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(54) **WEEPING SYSTEM FOR FIRE HYDRANT HAVING A PROTECTIVE VALVE OR DEVICE**

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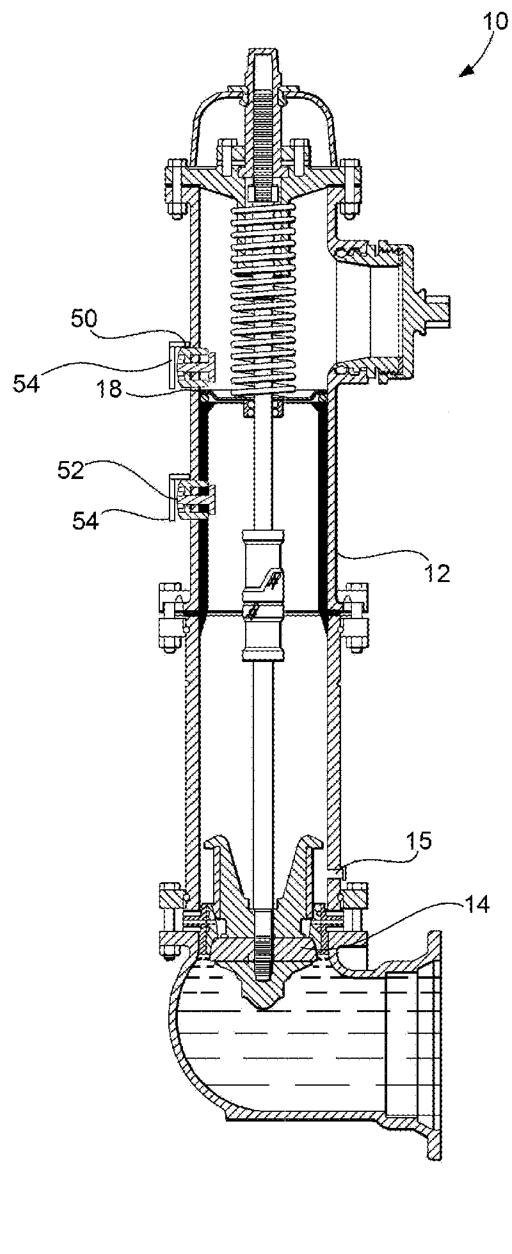
(57) **ABSTRACT**

Embodiments of the present invention provide improved weeping systems adapted for use with fire hydrants having protection systems. The weeping systems provide one or more check valves adapted to assist air to exit through a weeping hole of the hydrant.



