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Fluid flow control device

The present invention relates to a fluid flow control device for controlling flow of fluid from a fluid outlet.

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Many types of water saving devices are known. One example is illustrated in Figure 1a and is referred to, generally, as a "thimble". The thimble is issued to domestic water users by the water authority of at least one country. The thimble 2 comprises generally a round rubberised disc 2a with four through holes and a
10 retainer 2b for retaining the thimble at an outlet 4a of a water tap 4. One purpose of the thimble 2 is to create a back pressure within the tap 4 upstream of the rubberised disc 2a when installed, thereby to reduce flow from the outlet 4a of tap 4.

15 A disadvantage of thimble 2 is that flow rate is reduced only by a small amount. Further, at various locations within any one building, fluid pressure can vary for fluid outlets at the various locations. Accordingly, if a size of the apertures of the thimble is too small, users at locations where fluid pressure is low will suffer from too large a reduction in flow rate, causing inconvenience. However,
20 insertion of a thimble with a larger aperture size at these locations to overcome this problem defeats the purpose of inserting a thimble: reduction in flow rate would be negligible.

Another type of water saving device, an aerator, is shown in Figure 1b. The
25 aerator 2c is fitted onto a water tap 4 outlet and is simply a diffuser having many tiny holes (not shown) to restrict flow of water by causing a high pressure drop of water from the tap 4 at the aerator.

However, if a user of one of the devices of Figure 1 requires a higher flow rate,
30 the only way to achieve this is for the user to remove the device from the outlet.

Alternatively, if a lower flow rate than that offered by the fixed flow rate device is required, this will be difficult to achieve, as the user will have to control flow by variation of the amount of opening of the outlet valve. This is an imprecise operation and offers low repeatability. An alternative is for the user to change the device to a lower fixed flow rate device. However, this might necessitate frequent changing of devices to one that provides a fixed flow rate that suits the user's purpose at a particular point in time which will cause inconvenience.

The invention is defined in the independent claims. Some optional features of the invention are defined in the dependent claims.

A fluid flow control device according to the independent claims offers significant advantages over known devices. For instance, by having a user-selectable second position for the flow regulator, a higher flow rate can be achieved for a particular fluid pressure upon user selection. Additionally, in devices providing this feature, the flow regulator resets to the first flow regulator position when the fluid pressure is less than the first bias threshold. This means that the next time a user opens the fluid outlet valve (e.g. a user switches on a water tap) the flow rate is automatically set to low flow, thereby ensuring a default position in which possible wastage of fluid is reduced.

By having more than one fixed flow rate (for a particular fluid pressure), time can be saved for some applications such as filling large pots or vessels by switching the flow regulator to the second position to allow filling to be achieved within a shorter period. Flow control devices in accordance with the independent claims can also have multiple settings to provide the user with a choice of multiple flow rates for different applications.

The invention will now be described, by way of example only and with reference to the accompanying drawings in which:

Figure 1 illustrates two known fluid flow control devices;

Figure 2 is a block diagram illustrating a first fluid flow control device;

Figure 3 is a cross-sectional view of a second fluid flow control device;

Figure 4 is a top view of a body part of the device of Figure 3;

5 Figure 5 is a view of a flow regulator part of the device of Figure 3;

Figure 6 is a view of a seat part of the device of Figure 3 and the manner in which it engages with body part of Figure 4;

Figure 7 is a view of a lock ring part of the device of Figure 3;

10 Figure 8 is a functional view of the device of Figure 3 in use under a first set of conditions;

Figure 9 is a view of the seat part assembly within the body part assembly of the device of Figure 3;

Figure 10 is a functional view of the device of Figure 3 in use under a second set of conditions;

15 Figure 11 is a functional view of the device of Figure 3 in use under a third set of conditions;

Figure 12 is a functional view of the device of Figure 3 in use under a fourth set of conditions;

20 Figure 13 is a functional view of the device of Figure 3 in use under a fifth set of conditions;

Figure 14 is a functional view of the device of Figure 3 in use under a sixth set of conditions;

Figure 15 is a cross-sectional view of a third fluid flow control device;

Figure 16 is a cross-sectional view of the third device in use;

25 Figure 17 is a cross-sectional view of a fourth fluid flow control device; and

Figure 18 is a cross-sectional view of the fourth device in use.

Referring to Figure 2, a first new fluid flow control device will now be described.

