

WATER FLOW REGULATING DEVICE

FIELD OF INVENTION

5 The present invention relates broadly to a water flow regulating device.

BACKGROUND

10 Recently, some government bodies impose a limitation on an increase in flow rate between two pressure points to promote water efficiency and water saving. Therefore, suppliers of water flow regulators have to ensure a constant flow rate change between two pressure points.

15 Although there are existing water flow regulators in the market, some of these water flow regulators are unable to achieve a constant flow rate change with respect to the change in pressure. The main reason being that these water flow regulators comprise fixed elements and are mainly designed to achieve a desired maximum flow rate instead of a constant flow rate change.

20 There are also known water flow regulators which have been designed to achieve a constant flow rate change with respect to the change in pressure. Sealing materials such as neoprene are used in these water flow regulators because the flexibility of the sealing materials allows the materials to expand and contract according to the change in pressure. However, there is a problem that other than the change in
25 pressure, the sealing materials are also susceptible to expansion and contraction under hot and cold water respectively. Furthermore, the sealing materials are easily subjected to wear and tear and thus have a shorter life span.

30 Therefore, there is a need to provide a water flow regulator designed to address at least one of the above-mentioned problems.

SUMMARY

In accordance with a first aspect of the present invention, there is provided a water flow regulating device for use at or near a water outlet, the device comprising: a
5 valve element disposed adjacent to an aperture; a resilient member coupled to the valve element; and wherein movement of the valve element under a water pressure and against a resilience of the resilient member reduces a gap between the aperture and the valve element to regulate a flow of water through the device.

10 The resilient member may be further coupled to a support member functioning as a stopper element for the resilient member under the water pressure.

The support member may be adjustable, whereby a desired gap under a given water pressure can be set for the device.

15 The aperture may be formed in a first component of the device and the support member may be formed in a second component of the device, wherein the first and second components are connectable to each other in a manner such that a distance between the aperture and the support member is variable.

20 The first and second components may be screw fitted to each other.

The valve element may comprise a tapered outer surface.

25 The aperture may comprise a tapered internal surface.

The device may further comprise a balancing shaft, and the valve element and the resilient member comprise respective through holes for aligning along the balancing shaft.

30 The device may further comprise a first static flow regulating element disposed upstream from the valve element and the aperture.

The device may further comprise a second static flow regulating element disposed downstream from the valve element and the aperture.

The resilient member may comprise a spring.

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The valve element may be made from a substantially solid material.

BRIEF DESCRIPTION OF THE DRAWINGS

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Embodiments of the invention will be better understood and readily apparent to one of ordinary skill in the art from the following written description, by way of example only, and in conjunction with the drawings, in which:

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Figure 1a shows a cross-sectional view of a water flow regulator of a different design.

Figure 1b shows a cross-sectional view of a top enclosure of the water flow regulator.

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Figure 1c shows a top view of the top enclosure.

Figure 1d shows a cross-sectional view of a control valve of the water flow regulator.

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Figure 1e shows a cross-sectional view of a bottom enclosure of the water flow regulator.

Figure 1f shows a bottom view of the bottom enclosure.

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Figure 2 shows the water flow regulator being used in a shower head.

Figure 3 shows the water flow regulator being used in a water tap.

DETAILED DESCRIPTION

Figure 1a shows a cross-sectional view of a water flow regulator 100 of a different design. The water flow regulator 100 comprises a first component in the form of a middle enclosure 102, a second component in the form of a bottom enclosure 104 and a third component in the form of a top enclosure 106.

Figure 1b shows a top view of the top enclosure 106. The top enclosure 106 comprises a through-hole 108 of about 2 mm in the centre and six holes 110 of a diameter of about 1.8 mm each positioned around the through-hole 108. The holes 110 are provided as water inlets for the water flow regulator 100. Figure 1c shows a cross-sectional view of the top enclosure 106. The top enclosure 106 comprises a first static flow regulating element in the form of a surface 111 having the through-hole 108 and the holes 110 at one end and the other end of the top enclosure is open.

