

Pressure responsive flow regulator

The present invention relates to a device, notably to a flow responsive device for fitting to the outlet of a water tap.

BACKGROUND TO THE INVENTION:

A conventional water tap for controlling the supply of water or other fluid to a locus comprises an inlet adapted to be connected to the water mains or other supply of water or other fluid; a valve mechanism for controlling the flow of water through the tap; and an outlet orifice through which the flow of water discharges to the locus, for example into a basin, bath or the like. Such taps can take many forms and can be connected to both hot and cold water supplies to produce a mixed outlet stream of hot and cold water at some intermediate temperature. For convenience, the term tap will be used herein to denote in general all forms of such taps.

Such taps find use wherever a user desires to control the supply of water or other fluid to a locus, such as a hand basin or bath. However, the invention is of especial application in the supply of hot and/or cold water in a domestic situation and will be described hereinafter in terms of such an application.

It has become common practice to fit the outlet to the tap with an insert which aids even distribution of the outlet flow across the transverse area of the outlet orifice. Such inserts also aid uniform mixing of hot and cold water to minimise the risk that the user may scald his hands if the hot water stream is not adequately mixed with the cold water stream. Typically, such inserts take the form of a transverse metal, plastic or ceramic plug which is a

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push, screw or other fit into the outlet orifice and which has a plurality of axial bores through the plug. The bores are sized and located so that when the tap valve is fully open there is a uniform flow of water across the plug giving a generally cylindrical jet of water from the tap. Typically, the combined cross sectional area of the bores in the plug is marginally less than that required to accommodate the full flow rate of water through the valve mechanism so that the plug causes a small back pressure at the tap outlet to create a jet of water from the tap. However, when the tap valve is only partially opened, the combined cross sectional area of the bores in the plug exceeds that required to accommodate the flow of water through the plug. The water then issues from the tap outlet as slow flow of water due to the lack of pressure drop across the plug. Since the plane of the tap outlet is usually inclined at from 5 to 15° to the horizontal to project the jet of water from the tap towards the centre of the basin it serves, the slow flow of water does not fill the outlet orifice, but issues as a shallow flow over an arc at the lower portion of the plug. This shallow flow of water not only gives the appearance of a slow rate of flow of the water, but is aesthetically unacceptable to a user since the flow is in the form of a sluggish dribble from the tap. Therefore, most users will tend to open the valve of the tap further to achieve an aesthetically pleasing full jet of water from the tap outlet. This is wasteful of water, especially where the user only intermittently uses the water, for example in wetting a toothbrush or wetting his hands when washing his face. Furthermore, in opening the valve of a hot tap fully, there is a greater risk of the user scalding himself where the water is at an elevated temperature and is not mixed with cold water in a mixer tap.

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It has been proposed to incorporate a pressure responsive device in the tap outlet which limits the outflow of water when the tap valve is only partially opened, thus causing the water to issue as a jet from the limited orifice at low flow rates; but allows a full flow of water when the tap valve is fully open. Thus, in British Patent No 2 063 104 B a shower head is provided with a spring loaded obturator at its outlet. The obturator moves against the spring bias away from its seat in the shower head as the water flow and hence the water pressure applied to its upstream face increases. This movement increases the size of the annular gap between the obturator and the body of the shower head to provide a larger flow path to accommodate the larger flow rate fed to the shower head. However, the obturator in such a design will tend to move rapidly in response to fluctuations in the water flow and/or water pressure applied to its upstream face. Hence, there is a tendency for the outflow of water from such a design to fluctuate and in an extreme case the flow can oscillate between the maximum and minimum flow rate causing hammering within the device and associated pipework.

We believe that once the obturator has moved in response to the initial increase in pressure on its upstream face, there will be little or no pressure drop across the obturator since the outlet and the upstream passages in the shower head are all vented to atmospheric pressure. The obturator will thus be free to move under the influence of the bias spring resulting in rapid shutting of the annular outlet gap by the obturator. This causes a rapid build up of pressure upstream of the obturator causing the obturator to move rapidly to the open position, repeating the cycle of opening and shutting movement of the obturator.