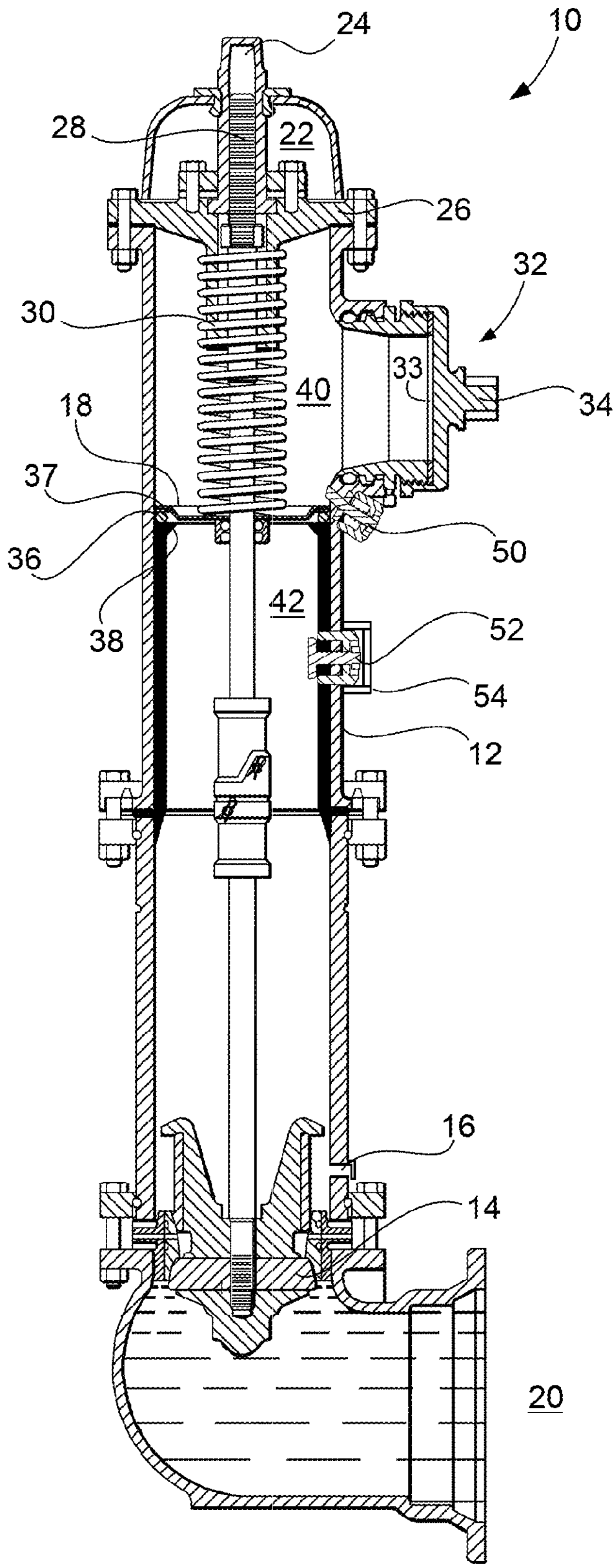


FIG. 1A

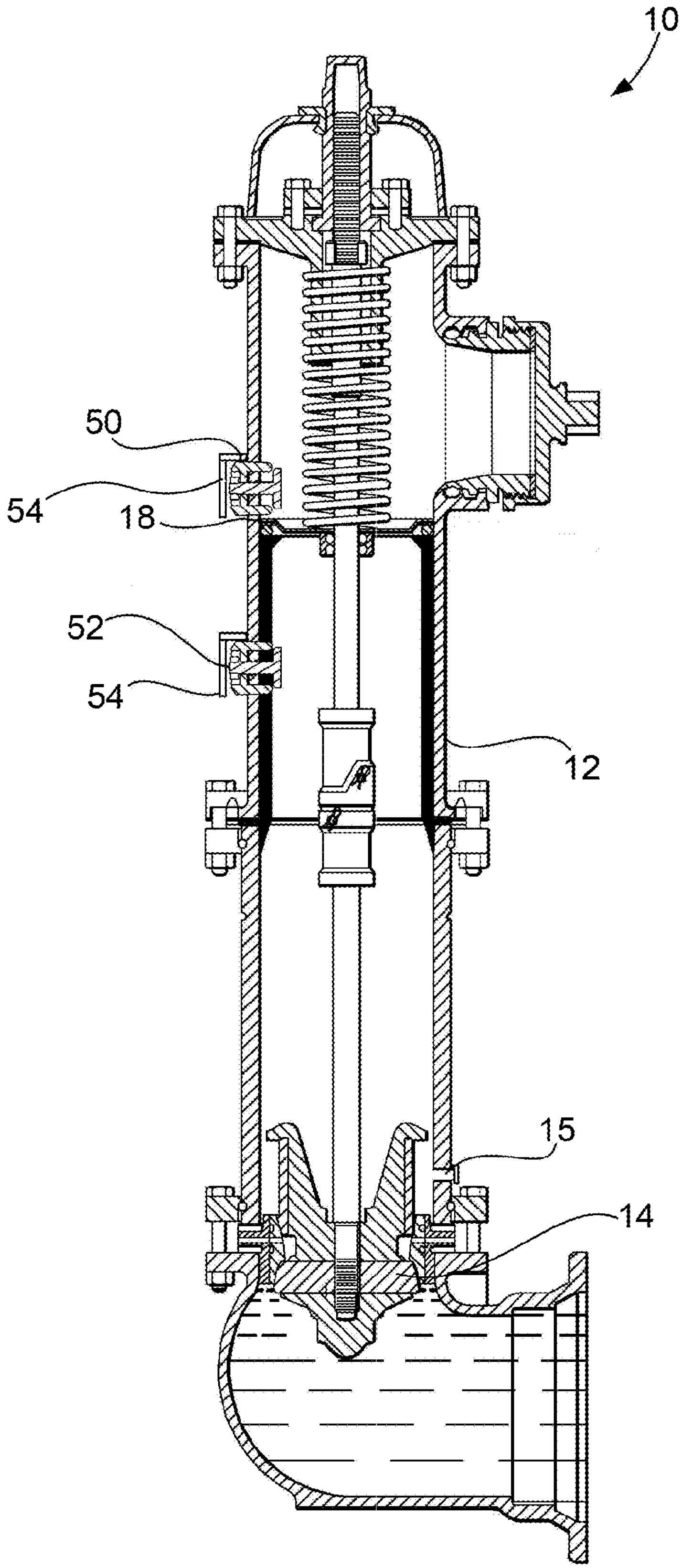


FIG. 1B

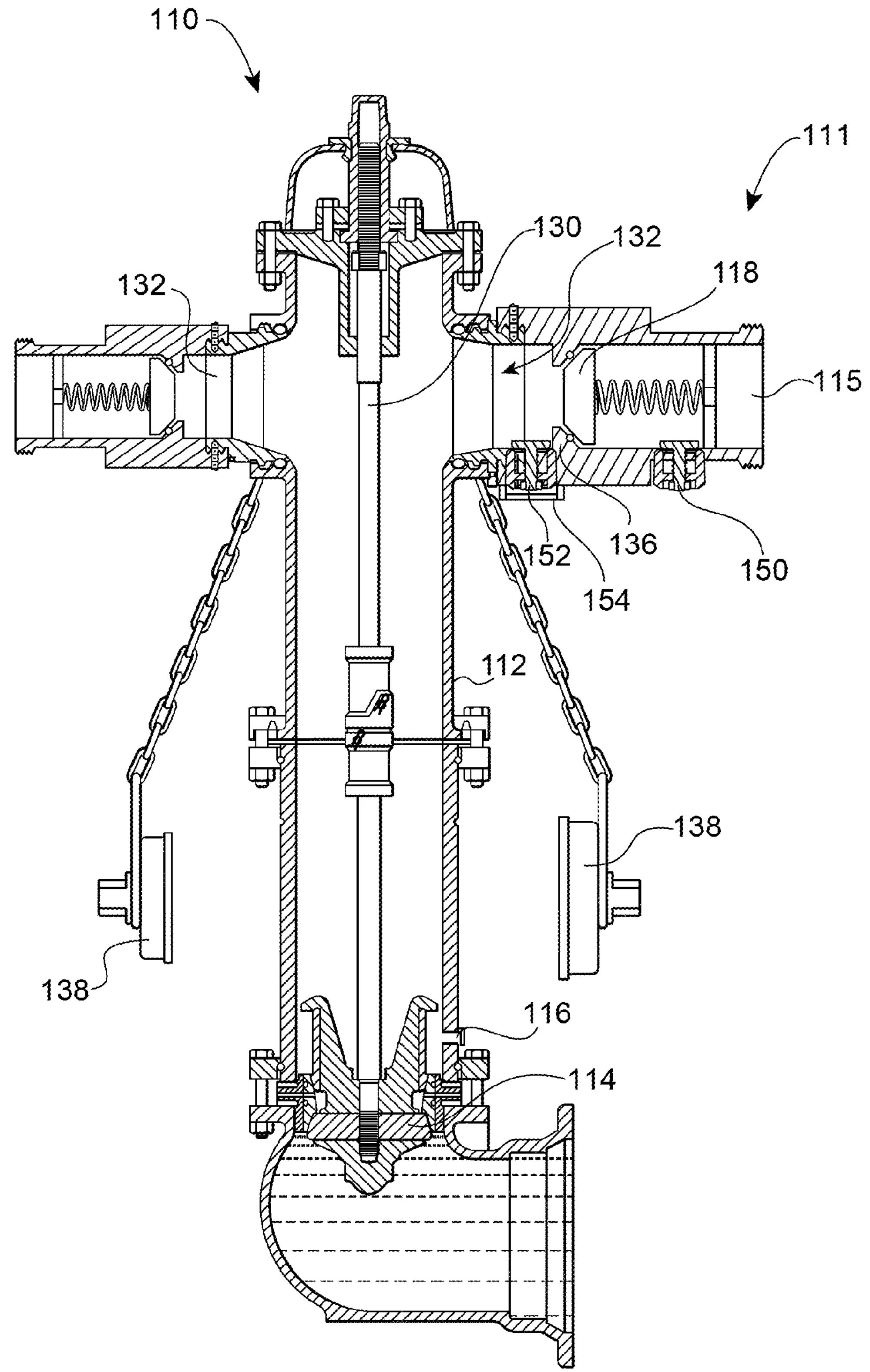

110
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FIG. 2

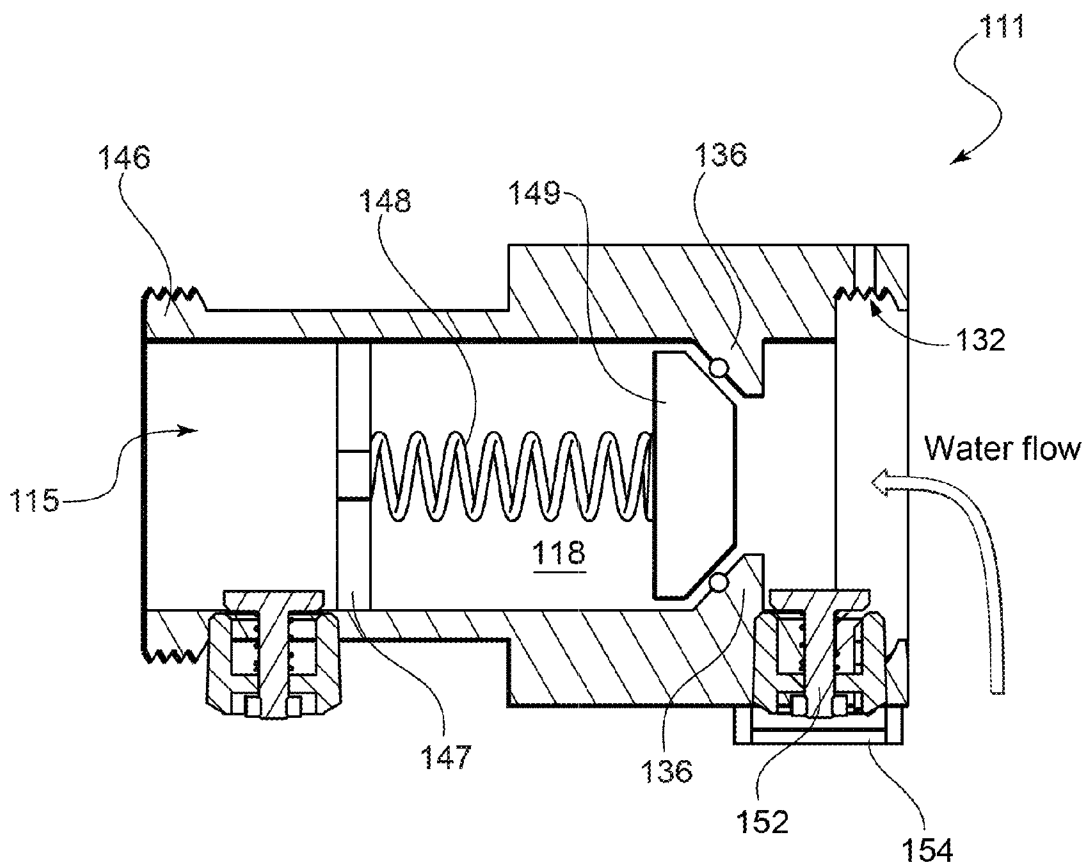

FIG. 3

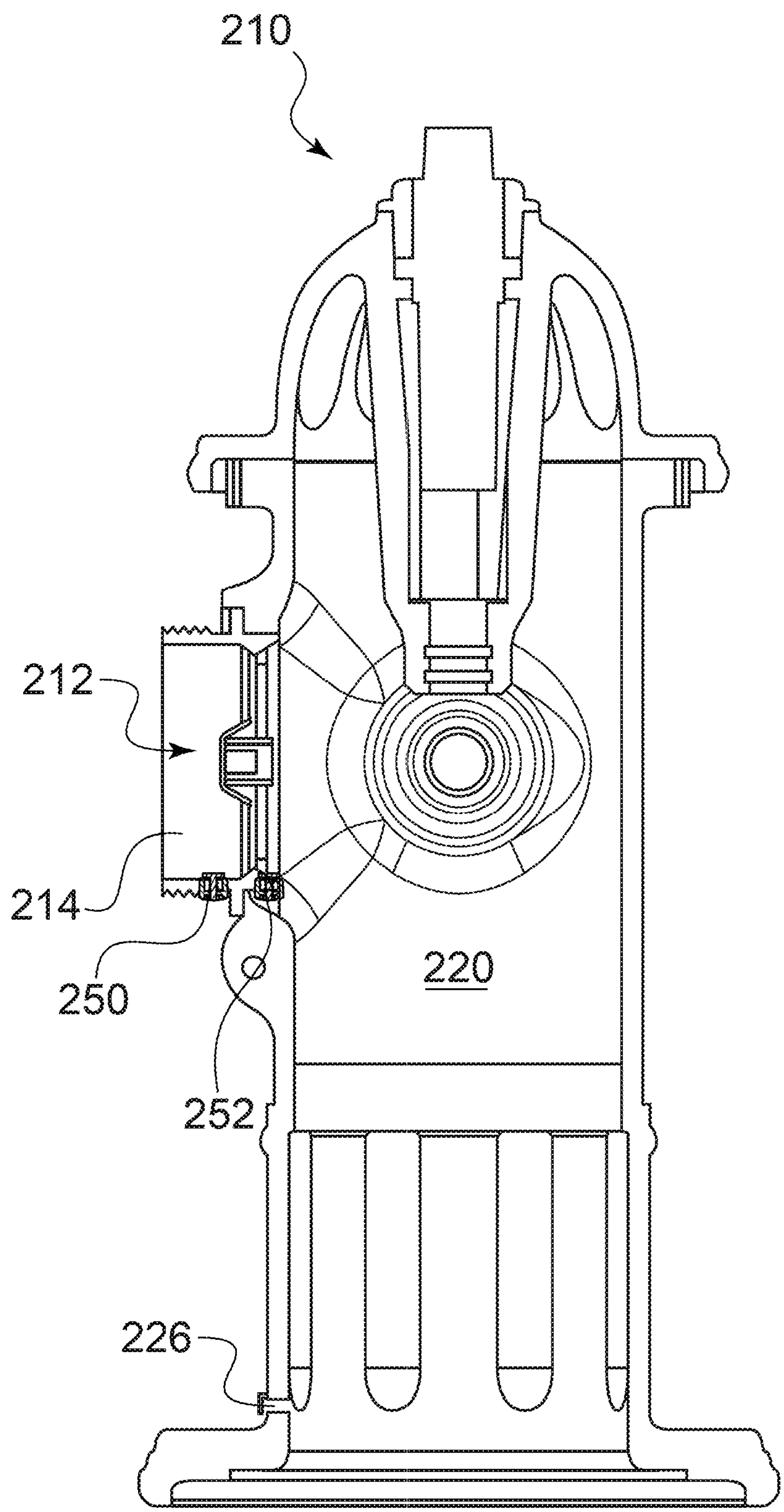

FIG. 4

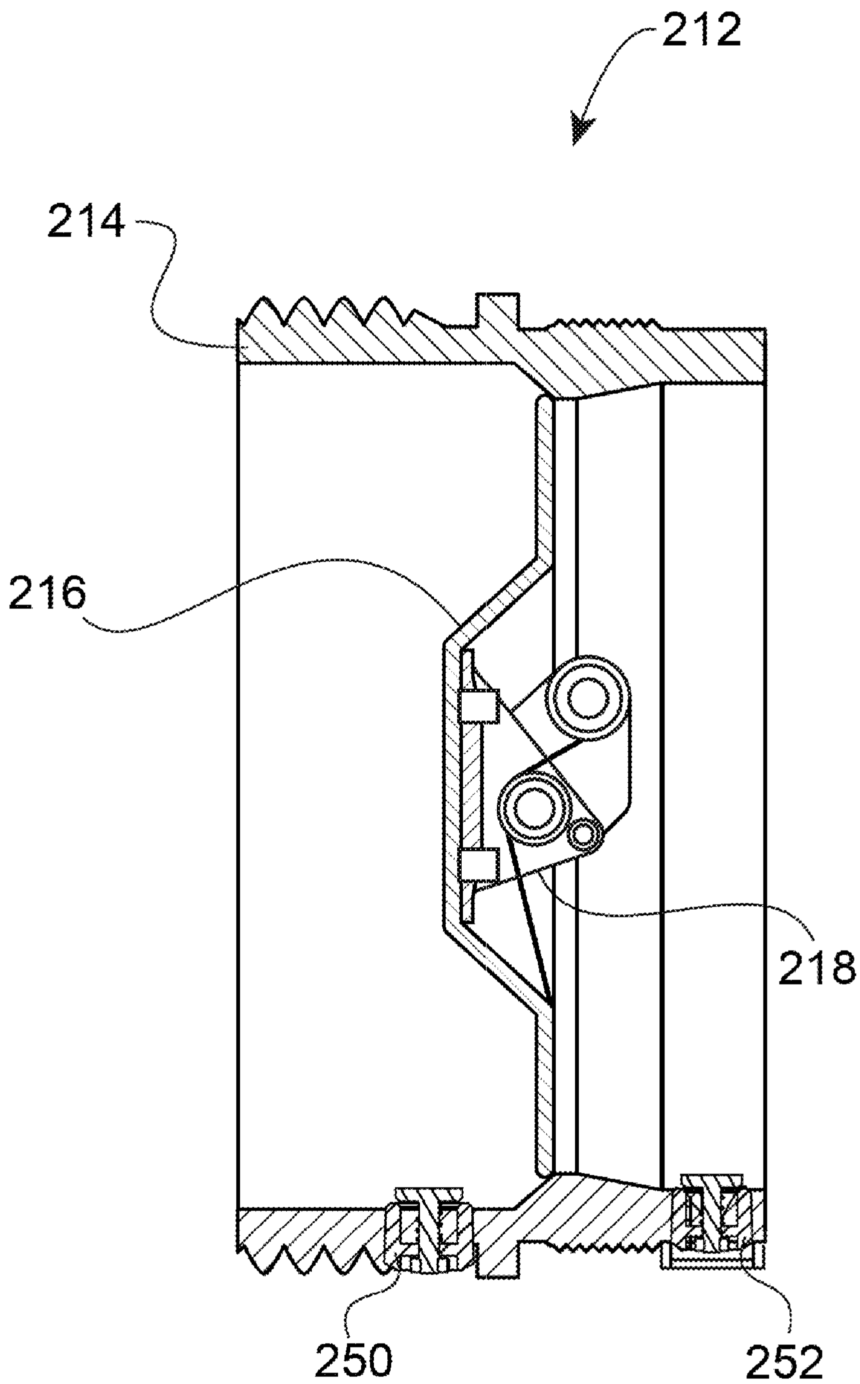

FIG. 5

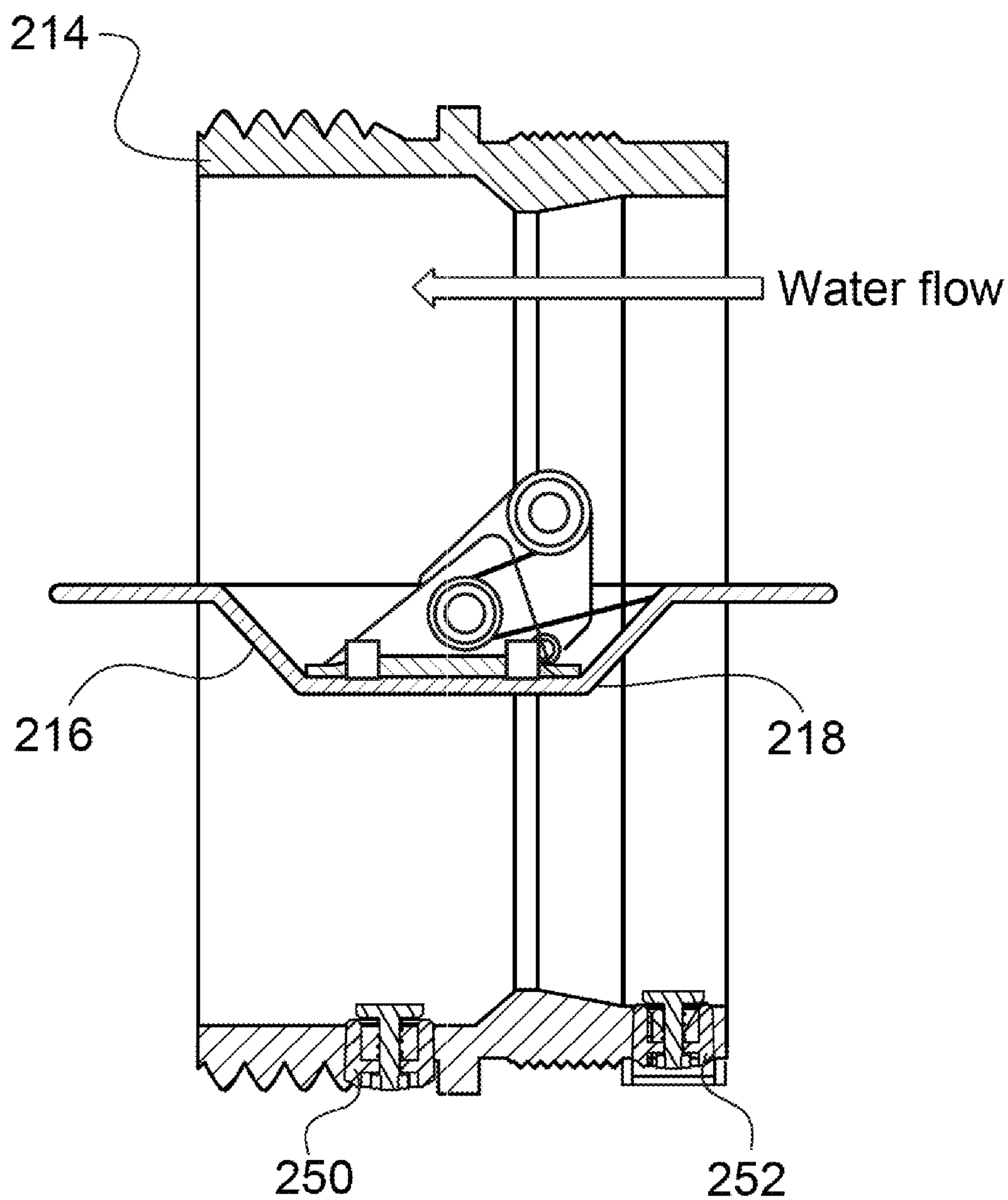

FIG. 6

WEEPING SYSTEM FOR FIRE HYDRANT HAVING A PROTECTIVE VALVE OR DEVICE

[0001] This application claims the benefit of U.S. Provisional Application Ser. No. 61/076,460, filed Jun. 27, 2008 titled "Weeping System For Hydrant With Protective Valve," the entire contents of which is hereby incorporated by reference.

FIELD OF INVENTION

[0002] Various aspects and embodiments of the present invention relate to providing fire hydrants having protective valves with one or more check valves in order to prevent water pooling and to allow the hydrant weep holes to vent faster.

BACKGROUND

[0003] Conventional fire hydrants offer access to a municipal water supply in a manner in which operatives with ill intent may appreciate. Briefly, conventional fire hydrants include at least one nozzle for coupling to a fire hose. A threaded cap typically closes off the nozzle when the hydrant is not in use. The hydrant also includes a main valve (sometimes referred to as a hydrant valve or main hydrant valve) that controls flow of water from the main water supply to and through the hydrant, through the nozzle(s), and into the fire hose.

