

EXTERNALLY ADJUSTABLE FLOW MANAGEMENT VALVE ASSEMBLY AND SYSTEM

BACKGROUND OF THE INVENTION

Cross Reference to Related Applications

[0001] This application claims priority to co-pending Application Serial Number 15/496,212 filed on April 25, 2017 and entitled, "Externally Adjustable Flow Management Valve Assembly and System," the contents of this co-pending application are incorporated herein for all purposes.

Field of the Invention

[0002] This invention relates to a valve. More specifically, the present invention relates to a valve that promotes the laminar flow of a gas or fluid traveling through the valve.

Description of the Background Art

[0003] The use of valve assemblies are known in the art. For example, U.S. Pat. App. 2009/0289207 to Barreda discloses a valve assembly that is adapted to be disposed within a water supply line. The valve assembly is structured to reduce, or significantly eliminate, the passage of air through the meter. The valve body includes a sealing structure which is biased under a predetermined force into sealing relation with an inlet of the channel. The predetermined force is sufficient to prevent displacement of the sealing structure, but insufficient to prevent displacement of the sealing structure in response to normal water flow. As a result, any air flow within the water supply line will be compressed or otherwise disbursed and prevented from passing through the meter, thereby preventing unnecessary charges being made to the metered facility.

[0004] Although the device of Barreda is sufficient to achieve its stated objective, it is lacking in many respects. The valve assembly of Barreda is needlessly complex with an excess number of moving parts. Moreover, the number of interconnected moving parts requires the device to be lubricated. This lubrication can result in the contamination of the associated water. The system of Barreda is also a problematic solution inasmuch as

its valve assembly must be installed upstream of the meter assembly. Retrofitting a valve assembly upstream of a water meter poses several logical, legal, and safety related issues. The system of the present invention is aimed at overcoming these and other shortcomings of the Barreda device.

SUMMARY OF THE INVENTION

[0005] It is therefore an object of the present invention to provide a system for increasing the density of water running through a meter to thereby increase the accuracy of the meter.

[0006] It is another object of the present invention to compress the air out of the water as it is being metered.

[0007] A further object of the present invention is to provide a valve assembly for increasing the efficiency of an upstream water meter.

[0008] Still yet another object of the present invention is to provide a valve assembly that is constructed from self-lubricating polymers to thereby reduce wear and avoid the need for external lubricants.

[0009] Yet another object of the present invention is to provide a valve construction that eliminates turbulence within a fluid or gas passing there through.

[0010] A further object of the present invention is to provide an improved valve construction with a minimal number of moving parts to thereby increase the life cycle of the valve and eliminate the need for repair and maintenance.

[0011] Another object of the present invention is to provide an improved valve construction that can be adjusted externally.

[0012] Another object of the present invention is to provide an adjustment tool which does not require individual calibration prior to installation.

[0013] Another object of the present invention is to provide the ability to fine-tune a valve for optimal performance after its installation.

[0014] Another object of the present invention is to provide the ability to adjust to future changes in system pressure or flow.

[0015] Another object of the present invention is to provide the ability to make adjustments without the need to hire a professional or turn off the water flow, or remove the device from the system.

[0016] The foregoing has outlined rather broadly the more pertinent and important features of the present invention in order that the detailed description of the invention that follows may be better understood so that the present contribution to the art can be more fully appreciated. Additional features of the invention will be described hereinafter which form the subject of the claims of the invention. It should be appreciated by those skilled in the art that the conception and the specific embodiment disclosed may be readily utilized as a basis for modifying or designing other structures for carrying out the same purposes of the present invention. It should also be realized by those skilled in the art that such equivalent constructions do not depart from the spirit and scope of the invention as set forth in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings in which:

[0018] FIG. 1 is an exploded view of a valve assembly of the present invention.

[0019] FIG. 2 is an exploded view of a valve assembly of the present invention with an alternative proximal shoulder construction.

[0020] FIG. 3 is an exploded view of a valve assembly of the present invention with an alternative distal shoulder construction.