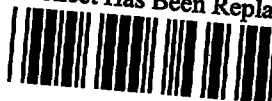
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It has also been proposed, for example in US Patent No 5,114 072, to introduce air into the water stream to give a soft aerated flow of water, particularly in shower heads. This is achieved in a ported plug which is inserted into or formed within the outlet to the tap or shower head which draws air into the water as it flows through the plug. Such a plug may contain a flow responsive component of the type described above. Such an aerated flow gives the impression of a full flow of water at low flow rates, but limits the maximum flow of water which can be achieved without significant enlargement of the tap or shower outlet.

It has also been proposed in US Patent No 4 352 462 to form a nozzle, which is used to inject cleansing water into a vessel containing a sludge, with a closure member to prevent back flow of sludge into the fluid flow passages of the nozzle. The closure member comprises an obturator which is spring biased to seat against the exterior of the nozzle housing so as to close off the nozzle outlet when cleansing water is not flowing through the nozzle. The obturator is connected by a rod to a transverse plate which is housed within a wider diameter portion of the fluid flow passage through the nozzle housing. The plate member butts against the shoulders formed in the wall at each end of the larger diameter portion at the extremes of its axial travel and thus limits the axial movement of the obturator. A bias compression coil spring is trapped between the transverse plate and the downstream shoulder to bias the obturator to seat against the nozzle orifice and close the orifice. The sole function of the transverse plate is to limit the axial movement of the obturator and it does not act in any way as a flow regulator. Furthermore, in its rest position when now water flows through the nozzle, the obturator seals the nozzle orifice so as to prevent

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ingress of sludge solids into the nozzle orifice. If such a device were used to regulate the flow of cleansing fluid through the nozzle orifice, the pressure acting on the upstream face of the obturator would cause the obturator to oscillate between the open and closed positions for the reasons given above.

I have now devised a form of pressure responsive device for use at the outlet of a tap, shower head or other fluid dispenser which reduces the above problems.

SUMMARY OF THE INVENTION:

Accordingly, the present invention provides a device for use upon a tap, shower head or other fluid dispensing apparatus, which apparatus is for controlling the supply of water or other fluid to a locus and comprises a body having an inlet adapted to be connected to a supply of water or other fluid, an outlet through which the fluid is to be discharged to the locus, a fluid path between said inlet and said outlet and a valve mechanism located in the fluid path between said inlet and outlet for regulating the flow of fluid through the apparatus, which device comprises:

- a. a body member adapted to be mounted on or in the outlet to the apparatus and in the flow path of fluid through said outlet, said body member defining one or more fluid flow paths through the device;
- b. a pressure responsive flow regulating mechanism mounted on or in said body member and in the fluid flow path through the device, which flow regulating mechanism is adapted to move within the device in response to the flow of fluid applied to said body member,

characterised in that:

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- c. the flow regulating mechanism of the device comprises two flow regulating members located respectively upstream and downstream of one another in the fluid flow path through the device; and
- d. both flow regulation members are moveable, preferably axially, within the body member and co-operate with the body member or a component operatively associated therewith whereby movement of the downstream flow regulation member in the direction of flow of fluid through the device enlarges an existing flow path or creates an additional one or more flow paths past that flow regulation member, and
- e. the upstream and downstream flow regulation members are mechanically linked to one another whereby movement of the upstream flow regulation member causes movement of the downstream flow regulation member with respect to the body member; and
- f. bias means for urging the flow regulation members into a rest position at which the downstream flow regulation member partially restricts fluid flow through the device; and
- g. the upstream flow regulation member is configured so that it partially restricts fluid flow through the device at all positions of the upstream flow regulation member in the body member, whereby a positive pressure acts in opposition to the bias means upon the upstream flow regulation member at all operative positions of that member within the body member.

The terms upstream and downstream are used herein to denote orientations of components of the device with

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respect to the direction of flow of fluid through the device.

