FIRE HYDRANT CHECK VALVE

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Abstract

A check valve for a fire hydrant system is configured to allow fluid to flow in a direction from a pressurized water supply to a fire hydrant and to restrict fluid from flowing from the fire hydrant to the pressurized water supply. The check valve includes an internal cavity and a flapper capable of moving between an open position wherein the flapper is positioned against a side of the internal cavity so as to substantially not impede flow of fluid therethrough and a closed position wherein the flapper creates a seal to restrict flow of fluid therethrough.

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FIRE HYDRANT CHECK VALVE

TECHNICAL FIELD

[0001] This invention relates generally to fire hydrant systems and in particular to contamination prevention systems for fire hydrants.

BACKGROUND

[0002] Fire hydrants are relatively simple valves that are typically connected to a pressurized municipal water supply via an underground water pipe to provide water at the surface in case of an emergency. A typical fire hydrant system includes a barrel containing one or more nozzles for connecting fire hoses to the fire hydrant system. A valve inside the barrel is generally in a closed position restricting water from flowing into the barrel, but the valve may be opened by turning a bolt with a portion exposed outside the barrel. The valve located inside the barrel restricts water from flowing from the pressurized water supply to the barrel and exiting the barrel via the nozzle when the fire hydrant is not in use. A nozzle cap disposed on the nozzle restricts foreign materials from entering the fire hydrant, but may also restrict the flow of water through the nozzle when the valve is in the open position. Additionally, a shut off valve is typically located along an underground water pipe, usually in an open position. The shut off valve may be closed to restrict the flow of water during maintenance or replacement of the fire hydrant.

[0003] It has become a concern, particularly after the terrorist events of Sep. 11, 2001, that individuals may attempt to introduce harmful foreign contaminants into a municipal water supply through a fire hydrant. It is believed that such individuals may attempt to connect a hose containing a contaminant to the fire hydrant nozzle. The individuals could connect the other end of the hose to an apparatus capable of producing a pressurized fluid flow exceeding the pressure of the pressurized municipal water supply. The greater pressure in the hose could thus overcome the water pressure in the fire hydrant system to create a backflow of fluid to introduce the contaminants into the municipal water supply.

[0004] Various approaches are known that attempt to address these security concerns. For example, it is known to place a locking mechanism on the hydrant to restrict unauthorized access. Another known system includes a check valve located in the barrel itself to restrict backflow from the barrel into the municipal water supply. Another apparatus includes a check valve integral with the elbow or shoe portion of the fire hydrant system.

[0005] There are several problems associated with the above mentioned attempts to restrict backflow in a fire hydrant system. Locking mechanisms require firefighters to possess means of opening the fire hydrant, which can result in delayed access to the fire hydrant during an emergency. Check valves located in the barrel itself or in the hydrant shoe require customers to purchase entire new barrel or shoe portions of the fire hydrant system to implement the security protections or to replace a failed valve, and distributors are forced to stock a separate line of hydrants to accommodate those customers desiring a check valve with their hydrants. The known integral check valves typically include structures that extend into the water flow path that at least in part interrupt water flow through the system. Additionally, these known check valves with structures in the water flow path substantially prevent pigging, a technique used to clean the water supply system by placing a flexible scrubber into the water line with the pressure shut off and then opening a hydrant so the scrubber is forced down the line by water pressure, removing built up scale and tuberculation. Moreover, the check valves in these known systems typically have problems with water hammer, a pressure wave or surge caused when water in motion is forced to suddenly stop, for example, with the sudden closing of the valve.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The above needs are at least partially met through provision of the fire hydrant check valve described in the following detailed description, particularly when studied in conjunction with the drawings, wherein:

[0007] FIG. 1 comprises a side view of a fire hydrant system including a check valve as configured in accordance with various embodiments of the invention;

[0008] FIG. 2 comprises a perspective view with a portion thereof cut away of a hydrant check valve including a swiveling mechanical joint flange at the inlet end as configured in accordance with various embodiments of the invention;

[0009] FIG. 3 comprises a side view with a portion thereof cut away of a hydrant check valve without a swiveling mechanical joint flange at the inlet end as configured in accordance with various embodiments of the invention;