Referring back to Figure 1a, the middle enclosure 102 comprises threads 103 around the outer circumference at one end of the middle enclosure 102. The outer circumference of the middle enclosure 102 is stepped at the outer circumference and providing a surface 112. The middle enclosure 102 comprises an aperture in the form of a tapered inner circumference 105 with an upper taper end 107 having a larger circumference than a lower taper end 109.

A valve element in the form of a control valve 114 is disposed in the middle enclosure 102. Figure 1d shows a schematic cross-sectional view of the control valve 114. The control valve 114 is tapered with an upper taper 115 end having a larger circumference than a lower taper end 117. At the lower end of the taper, the control valve 114 comprises a protrusion 116. The protrusion 116 has a smaller circumference than the end of the taper 117. The control valve 114 comprises a through-hole 118 in the centre.

Figure 1e shows a bottom view of the bottom enclosure 104. The bottom enclosure 104 comprises a through-hole 120 of about 2 mm in the centre and six water outlets 122 of a diameter of about 1.8 mm each positioned around the through-hole 120. Figure 1f shows a cross-sectional view of the bottom enclosure 104. The bottom

enclosure 104 comprises threads 119 around the inner circumference at one end and a second static flow regulating element in the form of a surface 121 having the through-hole 120 and the water outlets 122 at the other end.

5 Referring back to Figure 1a, a spring 124 is disposed in the bottom enclosure 104. A balancing shaft 126 is disposed in the centre of the water flow regulator 100. Both ends of the balancing shaft 126 are stepped and are received in the through-hole 108 (Figure 1b) of the top enclosure 106 and the through-hole 120 (Figure 1e) of the bottom enclosure 104 respectively, thus securing the balancing shaft 126 in the water flow
10 regulator 100. The body of the balancing shaft 126 is received in a through-hole 118 (Figure 1d) of the control valve 114 and in the spring 124. The control valve 114 is movable around the balancing shaft 126.

The top enclosure 106, the middle enclosure 102, the bottom enclosure 104, the
15 control valve 114 and the balancing shaft 126 are made of brass. The spring 124 is made of stainless steel. It will be appreciated by a person skilled in the art that the top enclosure 106, the middle enclosure 102, the bottom enclosure 104 and the control valve 114 can be manufactured using known methods including but not limited to e.g. milling and drilling.

20 To assemble the water flow regulator 100, the top enclosure 106 is press-fitted onto the middle enclosure 106 and sits on the protruding surface 112 and the bottom enclosure 104 is screwed into the middle enclosure 102. The protrusion 116 of the control valve 114 is received at one end of the spring 124 while the other end of the
25 spring 124 sits on the surface 121 of the bottom enclosure 104. The surface 121 acts as a support member for the spring 124.

In use, water first enters the water flow regulator 100 through the holes 110 of the top enclosure 106 as indicated by arrows 128a. Water then flows between the
30 middle enclosure 102 and the control valve 114 as indicated by arrows 128b. Water flows into the bottom enclosure 104 as indicated by arrows 128c and out of the water flow regulator 100 through the water outlets 122 as indicated by arrows 128d.

Under the water pressure, the control valve 114 moves as indicated by the arrow 130. The downward movement of the control valve 114 is being kept substantially vertical by the balancing shaft 126. The downward movement of the control valve 114 compresses the spring 124.

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A gap 132 between the control valve 114 and the inner circumference of the middle enclosure 102 becomes smaller as the pressure increases and the control valve 114 moves further in the direction 130. It will be appreciated by the person skilled in the art that the flow rate is regulated by the gap 132 between the control valve 114 and the inner circumference of the middle enclosure 102. Therefore, when the water pressure increases, the flow rate increases but is limited to a certain value due to the narrowing of the gap 132. A constant flow rate change with respect to the change in the water pressure is thus advantageously provided. In short, movement of the control valve 114 under a water pressure and against a resilience of the spring 124 reduces the gap 132 between the inner circumference of the middle enclosure 102 and the control valve 114 to regulate a flow of water through the water regulator 100.