[0021] FIG. 4 is an exploded view of a valve assembly of the present invention with alternative proximal and distal shoulder constructions.

[0022] FIG. 5 is a perspective view of the valve assembly and adjustment tool.

[0023] FIG. 6 is a cross-sectional view of the adjustment tool engaged with the valve assembly.

[0024] FIG. 7 is a cross-sectional view of the valve assembly while engaged with the adjustment tool.

[0025] FIG. 8 is a cross-sectional view of the valve assembly and adjustment tool after the adjustment tool has been rotated around the central axis.

[0026] FIG. 9 is a cross-sectional view of the valve assembly wherein the proximal shoulder has a female threaded connection head and the distal shoulder has a male threaded connection head.

[0027] FIG. 10 is a cross-sectional view of the valve assembly wherein the proximal shoulder and the distal shoulder have male threaded connection head.

[0028] FIG. 11 is a cross-sectional view of the valve assembly wherein the proximal shoulder has a male threaded connection head and the distal shoulder has a female threaded connection head.

[0029] FIG. 12 is a diagram showing the valve assembly positioned downstream from a flow meter.

[0030] FIG. 13 is a view of a combined valve and flow meter.

[0031] FIG. 14 is a diagram showing the flow meter positioned downstream of the valve assembly.

[0032] Similar reference characters refer to similar parts throughout the several views of the drawings.

PARTS LIST	
10 Assembly	36 Threading
12 Valve Housing	38 Outside Face
14 Upper Valve Housing	40 Adjustment Tool
16 Lower Valve Housing	42 Adjustment Bore
17 Window	44 Grip
18 Forward Valve Inlet	46 Proximal End
20 Rearward Valve Outlet	48 Distal End
22 Tapered Valve Seat	50 Curved Prong
24 Valve Disc	52 Extension
26 Spring	54 Housing Valve Inlet
28 Valve Shaft	56 Housing Valve Outlet
30 Shoulder	58 Male-Threaded Head
32 Retainer	60 Female-Threaded Head
34 Outer Housing	70 Flow Meter

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0033] This disclosure relates to an externally adjustable flow management valve assembly. In one embodiment, entrained water bubbles can be removed from a water supply. This, in turn, increases the density of the water running through the water meter. This ensures that the water meter is not inaccurately including entrained air as metered water. The result is more accurate water readings and reduced utility bills. The assembly can likewise be used to promote the laminar flow of other fluids or gases. The various components of the present invention and the manner in which they interrelate will be described in greater detail hereinafter.

[0034] With reference to FIG. 1, the assembly **10** is shown, including a spring biased plunger **24** that is triggered at a predetermined fluid pressure. With device **10** positioned adjacent a water meter, this has the effect of driving out any entrained air and thereby increasing the water density as it runs through a water meter. This, in turn, increases the efficiency of the water meter and ensures that the consumer is paying only for the water they use as opposed to water and entrained air. Water meters measure volume; water with air has more volume than water without air given that air has volume. When presented with pressure, the water displaces the air and increases the water density.

[0035] As seen in FIGS. 1-4, the assembly **10** comprises a cylindrical valve housing **12** which is nested within an outer housing **34**. Out housing **34** includes an upper housing **14** positioned over the outlet side of housing **12** and a lower housing **16** that is positioned over the inlet side of the housing **12**. The lower housing **16** has a forward valve inlet **18** and the upper housing **14** has a rearward valve outlet **20**. Lower housing includes a series of cut-outs or windows **17** about its periphery. Valve housing **12** has a housing valve inlet **54** and housing valve outlet **56**. The valve housing **12** is preferably constructed from a self-lubricating polymer such as Acetron GP, Vesconite™, or Delrin™. The valve housing **12** further includes a tapered valve seat **22** (FIG. 7) that is positioned adjacent to forward valve inlet **18**. The valve housing **12** has male threads **36** on its outer surface face **38**. These threads **36** mate with threads on inner surface of outer housing **34**, whereby valve housing **12** can rotate and move with respect to outer

housing **34**. The valve housing **12** further comprises a series of adjustment bores **42** which, as described below, can be used to rotate the valve housing **12** within outer housing **34**.

