

WATER PRESSURE MANAGEMENT

FIELD OF THE INVENTION

The present invention relates to the regulation of water pressure, particularly in a domestic setting. It is envisaged for use in regulating shower water pressure in an environment where many users are connected to the same water supply, such as in an apartment complex or hotel.

BACKGROUND TO THE INVENTION

Consistency of water pressure can be difficult to achieve where more than one user is connected to a single source of water pressure. This problem is commonly experienced where several showers are connected to a single source of water pressure. Typically, a user sets the water pressure of their shower to be at a desired level. When a subsequent user turns on a shower from the same source, the pressure available to the first user drops. This problem recurs each time a subsequent shower is turned on. As a corollary, the turning off of a shower in the system leads to a pressure rise in the other showers.

It is thus desirable to provide a valve within each shower which diminishes the effect of changes in upstream water pressure on shower output pressure.

The applicant sought to address this problem in their international patent application number PCT/SG2007/000400, the contents of which are incorporated herein by reference. This solution was to have a frustum shaped member located within a complementary shaped flow path, with the frustum shaped member resiliently biased away from sealing engagement with the flow path. The arrangement was such that axial position of the frustum shaped member, and hence the gap between it and the flow path, was a function of inlet water pressure. As water pressure dropped, the size of the flow path increased, thus maintaining a substantially constant rate of water flow through the valve.

Although this device has proved efficacious in many settings, it suffers a limitation in that its response to changes in upstream pressure does not reflect the way a shower is used, in practice. A user of a shower will frequently want to adjust the water pressure and flow rate from the shower, and a constant flow rate device makes this difficult. It is desirable to have a shower valve which allows fine adjustment of water pressure and flow rate, but which responds to step changes in inlet water pressure by maintaining substantially constant water flow.

The present invention seeks to meet these desiderata.

SUMMARY OF THE INVENTION

In accordance with a first aspect of the present invention there is provided a water flow regulating device comprising a flow restricting member axially moveable within a water flow chamber, the size of a gap between the flow
5 restricting member and internal walls of the water flow chamber varying according to an axial position of the flow restricting member, the water flow chamber having at least a first region and a second region whereby movement of the flow restricting member from the first region to the second region results in a step-
10 change in the size of the gap between the flow restricting member and the internal walls of the water flow chamber.

Preferably the water flow regulating device includes a biasing means which urges the flow restricting member towards incoming water flow. It is preferred that the resilience of the biasing means has a step change occasioned by movement
15 of the flow restricting member from the first region to the second region. This may be achieved by the use of a plurality of springs of different length or diameter, such that the axial position of the flow restricting member dictates how many springs are placed into tension or compression, and thus determines the total resilience acting on the flow resting member.

In a preferred embodiment, the water flow chamber has three regions, each being substantially cylindrical, with a step change in radius between each successive region. The arrangement is such that the largest radius region is adjacent a water inlet, with the smallest radius region being adjacent a water
20 outlet.

In this embodiment, the flow restricting member has at least three portions along a common axis: a cylindrical stem, a first frusto-conical portion and a second frusto-conical portion. There is a step change in radius between each of the portions.

BRIEF DESCRIPTION OF THE DRAWINGS

It will be convenient to further describe the invention with reference to
30 preferred embodiments of the water flow regulating device of the present invention. Other embodiments are possible, and consequently, the particularity of

the following discussion is not to be understood as superseding the generality of the preceding description of the invention. In the drawings:

Figure 1 is a schematic cross sectional view of a water flow regulating device according to the present invention, shown in a first position;

5 Figure 2 is a schematic cross sectional view of the water flow regulating device of Figure 1, shown in a second position;

Figure 3 is a schematic cross sectional view of the water flow regulating device of Figure 1, shown in a third position;

10 Figure 4 is a perspective of a water flow concentrator within the water flow regulating device of Figure 1; and

Figure 5 is a perspective of a flow restricting member within the water flow regulating device of Figure 1.

DESCRIPTION OF PREFERRED EMBODIMENT

15 Figures 1 to 3 show a water flow regulating device 10. The device is located within an outer housing 12, which is arranged for threaded connection within a water flow path. The outer housing 12 is arranged about a central axis, with a water inlet 14 at one axial end. The outer housing 12 has a substantially cylindrical inner wall 16, which extends axially from the water inlet 14, and terminates at an inner shoulder 18.