30 The device 10 is adapted for engagement with fluid outlet 12. The device may be engaged in any suitable manner including use of, for example, a screw

thread (not shown) on the device 10 arranged for engagement with a corresponding screw thread (also not shown) on the fluid outlet 12. Device 10 comprises a flow regulator 14 for controlling flow rate of fluid through the device 10. Device 10 also comprises flanges 20a, 20b, bias 16 and user selection mechanism 18. Flow regulator 14 forms a seal with flanges 20a, 20b as shown in Figure 2a to restrict fluid flow around the flow regulator 14 when in the first flow regulator position of Figure 2a. Fluid 11 discharges from fluid outlet 12 as indicated by the arrows 11. A force arising from fluid pressure acts on an upstream face 24 of flow regulator 14. However, user selection mechanism 18 provides a retention mechanism for retaining flow regulator 14 in the first flow regulator position of Figure 2a. That is, although fluid pressure acts on the upstream surface 24 of flow regulator 14, flow regulator 14 cannot move as its movement is restricted and the flow regulator 14 is retained at the first flow regulator position by user selection mechanism 18.

Bias 16 acts as a biasing force on flow regulator 14 in a direction opposing the force applied on the flow regulator 14 by fluid 11; that is, in a direction towards the fluid outlet.

Flow regulator 14 is arranged to move in a direction indicated by arrows 14a from the first flow regulator position illustrated in Figure 2a to a second flow regulator position indicated in Figure 2b. Guide means (not shown for the sake of clarity) are provided to ensure the flow regulator 14 is guided precisely from the first flow regulator position to the second flow regulator position.

User selection mechanism 18 is arranged to move in the directions indicated by arrows 18a.

In the position of Figure 2a, the only discharge flow path for fluid 11 from fluid outlet 12 is through aperture 15 in flow regulator 14. Fluid at a low flow rate 11b

is discharged from device 10 as illustrated. Because of the restricted flow caused by the seal between flow regulator 14 and flanges 20a, 20b, a back pressure force of fluid indicated by arrows 13 is created.

5 When a user desires a high flow rate through device 10 for the particular fluid pressure available from fluid outlet 12, the user operates user selection mechanism 18 in the direction 18b of Figure 2b. By doing so, the retaining function on flow regulator 14 by user selection mechanism 18 is removed. If the force of fluid pressure acting on the upstream surface 24 of flow regulator 14 is
10 greater than a first bias threshold (e.g. the force acting on the flow regulator 14 by bias 16), flow regulator 14 moves in the direction indicated by arrow 14b against the first bias force, as shown in Figure 2b. As the flow regulator 14 moves axially (in a longitudinal axis of the device – not indicated for the sake of clarity) in the direction of 14b from the first flow regulator position of Figure 2a to
15 the second flow regulator position of Figure 2b, the seal between flow regulator 14 and flanges 20a, 20b is broken, thereby creating new flow paths through positions 22. Bias 16 is compressed to the state illustrated in Figure 2b. Fluid 11 also continues to flow through the aperture 15 of flow regulator 14 with an overall result of an increased flow rate through the device as indicated by 11c.

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That is, the device 10 allows fluid flow through the device 10 for a particular fluid pressure at a first flow rate when the flow regulator 14 is at a first flow regulator position and at a second flow rate when the flow regulator 14 is at a second flow regulator position, the second flow rate being greater than the first flow rate.

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When the user closes the control valve (not shown) of the fluid outlet 12, fluid pressure of the fluid 11 drops below the force of the first bias threshold thereby causing the flow regulator 14 to move back to the first flow regulator position of Figure 2a under action of the force of the bias 16. The seal at positions 22
30 between flow regulator 14 and flanges 20a, 20b is thereby made again.

Optionally, the device 10 can be provided with a second bias (not shown) to urge user selection mechanism 18 back to the position of Figure 2a, thereby again to provide the retaining function on flow regulator 12 when discharge of fluid 11 from fluid outlet 12 is initiated by user. Thus, when a user opens the fluid outlet valve again, the setting of the device 10 is reset to a low flow rate, the flow rate when the flow regulator 14 is at the first flow regulator position.

Figure 3 is a cross-sectional view of a second fluid flow control device. The device 200 is arranged to engage with a fluid outlet (not shown).

The device 200 comprises:

- a body 222 for housing the components of the device 200;
- an adaptor 220 to facilitate engagement with the fluid outlet (not shown);
- a rubber washer 218 to prevent leaking between the device 200 and the fluid outlet;
- a flow regulator 202 for controlling the flow rate of fluid through the device 200;
- a seat 208 for engagement with the flow regulator 202;
- a compression spring 204 to provide a biasing force on the flow regulator 202 to reset the flow regulator 202 to the original position when flow pressure force is less than the force of the bias of the spring 204;
- a lock ring 214 for preventing the body 222 and the seat 208 from being separated;
- a nut 212 which is a user-selection mechanism for selection of the flow rate. In the example of Figure 3, the nut 212 is a casing that holds the seat 208 and the diffuser 206;
- a torsion spring 210 which provides a second biasing means in the device 200 to create a counteracting force to the nut 212 and the seat 208 to return

these to the first seat position (resets to position for first flow rate) once flow of fluid from the fluid outlet has been switched off by the user;

- O-ring 216 for preventing fluid leaking between the body 222 and the nut 212;
- 5 • a (removable) high-pressure washer 226 which restricts the area of the flow regulator 202 in contact with fluid from the fluid outlet, thereby to reduce the force of the fluid on the flow regulator 202 at fluid outlets discharging fluids at high pressure;
- a diffuser 206, made of stainless steel meshed wires, to create a pressure
- 10 drop to avoid a spraying effect of fluid discharged from the device 200; and
- a screen 224 to prevent debris in the fluid entering into the device 200.