[0004] Conventional dry barrel fire hydrants also feature weep holes, which are typically positioned at a lower portion of the barrel and allow water remaining in the barrel to drain after use. In normal infrastructure settings, the dry barrel hydrant weep holes are typically open (and remain open) when the hydrant is not in use, and allow any water left in the barrel to properly drain out. Weep holes are particularly beneficial in colder climates, where water remaining in the barrel after use may freeze and cause damage to the hydrant. After use, hydrants need air to quickly drain water through the weep holes. If the cap is put back on too quickly after the hydrant is used, it may slow the draining process down. However, as long as the hydrant is operating properly, the hydrant should eventually drain completely.

[0005] Conventionally, the barrel of the hydrant between the nozzle and the main hydrant valve, which is typically in the lower portion of the hydrant, accommodates several gallons of fluid. Accordingly, it is possible to unscrew a nozzle cap, introduce gallons and/or pounds of toxin, reattach the nozzle cap and open the main hydrant valve to allow the toxins to communicate with and flow by gravity and perhaps at least to some extent by Bernoulli's principle, into the municipal water supply. This is partly because, when the nozzle cap is attached, water pressure from the water supply would not force the toxins back out of the hydrant.

[0006] Examples of systems and methods for preventing toxins from being introduced to a water supply through a hydrant are described in U.S. Pat. No. 6,868,860, entitled "Fire Hydrant With Second Valve," the entire contents of which are hereby incorporated by this reference. In some examples described in U.S. Pat. No. 6,868,860, a valve structure is introduced between the nozzle and the primary valve that makes it more difficult or impossible to introduce toxins into a water supply through a fire hydrant. The valve structure prevents or substantially prevents the flow of water through the hydrant upon certain conditions and closes off portions of the hydrant barrel when a nozzle is open, but the main hydrant valve is closed. Generally, the valve structure can include a seat, a restriction member, and a biasing structure.

[0007] A further example is described in U.S. Pat. No. 6,910,495, entitled "Backflow Prevention System," the entire contents of which are hereby incorporated by this reference. This patent describes a system within a nozzle of a hydrant that prevents outside liquids and substances from entering into the fire hydrant.