[0010] FIG. 4 comprises a side view of a hydrant check valve connected to a fire hydrant system as configured in accordance with various embodiments of the invention;

[0011] FIG. 5a comprises a cross-sectional view of the seat ring of FIG. 6 without a sealing element attached to a front face of the seat ring in accordance with various embodiments of the invention;

[0012] FIG. 5b comprises a cross-sectional view of the seat ring of FIG. 6 with a sealing element disposed on a front face of the seat ring in accordance with various embodiments of the invention;

[0013] FIG. 6 comprises a front elevation view of a seat ring of the fire hydrant check valve in accordance with various embodiments of the invention;

[0014] FIG. 7 comprises a side elevation view of the flapper of the fire hydrant check valve in accordance with various embodiments of the invention;

[0015] FIG. 8 comprises a front elevation view of the flapper of the fire hydrant check valve in accordance with various embodiments of the invention;

[0016] FIG. 9 comprises a perspective view of a traditional fire hydrant system assembly with thrust blocking;

[0017] Skilled artisans will appreciate that elements in the figures are illustrated for simplicity and clarity and have not necessarily been drawn to scale. For example, the dimensions and/or relative positioning of some of the elements in the figures may be exaggerated relative to other elements to help to improve understanding of various embodiments of the present invention. Also, common but well-understood elements that are useful or necessary in a commercially feasible embodiment are often not depicted in order to facilitate a less obstructed view of these various embodiments of the present invention. It will further be appreciated that certain actions and/or steps may be described in a particular order of occurrence while those skilled in the art will understand that such specificity with respect to sequence is not actually required. It will also be understood that the terms and expressions used herein have the ordinary technical meaning as is accorded to such terms and expressions by persons skilled in the technical
field as set forth above except where different specific meanings have otherwise been set forth herein.

DETAILED DESCRIPTION

[0018] Generally speaking, pursuant to these various embodiments, a fire hydrant check valve is configured to allow fluid to flow in a fire hydrant system from a pressurized water supply to a fire hydrant and restrict fluid from flowing in the opposite direction. The fire hydrant check valve includes a flapper that is configured to move between a closed position to create a seal with a seat ring to restrict the flow of fluid from an outlet end to an inlet end of the internal cavity and an open position to substantially not impede fluid flow from the inlet end to the outlet end. By one approach, a torsion spring provides a spring force to the flapper to hasten the movement of the flapper and prevent a water hammer effect. In one example, the check valve includes a swiveling mechanical joint flange disposed on at least one of the inlet end and the outlet end. The swiveling mechanical joint flange allows the check valve to be installed into different fire hydrant systems using different end connections.

[0019] So configured, the fire hydrant check valve allows water to flow from a pressurized municipal water supply to the fire hydrant in case of emergencies, but the valve also restricts the backflow of water from the fire hydrant to the pressurized municipal water supply to stop introduction of contaminants into the municipal water supply. The check valve connections may be adaptable so that the check valve may be connected to existing fire hydrant systems without requiring customers to purchase entirely new fire hydrants or for distributors to carry separate components for customers requiring backflow protection. The check valve in various approaches is designed such that pigging the system is possible because there are no undue restrictions in the water flow path.

[0020] These and other benefits may become clearer upon making a thorough review and study of the following detailed description. Referring now to the drawings and in particular to FIG. 1, an example fire hydrant system with a check valve that is compatible with many of these teachings will now be presented. A fire hydrant system 2 generally includes a fire hydrant 4 with a barrel 6 extending generally vertically above ground level. The barrel 6 includes at least one nozzle 8 with a cap 10 that emergency personnel can remove to connect a hose to the nozzle 8 to receive water flow. A vertical pipe 12 extends generally vertically downward under ground level from end in communication with the barrel 6. An elbow 14, commonly known as a shoe and/or base, in communication with the vertical pipe 12, extends vertically downward from the vertical pipe 12 and shifts approximately ninety degrees to extend generally horizontally therewith from under ground level. An underground water pipe 16 is in fluid communication with a pressurized water supply 18 that supplies water to the fire hydrant 4. A check valve 20 is separate from and in communication with the elbow 14 at an outlet end 22 of the check valve 20. The check valve 20 is in communication with the underground water pipe 16 at an inlet end 24 of the check valve 20. So configured, the check valve 20 allows flow of water from the underground water pipe 16 to the barrel 6 and restricts the flow of water from the barrel 6 to the underground water pipe 16.