The component functionality and their interaction with one another will now be described.

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The body 222 acts as a housing or “frame” for all the components of the device 200. Figure 4 shows a top view of the body 222 in the direction ‘A’ shown in Figure 3. The body 222 has three female slots, 402, for engagement with male projections 602 on the seat 208 (discussed below). Body 222 of Figure 3 is

20 made from brass, with or without nickel- or chrome-plating.

Rubber washer 218 is a moulded rubber washer ring. The washer 218 rests inside aperture 201 of device 200 on high-pressure washer 226 (if fitted) and on top of lock ring 214 if the high-pressure washer 226 has been removed. The

25 purpose of the rubber washer 218, as mentioned above, is to prevent leaking between the device 200 and the fluid outlet. Without the rubber washer 218, fluid may leak through gaps between the fluid outlet and device 200, unless a perfect mating join can be made.

Actual engagement of the device 200 with a fluid outlet is facilitated with the adaptor 220, which has an internal screw thread 221 for engagement onto an externally threaded part of the fluid outlet. Alternatively, adaptor 220 is provided with an external screw thread (not shown) for engagement with an internal thread on the fluid outlet. Of course, any other suitable retaining means for retaining the device 200 in engagement with the fluid outlet may be used. Suitable materials for the construction of the adaptor 220 include, for example, brass, with or without a nickel- or chrome-plating.

Flow regulator 202 is the flow regulating mechanism of device 200 and acts in concert with seat 208 and, in turn, nut 212. The flow regulator 202 rests on the seat 208 and the lock ring 214 and, optionally, the high-pressure washer 226, rests on the flow regulator 202. Although, in the example of Figure 3 the flow regulator 202 rests on seat 208 in the first flow regulator position (discussed below) other devices implement a flow regulator 202/seat 208 combination where the flow regulator 202 does not engage with the seat 208 when in the first flow regulator position, but only in the second flow regulator position.

Flow regulator 202 is shown in greater detail in Figure 5. Figure 5a illustrates a top view of flow regulator 202 in the direction 'A' of Figure 3. As shown, the flow regulator 202 is generally circular when viewed from above with slots or notches 506, which act as guides for engaging guide legs 704 of the lock ring 214, as seen in Figure 7, and as explained further below.

Flow regulator 202 has five different types of apertures: 205, 504, 508, 510 and 512. Apertures 504 are for fluid to pass through the flow regulator when moved to a position for increased flow rate.

Figure 5b shows an underside view of the flow regulator 202, illustrating apertures 504 and notches 506 from an opposing viewpoint than that of

direction 'A' of Figure 3. Also shown in Figure 5b are protrusions 514, which are flow regulator legs projecting from an underside 503 of flow regulator 202 to engage recesses in seat 208, as will be discussed below. Flow regulator legs 514 are more clearly illustrated in Fig. 5c, which provides a cross-sectional view along lines C-C of Figure 5b. Figure 5c also illustrates the manner in which apertures 205, 504 and 512 pass through the flow regulator 202 to allow fluid flow through the device 200.

In situ, as shown in Figure 3, flow regulator 202 has an area 203 exposed to fluid supplied from the fluid outlet through aperture 201. Area 203 comprises an elevated portion of flow regulator 202 and, as such, is positioned inside the inner edge 226a of removable high-pressure washer 226, which rests around and encircles first stepped portion 203a of flow regulator 202.

High-pressure washer 226 acts as a fluid force reducer. When in place, high-pressure washer 226 covers a portion 203c of the surface of flow regulator 202 exposed to fluid to reduce fluid force acting on the flow regulator 202. In mechanics, it is known that an applied force is equal to a product of a pressure applied and the area over which the pressure is applied to. Thus, if high-pressure washer 226 covers a portion 203c of the upstream surface of flow regulator 202, the effective area exposed to fluid from the fluid outlet is reduced, thereby reducing the amount of force applied to the flow regulator 202 from fluid pressure.

When the fluid pressure available at the fluid outlet is above a pre-determined amount, high fluid pressure force will cause flow regulator 202 to push too hard against seat 208 and accordingly, nut 212 will be difficult to turn when a different flow rate through the device 200 is required, as discussed below. Thus, removable high-pressure washer 226 reduces the area of the flow regulator 202 in contact with the higher fluid pressure. Therefore, by reducing the surface

area, the force produced by the fluid on the flow regulator 202 will decrease. If the fluid pressure is lower than the pre-determined amount, high-pressure washer 226 may be removed from the device 200.