As indicated above, the invention can be applied to fluid dispensing apparatus other than taps and the valve mechanism controlling the flow of water or other fluid through the discharge outlet may be located remotely from the outlet, as with a shower head. The term tap is therefore used herein to denote in general all such dispensing apparatus and the invention will, for convenience be described in terms of a tap or faucet.

Preferably, the upstream flow regulation mechanism comprises a transverse member located within a fluid flow path through the body member, the transverse member having one or more apertures therethrough whereby fluid can flow through or past the transverse member, which aperture(s) are sized so as to accommodate at least part of the expected range of flows of fluid through the device without creating sufficient back pressure in the fluid upstream of the upstream flow regulation member to cause that member to move against the bias of the bias means. At low flow rates of fluid through the device, the upstream flow regulation member will thus remain retained in its rest position by the bias means. When the valve of the tap on which the device is mounted is opened further, this will generate an increase in fluid pressure acting on the upstream face(s) of the upstream flow regulation member. When this pressure exceeds the bias of the bias means, the upstream flow regulation member will move under the water pressure. The movement of the upstream flow regulation member causes the downstream flow regulation member to move and create or enlarge the flow paths through or around that downstream member. This increased flow path allows the increased flow of fluid passing the upstream flow regulation member to escape

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through the tap outlet without the creation of any significant back pressure in the fluid upstream of the outlet and the downstream flow regulation member. However, the pressure continues to act on the upstream face(s) of the upstream flow regulation member so that that member is retained in a stable position against the bias of the bias means. As a result, the flow regulation members move positively to one extreme of their travel or the other within the device and do not oscillate as with previous proposals where only one flow regulation member is used or where the flow regulation members are capable of independent movement within the device.

The flow path(s) through or around the upstream flow regulation member are thus not sufficient to permit free flow of water from the tap when it is fully opened, but will generate a back pressure at all flow rates so that at all positions of the upstream flow regulation member there is a positive force acting on the means to oppose the bias means. The optimum size, shape and position of the apertures can readily be determined for any given case by simple trial and error tests.

The downstream flow regulation means is preferably a second transverse member which at least partially obstructs the flow of fluid passing the upstream flow regulation means so that a back pressure is created in the flow of fluid between the two flow regulation means so that at low flow rates of fluid into the device, the fluid exits from the tap as a perceived jet of fluid. Thus, the second transverse member can have one or more apertures which provide a smaller total small flow path across the plane of the second transverse member than across the first, upstream transverse member. Preferably, the downstream flow regulation member has flow apertures which provide from 5 to 95%, preferably from 20 to 60%, of the flow area of the apertures of the upstream flow regulation

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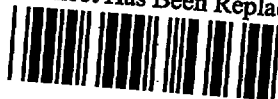


member. Thus, for example, the upstream flow regulation member can be a transverse member having four flow apertures therethrough, each 4 mm in diameter, and the downstream flow regulation member can be a transverse member having eight 1.5 mm diameter apertures therethrough.

The downstream flow regulation member also acts to enlarge one or more existing flow paths past it or to create one or more new flow paths past it as it is moved with respect to the body member when the upstream flow regulation member moves due to increased fluid flow to the device. Thus, the downstream member can have part of the effective flow path through apertures therethrough obstructed when in its rest position, for example by tapered pins carried by the body member engaging in some or all of the apertures. When the downstream flow regulation member moves with respect to the body member, these obstructions are reduced and the existing flow paths through the downstream flow regulation member are enlarged. However, it is preferred that the movement of the downstream flow regulation member creates one or more new flow paths past it, for example by creating an annular flow path around the periphery of the flow regulation member as it moves axially away from a seat against which it engages in its rest position.

The flow paths created or enlarged as the downstream flow regulation member moves are sufficiently large to ensure that fluid upstream of the downstream flow regulation member can flow virtually freely to and through the tap outlet. As a result any back pressure due to flow restriction by this member is minimised and the pressure drop across the upstream flow regulation member is maximised, thus aiding positive movement and position retention of the upstream member and hence of the down

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stream member.