[0021] In the example of FIG. 1, the pressurized water supply 18 contains water tending to flow from the pressurized water supply 18 to the fire hydrant 4 and specifically to one or more nozzles 8 located above ground where the pressurized water can be accessed by emergency personnel. The fire hydrant 4 also includes a control valve (not shown) that is normally in a closed position to prevent water from flowing into the barrel 6 of the fire hydrant 4 when it is not in use. The control valve must be manually opened by emergency personnel to initiate the flow of water into the barrel 6, usually by turning a bolt 26 disposed on the top of the barrel 6. The nozzle 8 includes a cap 10 to prevent water from flowing from the fire hydrant 4 when it is not in use and when the control valve is open. Thus, when the fire hydrant 4 is not in operation, the cap 10 and the control valve ensure that there is substantially no fluid flow through and from the fire hydrant system 2, but when the fire hydrant 4 is in operation, fluid flows from the pressurized water supply, through the fire hydrant system 2, and out of the fire hydrant 4 through the one or more nozzles 8. Typically, located along the underground water pipe 16 is an emergency shutoff valve 28 for manually cutting off the water supply to the fire hydrant in the case of an emergency such as the failure of the hydrant 4, during routine maintenance, or during the replacement of the fire hydrant 4.

[0022] Those skilled in the art will recognize and appreciate that such a fire hydrant may comprise a dry barrel fire hydrant or a wet barrel fire hydrant. These options are well known and understood in the art and require no further description here.

[0023] With reference to FIGS. 2 and 3, an example check valve 20 will be further described. In this example, a flapper 30 is disposed in the check valve 20. The flapper 30 includes an arm portion 32 attached to a pivot point 34 such that the flapper 30 can move between an open position 36 and a closed position 38. In this example, the pivot point 34 is defined by a pair of valve flanges 35 extending from the valve body 58 and a hinge pin 37 extending through apertures in the valve flanges 35. The hinge pin 37 secured through the valve flange 35 apertures defines the pivot point 34 to which the flapper 30 and seat ring 44 are attached. In an alternative approach the pivot point 34 may be defined by pair of cavities formed in the inner wall of the check valve body 58 on each side of the flapper arm terminal ends 48, and each end of the hinge pin 37 extending into one of the cavities. The hinge pin 37 should be of sufficient length so that it may not slide laterally within the cavities by an amount great enough for the hinge pin 37 to slip out of one of the cavities. In this approach, the hinge pin 37 secured on both ends into the cavities define the pivot point 34 to which the flapper 30 and seat ring 44 are attached. Regardless of the approach used to define the pivot point 34, in the open position 36, the flapper 30 is positioned against a top portion 40 of the check valve 20 so as to substantially not impede fluid flow from the underground water pipe 16 to the barrel 6 as the fluid passes through the check valve 20. In the closed position 38, the flapper 30 is positioned with a sealing face 42 of the flapper 30 in contact with a seat ring 44 to create a seal between the flapper 30 and the seat ring 44 restricting the flow of water from the fire hydrant 4 toward the pressurized water supply 18. The seat ring 44 may be disposed on or integral with the check valve 20. For instance, the seat ring 44 may be disposed on the inlet end 24 such that the seat ring 44 engages the flapper 30 when the flapper 30 is in the closed position 38. In the example of FIGS. 2 and 3, the check valve 20 is configured such that the flapper arm portion 32 is attached to a pivot point 34 that is located at the top of the check valve 20 closest to ground level. So situated, the force
of gravity, in conjunction with assistance from the torsion spring 56 as described herein, will act downward on the flapper 30, to hasten movement thereof to the closed position 38.