As will be appreciated by the person skilled in the art, springs of a same specification would have variations in their tensile strengths within a specified tolerance range. Since the bottom enclosure 104 and the middle enclosure 102 are screw-fitted, it is possible to advantageously accommodate the variations of the tensile strength of the springs by shifting the bottom enclosure 104 relative to the middle enclosure 102. The bottom enclosure 104 and the middle enclosure 102 can be fixed in place by applying an adhesive on the threads before the bottom enclosure 104 and the middle enclosure 102 are screw-fitted. This facilitates mass production of the water flow regulator 100 while accommodating variations in tensile strength of the springs used. Therefore, the surface 121 is adjustable, whereby a desired gap 132 under a given water pressure can be set for the water regulator 100.

It will also be appreciated by the person skilled in the art that when the desired levels of constant flow rate change between two pressure points are different, springs of different tensile strengths can be used. Therefore, the water flow regulator 100 is also designed to advantageously accommodate springs of different tensile strengths.

With the middle enclosure 102 having a tapered inner circumference and the control valve 114 having a long taper surface, there is a wider range of the width d of the gap 132. Therefore, a wider range of the desired levels of constant flow rate change between two pressure points is advantageously provided. A gradual flow rate change with respect to the water pressure is also advantageously provided.

Further, the larger end 115 of the control valve 114 is advantageously smaller than the smallest inner circumference at end 109 of the middle enclosure 102. Therefore, a gap always remains open. This advantageously provides a continuous water flow in the water flow regulator 100 even when the water pressure is very high.

An example of a constant flow rate change between two pressure points is described in the following. For example, the initial pressure is about 1.5 bar and the initial flow rate is X litre/min. Assuming that the increase in flow rate has to be kept at less than or equal to 2 litre/min when the pressure is increased to about 3.5 bar, the maximum flow rate should be $(X+2)$ litre/min.

The water flow regulator 100 can be used at water outlets such as a shower head (Figure 2) and a water tap (Figure 3). The water flow regulator 100 is fitted into cavities in the shower head and the water tap, which are in turn connected to the water supply line.

It will be appreciated by a person skilled in the art that numerous variations and/or modifications may be made to the present invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects to be illustrative and not restrictive.

The materials used for manufacturing the various components of the water flow regulator are not restricted to those mentioned. The shapes of the top enclosure, the middle enclosure and the bottom enclosure are not limited to that as described above. There may be differently shaped control valves, balancing shafts, upper spring supports, and lower spring supports.

The number of holes and the number of water outlets are not limited to that as described above. The holes and the water outlets may adopt other shapes. The size of the holes and the water outlets are also not limited to that as described above.

CLAIMS

1. A water flow regulating device for use at or near a water outlet, the device comprising:

- a valve element disposed adjacent to an aperture;
- a resilient member coupled to the valve element; and

wherein movement of the valve element under a water pressure and against a resilience of the resilient member reduces a gap between the aperture and the valve element to regulate a flow of water through the device.

2. The device as claimed in claim 1, wherein the resilient member is further coupled to a support member functioning as a stopper element for the resilient member under the water pressure.

3. The device as claimed in claim 2, wherein the support member is adjustable, whereby a desired gap under a given water pressure can be set for the device.

4. The device as claimed in claim 3, wherein the aperture is formed in a first component of the device and the support member is formed in a second component of the device, wherein the first and second components are connectable to each other in a manner such that a distance between the aperture and the support member is variable.

5. The device as claimed in claim 4, wherein the first and second components are screw fitted to each other.

6. The device as claimed in any one of the preceding claims, wherein the valve element comprises a tapered outer surface.

7. The device as claimed in any one of the preceding claims, wherein the aperture comprises a tapered internal surface.

8. The device as claimed in any one of the preceding claims, further comprising a balancing shaft, and the valve element and the resilient member comprise respective through holes for aligning along the balancing shaft.

5 9. The device as claimed in any one of the preceding claims, further comprising a first static flow regulating element disposed upstream from the valve element and the aperture.

10 10. The device as claimed in any one of the preceding claims, further comprising a second static flow regulating element disposed downstream from the valve element and the aperture.

11. The device as claimed in any one of the preceding claims, wherein the resilient member comprises a spring.

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12. The device as claimed in any one of the preceding claims, wherein the valve element is made from a substantially solid material.