- 5 High-pressure washer 226 is made from of any suitable material, for example, delrin.

Device 200 also comprises seat 208. A top view of seat 208 in the direction 'A' of Figure 3 is shown in Figure 6a while Figure 6b shows a sectional view of seat
10 208 through section D-D of Figure 6a. Seat 208 has a pair of apertures 604 in the shape of kidneys for fluid to flow from the flow regulator 202 through the seat 208 to the diffuser 206 prior to discharge from the device 200. Seat 208 has three male protrusions 602 for engaging female slots 402 of the body 222, as will be discussed below. Further, the seat 208 has two recesses 606 for
15 engaging the flow regulator legs 514 of Figure 5 (again, discussed below). The portions of seat 208 defining recesses 606 comprise a stepped arrangement. The profile of the stepped arrangement with steps ①, ① and ② is illustrated in Figure 6b.

- 20 In the example of Figures 3 and 6, seat 208 is made from delrin.

Nut 212 allows a user to select the flow rate for fluid to discharge from the device 200 for a particular fluid pressure from the fluid outlet. The combination of the seat 208 and the nut 212 corresponds, approximately, with user selection
25 mechanism 18 of Figure 2.

During fabrication, seat 208 is press fit into the nut 212 and fully engaged with the nut 212 so that turning of the nut 212 effects turning of the seat 208. The nut 212 is made of brass, and can be nickel- or chrome-plated. The seat 208 is also
30 engaged with the body 222 as shown in Figure 6c. The protrusions 602 of seat

208 are dropped into female slots 402 of body 222. Seat 208 is then turned approximately 20 degrees anti-clockwise indicated by arrow 610 of Figure 6d. A channel 612 is formed between body 222 and seat 208 for seat protrusions 602 to rotate in. Guide legs 704 of lock ring 214 of Figure 7 are pushed into the female slots 402 of body 222 shown in Figure 6e. As seat protrusions 602 are in the groove 612 of seat 208, seat 208 is prevented from moving back to the position shown in Figure 6c. Therefore, protrusions 602 of the seat 208 are locked in channel 612.

10 Alternatively, nut 212 and seat 208 are fabricated as a single piece.

Device 200 also comprises a compression spring 204 which acts as a bias – i.e. provides a biasing force – against flow regulator 202. In particular, the compression spring 204 will bias or urge the flow regulator 202 towards the first flow regulator position.

Device 200 comprises a second bias in the form of torsion spring 210. Torsion spring 210 creates a counteracting force against nut 212 and seat 208. Torsion spring 210 biases or urges nut 212 and seat 208 to return to the first seat position as will be discussed below.

Device 200 also comprises the lock ring 214 of Figure 7. Figure 7a illustrates a side view of the lock ring 214 and Figure 7b provides an underside (from the opposing viewpoint of direction 'A' of Figure 3) view of the lock ring 214. Lock ring 214 is generally circular in shape (as seen in Figure 7b) similar to a washer when viewed from the underside with an aperture 705 through which second stepped portion 203b of flow regulator 202 projects when lock ring 214 rests upon flow regulator 202. Projecting from flat underside 702 – which comprises a seat for the lock ring 214 to rest on the flow regulator 202 – of the lock ring 214

are guide legs 704 for engagement with the guide slots 506 of the flow regulator 202 illustrated in Figure 5.

Lock ring 214 also prevents the body 222 and the seat 208 from being separated. Lock ring 214 is made from any suitable material including delrin.

Lock ring 214 restrains flow regulator 202 and acts as a guide for flow regulator 202 within body 222 when moving from the first flow regulator position to the second flow regulator position. Lock ring 214 corresponds approximately with the guide means (not shown) of the device of Figure 2.

Device 200 also comprises rubber washer 218 which rests on the high-pressure washer 226 when provided, and on lock ring 214 when the high-pressure washer 226 is removed. Rubber washer 218 is disposed to surround screen 224, discussed below. Rubber washer 218 prevents fluid leakage between the device 200 and the fluid outlet. In particular, the rubber washer 218 prevents leakage of fluid through gaps between the fluid outlet and the device 200 when the device 200 is engaged with the fluid outlet. In use, the fluid outlet is disposed within aperture 201. Engagement of device 200 with fluid outlet causes the outlet to abut washer 218, providing a sealing function.

Device 200 also comprises an O-ring 216 resting in recessed portion 212a of nut 212 as shown in Figure 3. O-ring 216 prevents fluid leakage between body 222 and nut 212 and is made of any suitable material, for example, rubber.

Device 200 also comprises screen 224 made from, for example, stainless steel mesh wires. Screen 224 prevents debris in fluid flow from entering the device 200 at aperture 201.

Device 200 also comprises diffuser 206 made from, for example, stainless steel meshed wires. Diffuser 206 diffuses the high-pressured fluid flow discharged through the device 200 from seat 208 to a low pressured fluid flow so as not to create a spraying effect when the fluid hits a surface after flowing out of the device 200.