The upstream and downstream flow regulation members are mechanically linked to one another so that movement of the upstream member causes the downstream member to move. This ensures that when the upstream member responds to the application of increased fluid flow to the device, the downstream member inherently moves with the upstream flow regulation member to create sufficient flow path to accommodate the additional flow.

The mechanical linkage between the two flow regulation members can be achieved in a number of ways, for example by one or more flexible members carried by one member engaging the other or by a compression spring located between them. Alternatively, the flow regulation members can be linked by a collapsible closed chamber between them which is partially collapsed as the upstream flow regulation member moves to apply a pneumatic or hydraulic pressure to the downstream flow regulation member. The term mechanically linked is therefore used herein to denote that the two flow regulation members are linked in some manner which transmits the movement of the upstream member to the downstream member.

However, it is preferred that the two flow regulation members are directly linked to one another by an axially rigid member, so that they move as a unitary member with respect to the body member. Thus, the upstream member preferably carries a dependent stem or the like upon which the downstream member is secured, or vice versa, so that the two member move as a unit in fixed relationship to one another. Alternatively, the two members can be provided as the two end faces of a hollow piston like member, the side wall of the piston having lateral ports through which the fluid can flow past the top and bottom ends and/or the

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end faces of the piston forming the upstream and downstream flow regulation members can have ports therein.

However, for simplicity and economy of manufacture, it is preferred that the flow regulation members are transverse plate-like members with the appropriate apertures therethrough and that they are connected by an axial stem so that free flow of fluid within the space between the members can occur.

The body member of the device is preferably a generally cylindrical tubular member within which the upstream and downstream flow regulation members move axially under the influence of the flow of fluid applied to the inlet end of the body. The tubular member is preferably provided with a radially inwardly projecting annular shoulder or web which subdivides the member into an upstream portion housing the upstream flow regulation member and a downstream portion housing the downstream flow regulation member. It is preferred that the upstream flow regulation member extends over substantially the full internal transverse area of the upstream portion of the tubular member. There is thus little or no fluid flow past the periphery of the flow regulation member and substantially all the fluid flow past the flow regulation member occurs through apertures in the member communicating with the downstream portion of the tubular member. It is particularly preferred to form the upstream flow regulation member as a cup shaped piston-like member which is journaled in sliding substantially sealing engagement within the opposed interior cylindrical face of the upstream portion of the tubular member. If desired, seals can be provided between the opposed sliding faces. However, we have found that this is not usually necessary and a simple sliding fit of the piston within the tubular member is adequate for present use.

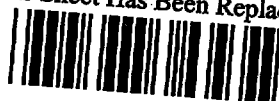
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The downstream flow regulation member preferably seats against the downstream face of the radial projection so that in this rest position substantially all the fluid flows past this downstream flow regulation member via the apertures in the transverse member. If desired an annular seal can be provided between the opposing faces of the radial projection and the downstream flow regulating member. Preferably, as indicated above, an additional annular flow path is created between the periphery of the downstream flow regulation member and the radial projection, which increases as the member is moved axially away from the radial projection. In order to permit free flow of fluid past the member, it is preferred that the member does not extend for the full internal diameter of the downstream portion of the tubular member. Typically, it extends for only from 50 to 80% of the internal diameter, so that fluid can flow freely through the annular gap between the periphery of the downstream flow regulation member and the interior surface of the downstream portion of the tubular member once the downstream flow regulation member moves axially away from the downstream face of the radial projection. The total cross sectional area of the flow path past the downstream flow regulation member, when in its extreme of axial movement away from the radial projection, exceeds the total cross sectional area of the flow path past the upstream flow regulation member, typically by from 10 to 100% or more.

The device also comprises a bias means which acts to oppose movement of the flow regulation members in the direction of the flow of fluid through the device. Such a bias can be provided by a spring, notably a coil spring trapped between the radial projection in the tubular member and the upstream flow regulation member. If desired, the bias force applied by the spring can be

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adjustable to accommodate different operating requirements for the device. The bias may also be provided by the use of a resilient mounting to support the upper flow regulation member which allows the member to move axially within the tubular member. Alternatively, part or all of the upstream flow regulation member can be made from a flexible or resilient material which allows the upstream member to flex and thus allow the downstream flow regulation member to move. However, the use of a coil spring provides a simple and cost effective bias means.

