherein the drain cleaning and maintenance assembly is devoid of a pumping mechanism.

30. The drain cleaning and maintenance system of claim 1, wherein the pipe is the only volume of the drain cleaning and maintenance assembly adapted to have liquid disposed therein.

31. A drain device, comprising:

(a) a drain trap, having a first inlet, adapted to be in fluid communication with a drain of a plumbing fixture and a second inlet; and

(b) a cleaning and maintenance assembly, integrally formed with the drain trap, and including:

(i) a maintenance-assembly inlet, adapted to be in fluid communication to a source of pressurized liquid;

(ii) a maintenance-assembly outlet in fluid communication with the second inlet;

(iii) a pipe disposed between the maintenance-assembly inlet and the maintenance-assembly outlet;

(iv) an electronic valve having an open state allowing flow of liquid, from the maintenance-assembly inlet to the maintenance-assembly outlet, through the pipe, and a closed state blocking flow of liquid from the maintenance-assembly inlet to the maintenance-assembly outlet;

(v) an electronic controller adapted to transition the electronic valve between the open state and the closed state; and

(vi) a power source adapted to power the electronic valve and the electronic controller,

wherein, when the maintenance-assembly inlet is in fluid communication to the source of pressurized fluid and the electronic valve is in the open state, liquid flows from the source to the drain trap via the second inlet to clean the drain trap.

32. (canceled)

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