[0024] As illustrated in FIGS. 5a and 6, an example seat ring 44 includes a body 100 having a generally ring shape with an outer surface 102 at an outer diameter and an inner surface 104 located at an inner diameter of the body 100. The inner surface 104 defines a generally circular hole extending longitudinally through the seat ring body 100 with respect to a water flow direction. In this example, the seat ring 44 includes several rounded projections 106 extending from the seat ring body 100 outer surface 102 and having bore holes 108 extending therethrough for accepting bolts or other fasteners. The seat ring body 100 has a front surface 122 that faces the body inlet 50, and a rear surface 120 that faces the internal cavity 60.

[0025] Referring again to FIGS. 2 and 3, an inlet inner surface 51 of the check valve body 58 inlet 50 extends circumferentially around the inlet 50 opening and includes threaded cavities 53 positioned thereabout to match the bore holes 108 of the seat ring 44. The front surface 122 of the seat ring 44 is positioned against the inlet inner surface 51, such that the seat ring flanges 118 are located at the top of the seat ring 44 with respect to the above ground surface. Sealing elements are positioned between the rear surface 120 of the seat ring 44 and the flapper 30 when the flapper 30 is in the closed position 38 and between the front surface 122 of the seat ring 44 and the check valve body 58 to create water-tight seals therewith. In one aspect, the sealing elements include one O-ring 112 disposed in a channel 110 defined by the rear surface 120 of the seat ring 44 configured to create a water-tight seal between the rear surface 120 of the seat ring 44 and the flapper 30 in the closed position 38. The sealing elements also include another O-ring 113a disposed in a channel 111a defined by the inlet inner surface 51 of the check valve body 58 configured to create a water-tight seal between the front surface 122 of the seat ring 44 and the inlet inner surface 51 of the check valve body 58.

[0026] In one approach, a recess in the form of a narrow seat channel 110 extends circularly around the seat ring body 100 to rear surface 120. A similar seat channel 111a extends around the inlet inner surface 51. The rear channel’s 110 inner surfaces are generally rounded and typically have both a small width and depth. The upper edges of the rear channel’s 110 inner surfaces merge with the seat ring body rear surface 120 at upper inner and outer junctures 114 and 116. The distance between the inner and outer junctures 114 and 116 is less than the distance between the center portions of the channel inner surface walls allowing a flexible O-ring 112 to be snap fitted into the channel 110. A similar channel and O-ring configuration is applied to the inlet inner surface 51 inlet channel 111a.

[0027] Rear and inlet O-rings 112 and 113a have ring-shaped bodies narrower than the seat ring body. The O-ring bodies are sized to snap fit into the front and inlet channels 110 and 111a, with a portion of the O-ring body extending into the channels 110 and 111a to engage the channels’ inner surfaces. Additional portions of the O-ring bodies extend beyond the upper junctures 114 and 116 and 114a and 116a to engage other surfaces.

[0028] The portion of the inlet O-ring 113a extending beyond the upper junctures 114a and 116a engages the seat ring front surface 122. Bolts pass through the bore holes 108 of the seat ring 44 and are tightened into threaded cavities 53 of the inlet inner surface 51 to secure the seat ring 44 to the inlet inner surface 51. Upon sufficient tightening, the inlet O-ring 113a is compressed between the seat ring front surface 122 and the inlet inner surface 51 forming a water-tight seal therebetween. Similarly, a rear O-ring 112 is snap fit into the rear channel 110 extending about the seat ring rear surface 120, with a portion extending into the rear channel 110 and engaging the rear channel 110 inner surface, and a portion extending beyond the rear channel 110 upper junctures 114 and 116. Thus, when the flapper 30 is in the closed position 38, the flapper sealing face 42 engages the rear O-ring 112, compressing the rear O-ring 112, to form a water-tight seal between the seat ring rear surface 120 and the flapper sealing face 42 to restrict water or other contaminants from passing therethrough.

[0029] In another approach (FIG. 5b), a front O-ring 113b replaces the inlet O-ring 113a of the previous example. In this approach, a front channel 111b of substantially similar configuration to rear channel 110 extends circularly about the front surface 120 of the seat ring 44. The front O-ring 113b is snap fit into the front channel 111b, so that a portion thereof protrudes slightly beyond channel upper junctures 114b and 116b to engage the inlet inner surface 51 when the seat ring 44 is attached thereto forming a water-tight seal therebetween. In this approach, the front O-ring 113b and front channel 111b replace the inlet O-ring 113a and inlet channel 111a such that the inlet inner surface 51 provides a flat surface to engage the front O-ring 113b.