The optimum dimensions for the various components of the device, the strength of the bias spring and the size of apertures in the flow regulation members can readily be determined by simple trial and error tests. The device readily lends itself to fabrication of the components from injection moulded or cast engineering plastics or by machining metal. The components are conveniently assembled upon one another using any suitable technique, for example by the use of adhesive, ultrasonic or other welding or by snap fitting the parts together.

The device is preferably of a generally cylindrical shape so that the internal components and the fluid flow paths through the device are radially substantially symmetrical about the longitudinal axis of the device.

The device is provided with means, for example a screw thread, a bayonet type fitting or a series of circumferential external saw tooth ribs, whereby the device can be secured within the outlet of the tap or other apparatus. However, we have devised a particularly preferred form of securement of the device within the outlet to the tap which overcomes many of the problems of poor fit due to manufacturing tolerances of the device and, particularly, of the tap outlet. This preferred

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securement comprises a natural or synthetic rubber O ring carried externally and circumferentially upon the device. This is expanded radially by two opposed tapered shoulders carried by components of the body member which are moved axially with respect to one another. As the tapers are moved progressively further into the centre hole of the O ring, the effective radial diameter of the O ring is increased. This expands the O ring into contact with the radially opposed surfaces of the outlet to the tap and secures the device within the outlet by frictional forces. Alternatively, one tapered shoulder co-operating with a radial stop or shoulder may be used; or the exterior profile of the tubular member can be in the form of an oval so that relative rotation of each end of the tubular body about the longitudinal axis of the body causes the oval sections to move out of alignment with one another and thus act as camming members which radially expand the O ring. Such forms of securement can be readily operated both to install the device and to permit its removal from the outlet for repair or servicing. Furthermore, by using a thicker O ring, the device can be secured into wider bore outlets, thus enabling a standard size of device to be fitted to a wide range of tap sizes simply by selecting the appropriately sized O ring.

As indicated above, the device of the invention finds use in a wide range of apparatus for dispensing fluids over a wide range of flow rates. By having the two linked flow regulation members, the device smoothly responds to changes in flow rate without the rapid random reciprocation encountered with other forms of flow regulation devices and enables an apparently solid stable jet of fluid to be discharged from the outlet. Furthermore, the major pressure drop in the flow of fluid from the inlet to the outlet of the device occurs across the upstream flow regulation member. This is located within the device and

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the device is quieter in operation than a conventional pressure responsive device where the sole or major pressure drop occurs at the outlet to the device.

DESCRIPTION OF THE DRAWINGS:

The invention will now be described by way of illustration with respect to preferred embodiments of the invention as shown in the accompanying drawings in which Figure 1 is a longitudinal cross section and axial views from each end of one form of the device for mounting in the outlet to a water tap, Figure 1a shows the device in its rest position with no or only a low flow of water through the device and Figure 1b shows the position of the flow regulation members at a high flow of water through the device; Figure 2 shows the device of Figure 1a fitted into a tap outlet; Figure 3 shows the device of Figure 1b fitted into a tap outlet; Figure 4 shows a device with the preferred method of securing the device in a tap outlet; Figures 5 and 6 show stages in securing the device of Figure 4 into a tap outlet; Figure 7 shows an alternative form of the device of Figure 1; Figure 8 shows a device with an alternative form of the flow regulation members; and Figure 9 shows an alternative form of the device of Figure 7.