[0008] U.S. Pat. No. 7,240,688 entitled "Retrofitting a Fire Hydrant with Secondary Valve" and U.S. Pat. Nos. 7,055,544 and 7,174,911 entitled "Fire Hydrant with Second Valve," the entire contents of each of which are hereby incorporated by this reference, describe a system that may be added to an existing fire hydrant. These patents describe a seat affixed to the interior cavity of the fire hydrant, and another secondary protective valve structure introduced between the nozzle and the main hydrant valve. The secondary protective valve cooperates with the seat to make it more difficult or impossible to introduce toxins to a water supply through a fire hydrant. The valve structure is intended to prevent the flow of water through the valve, closing off portions of the hydrant barrel when the nozzle is open but the main hydrant valve is closed. Generally, the valve structure can include a secondary valve, a seat, and a biasing structure. Retrofitting a hydrant with a secondary valve may be accomplished by removing the hydrant barrel, inserting the secondary valve, and affixing the seat to hydrant body with an adhesive or mechanical securing system (for example, a screw) or as described in U.S. application Ser. No. 11/838,534, also incorporated herein by reference. In an alternate embodiment, the valve seat may be molded or casted in the upper barrel of the hydrant.

[0009] Additionally, U.S. patent application Ser. No. 12/099,407, entitled "Nozzle Attachment for Fire Hydrant," the entire contents of which are hereby incorporated by this reference, describes a nozzle attachment for quick installation of an additional protective valve at the nozzle of a fire hydrant. The system may be used to retrofit an existing hydrant. The system introduces a physical structure before the nozzle through which water flows to close off portions of the nozzle when water is not flowing out of the nozzle. The system features a seat that engages a valve to close the channel of the nozzle attachment, but allows water to flow out of the hose receiving end of the nozzle attachment when a hydrant's main valve is opened.

[0010] A further attempt to protect a fire hydrant from introduction of dangerous chemicals or otherwise undesired acess is described in U.S. Publication No 2007/0028967, the entire contents of which are hereby incorporated by this reference. This publication describes a protection system having a nozzle, a protection device, and a bracket assembly. The protection device is carried by the nozzle and is coupled to the bracket. In a first position, the protection device prevents access to the interior of the fire hydrant and enables to protective device to act as a barrier. In a second position, water is permitted to flow from the interior of the fire hydrant out through the nozzle. As a result of the water pressure or flow, the protection device can be rotated (via the bracket) to allow water to flow past.

[0011] While all of these methods help to protect water sources, if the weep hole at the bottom of the hydrant is plugged, if the hydrant is not installed properly, or if the hydrant is not provided with a weep hole in the first, water may remain in the hydrant barrel after use. Water may also pool above and/or below any protective valve or device provided when the valve or device is state. In some instances, the protective valve or device can create a vacuum, prevent the weeping hole (if provided) from allowing all liquid in the barrel to drain. In the case of a miscreant attempting to add toxins or other items to the water supply, the supplied toxins could pool above, near, or against the protective valve or device while it is closed.

[0012] A number of effective solutions have been provided to address these issues, examples of which are shown and described in U.S. Pat. No. 7,428,910 (describing a breathable stem valve), embodiments of hydrants that include a vented check valve in an insert, and U.S. application Ser. No. 12/047,681 (describing a vented cap that replaces the hydrant cap), the entire contents of each of which are incorporated by reference. These methods may be used to help vent the upper and lower barrel.

[0013] The purpose of the embodiments described in this application are intended to provide further options and additional solutions to replacing the upper barrel to include the valve seat and/or modifying the existing hydrant barrel.

[0014] Without using one of the above-described venting methods or the embodiments described in the present application, any toxins added to the hydrant may still be present when the hydrant is used again, potentially exposing the users to harmful materials. As such, there is a need to prevent the pooling of liquids against a protective valve or device in fire hydrants.

BRIEF SUMMARY

[0015] Embodiments of the present invention provide one or more check valves adapted to provide and help improve effective weeping of fire hydrants featuring a protective valve system.

[0016] Specific embodiments relate to a fire hydrant, comprising (a) a barrel comprising a weeping hole, the barrel adapted to communicate with a water supply through a main valve; (b) a nozzle associated with the barrel, the nozzle comprising a first end adapted to receive at least one of a nozzle cap or a hose; (c) a protection system located between the first end of the nozzle and the main valve, the protection system adapted to prevent introduction of external materials into the barrel but to allow water to exit through the nozzle under pressure; and (d) at least one check valve adapted to allow air to enter the barrel between the protection system and the main valve.

[0017] In some embodiments, the protection system is located in the barrel and the check valve is located in a vertical wall of the barrel. In other embodiments, the protection system is located in the nozzle and the check valve is located in the nozzle between the protection system and the barrel. In further embodiments, the protection system is located inside the barrel between the nozzle and the main valve, and the at least one check valve is located between the protection system and the main valve.

[0018] The at least one check valve may comprise a lower check valve located in the barrel of the hydrant and/or an upper second check valve located between the first end of the nozzle and the protection system.

[0019] The check valves described herein are intended to be usable with various type of protection systems, For examples, the protection system may comprise a protective valve adapted to interact with a seat to provide a seal between the first end of the nozzle and the main valve. It may comprise a rotatable protection device housed within the nozzle, the protection device having a first position adapted to prevent the flow of water from the main valve to the first end of the nozzle and a second position adapted to allow water to flow from the main valve to the first end of the nozzle.

[0020] In one embodiment, the at least one check valve comprises an inner check valve located on the nozzle between the protection system and the main valve. It may also have a second check valve located between the first end of the nozzle and the protection system, wherein the second check valve comprises an outer check valve located on the nozzle.

[0021] Embodiments of the check valve system may have the one or more check valves provided with one or more shields adapted to cover the check valve.

[0022] Further embodiments include nozzle attachments. For example, there is provided a fire hydrant, comprising (a) a barrel comprising a weeping hole, the barrel adapted to communicate with a water supply through a main valve; (b) a nozzle associated with the barrel, the nozzle comprising a first end; (c) a nozzle attachment adapted to be secured to the first end of the nozzle at one end and further comprising a hose/cap receiving end; (d) a protection system located on the nozzle attachment, the protection system adapted to prevent introduction of external materials into the barrel but to allow water to exit through the nozzle attachment under pressure; and (e) at least one check valve on the nozzle attachment adapted to allow air to enter the barrel between the protection system and the main valve. There may also be provided a second check valve located between the first end of the nozzle and the protection system. The protection may comprise a seat, an anchor member, a biasing member, and a stopper, wherein the biasing member forces the stopper against the seat, creating a seal.

[0023] In a more general sense, there is provided a fire hydrant comprising a nozzle, a barrel, and a main valve, further comprising: (a) a protection system located between the nozzle and the main valve, the protection system adapted to prevent introduction of external materials into the barrel but to allow water to exit through the nozzle under pressure; and (b) a check valve adapted to allow air to enter the barrel between the protection system and the main valve.

BRIEF DESCRIPTION OF THE FIGURES

[0024] FIG. **1**A shows a cross-sectional view of a hydrant employing a weeping system according to one embodiment of the present invention.

[0025] FIG. **1**B shows a cross-sectional view of a hydrant employing a weeping system according to a further embodiment of the present invention.

[0026] FIG. **2** shows a cross-sectional view of a hydrant with a nozzle attachment employing a weeping system according to another embodiment of the present invention.

[0027] FIG. **3** shows a close up view of the nozzle attachment of FIG. **2**.

[0028] FIG. **4** shows a cross-sectional view of a hydrant with a nozzle and another embodiment of a protection device that may be used with embodiments of the weeping systems described herein.

[0029] FIG. **5** shows the protection device of FIG. **4** in a first closed position.

[0030] FIG. **6** shows the protection device of FIG. **4** in a second open position.