Diffuser 206 is fitted into the seat 208 and retained by any suitable means.

In use, fluid from the fluid outlet enters the device 200 under pressure at aperture 201.

Figure 3 illustrates device 200 when no fluid flows from the fluid outlet. In figure 3, flow regulator 202 is in the first flow regulator position (corresponding to a first flow regulator position of Figure 2a) and seat 208 is in a first seat position. In this state, flow regulator legs 514 of Figure 5 engage the ① step of seat 208, shown in Figure 6b.

Operation of the device 200 and fluid flow through the device 200 in varying conditions is now discussed, first with reference to Figure 8.

When the valve of the fluid outlet is opened to allow fluid to flow from the fluid outlet through the device 200, fluid pressure acts on the surface 203 of flow regulator 202. In the example of Figure 8 and following, the fluid outlet is a water tap and flow regulator 202 is for controlling flow of water from the tap.

When the tap (not shown) is turned on, seat 208 is at a first seat position and flow regulator 202 remains at the first flow regulator position. Flow regulator legs 514 of Figure 5 remain engaged with step ① of seat 208, as shown in Figure 6b and Figure 9a. Water will first flow through aperture 201 of device 200 at a first flow rate for the particular water pressure available at the tap outlet.

Water then flows through aperture 205 of flow regulator 202, through compression spring recess 252 and holes 604 of seat 208. The arrangement of aperture 205 is such that only a fixed amount of water can flow through it for a particular water pressure. The water will then continue to flow through the device 200 through holes 604 of seat 208, and eventually through diffuser 206.

If a user wishes to select a higher flow rate of water through the device 200, the user selects a second flow regulator position by turning nut 212 approximately 40 degrees rotatably about a centre axis (not indicated) of device 200. Seat 208 is then moved (rotated) from a first seat position to a second seat position. At this time, the stepped arrangement of the seat 208 illustrated in Figure 6b rotates with the seat 208, so that step ① is disposed below a flow regulator leg 514 illustrated in Figure 5c. If fluid pressure force acting on upper surface 203 of flow regulator 202 in direction 'X' is greater than the bias force of compression spring 204 acting in the opposite direction 'Y', flow regulator 202 moves from the first flow regulator position to the second flow regulator position and, in doing so moves down a step from step ⑥ to step ① such that the flow regulator legs 514 engage recess 606 of the seat 208 at position ①, as shown in Figure 9b. Water pressure force applied to surface 203 of the flow regulator 202 causes the flow regulator legs 514 to press against the seat 208. Torsion spring 210 acts to urge the nut 212 and the seat 208 to the first seat position but is prevented from returning to the first seat position as the fluid pressure force forces the flow regulator leg 514 into recess 606 of seat 208 and position ①. A friction force acting between flow regulator 202 and seat 208 caused by torsion spring 210 urging seat 208 towards the first seat position may contribute to the bias threshold force.

Water still flows through aperture 205 as shown in Figure 10. With flow regulator 202 in the second flow regulator position, new flow path 1202 between the flow regulator 202 and the lock ring 214 and flow path 1204 between high-

pressure washer 226 and flow regulator 202, open for water to flow through. Accordingly, there are two additional flow paths through the aperture 510. When flow regulator 202 is in the first flow regulator position, flow through flow path 1204 is inhibited by high-pressure washer 226, as shown in Figure 8. The flow path of the water is from aperture 510 through aperture 508, holes 604 of seat 208 and eventually through diffuser 206. The size of aperture 510 is such that an additional flow rate to supplement the flow rate created by aperture 205 is produced, thereby achieving a second flow rate, the second flow rate being greater than the first flow rate.

Thus, the flow paths in the device 200 when the flow regulator 202 is in the second flow regulator position defines a composite flow path of greater cross-sectional area than that of the first flow path, thereby to allow the second flow rate to be greater than the first flow rate.

Flow regulator 202 is guided in its movements within body 222 by engagement of guide legs 704 on lock ring 214 with the flow regulator notches/guides 506 such that when the nut 212 is turned by a user to select the second flow regulator position, flow regulator legs 514 engage with a corresponding recess 606 of the seat 208. Accordingly, without the lock ring 214, the flow regulator 202 will move together with the nut 212 and the seat 208 without engaging with the recess 606 of the seat 208. Therefore, a different flow rate will not be achieved.

When the user does not need water to flow through the device 200 any longer, the user simply turns off the tap. Water pressure force acting on the surface 203 of the flow regulator 202 is reduced to zero. Thus, this force is less than the bias threshold (the water pressure force acting in direction 'X' (as shown in Figure 8) is less than the bias force acting in direction 'Y' (as shown in Figure 8)) and the flow regulator 202 returns to the first flow regulator position of Figure 3.