[0030] Although the seal in the above examples is accomplished through the use of O-rings disposed in O-ring channels, other sealing elements and methods known in the art for creating a seal between two flat surfaces, such as permanently vulcanized rubber surfaces, mechanically retained gasket materials, or gasket materials that are bonded to the surfaces via adhesives, may be applied in various approaches.

[0031] In one aspect of the invention, a pair of parallel seat ring flanges 118 extend from the top portion of the seat ring 44 obliquely to the seat ring vertical axis 124 toward the internal cavity 60. The seat ring flanges 118 are symmetrical about the seat ring vertical axis 124, and each contains an identical bore hole 126 extending laterally with respect to the direction of water flow, through its upper portion, such that a hinge pin 37 can extend laterally across the water flow path through the seat ring flanges 118 bore holes 126.

[0032] As illustrated with respect to the flapper 30 shown in FIGS. 2, 3, 7, and 8, a flapper body 46 of the flapper 30 is generally disk shaped and includes a sealing face 42 located approximately around its circumference. By one approach, the flapper 30 is preferably made from bronze with no lead, no zinc, and high strength, although other materials may be used such as stainless steel, titanium, or other materials that provide strength, durability, and corrosion resistance in a fluid environment. Extending distally from the sealing face 42 is a pair of symmetrical flapper arm portions 32. The flapper arm portions 32 are typically integral with the flapper body 46, but may also be securely connected to the flapper body 46. Each flapper arm portion 32 includes a terminal end 48 for pivotably mounting the flapper arm portion 32 to a pivot point 34 in the check valve 20. Typically, the terminal end 48 includes a bore hole 49 extending therethrough for pivotably mounting the flapper 30 to the hinge pin 37 extending through the bore holes 126 of the seat ring flanges 118 and the valve flanges 35. Thus configured, the flapper 30 can rotate about the hinge pin 37 between the open position 36 and the closed position 38.
As discussed above, in the closed position, the flapper 30 sealing face 42 engages the portion of the rear O-ring 112 or other sealing element that extends beyond the upper junctions 114 and 116 of the rear channel 110, forming a water-tight seal for restricting water or contaminants from flowing there-through.

The check valve 20 includes an inlet 50 for receiving water from the underground water pipe 16 and an outlet 52 for discharging water to the elbow 14 of the fire hydrant 4. Typically, when the fire hydrant system 2 is in operation, the flow of water from the underground water pipe 16 to the barrel 6 will create a force against the flapper 30 in a direction from the inlet 50 toward the outlet 52 such as to bias the flapper 30 toward the open position whereby the flapper 30 is positioned against an inner portion 40 of the check valve 20. In this example, the check valve 20 is configured such that the flapper 30 is positioned against a top portion 54 of the check valve 20, closer to the ground surface, when in the open position 36 so that the force of gravity, in conjunction with assistance from the torsion spring 56 as described herein, will act downward on the flapper 30, to hasten movement thereof to the closed position 38. When in the open position 36, the flapper 30 is positioned to substantially not impede the fluid flow from the underground water pipe 16 to the barrel 6.

By one approach, the check valve 20 includes a torsion spring 56 that provides a spring force against the flapper 30. In the examples of FIGS. 2 and 3, the torsion spring 56 is disposed on the pivot point 34 with one portion in contact with a side of the flapper 30. The torsion spring 56 may also be disposed on a separate pin in the check valve 20 and have one portion in contact with a side of the flapper 30. In this example, the torsion spring 56 biases the flapper 30 to the closed position 38 by exerting a spring force against an inside side of the flapper 30 with regard to the interior of the check valve 20. In this manner the torsion spring 56 impedes the movement of the flapper 30 toward the open position 36 and hastens the movement of the flapper toward the closed position 38 preventing a water hammer effect caused by a pressure wave from the hydrant 4 from occurring. A sudden closure of a hydrant valve can cause a pressure wave to propagate through the system toward the water supply, potentially damaging portions of the pipe system. By closing the flapper 30 quickly, the pressure wave reflecting back from the hydrant 4 to the water system can be stopped or mitigated.