DETAILED DESCRIPTION

[0031] One or more of various structures and embodiments according to the present invention include an improved weeping system for a fire hydrant incorporating a protection system. The weeping system is adapted to prevent the pooling of liquid within the fire hydrant or other attached devices. The system provides a secondary opening, such as one or more check valves, within a chamber or barrel of the hydrant, allowing air to enter the chamber and replace the liquid. The one or more check valves may be located along the vertical barrel of the hydrant, at or near a nozzle of the hydrant, at or near a nozzle attachment of the hydrant, or at any other appropriate location of the hydrant or nozzle. Improved weeping systems according to various embodiments of the present invention allow for the safe drainage of compartments within the fire hydrant or various attachments when the hydrant's main and protective valves or devices are closed. A weeping system or other structure according to various embodiments of the present invention preferably interacts with the protective valve or device. Such systems may be used with wet and dry barrel hydrants as well as with hydrants employing various types of nozzle attachments.

[0032] FIG. 1A shows a conventional dry barrel fire hydrant **10** with a secondary protective valve **18** that cooperates with a weeping system. The hydrant **10** typically includes a substantially vertical barrel **12** through which water may flow from a water main into a fire hose. At one end of the barrel is a main valve **14**, which controllably interrupts fluid flow between a water supply **20** and the barrel **12**. A weeping hole **16** may be located in the wall of the barrel **12** near the main valve **14**, which allows water trapped above the main valve **14** to escape.

[0033] The upper end of the barrel may have a cap structure **22** that includes an operating nut **24** adapted to rotate within a housing cover **26**. The operating nut **24** may include threads **28** that receive threads on an actuator rod **30**, which in turn connects to the main valve **14**. The cap structure **22** seals the top portion of the barrel **12** to prevent the flow of water, and fire fighters may use the operating nut **24** to open the main valve **14** via the actuator rod **30**. The hydrant **10** also includes at least one nozzle **32** (and can feature more that one nozzle in some embodiments.) Each nozzle typically has a first end **33** adapted to receive at least one of a cap or a hose. First end **33** is typically threaded. When a hose is not attached to the nozzle **32**, the nozzle **32** may be closed with a cap **34**. Caps **34** are typically threaded and are screwed onto the first end **33** of nozzle **32**.

[0034] An insert comprising a protective valve **18** is located within the barrel **12** above the main valve **14**. The protective valve **18** interacts with a seat **36** to prevent toxins or liquids or other foreign objects from entering the hydrant **10** through the nozzle **32** and infiltrating the water system. This is one example of a retrofitting option that can be applied to an existing hydrant. The top portion of the hydrant may be removed from the lower portion at the breakaway section and an insert (e.g., a round tube of metal) may be positioned inside. (The lower edge of the insert has an angled portion that helps ease the transition from the inner portion of the lower hydrant to the insert; it urges smooth upward water flow and prevents water turbulence during the hydrant's use.) At the top of insert is an o-ring or quad ring that forms a seat **36** for the protective valve **18**. In some embodiments, the insert may have a cast-in valve that allows water to drain from portions of the insert.

[0035] In some embodiments, the seat **36** is affixed to the interior cavity **38** of the fire hydrant **10** using an adhesive or mechanical means or any other appropriate securing mechanism. The seat **36** may be casted into a upper replacement body. Seat **36** and engages a secondary protective valve structure **18** that is positioned between the nozzle **32** and the main valve **14**. The protective valve structure **18** closes the channel of the hydrant in order to make it more difficult or impossible to introduce toxins to a water supply through the fire hydrant. In essence, it prevents (or substantially prevents) the flow of water through the valve **18** and thus closes off portions of the hydrant barrel **12** when the nozzle **32** is open but the main valve **14** is closed. When water pressure is applied to the valve, it moves up, compresses the spring upward, and allows water to pass into the nozzle.

[0036] Specifically, when the hydrant **10** is used to provide water to extinguish fires or for any other water-providing use, the threaded cap **34** is removed and a fire hose (not shown) is connected to the nozzle **32** (usually in a threaded fashion). The operating nut **24** is rotated with a wrench in one direction to cause the actuator rod **30** to push down on relevant portions of the main valve **14** in order to open the main valve **14**. When the valve **14** opens, water flows from the water supply **20** through the main valve **14** through the barrel **12**, out the nozzle **32**, and into the hose. When the need for water no longer exists, the nut **24** is rotated in a second direction to close the portions of the main valve. The spring then pushes the valve back down onto seat **36**.

[0037] However, water may remain in the fire hydrant cavity after these portions of the main valves are closed. Some fire hydrants provide a drain or weep hole **16** at the base of the hydrant to allow the water in the hydrant to drain. Although solutions have been provided to allow air to enter the hydrant and help water drain through weep hole (e.g., providing the hydrant with a breathable stem, an insert with a vented valve, or a vented cap that replaces the hydrant cap, all of which are discussed above), further alternate solutions are provided herein for assisting the hydrant's venting process.

[0038] Referring back to the embodiment shown in FIG. **1**, the secondary protective valve **18** prevents toxins from reaching the main water supply in order to prevent water and toxins from mixing. However, without use of one of the above venting solutions, air from the atmosphere does not reach the interior area **44** of the hydrant, and water does not always appropriately drain or weep from the weeping hole. A further solution has thus been identified by the present inventors.

[0039] Embodiments of the present invention provide a check valve system that can be located in a fire hydrant having a protection system (typically located between the first end of the nozzle and the main valve). The protection system is adapted to prevent introduction of external materials into the barrel but to allow water to exit through the nozzle under pressure, and the check valve system is adapted to allow air to enter the barrel between the protection system and the main valve. The check valve system may include one or more check valves located between the protection system and the main valve in order to help air enter the hydrant quickly and effectively. Generally, the one or more check valves are adapted to remain open when the hydrant is not in use. They allow air to enter the hydrant so that draining through the weeping system is encouraged and assisted. The one or more check valves may close when a certain level of water pressure is detected, indicating that the hydrant is in use. For example, in one embodiment, the one or more check valves close once a pressure of one and a half pounds is reached. This causes the one or more check valves to close so that water does not exit the hydrant through the check valve(s) when the hydrant is in use.

[0040] Once the hydrant is closed and the pressure is relieved, the one or more check valves automatically open and allow water to drain out and air to enter. (In various embodiments, water may drain through the one or more check valves and/or through the weeping hole.) The check valve system is designed to generally draw air into the hydrant chamber so that the hydrant will weep properly and as intended. This is particularly beneficial when a vented (or breathable) cap is not used and when the hydrant cap is replaced immediately after use. The hydrant must draw air from somewhere in order to vent, and once a regular hydrant cap is replaced, the hydrant will typically drain much slower than desired.

[0041] Specifically, as shown in FIG. **1**, embodiments of this invention provide a first, lower check valve **52** located within the barrel wall, between the main valve **14** and the protective valve **18**. In FIG. **1**, lower check valve **52** is shown as located below the protective valve **18** and seat **36**. The lower check valve **52** allows air to enter the system, which assists any collected liquid above the main valve **14** to exit through the weeping hole **16**. The lower check valve **52** allows air to enter into the portion of the hydrant **10** below the seat **36**, preventing a vacuum from being created, making it easier for the pooled liquid to exit through the weeping hole **16**.

[0042] A shield **54** may cover the lower check valve **52** along the outside of the hydrant **10**. The shield **54** prevents access to the lower check valve **52** from the outside of the barrel while allowing air to enter and exit the check valve **52**. The hydrant **10** may employ similar shields at other sites of check valves and weeping holes as well. The shield **54** may be provided in any appropriate material and in any appropriate shape or structure. Its general function is to provide an additional protective feature surrounding the check valves, in order to allow air to enter, but to prevent access to the hydrant.