Consequently, the seat 208, together with the nut 212, are urged to the first seat position under force of the second bias, torsion spring 210, with flow regulator legs 514 once more engaging recess 606 of seat 208 at position ①, as shown in Figure 9a.

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Alternatively, with water from the tap flowing through the device 200 at the second flow rate, a user may choose to turn the nut 212 once more to achieve a third, yet higher flow rate. This is done by turning the nut 212 a second time by another forty degrees or so to move the seat 208 from the second seat position to a third seat position. At this time, the stepped arrangement of the seat 208 illustrated in Figure 6b rotates with the seat 208, so that step ② is disposed below a flow regulator leg 514 illustrated in Figure 5c. If fluid pressure force acting on upper surface 203 of flow regulator 202 in direction 'X' (as shown in Figure 8) is greater than the bias force of compression spring 204 acting in the opposite direction 'Y' (as shown in Figure 8), flow regulator 202 moves from the second flow regulator position to a third flow regulator position and moves down a step from step ① to step ② such that the flow regulator legs 514 engage recess 606 of the seat 208 at position ②, as shown in Figure 9c. Water pressure force applied to surface 203 of the flow regulator 202 causes the flow regulator legs 514 to press against the seat 208. Torsion spring 210 acts to urge the nut 212 and the seat 208 to the first or second seat position but is prevented from doing so as the fluid pressure force forces the flow regulator leg 514 into recess 606 of seat 208 to position ②.

25 Device 200 works well for user selection of flow rate without torsion spring 210. However, nut 212 with seat 208 have to be turned back to the first seat position manually once the fluid flow from the fluid outlet is reduced.

As seen from Figure 11a, when the flow regulator 202 is at the third flow regulator position, the opening 1204 between high-pressure washer 226 and flow regulator 202 is at its maximum. Opening 1202 between lock ring 214 and flow regulator 202 is also at its maximum. With the openings 1202 and 1204 at their maximum, water is able to flow through the openings 1202 and 1204 at an overall higher flow rate, through aperture 205, aperture 508, aperture 510 and aperture 512, holes 604 of the seat 208 and, eventually, diffuser 206, as seen from Figure 11b.

- 10 The size of the holes 504 on the flow regulator 202 is calculated to produce a high flow rate setting. These holes 504 are sized so that fluid pressure from the fluid outlet creates enough force to overcome the force created by the compression spring 204 so that the flow regulator 202 can be pressed against the seat 208 at its final recess at position ②, as shown in Figure 9c. If the size of the holes 504 is too large, flow rate through the holes 504 will be too high and the fluid pressure on flow regulator 202 will not be able to create enough force for the flow regulator 202 to overcome the force of compression spring 204 and press flow regulator 202 against the seat 208.
- 20 Similar to that described above, when the user does not need water to flow through the device 200 any longer and the user turns off the tap, flow regulator 202 returns to the first flow regulator position and seat 208 returns to the first seat position of Figure 3.
- 25 In this way, seat 208 is in its first seat position and flow regulator 202, in its first flow regulator position. Accordingly, when the tap is turned on again, the water from the tap will flow through device 200 at the first flow rate until the user turns the nut 212 to move the seat 208 to the second seat position or a third seat position to achieve a higher flow rate.

Figures 12, 13 and 14 show the device 200 when the flow regulator 202 is in the first flow regulator position, second flow regulator position and third flow regulator position respectively when the high-pressure washer 226 is removed. As mentioned above, the high-pressure washer 226 is removed when the water pressure from the tap is lower than a predetermined pressure.

For example, in Figure 12, removal of the high-pressure washer 226 exposes aperture 512 even when the flow regulator 202 is in the first flow regulator position and the seat 208 is in the first seat position. Apertures 512 are blanked by removable high-pressure washer 226 when in position. When the tap is turned on, water will still flow through aperture 205 as in Figure 8, as well as through aperture 512. The flow rate through aperture 512 will supplement the lower flow through aperture 205 as a result of the low water pressure. As described previously for Figure 8, the water will then pass through holes 604 of the seat 208 and eventually through the diffuser 206.

Figure 13 shows the water flow paths when the user turns the nut 212 so that the seat 208 moves to the second seat position to achieve a second flow rate. The flow regulator 202 moves to the second flow regulator position in a similar manner as described for Figure 10 above. However, as seen from Figure 13, aperture 205, aperture 508 and aperture 512 are exposed to allow water to flow through them.

Figure 14 shows the water flow paths when the user turns the nut 212 further so that the seat 208 moves to the third seat position to achieve a third flow rate. The flow regulator 202 moves to the third flow regulator position in a similar manner as described for Figures 11a and 11b. As seen from Figure 14, the opening 1202 between the flow regulator 202 and the lock ring 214 is at its maximum when the flow regulator 202 is in the third flow regulator position.