By another approach, as illustrated in FIGS. 2 and 4, the swiveling mechanical joint flange 80, also known as a swivel gland, is disposed on the inlet 50. The swiveling mechanical joint flange 80 can be included in one of the outlet 52 or the inlet 50. If the swiveling mechanical joint flange 80 is included at the outlet 52, it is configured to rigidly couple the outlet 52 to the elbow 14 or structure leading to the elbow 14, and if the swiveling mechanical joint flange 80 is included at the inlet 50, it is configured to rigidly couple the inlet 50 to the underground water pipe 16 or structure leading to the underground water pipe 16. The swiveling mechanical joint flange 80 may be disposed on or integral with the check valve 20.

The swiveling mechanical joint flange 80 rigidly couples the check valve 20 to the elbow 14 and/or the underground water pipe 16 and prevents axial movement thereof without the need for yokes and rods 90 or thrust blocks 92 as used in the known system configuration illustrated in FIG. 9. In such a system, thrust blocks 92 are positioned to counteract the axial forces caused by the system water pressure’s tending to push apart pipe couplings. In some systems, yokes and rods 90 are added with increased cost and installation effort to support the pipe couplings. A check valve 20 with a swiveling mechanical joint flange 80 reduces the reliance on such structures, such as braces, blocking, or strapping, to counter the axial forces. The swiveling mechanical joint flange 80 also provides flexibility by being adaptable for attachment to many different components so that the check valve 20 can be installed directly into existing fire hydrant systems without the need for replacing existing components with specialized components. The swiveling mechanical joint flange 80 allows for full 360 degree rotation to provide installer freedom, for example, in making grade adjustments regardless of the placement. Additional freedom is provided angularly to fit.

With reference again to FIGS. 2 and 3, the check valve 20 includes a body 50 that defines an internal cavity 60. The body 50 is typically made of ductile cast iron, but it can also be made of gray cast iron, brass, bronze, stainless steel, or other like materials. The internal cavity 60 is generally cylindrical in shape and includes an inlet end 24 and an outlet end 22. The inlet end 24 and the outlet end 22 have respective openings for receiving water from a pressurized water supply and discharging water to a fire hydrant 4. In one approach, the inlet end 24 and outlet end 22 have a respective inlet end diameter 25 and an outlet end diameter 23 that are approximately equal. In this example, the body 50 additionally defines a recess portion 66 of the internal cavity 60 located adjacent to an internal cavity opening 70. The recess portion 66 may be located at a top portion 54 of the internal cavity 60, closer to the ground level, such that gravity biases the flapper 30 away from the open position 36 and toward the closed position 38. The recess portion 66 is sized to substantially accept the flapper body 46 when the flapper 30 is in the open position 36 so that a diameter of the internal cavity opening 70 is at least approximately equal to at least one of the inlet end diameter 25 and the outlet end diameter 23. In this configuration, the flapper 30 substantially does not impede the flow of fluid from an inlet 50 to the outlet 52 through the internal cavity opening 70, because there are no valve portions or other structures disposed in the fluid flow path. So configured, fluid flow to the fire hydrant is not interrupted by the check valve. Also, traditional system cleaning methods, including pigging, can be practiced with little risk of interference by the check valve 20.

A seat ring 44 is typically disposed on the inlet end 24 of the check valve 20. The check valve 20 includes a flapper 30, as described above, which is pivotally attached to the pair of valve flanges 35 disposed on or integral with the valve body 58 with the hinge pin 37. Thus configured, the flapper 30 can pivot between a closed position 38 and an open position 36. In the closed position, the flapper 30 creates a seal with the seat ring 44 and the inlet 50 to restrict the flow of fluid from the outlet end 22 to the inlet end 24.