DESCRIPTION OF THE PREFERRED EMBODIMENTS:

The device shown in Figure 1 comprises a generally tubular body member which is formed in two parts 1 and 2. The upstream part 1 has a reduced diameter upstream portion which provides an internal shoulder 3. The downstream part 2 is an axial extension of part 1 and is provided with an inwardly extending circumferential ridge 4 at its upstream end. Within the internal chamber in part 1 defined by shoulder 3 and ridge 4 is located a cup-like member 10 having its side wall 11 directed in the

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downstream direction and in sliding engagement with the interior surface of part 1. Member 10 forms the upstream flow regulation member and carries an axial hub 12 into which engages the stem 13 of a transverse plate 14 which forms the downstream flow regulation member and is located on the downstream side of ridge 4. The member 10 and plate 14 form a unitary assembly which is capable of moving axially within the body member 1/2, but whose movement is limited by shoulder 3 and ridge 4. A coil spring 15 is trapped between the base of the cup-like member 10 and ridge 4 so as to bias the assembly 10~~8~~14 in the upstream direction at which the periphery of plate 14 engages ridge 4. As shown in Figure 9, an annular O ring seal can be provided in a groove in the downstream face of ridge 4 to provide sealing engagement between plate 14 and ridge 4.

The transverse wall of member 10 and plate 14 are provided with a plurality of apertures 17 and 18 which provide the flow path for fluid through the device when plate 14 engages ridge 4. As shown, the apertures 18 in plate 14 provide a flow path area which is only about 40-45% of that provided by apertures 17 in member 10. Since plate 14 sealingly engages ridge 4, the apertures 18 form the flow path for water past plate 14 so that plate 14 provides a measure of flow restriction at low flow rates of water through the device.

As shown in Figure 2, this causes the outlet of the tap 19 to fill with water due to the back pressure generated by plate 14 and the apertures 18. This results in jets 20 of water issuing from the apertures 18 giving the impression of a fast flow of water from the tap. This impression reduces the desire of the user to open the tap valve further merely to obtain a visually satisfying flow of water where only small amounts of water are required,

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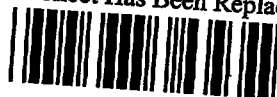


for example during brushing of teeth.

However, as shown in Figure 3, when a greater flow of water is required, the tap valve is opened further. This increases the pressure applied to the upstream of member 10 since apertures 17 are sized so that they restrict the flow of water past member 10 to from 80 to 95% of the free flow when no device is present in the tap outlet. This pressure overcomes the bias of spring 15 so that member 10 moves axially within the internal chamber within parts 1 and 2 to but against the radial shoulder 4 as shown in Figure 1b and Figure 3. Since the plate 14 is carried with member 10, the upstream face of plate 14 moves out of sealing engagement with ridge 4 to form the annular gap 30 between the periphery of plate 14 and the adjacent interior wall of part 2, which can be curved as shown to assist the formation of a smooth flow of water out of the device. This gap 30, with apertures 18, discharges the water to atmospheric pressure, thus reducing any back pressure within the device due to the small size of apertures 18. Since the combined flow path area of apertures 18 and gap 30 exceeds that of apertures 17, water passing through apertures 17 can flow freely out of the device and the tap outlet. There is therefore little or no back pressure reducing the flow of water through apertures 17. However, the pressure on the upstream face of member 10 remains and by suitable sizing of the apertures 17 the back pressure above member 10 exceeds the bias of spring 15. Member 10 thus remains biased to the position shown in Figures 1b and 3 allowing near free flow of water through the device to give a solid jet of water 31 at the tap outlet.

When the flow rate of water through the tap is reduced, the pressure acting on the upstream face of member 10 will then drop. The bias of spring 15 will then overcome the

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reduced pressure and allow member 10 and plate 14 to revert to the rest position shown in Figures 1a and 2.

The device shown in Figure 1 can be a push fit into the tap outlet orifice as shown. However, due to casting and other manufacturing tolerances in the manufacture of a tap, the fit of part 1 into the tap outlet orifice can vary. In order to be able to compensate for this, as shown in Figures 4 to 6, the upstream end of part 1 is provided with an internal screw thread into which is located a sleeve 40 having a corresponding external screw thread, a hexagonal longitudinal bore 41 and an external radial flange 42 at its upstream end. The upper lip of part 1 and the lower lip of flange 42 are chamfered to form a generally V shaped circumferential groove at the junction of part 1 and the flange 42. Located in this groove is a rubber or neoprene O ring 43. When the sleeve 40 is in the unscrewed state as shown in Figure 4a, the V groove is broad and the O ring 43 retracts radially into the full depth of the groove. However, when the sleeve 40 is screwed further into part 1, the chamfers on part 1 and flange 42 are drawn axially closer together to reduce the axial width of the V groove and the O ring 43 is forced radially outwards.