Figure 15 is a cross-sectional view of a third device 1500. Device 1500 is similar to device 200 of Figure 3. However, the differences are that device 1500 comprises a lock ring 1514 which is external to the body 1522 of device 1500. The arrangement of device 1500 is suitable for externally threaded fluid outlets.

5 Further, device 1500 does not comprise a seat. However, nut 1512 of device 1500 comprises recesses (not shown) instead of the seat 208 in the device 200 of Figure 3. Accordingly, the nut 1512 functions as the nut 212 and seat 208 of device 200. Similarly to device 200 of Figure 3, device 1500 also comprises a body 1522, a flow regulator 1502, a compression spring 1504, a diffuser 1506, a
10 torsion spring 1510 which biases the nut 1512 towards a first nut position, an O-ring 1516 and a rubber washer 1518.

Figures 16a, 16b and 16c show the device 1500 when the flow regulator 1502 is at the first flow regulator position, second flow regulator position and third flow
15 regulator position respectively. The flow regulator 1502 moves to the first, second and third flow regulator position when a user turns the nut 1512 to a first nut position, second nut position and third nut position respectively. When the flow regulator 1502 is at the first flow regulator position (Figure 16a), the water flows through the device 1500 from the tap to which device 1500 is engaged
20 with at a first flow rate. Similarly, when the flow regulator 1502 is at the second (Figure 16b) and third flow regulator (Figure 16c) positions, water flows through the device 1500 at a second flow rate and a third flow rate respectively, wherein the third flow rate is greater than the second flow rate and the second flow rate is greater than the first flow rate. As shown in Figure 16a, when the flow
25 regulator 1502 is at the first flow regulator position, the water flows from the tap (not shown) through orifice 1520 in the device 1500 following flow paths 1530. When the flow regulator 1502 is at the second flow regulator position, as shown in Figure 16b, the water flows through orifices 1520 and 1521 following flow paths 1530. Figure 16c shows water flowing through orifices 1520 and 1521

following flow paths 1530 when the flow regulator 1502 is at the third flow regulator position.

As described above for device 200, when the water pressure force acting on the surface 1503 of the flow regulator 1502 is reduced as a result of, for example, a user turning off the tap, the counterforce from the compression spring 1504 is greater than the water pressure force and therefore the flow regulator 1502 returns to the position as shown in Figure 15. Consequently, as the force of the legs 1515 of the flow regulator 1502 acting on the nut 1512 is reduced to lower than the counterforce of the torsion spring 1510, the nut 1512 returns to the position as shown in Figure 15. Accordingly, when the user turns on the tap again, the nut 1512 and flow regulator 1502 will be at the first nut position and first flow regulator position respectively, as shown in Figure 15.

Figure 17 shows a cross-sectional view of a fourth device 1700. In device 1700, the seat 208 of device 200 of Figure 3 is in the form of a pin 1708. The pin 1708 comprises steps 1730 for engagement with the flow regulator protrusion 1732. The pin 1708 is arranged to move normally to the centre vertical axis of the device 1700, while the flow regulator 1702 is arranged to move axially in the centre vertical axis of the device 1700. In particular, the flow regulator 1702 moves in the direction indicated by arrows 'X' while the pin 1708 moves in the direction indicated by arrows 'Y'. Device 1700 further comprises a compression spring 1704 biasing the flow regulator 1702 to a first flow regulator position, a diffuser 1706 and a torsion spring 1710 biasing the pin 1708 to a first pin position.

Figure 17 illustrates device 1700 when no fluid flows from the fluid outlet to which device 1700 is engaged with. In Figure 17, flow regulator 1702 is in the first flow regulator position and pin 1708 is in a first pin position. In this state,

flow regulator protrusion 1732 engages step 1730 in the manner as shown in Figure 17.

Operation of device 1700 and fluid flow through device 1700 in varying conditions is described, first with reference to Figure 18a. In the example of Figure 18a and following, the fluid outlet is a water tap and flow regulator 1702 is for controlling flow of water from the tap. Device 1700 operates, in principle, in a similar manner to device 200 of Figure 3 and pin 1708 corresponds, in principle, with seat 208 of Figure 3.

When the tap (not shown) is turned on, pin 1708 is at a first pin position and flow regulator 1702 remains at the first flow regulator position. Water will first flow through aperture 1701 at a first flow rate for the particular water pressure available at the tap outlet. Water then flows through aperture 1705, through the side of pin 1708 and eventually through diffuser 1706.

If a user wishes to select a higher flow rate of water through device 1700, the user selects a second flow regulator position by pushing pin 1708 in the direction 'Z' shown in Figure 18a. The pin is then moved to a second pin position, as shown in Figure 18b. if fluid pressure force exerted on flow regulator 1702 by water discharging from the tap (not shown) is greater than the force of bias 1704 exerted on flow regulator 1702 in the opposite direction, flow regulator 1702 moves to a second flow regulator position such that flow regulator protrusion 1732 engages step 1730 as shown in Figure 18b. Optionally, restriction means (not shown) is provided to ensure smooth transition of pin 1708 from the first pin position to the second pin position and to ensure pin 1708 does not immediately overshoot from the first pin position to a third pin position (described below).