[0036] Upper housing **14** and lower housing **16** may be any type of threaded head. For example, FIG. 1 depicts a female-threaded head **60** for the upper housing **17** and a male-threaded head **58** for the lower housing **16**. FIG. 2 depicts both ends having male threads. FIG. 3 depicts both ends having female threads. FIG. 4 depicts lower housing **16** having female threads and upper housing **14** having male threads. FIGS. 9-11 depict cross-sectional views of the assembly **10** with male-female, male-male, and female-male connections. Other connection types are also possible, such as flanged or friction fit connections. These varying connection types can be of any variety so long as it allows the outer housing **34** to be attached to a water meter and water line. Alternatively, housing **34** can be connected to a gas or other fluid line.

[0037] The assembly **10** can be opened and closed by way of a valve disc **24**. Again, this valve disc **24** is preferably formed from a self-lubricating polymer which may be the same polymer used for the cylindrical valve housing **12**. The valve disc **24** includes a tapered extent and is generally in the shape of a frustro cone. As illustrated in FIG. 2, the taper of the valve seat **22** approximately matches the taper of the valve disc **24** so that the two can be placed in a fluid tight seal. The use of self-lubricating polymers eliminates the need for any gasket or sealing rings. As such, the valve disc **24** includes a seated orientation where it is in positive and sealing contact with the valve seat **22** to prevent fluid flow. The valve disc **24** also includes an unseated orientation wherein it is spaced a distance from the valve seat **22**. The unseated orientation requires the bias of spring **26** to be overcome.

[0038] With continuing reference to FIGS. 1-4, the valve shaft **28** is depicted. The valve shaft **28** is generally defined with a forward end, a rearward end, and an intermediate extent therebetween. The valve disc **24** includes a centrally located threaded passage into which an end of shaft **28** is secured. The spring **26** is positioned along the intermediate extent of the valve shaft **28**. The spring has a first end which is in

contact with a shoulder **30** of the retainer **32** positioned on the rearward end of the valve shaft **28** and a second end which is in contact with the valve disc **24**. As such, the spring **26** acts to bias the valve disc **24** into a seated orientation. However, the tension of the spring **26**, and thus the force needed to unseat disc **24**, can be changed by the user by rotating the valve housing **12** within housing **34** in a manner described in further detail below.

[0039] With this arrangement, water or fluid contacting the valve disc **24** will be prevented from flowing through the valve housing **12** unless it exceeds a predetermined threshold pressure as dictated by the spring tension. Once the threshold pressure is achieved, spring force will be overcome and the valve disc **24** will unseat. This will allow the water, fluid, or gas to pass through the valve housing **12**. It is envisioned that the fluid will repetitively cross this threshold pressure. This will cause the valve disc **24** to repetitively open and close. This, in turn, results in the fluid upstream of valve **12** becoming more dense and driving out any entrained air. It also results in the downstream flow becoming more stable and laminar.

[0040] FIG. 5 is a perspective view of the assembly **10** and the associated adjustment tool **40**. Adjustment tool **40** comprises a grip **44** having a proximal end **46** and distal end **48**. Distal end **48** terminates with a curved prong **50** having an extension **52**. Extension **52** is preferably cylindrical but may be rectangular or any other prismatic shape which corresponds with the shape and size of adjustment bores **42**. As seen in FIG. 6, the extension **52** can be inserted into an adjustment bore **42** (via a window **17** in lower valve housing **16**). Further, as shown in FIGS. 7 and 8, once the adjustment tool **40** engages the adjustment bore, the valve housing **12** can be rotated with respect to outer housing **34**. Rotating housing **12** in this manner causes housing **12** shift its linear position within housing **34**. This, in turn, changes the distance between valve seat **22** and valve housing **14**. As illustrated in FIGS. 7-8, this changes the tension spring **26** and thus the force needed to unseat disc **24**.