20 A water flow concentrator 20 extends from the outer flow housing 12 in a direction away from the water inlet 14. The concentrator 20 has a substantially cylindrical outer wall 22, with an upper lip 24. The upper lip 24 is sized to engaged with the inner shoulder 18 of the outer housing 12.

25 The concentrator 20 has an inner wall having a first portion 26 and a second portion 28. The first portion 26 extends axially from the upper lip 24 in a direction away from the water inlet 14, and is substantially cylindrical with a radius less than that of the outer housing inner wall 16. The second portion 28 extends axially from the first portion 26 in a direction away from the water inlet 14, and is substantially cylindrical with a radius less than that of the first portion 26. The
30 second portion 28 terminates in a water outlet 30, which consists of a circular end piece having a plurality of holes 29 spaced around it at a constant positioning radius, together with a centrally located aperture 32.

A water flow chamber is thus created between the water inlet 14 and the water outlet 30. The water flow chamber has three substantially cylindrical regions: a first region 34 between the water inlet 14 and an edge of the concentrator upper lip 24, the first region having a radius defined by the housing side walls 16; a second region 36 within the first portion 26 of the concentrator; and a third region 38 within the second portion 28 of the concentrator, ending at the water outlet 30. Between each region is a step change in radius, with the first region 34 having the largest radius and the third region 38 having the smallest radius.

The water regulating device 10 also has a flow restricting member 40. The flow restricting member 40 is arranged along an axis, with a relatively long stem 42 abutting a first frusto conical portion 44, which in turn abuts a second frusto conical portion 46.

The arrangement is such that the stem 42 has substantially the same radius as the central aperture 32 of the water outlet 30, and is arranged to be located within the central aperture 32. The second frusto conical portion 46 tapers inwardly towards the first frusto conical portion 44, from a base radius, which is similar to the radius of the third region 38, to an inner radius which is about 90% of the base radius. The first frusto conical portion 44 tapers inwardly towards the stem 42, from a base radius about 75% that of the second frusto conical portion 46 to an inner radius about 80% that of the second frusto conical portion.

In the embodiment shown in Figure 5, the first frusto conical portion 44 has cylindrical extensions on either axial side.

There is thus a step change in radius between the first and second frusto conical portions, and also between the first frusto conical portion 44 and the stem 42.

The water flow regulating device 10 further includes a biasing means comprising two independent compression springs, a first spring 50 and a second spring 52. The second spring 52 has an axial length when unstressed equal to the axial length of the second portion 28 of the concentrator inner wall. The first spring 50 has an unstressed axial length equal to the axial length of the entire concentrator 20 inner wall. The first spring 50 has a radius smaller than the inner radius of the first frusto conical portion 44, and greater than the radius of the stem

42. The second spring 52 has a radius smaller than the inner radius of the second frusto conical portion 46, and greater than the base radius of the first frusto conical portion 44. The radius of the second spring 52 is similar to that of the positioning radius of the holes 29.

5 The arrangement is such that the flow restricting member 40 is located within the water flow chamber, with the stem 42 being located within the central aperture 32 of the water outlet 30. The flow restricting member 40 is thus constrained to move axially within the water flow chamber. The first spring 50 is located about the stem 42 between the first frusto conical portion 44 and the
10 water outlet 30, and the second spring 52 is located about the stem 42 and the first frusto conical portion 44, between the second frusto conical portion 46 and the water outlet 30.

 In use, the flow restricting member 40 is subject to water pressure urging it towards the water outlet 30, and to the springs 50, 52 resisting this water
15 pressure. The axial location of the flow restricting member 40 is determined by the balance of these forces.

 The dynamic water pressure and water velocity at the water outlet 30 is a function of both the inlet water pressure, and also the minimum cross sectional area of water flow within and out of the water flow chamber. A decrease in the
20 minimum cross sectional area of water flow will have the effect of an accelerating nozzle, increasing both the velocity and dynamic pressure of the water within the water flow chamber.