As shown in Figures 5 and 6, the device is formed in two parts, one comprising the upstream part 1 of the body carrying sleeve 40 and the O ring 43, the other comprising the downstream part 2 of the body carrying the member 10 and plate 14 and spring 15. As shown in Figures 5 and 6, the upstream end of part 1 and the exposed end of sleeve 40 are inserted into the orifice of the tap outlet. An Allen key 44 is inserted into bore 41 and the sleeve 40 is screwed into part 1 to expand the O ring 43 radially outward into contact with the interior surface of the tap outlet as shown in Figure 6. The O ring deforms to

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accommodate surface irregularities in the tap outlet and secures part 1 within the outlet. The second part of the device can then be fitted onto the exposed end of part 1 and secured in position using adhesive, ultrasonic welding or any other suitable technique. However, it is preferred that the second part be de-mountable, for example by being a bayonet or screw fitting into the exposed end of part 1 so as to enable the second part to be removed for servicing and/or repair. By using a larger O ring, part 1 can be secured in a larger bore tap outlet thus making it possible to make the device of the invention in one, two or three standard sizes and to make it fit a wide range of tap outlet sizes merely by selecting the appropriate O ring.

In the device shown in Figure 7, a cylindrical tubular component 50 replaces parts 1 and 2 of the device of Figure 1. An internal circumferential ridge 51 corresponds to ridge 4 and parts 10, 11, 12, 14, 15 and the apertures 17 and 18 are of essentially the same construction and function as the corresponding parts in the device of Figure 1. However, in this case the operative parts of the device are contained within a housing 52 which is screw fitted, cemented or otherwise secured to the outlet of the tap 19. An O ring or other annular seal is located between the base of the socket in the lip of the wall of the tap outlet and the upstream face of part 50. Such a form of device works in the same way as the device of Figure 1, but is in a form which can readily be incorporated into a tap outlet during manufacture of the tap or to replace a conventional flow restrictor or water aerator already fitted to the tap outlet.

In the form of device shown in Figure 8, the assembly comprising member 10 and plate 14 is formed as a hollow

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cylinder 60 journalled within an axial bore in a body member 61. The upstream and downstream end faces of the cylinder correspond to member 10 and plate 14 respectively and have apertures corresponding to apertures 17 and 18 therethrough. The travel of cylinder 60 is limited by stops 62 which engage in axial slots in the cylindrical wall of the cylinder 60. The stops also provide the seat for a compression spring 63 bearing against the upstream end wall in the same manner as spring 15. Since the cylinder cannot readily co-operate with a radial flange or ridge carried by the body member 60 to form an annular flow path corresponding to gap 30, the downstream portion of the cylinder wall is cut with radial ports 64 located circumferentially around the longitudinal axis of body 60. As body 60 is moved axially under the influence of high pressure on the upstream end wall of the cylinder, the ports 64 are carried clear of the opposing wall of the axial passage within body 60 in which the piston is slideably journalled to form new flow paths corresponding to the annular gap 30 in the device of Figure 1.

Figure 9 illustrates an alternative form of the working parts for use in the device of Figure 7 and demonstrates the location of the O ring seal 16 between the plate 14 and the ridge 4. The device is shown in its rest configuration in Figure 9a and in the high water flow configuration in Figure 9b and screws directly into the outlet of the tap 19 by way of an external screw thread 21.