[0041] Although the devices detailed above have been disclosed for use in driving air out of water, device **10** can likewise be used in connection with a wide variety of other

fluids. As used herein, "fluid" includes both liquids as well as gases. By way of non-limiting example, device **10** can be used with a variety of liquid lubricants, such as synthetic or natural oils, as well as liquid coolants such as antifreeze or refrigerants such as R-22. Regardless of the fluid traveling through device **10**, the device can be used to effectively drive out unwanted materials. These unwanted materials can be air, water, or various contaminants. In this regard, device **10** can be used with any of a variety of gases, such as natural gas, carbon dioxide, hydrogen chloride, or nitrous oxide. Again, device **10** can be used to drive other gases or fluids from the primary gas traveling through device **10**. Device **10** can likewise be used with variety of vapors or condensates. Those of ordinary skill in the art will appreciate still yet other common fluids, gases, or condensates that can be used in connection with device **10**.

[0042] FIGS. 12-14 disclose various systems in which the device **10** can be utilized. In particular, FIG. 12 illustrates a system wherein device **10** is positioned downstream of an associated water meter **70**. This allows water meter **70** to accept an incoming flow from, for example, a municipal water source. Water meter **70** would monitor and keep track of the volume of water flowing through meter **70**. Water exiting meter **70** would then be passed to the valve inlet **18** of valve assembly **10**. Thereafter, water leaving the valve outlet **20** would be distributed to the occupants of the associated building. The benefit of this system is that device **10** would, as described hereinabove, remove any entrained air from the flow of water. This would have the benefit of removing the entrained air at a location upstream of device **10** thereby increasing the efficiency and accuracy of water meter **70**.

[0043] FIG. 14 discloses still yet another system in which the position of the valve assembly **10** and water meter **70** are reversed. In this embodiment, device **10** is placed upstream of water meter **70**. In other words, water meter **70** is placed downstream of device **10**. This arrangement would still achieve many of the benefits described in conjunction with the system of FIG. 12, but would add yet another desired effect. Often times the flow of water through meter **70** is insufficient for measurement. For example, if the building being monitored has a slow leak, this volumetric flowrate may be too

small to be monitored or measured. In such instances, hundreds or thousands of gallons of water can be slowly consumed over time without any corresponding measurement by meter **70**. To avoid this, device **10** can be placed upstream of water meter **70**. The valve disc **24** and spring **26** would be arranged such that only water flowing at a pre-designated flow rate would be delivered to water meter **70**. This pre-designated flow rate can be chosen to ensure that it is sufficient to trigger water meter **70** and thereby be measured. Finally, FIG. 13 shows still yet another embodiment of the present invention wherein device **10** is physically coupled to an associated flow meter **70**. This combined device ensures that fluid is delivered to meter **70** only at a designated and measurable volume.

[0044] The present disclosure includes that contained in the appended claims, as well as that of the foregoing description. Although this invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and scope of the invention.

CLAIMS

1. A valve assembly having an inlet and an outlet, the valve assembly adapted to increase the accuracy of an upstream water meter, the valve assembly comprising:

- a cylindrical valve housing nested within an upper housing and lower housing, the valve housing having a housing valve inlet and a housing valve outlet, a tapered valve seat positioned adjacent to the housing valve inlet, a plurality of adjustment bores, and a series of housing threads on an outside face of the valve housing;

- a valve disc positioned within the valve housing, the disc being tapered along its length, wherein the taper of the valve seat matches the taper of the valve disc, the valve disc having a seated orientation wherein it is in contact with the valve seat and an unseated orientation wherein the valve disc is spaced from the valve seat;

- a valve shaft having a forward end, a rearward end, and an intermediate extent therebetween, the valve shaft further comprising a retainer having a shoulder on the rearward end extending perpendicularly from a surface of the retainer and having an axial passage, the valve shaft slidably positioned within the axial passage;

- a coil spring positioned about the intermediate extent of the valve shaft, the coil spring having a first end in contact with the shoulder of the retainer, a second end of the coil spring contacting the valve disc, whereby the spring tension is varied depending upon the position of the housing threads which may be raised or lowered using an adjustment tool, the adjustment tool comprising a grip having a proximal and a distal end wherein the distal end terminates in a curved prong having an

extension which protrudes from the curved prong; whereby water flowing from the housing valve inlet to the housing valve outlet of the valve assembly contacts the valve disc and further wherein a pre-determined water pressure is sufficient to unseat the valve disc and thereby compress air into the upstream water source thereby increasing the density of the water.