In another approach, a torsion spring 56 is disposed on a pivot point 34, and one portion of the torsion spring 56 is in contact with one side of the flapper 30 to bias the flapper 30 toward the closed position as illustrated in FIGS. 2 and 3. In this example, the pivot point 34 is located in the recess portion 66 such that the pivot point 34 is substantially outside of the internal cavity opening 70 so as not to impede the flow of fluid therethrough. In the example of FIGS. 2 and 3, the torsion spring 56 is in contact with an inside surface of the flapper 30 with respect to the internal cavity 60 so that the torsion spring 56 biases the flapper to the closed position 38.
In such a configuration, a fluid force caused by the flow of pressurized water moving from the inlet end 24 to the outlet end 22 will contact an outer surface of the flapper 30 with respect to the internal cavity 60 when fluid is flowing toward the fire hydrant 4. A fluid force typical of most pressurized water supplies will overcome the gravity force and the spring force acting on the flapper 30 to pivot the flapper 30 to the open position 36. When the fluid flow from the inlet end 24 to outlet end 22 stops or if the fluid flow is backward toward the pressurized water supply 18, such as if an individual attempts to cause pressurized fluid or contaminants to flow from the outlet end 22 to the inlet end 24, the flapper 30 will move to or remain in the closed position 38 thereby creating a seal with the seat ring 44 and the inlet 50 to restrict the flow of fluid from the outlet end 22 to the inlet end 24. The torsion spring 56 hastens the flapper 30 movement toward the closed position to substantially prevent a water hammer effect from occurring due to the abrupt stoppage of the fluid flow at the hydrant 4.

Those skilled in the art will recognize that a wide variety of modifications, alterations, and combinations can be made with respect to the above described embodiments without departing from the scope of the invention. For example, different methods may be used for connecting the check valve to the fire hydrant system, various shapes and sizes of the components included in the check valve may be used, and the fire hydrant system may include different components or other components in addition to those of FIGS. 1 and 5. Such modifications, alterations, and combinations are to be viewed as being within the ambit of the inventive concept.

What is claimed is:

1. A check valve for restricting backflow of fluid in a fire hydrant system, comprising:
   a body defining an internal cavity having a generally hollow and generally cylindrical shape with an inlet end and an outlet end wherein the inlet end and the outlet end have respective openings;
   a seat ring disposed on the inlet end;
   a flapper configured when in a closed position to create a seal with the seat ring and inlet end to restrict the flow of fluid from the outlet end to the inlet end;
   wherein the flapper and the body are configured such that the flapper pivots against a side of the internal cavity in an open position during fluid flow from the inlet end to the outlet end leaving an internal cavity opening of the internal cavity and the flapper at least approximately as wide as the respective openings of the inlet end and the outlet end.

2. The check valve of claim 1 wherein the flapper and body are configured so that the flapper in the open position pivots against a top side of the internal cavity such that gravity force biases the flapper toward the closed position.

3. The check valve of claim 1 further comprising sealing elements positioned between a rear surface of the seat ring and the flapper in the closed position and a front surface of the seat ring and the check valve body to create water-tight seals therebetween.

4. The check valve of claim 3 wherein the sealing element comprises O-rings disposed in channels defined by a rear surface of the seat ring and an inlet inner surface of the check valve body configured to create a water-tight seal between the rear surface of the seat ring and the flapper in the closed position and the front surface of the seat ring and the inlet inner surface of the check valve body.

5. The check valve of claim 1 further comprising a torsion spring disposed in the body to provide a spring force against the flapper to hasten movement of the flapper toward the closed position to restrict a water hammer effect.

6. The check valve of claim 5 wherein the torsion spring biases the flapper to the closed position.

7. The check valve of claim 1 wherein the respective openings of the inlet end and the outlet end have approximately equal diameters and the internal cavity opening of the internal cavity and the flapper when in the open position has an internal diameter at least as wide as the respective openings of the inlet end and the outlet end.

8. The check valve of claim 1 further comprising a swiveling mechanical joint flange disposed on at least one of the inlet end and the outlet end to rigidly couple the check valve to a pipe extending therefrom.