With flow regulator 1702 in the second flow regulator position, new flow paths are created by opening 1750. Accordingly, water flows through aperture 1701 as in Figure 18a, as well as through opening 1750, resulting in additional flow, thereby allowing a second flow rate, the second flow rate being greater than the first flow rate.

If a user further moves pin 1708 in the direction 'Z' in Figure 18a, pin 1708 moves from a second pin position to a third pin position, as shown in Figure 18c. As in Figure 18b, flow regulator 1702 moves from a second flow regulator position to a third flow regulator position when the force of fluid pressure exceeds the force of bias 1704. Flow regulator protrusion 1732 engages step 1730 as shown in Figure 18c. When flow regulator 1702 is in the third flow regulator position, the size of opening 1750 is increased, thereby allowing more water to flow through opening 1750, and eventually through diffuser 1706. Flow regulator 1702 in the third flow regulator position allows a third flow rate, wherein the third flow rate is greater than the second flow rate.

Although the devices have been described with particular reference to the accompanying figures, many variations are possible, as will be clear to the skilled reader, without departing from the spirit and scope of the invention.

Claims

1. A fluid flow control device arranged to engage with a fluid outlet, the device comprising:

5 a flow regulator arranged to move within the device against a first bias between a first flow regulator position which allows fluid flow from the fluid outlet through the device at a first flow rate for a particular fluid pressure and a second flow regulator position which allows fluid flow from the fluid outlet through the device at a second flow rate for the particular fluid pressure, the second flow
10 rate being greater than the first flow rate;

the flow regulator being arranged, upon user selection of the second flow regulator position, to move to the second flow regulator position under fluid pressure force through the device if the fluid pressure force exceeds a first bias threshold, and to reset to the first flow regulator position when the fluid pressure
15 force is less than the first bias threshold.

2. The fluid flow control device of claim 1, further comprising a seat for engaging with the flow regulator when in the second flow regulator position, and wherein, upon user selection of the second flow regulator position, the device is
20 arranged to move the seat from a first seat position to a second seat position, thereby to allow the flow regulator to move to the second flow regulator position under the fluid pressure force.

3. The fluid flow control device of claim 2, further comprising a second bias
25 arranged to urge the seat to the first seat position.

4. The fluid flow control device of claim 2 or claim 3, wherein the flow regulator is arranged to move axially in an axis of the device and the seat is arranged to move rotatably about the axis of the device.

5. The device of claim 2 or claim 3, wherein the flow regulator is arranged to move axially in an axis of the device and the seat is arranged to move normally to the axis of the device.

5 6. The fluid flow control device of any one of claims 2 to 5, wherein the seat comprises a recessed portion and the flow regulator comprises a protrusion for engaging with the recessed portion of the seat.

7. The fluid flow control device of claim 6, wherein the recessed portion of
10 the seat comprises a portion of stepped profile.

8. The fluid flow control device of any one of claims 1 to 7, wherein the flow regulator is arranged such that movement of the flow regulator from the first flow regulator position to the second flow regulator position defines a second
15 composite flow path of greater cross-sectional area relative to a first composite flow path when in first flow regulator position thereby to allow the second flow rate to be greater than the first flow rate.

9. The fluid flow control device of any one of claims 1 to 8, wherein the flow
20 regulator is arranged to allow user selection of a third flow regulator position which allows fluid flow from the fluid outlet through the device at a third flow rate for the particular fluid pressure, the third flow rate being greater than the second flow rate.

25 10. The fluid flow control device of any one of claims 1 to 9, further comprising a removable fluid force reducer arranged to cover a portion of a surface area of the flow regulator exposed for contact with fluid from the fluid outlet, thereby to reduce fluid pressure force acting on the flow regulator.

11. The fluid flow control device of claim 10, wherein the flow regulator comprises apertures arranged to be blanked by the removable fluid flow reducer when in position.

5 12. A fluid flow control device arranged to engage with a fluid outlet, the device comprising:

a flow regulator arranged to move within the device against a first bias between a first flow regulator position which allows fluid flow from the fluid outlet through the device at a first flow rate for a particular fluid pressure and a second
10 flow regulator position which allows fluid flow from the fluid outlet through the device at a second flow rate for the particular fluid pressure, the second flow rate being greater than the first flow rate;

the flow regulator being arranged, upon user selection of the second flow regulator position, to move to the second flow regulator position under fluid
15 pressure force through the device if the fluid pressure force exceeds a first bias threshold.

13. The fluid flow control device of claim 12, the device being arranged to allow a user to reset the flow regulator to the first flow regulator position
20 manually.

14. A method of controlling fluid flow from a fluid outlet comprising using the device of any one of claims 1 to 13.