 When water inlet pressure is high, as shown in Figure 1, the flow restricting member 40 is urged into a first position, whereby both springs 50, 52 are
25 compressed and thus are acting against the flow restricting member 40. In this position the minimum cross sectional area of water flow within the water flow chamber is found between the second portion 28 of the concentrator internal wall and the second frusto conical portion 46. As inlet water pressure increases, the flow restricting member moves towards the water outlet 30, albeit slowly against
30 the resistance of both springs 50, 52. The cross sectional area between the edge of the second portion 28 of the concentrator internal wall and the second frusto conical member decreases, thus restricting the flow of water through the device. In addition, when the second spring 52 is compressed, it partially covers the holes

29 of the water outlet 30. This creates an additional constriction in the water flow, and assists to increase the water velocity at the water outlet 30.

Where there is a sudden drop in inlet water pressure, for instance due to a second device being engaged, the springs 50, 52 will urge the flow restricting member into a second position, as shown in Figure 2. In this position the only the first spring 50 is compressed, and thus the flow restricting member is able to move in response to changes in input water pressure with more freedom than when in the first position. In this position the minimum cross sectional area of water flow is found between the first portion 26 of the concentrator internal wall and the second frusto conical portion 46. This is significantly larger than the minimum cross sectional area in the first position, and therefore the step change in inlet water pressure is largely negated by this step change in cross sectional area. Additionally, the second spring 52 no longer covers the holes 29, thus removing the additional constriction. As water pressure increases, the flow restricting member moves towards the water outlet 30, against the resistance of only the first spring 50. The cross sectional area between the edge of the first portion 26 of the concentrator internal wall and the second frusto conical member 46 decreases, thus restricting the flow of water through the device.

Where there is a further drop in inlet water pressure, for instance due to a further device being engaged, the first spring 50 will urge the flow restricting member into a third position, as shown in Figure 3. The second spring 52 is disengaged/suspended from the holes 29, causing no pressure or constriction to the flow within the water flow chamber. In this position the minimum cross sectional area of water flow is found between the first portion 26 of the concentrator internal wall and the first frusto conical portion 44. This is significantly larger than the minimum cross sectional area in the second position, and therefore again the step change in inlet water pressure is largely negated by this step change in cross sectional area. As water pressure increases, the flow restricting member moves towards the water outlet 30. The cross sectional area between the edge of the first portion 26 of the concentrator internal wall and the first frusto conical member 44 decreases, thus restricting the flow of water through the device.

Modifications and variations as would be apparent to a skilled addressee are deemed to be within the scope of the present invention.

CLAIMS:

1. A water flow regulating device comprising a flow restricting member axially moveable within a water flow chamber, the size of a gap between the flow restricting member and internal walls of the water flow chamber varying according to an axial position of the flow restricting member, the water flow chamber having at least a first region and a second region whereby movement of the flow restricting member from the first region to the second region results in a step-change in the size of the gap between the flow restricting member and the internal walls of the water flow chamber.
2. A water flow regulating device as claimed in claim 1, wherein the water flow regulating device includes a biasing means which urges the flow restricting member towards incoming water flow.
3. A water flow regulating device as claimed in claim 2, wherein the biasing means can be urged under pressure into a position whereby it presents a constriction in the water flow path.
4. A water flow regulating device as claimed in claim 2 or claim 3, wherein the resilience of the biasing means has a step change occasioned by movement of the flow restricting member from the first region to the second region.
5. A water flow regulating device as claimed in claim 4, wherein the biasing means comprises a plurality of springs of different length, such that the axial position of the flow restricting member dictates how many springs are placed into tension or compression.
6. A water flow regulating device as claimed in claim 5, wherein the biasing means comprises two springs.
7. A water flow regulating device as claimed in claim 5 or claim 6, wherein the springs are compression springs.

8. A water flow regulating device as claimed in any preceding claim, wherein the water flow chamber has three regions, each being substantially cylindrical, with a step change in radius between each successive region.

5 9. A water flow regulating device as claimed in claim 8, whereby the largest radius region is adjacent a water inlet, with the smallest radius region being adjacent a water outlet.

10. A water flow regulating device as claimed in claim 9, wherein the flow restricting member has at least three portions along a common axis: a cylindrical stem, a first frusto-conical portion and a second frusto-conical portion.

10 11. A water flow regulating device as claimed in any preceding claim, wherein a reduction in the size of the gap leads to an increase in water velocity.