9. The check valve of claim 8 wherein the swiveling mechanical joint flange is integral with the body.

10. A fire hydrant system for restricting the backflow of water, the fire hydrant system comprising:
    a barrel extending generally vertically upward above ground level;
    a pipe in communication with the barrel and extending generally vertically downward therefrom below ground level;
    an elbow in communication with the pipe and extending generally horizontally therefrom;
    an underground water pipe in communication with a pressurized water supply configured to facilitate flow of water from the pressurized water supply to the barrel;
    a check valve separated from and in communication with the elbow on a first side and in communication with the underground water pipe on a second side to allow flow of water from the underground water pipe to the barrel and to restrict the flow of water from the barrel to the underground water pipe;
    a flapper disposed in the check valve and configured to come in contact with a seat ring thereby creating a seal to restrict the flow of water from the barrel to the underground water pipe;
    the flapper and check valve further configured to substantially not impede fluid flow from the underground water pipe to the barrel.

11. The fire hydrant system of claim 10 wherein the flapper is rotatably attached to a pivot point in the check valve such that the flapper can move between an open position wherein the flapper is positioned against an inner portion of the check valve and a closed position wherein a sealing face of the flapper is in contact with the seat ring for creating a seal between the flapper and the seat ring to restrict the flow of water from the barrel to the underground water pipe.

12. The fire hydrant system of claim 11 further comprising sealing elements positioned between a rear surface of the seat ring and the flapper in the closed position and a front surface of the seat ring and the check valve body to create water-tight seals therebetween.

13. The check valve of claim 12 wherein the sealing elements comprise O-rings disposed in channels defined by a rear surface of the seat ring and an inlet inner surface of the check valve body configured to create a water-tight seal between the rear surface of the seat ring and the flapper in the closed position and the front surface of the seat ring and the inlet inner surface of the check valve body.
14. The fire hydrant system of claim 10 wherein the check valve and the flapper are configured such that when the flapper is in the open position it is positioned against a top portion of the check valve closer to the ground surface so that gravity biases the flapper away from the open position and toward the closed position.

15. The fire hydrant system of claim 10 further comprising: a torsion spring to provide a spring force against the flapper to hasten movement of the flapper and restrict a water hammer effect of the flapper.

16. The fire hydrant system of claim 15 wherein the torsion spring biases the flapper to the closed position.

17. The fire hydrant system of claim 10 further comprising a swiveling mechanical joint flange disposed on at least one end of the check valve for rigidly coupling the check valve to the underground water pipe or the elbow.

18. The check valve of claim 17, wherein the swiveling mechanical joint flange is integral with the check valve.

19. A check valve for restricting backflow of water in a fire hydrant system comprising:
   a body defining a hollow internal cavity and having an inlet and an outlet, wherein water can enter from a pressurized system at the inlet and exit from the outlet;
   a seal ring;
   a flapper of generally disk shape pivotally connected in the hollow internal cavity such that the flapper can move between an open position wherein the flapper is positioned against an inner portion of the hollow internal cavity and a closed position wherein a sealing face of the flapper is in contact with the seal ring for creating a seal between the flapper and the seal ring to restrict flow of water from the outlet to the inlet;
   a torsion spring attached to the pivot point with an extension for contact to an outer surface of the flapper to bias the flapper to the closed position.

20. The check valve of claim 19 further comprising sealing elements positioned between a rear surface of the seal ring and the flapper in the closed position and the front surface of the seal ring and the check valve body to create water-tight seals therebetween.

21. The check valve of claim 20 wherein the sealing elements comprise O-rings disposed in channels defined by a rear surface of the seal ring and an inlet inner surface of the check valve body configured to create a water-tight seal between the rear surface of the seal ring and the flapper in the closed position and the front surface of the seal ring and the inlet inner surface of the check valve body.

22. The check valve of claim 19 further comprising a swiveling mechanical joint flange disposed on at least one of the inlet and the outlet for rigidly coupling the check valve to pipes extending therefrom.

23. The check valve of claim 22, wherein the swiveling mechanical joint flange is made integral with the body.

24. The check valve of claim 19 wherein the inner portion is shaped to receive the flapper when in the open position such that an internal cavity opening for the body with the flapper in the open position is at least as large as an inlet opening and an outlet opening.

25. The check valve of claim 24 wherein the inlet opening and the outlet opening have approximately equal diameters.

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