2. The valve assembly of claim 1 wherein the valve assembly is used in connection with a water meter.

3. The valve assembly of claim 1 wherein the valve housing is constructed from a self-lubricating polymer.

4. The valve assembly of claim 1 wherein the valve disc is constructed from a self-lubricating polymer.

5. The valve assembly of claim 1 wherein the extension of the adjustment tool is cylindrical.

6. The valve assembly of claim 1 wherein the extension of the adjustment tool comprises a prisms shape.

7. A water metering system for accurately measuring the volume of water used by an individual water consumer over a pre-determined amount of time, the system comprising:

- a water supply reservoir for storing a large volume of potable water to be distributed to a plurality of water consumers;

- a distribution network interconnected to the water supply reservoir, the distribution network interconnecting the plurality of water consumers, the distribution network having upstream and downstream ends;

- a water meter positioned upstream from the individual water consumer, the water meter operable to measure the volume of water used by the water consumer over a pre-determined period of time;

- a valve assembly comprising:
 - a cylindrical valve housing nested within an upper housing and lower housing, the valve housing having a housing valve inlet and a housing valve outlet, a tapered valve seat positioned adjacent to the housing valve inlet, a plurality of adjustment bores, and a series of housing threads on an outside face of the valve housing;
 - a valve disc positioned within the valve housing, the disc being tapered along its length, wherein the taper of the valve seat matches the taper of the valve disc, the valve disc having a seated orientation wherein it is in contact with the valve seat and an unseated orientation wherein the valve disc is spaced from the valve seat;
 - a valve shaft having a forward end, a rearward end, and an intermediate extent therebetween, the valve shaft further comprising a retainer having a shoulder on the rearward end extending perpendicularly from a surface of the retainer and having an axial passage, the valve shaft slidably positioned within the axial passage;
 - a coil spring positioned about the intermediate extent of the valve shaft, the coil spring having a first end in contact with the shoulder of the retainer, a second end of the coil spring contacting the valve disc, whereby the spring tension is varied depending upon the position of the housing threads which may be raised or lowered using an adjustment tool, the adjustment tool comprising a grip having a proximal and a distal end wherein the distal end terminates in

a curved prong having an extension which protrudes from the curved prong;

whereby water flowing from the housing valve inlet to the housing valve outlet of the valve assembly contacts the valve disc and further wherein a pre-determined water pressure is sufficient to unseat the valve disc and thereby compress air into the upstream water source thereby increasing the density of the water.

8. A water metering system for accurately measuring the volume of water used by an individual water consumer over a pre-determined amount of time, the system comprising:

- a water supply reservoir for storing a large volume of potable water to be distributed to a plurality of water consumers;
- a distribution network interconnected to the water supply reservoir, the distribution network interconnecting the plurality of water consumers, the distribution network having upstream and downstream ends;
- a water meter positioned upstream from the individual water consumer, the water meter operable to measure the volume of water used by the water consumer over a pre-determined period of time;
- a valve assembly including an inner housing that is threadably positioned within an outer housing, the inner housing including a disc and a spring, the spring having a tension for biasing the disc into a closed position within the inner housing, a plurality of

adjustment bores positioned within the inner housing and being accessible through the outer housing, an adjustment tool for engaging one of the plurality of adjustment bores from outside of the outer housing, whereby the position of the inner housing with respect to the outer housing can be selectively adjusted to thereby change the tension of the spring.