[0043] FIG. **1** also shows a second, upper check valve **50** located within the barrel wall, between the first end **33** of the nozzle and the and the protective valve **18**. In FIG. **1**, upper check valve **50** is shown as located just above the protective valve **18**. The upper check valve **50** provides an exit for pooled liquid collected above the protective valve **18** when the protective valve **18** is closed. The upper check valve **50** is located within the wall of the barrel **12** of the hydrant **10** and is positioned above the seat **36**, preferably as close to the seat's upper surface **37** as possible. This ensures that even the lowest collected liquid has access to the check valve **50** to exit. Upper check valve **50** provides an opening to the atmosphere outside the hydrant in order to allow collected water located directly above the seat **36** to escape the hydrant.

[0044] Any appropriate type of valve may be used as the check valve(s) described herein. In certain embodiments, they are ⅜ inch threaded or non-threaded openings that are normally open all the time, except when the hydrant is in use. Alternatively, they may be flapper valves, pressure valves, flange valves, twistable inserts, or any other appropriate mechanism that may move to a closed position upon detection of pressure and revert back to an open position when pressure is released.

[0045] When a nozzle cap **34** is attached at the end **33** of the one or more nozzles **32** of the hydrant as shown in FIG. **1**, it is possible that the cap **34** may not form an air tight seal at the nozzle. As such, air may be allowed to enter between the nozzle **32** and the cap **34** into the hydrant **10**, which creates an atmospheric equilibrium between the compartment of the hydrant and the outside world. Atmospheric equilibrium may also be achieved by use of a breathable or vented cap, as described in U.S. Ser. No. 12/047,681. The equal pressure created helps assist the escape of liquid through the upper check valve **50**. One or more additional check valves may be included between the upper check valve **50** and the end caps in the wall of the nozzle or barrel **12** to increase the air flow into the hydrant **10**.

[0046] FIG. **1**B shows an alternate embodiment of the dry barrel fire hydrant **10** having the check valves in different locations on the hydrant **10**. In FIG. **1**B, check valves **50** and **52** are located on the back side of the hydrant. Lower check valve **52** is located between the protection system **18** and the water main valve **14**, and upper check valve **50** is located between the protection system **18** and the nozzle. Check valves **50**, **52** are also shown as both having shields **54**, which prevent access to the interior of the hydrant **10**. One or more of the check valves of all embodiments described herein may have such optional covering shields.

[0047] FIG. **2** shows a fire hydrant **110** with a weeping system that has been retrofitted with a with a nozzle attachment **111** having a protective valve **118**. Although one specific embodiment of a nozzle attachment is shown and described (and is detailed further in U.S. Publication No. 2008/0245420), it should be understood that other nozzle attachment systems having protective systems included therein are included within the scope of this invention and the appending claims. The general purpose of such nozzle attachment systems is to provide an existing hydrant with a protection system, without having to completely replace the existing hydrant. The nozzle attachment may be placed directly onto the hydrant.

[0048] As shown in FIG. **2**, the hydrant **110** includes a barrel **112** through which water may flow from a water main. At one end of the barrel is a main valve **114**, similar to the main valve **14** discussed above. The hydrant **110** may have a weeping hole **116** in its barrel wall **112** near the main valve **114**, which allows water trapped above the main valve **114** to escape. The main valve **114** is operated by an actuator rod **130**, as described above. The nozzle attachment **111** is introduced to the hydrant **110** at a nozzle **132**. It may be threaded on, and may be made of the same or different material as the barrel **112**. The nozzle attachment **111** includes a channel **115**, a protective valve **118**, and a valve seat **136** found within the channel **115**. When the protective valve **118** engages the seat **136**, a seal is formed, preventing outside liquids from entering the hydrant **110** through the nozzle attachment **111**. An o-ring, quad ring, or some type seal may help form the seal. The nozzle attachment may receive a cap **138** of the hydrant **110**.

[0049] The nozzle attachment **111** is shown in more detail in FIG. **3**. The structure of the nozzle attachment **111** prevents toxins and/or other liquids or solutions from entering the hydrant **110**, while allowing water to exit the hydrant when needed without manual control. The seat **136** may be an extension of the nozzle attachment **111** and may be essentially circular or otherwise configured to form a ledge within the channel. In use, the seat **136** engages a valve **118** that closes the channel **115** of the nozzle attachment **111**, but allows water to flow out the hose/cap receiving end **146** when a hydrant's main valve **114** is opened. The valve **118** includes an anchor **147**, a biasing member **148**, and a stopper **149**. The biasing member **148** forces the stopper **149** against the seat **136**, creating a seal. When the valve **114** of the hydrant **110** is opened, the water pressure exerts a force against a front surface of the stopper **149** that is greater than that of the force applied by the biasing member **148**, and pushes the stopper **149** in a direction parallel to that of the inner channel **115** away from the seat **136**. As such, the seal between the stopper **149** and the seat **136** is broken, and water flows from the barrel **112** through the nozzle **132** out the nozzle attachment **111**. While the valve **118** is no longer creating a barrier at the nozzle **132** to prevent toxins or other foreign substances from being introduced into the hydrant **110**, the water flowing outward may prevent any outside substance from entering into the hydrant **110** to the water supply **120**.

[0050] A first, inner check valve **152** may be located within the wall of the nozzle attachment **111** between the seat **136** and the location where the attachment **11** secures to the hydrant's nozzle **132**. The inner check valve **152** works to assist pooled liquid collected above the main valve **114** with its exit through the weeping hole **116** by allowing air to enter the hydrant. The inner check valve **152** allows air to enter into the barrel **112** of the hydrant **110** behind the seat **136** of the nozzle attachment **111**. This assists in creating an atmospheric equilibrium, making it easier for the pooled liquid to exit the hydrant **110** through the weeping hole **116**. A shield **154** may cover the inner check valve **152** along the outside of the hydrant **110**. The shield **154** prevents access to the lower check valve **152** from the outside of the barrel while allowing air to enter and exit the check valve **152**. The hydrant **110** may employ similar shields at other sites of check valves and weeping holes as well.

[0051] A second, outer check valve **150** may be positioned between the hose/cap receiving end **146** of the nozzle attachment **111** and the protective valve **118**. The outer check valve **150** provides an exit for pooled liquid collected between an attached nozzle cap **138** and the protective valve **118** when the protective valve **118** is closed. The nozzle attachment **111** is preferably oriented so that the outer check valve **150** drains downward, having gravity assist in draining of the attachment **111**. The nozzle cap **138** attached at the end of the hose/cap receiving end **146** of the nozzle attachment **111** may not form an air tight seal. As such, air may enter the nozzle attachment **111** through the cap **138** and the hose/cap receiving end **146**, assisting the escape of liquid through the outer check valve **150** by creating an atmospheric equilibrium. One or more additional check valves may also be included between the protective valve **118** and the hose/cap receiving end **146** of the nozzle attachment in order to increase the air flow into the nozzle attachment **111**. Preferably, any such check valve is located in the nozzle attachment's wall opposite the outer check valve **150**.

[0052] Although this specific nozzle attachment and its use of a check valve system has been described in detail, it should be understood that other nozzle attachment systems may be used. One example of such a further nozzle attachment system is shown and described in U.S. Publication No. 2008/0245420 FIGS. 12 and 13, which may use the check valve systems described herein. For example, nozzle globe attachment systems having hinged flapper valves may provide a protection system. The nozzle globe may screw onto the hydrant nozzle where the cap and/or hose would attach. In use, a hinged flapper opens up to allow water to pass when an appropriate pressure is reached. When that pressure is relieved, the flapper is allowed to shut via its hinged movement. These and other nozzle attachment systems may benefit from use of the check valve systems described herein.

[0053] A further embodiment of the described check valve weeping system is shown in FIG. **4**. FIG. **4** provides a fire hydrant **210** having a protection system **212** located in nozzle **214** and defined by a protection device **216** and a bracket assembly **218**. As shown in more detail in FIG. **5**, the protection device **216** is carried by the nozzle **214** and is coupled to the bracket assembly **218**. In its first closed position, the protection device **216** prevents access to the interior of the fire hydrant and enables the protective device **216** to act as a barrier. In its second open position shown in FIG. **6**, water is permitted to flow from the interior of the fire hydrant out through the nozzle. As a result of the water pressure or flow, the protection device **216** is rotated via the bracket **218** to allow water to flow past device **216**. Examples of such protection systems **212** are shown and described in U.S. Publication No. 2007/0028967, from which one embodiment is described herein, but from which all embodiments are hereby incorporated herein by reference.

[0054] Such hydrants may also be provided with a one or more check valves. For example, one or more check valves may be located within the wall of the nozzle(s) **214** and/or the barrel of the hydrant. For instance, a check valve may be found in the wall of the nozzle, between the protection device **216** and the hose/cap receiving end of the nozzle, which may provide an outlet, or exit, for pooled liquid. Additionally, one or more check valves may be located with access to the inner chamber of the barrel of the hydrant behind the protection device, to assist in creating an atmospheric equilibrium to make it easier for liquid to exit through a weeping hole located above a main valve.

[0055] Specifically, hydrant **210** may have a first inner check valve **252** located within the wall of the nozzle **214** behind the protective device **216**, such that it is located between the protective device **216** and the main valve. For example, FIG. **4** shows inner check valve **252** located near an area where the nozzle **214** and the hydrant barrel **220** meet. The inner check valve **252** works to assist pooled liquid collected above the main valve (not shown, but located near the base of the hydrant) with its exit through the weeping hole **226**. The inner check valve **252** allows air to enter into the barrel **220** of the hydrant **210**, behind the protection device **216** of the nozzle **214**. This assists in creating an atmospheric equilibrium, making it easier for the pooled liquid to exit the hydrant **210** through a weeping hole **226**.

[0056] As described and shown above with other embodiments, an optional shield may cover the inner check valve **252** along the outside of the hydrant **210**. The shield prevents access to the lower check valve **252** from the outside of the barrel while allowing air to enter and exit the check valve **252**. The hydrant **210** may employ similar shields at other sites of check valves and weeping holes as well.

[0057] Optionally, hydrant **210** may also feature a second outer check valve **250** positioned between the end of the nozzle **214** and the protection device **216**. The outer check valve **250** provides an exit for pooled liquid collected between an attached nozzle cap (not shown) and the protection device **216** when the protection device **216** is closed. The outer check valve **250** drains downward, having gravity assist in draining of the nozzle **214**. A nozzle cap (not shown) attached at the end of the nozzle **214** may not form an air tight seal. As such, air may enter the nozzle **214** through the cap and the nozzle end, assisting the escape of liquid through the outer check valve **250** by creating an atmospheric equilibrium. One or more additional check valves may also be included between the protection device **216** and the end of the nozzle to increase the air flow into the nozzle. Preferably, any such check valve is located in the nozzle's wall opposite the outer check valve **250**.

[0058] Other embodiments are also envisioned and within the scope of the pending claims. For example, in embodiments of this invention using a nozzle attachment with a protective valve, the inner check valve may be found in the wall of the barrel of the hydrant in embodiments of this invention using a nozzle attachment with a protective valve, the inner check valve may be found in the wall of the barrel of the hydrant. In embodiments using a nozzle with a protection device directly secured therein, the inner check valve may also be found in the wall of the barrel of the hydrant, anywhere along the length of the hydrant.

[0059] Although some hydrants are currently being made with protection systems or valves incorporated therein, existing hydrants are still being retrofitted with protection systems in order to prevent introduction of dangerous chemicals or substances. The check valve systems described herein are intended for use with both new hydrant systems designed to incorporate protection systems, as well as options provided to retrofit existing hydrants. Such retrofitting options include but not are limited to nozzle attachments, nozzle globes, hydrant inserts, replacement of the upper hydrant barrel body, and other systems.

[0060] Changes and modifications, additions and deletions may be made to the structures and methods recited above and shown in the drawings without departing from the scope or spirit of the invention and the following claims.

What is claimed is:

1. A fire hydrant, comprising:

(a) a barrel comprising a weeping hole, the barrel adapted to communicate with a water supply through a main valve;

(b) a nozzle associated with the barrel, the nozzle comprising a first end adapted to receive at least one of a nozzle cap or a hose;

(c) a protection system located between the first end of the nozzle and the main valve, the protection system adapted to prevent introduction of external materials into the barrel but to allow water to exit through the nozzle under pressure; and

(d) at least one check valve adapted to allow air to enter the barrel between the protection system and the main valve.

2. The fire hydrant of claim **1**, wherein the protection system is located in the barrel and the check valve is located in a vertical wall of the barrel.

3. The fire hydrant of claim **1**, wherein the protection system is located in the nozzle and the check valve is located in the nozzle between the protection system and the barrel.

4. The fire hydrant of claim **1**, wherein the protection system is located inside the barrel between the nozzle and the main valve, and wherein the at least one check valve is located between the protection system and the main valve.

5. The fire hydrant of claim **1**, wherein the at least one check valve comprises a lower check valve located in the barrel of the hydrant.

6. The fire hydrant of claim **1**, wherein the protection system is located inside the barrel between the nozzle and the main valve, further comprising a second check valve located between the first end of the nozzle and the protection system.

7. The fire hydrant of claim **6**, wherein the second check valve comprises an upper check valve.

8. The fire hydrant of claim **1**, wherein the protection system comprises a protective valve adapted to interact with a seat to provide a seal between the first end of the nozzle and the main valve.

9. The fire hydrant of claim **1**, wherein the protection system comprises a rotatable protection device housed within the nozzle, the protection device having a first position adapted to prevent the flow of water from the main valve to the first end of the nozzle and a second position adapted to allow water to flow from the main valve to the first end of the nozzle.

10. The fire hydrant of claim **9**, wherein the at least one check valve comprises an inner check valve located on the nozzle between the protection system and the main valve.

11. The fire hydrant of claim **9**, further comprising a second check valve located between the first end of the nozzle and the protection system, wherein the second check valve comprises an outer check valve located on the nozzle.

12. The fire hydrant of claim **1**, further comprising a shield adapted to cover the check valve.

13. Afire hydrant, comprising:

(a) a barrel comprising a weeping hole, the barrel adapted to communicate with a water supply through a main valve;

(b) a nozzle associated with the barrel, the nozzle comprising a first end;

(c) a nozzle attachment adapted to be secured to the first end of the nozzle at one end and further comprising a hose/cap receiving end;

(d) a protection system located on the nozzle attachment, the protection system adapted to prevent introduction of external materials into the barrel but to allow water to exit through the nozzle attachment under pressure; and

(e) at least one check valve on the nozzle attachment adapted to allow air to enter the barrel between the protection system and the main valve.

14. The fire hydrant of claim **14**, further comprising a second check valve located between the first end of the nozzle and the protection system.

15. The fire hydrant of claim **1**, wherein the protection system comprises a seat, an anchor member, a biasing member, and a stopper, wherein the biasing member forces the stopper against the seat, creating a seal.

16. A fire hydrant comprising a nozzle, a barrel, and a main valve, further comprising:

(a) a protection system located between the nozzle and the main valve, the protection system adapted to prevent introduction of external materials into the barrel but to allow water to exit through the nozzle under pressure; and

(b) a check valve adapted to allow air to enter the barrel between the protection system and the main valve.

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