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CLAIMS:

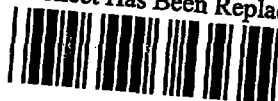
1. A device for use upon a tap, shower head or other fluid dispensing apparatus, which apparatus is for controlling the supply of water or other fluid to a locus and comprises a body having an inlet adapted to be connected to a supply of water or other fluid, an outlet through which the fluid is to be discharged to the locus, a fluid path between said inlet and said outlet and a valve mechanism located in the fluid path between said inlet and outlet for regulating the flow of fluid through the apparatus, which device comprises:

- a. a body member adapted to be mounted on or in the outlet to the apparatus and in the flow path of fluid through said outlet, said body member defining one or more fluid flow paths through the device;
- b. a pressure responsive flow regulating mechanism mounted on or in said body member and in the fluid flow path through the device, which flow regulating mechanism is adapted to move within the device in response to the flow of fluid applied to said body member,

characterised in that:

- c. the flow regulating mechanism of the device comprises two flow regulating members located respectively upstream and downstream of one another in the fluid flow path through the device; and
- d. both flow regulation members are moveable within the body member and co-operate with the body member or a component operatively associated therewith whereby movement of the downstream flow regulation member in the direction of flow of fluid through the device enlarges an existing flow path or creates an

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additional one or more flow paths past that flow regulation member, and

- e. the upstream and downstream flow regulation members are mechanically linked to one another whereby movement of the upstream flow regulation member causes movement of the downstream flow regulation member with respect to the body member; and
- f. bias means for urging the flow regulation members into a rest position at which the downstream flow regulation member partially restricts fluid flow through the device; and
- g. the upstream flow regulation member is configured so that it partially restricts fluid flow through the device at all positions of the upstream flow regulation member in the body member, whereby a positive pressure acts in opposition to the bias means upon the upstream flow regulation member at all operative positions of that member within the body member.

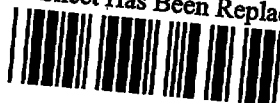
2. A device as claimed in claim 1, characterised in that the flow regulating members are adapted to move axially with respect to the body member.

3. A device as claimed in either of claims 1 or 2, characterised in that the flow regulating members comprise a pair of transverse members connected by an axial stem member.

4. A device as claimed in any one of the preceding claims, characterised in that the upstream flow regulation mechanism comprises a transverse member located within a fluid flow path through the body member, the transverse member having one or more apertures therethrough whereby fluid can flow through or past the transverse member,



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which aperture(s) are sized so as to accommodate at least part of the expected range of flows of fluid through the device without creating sufficient back pressure in the fluid upstream of the member to cause the member to move against the bias of the bias means, whereby at low flow rates of fluid through the device, the upstream flow regulation member will remain retained in its rest position by the bias means and once a predetermined flow rate of fluid through the device has been reached, sufficient fluid pressure acts on the upstream face(s) of the upstream member to cause the upstream flow regulation member to move against the bias means to cause the downstream flow regulation member to move and enlarge the flow path past the downstream flow regulation member.

5. A device as claimed in any one of the preceding claims, characterised in that the downstream flow regulation member has apertures across the plane thereof in its rest position which have a total cross sectional area of from 20 to 60% of that of the flow apertures across the plane of the upstream flow regulation member in its rest position.

6. A device as claimed in any one of the preceding claims, characterised in that the flow paths across the plane of the downstream flow regulation member in its operative position do not cause significant back pressure within the space between the downstream and upstream flow members.

7. A device as claimed in any one of the preceding claims, characterised in that the body member is provided with an inwardly directed radial projection which subdivides the interior of the body member into an upstream portion and a downstream portion within which the respective flow regulation members are slideably



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journalled.



8. A device as claimed in claim 7, characterised in that the upstream flow regulation member extends for substantially the full transverse flow area of the upstream portion of the body member, and in that substantially all flow of fluid past the upstream flow regulation member occurs through apertures in the member.

9. A device as claimed in claim 8, characterised in that the upstream flow regulation member is in the form of an apertured transverse member having an axially extending skirt member in sliding engagement with the opposed face of the upstream portion of the body member.

10. A device as claimed in claim 7, characterised in that the downstream flow regulation member is a transverse apertured member which in its rest position bears against the downstream face of the radial projecting member.

11. A device as claimed in claim 7, characterised in that the bias is provided by a compression coil spring trapped between the radial projecting member and the downstream flow regulation member.

12. A device as claimed in claim 1, characterised in that it comprises:

- a. a tubular body member having a longitudinal bore therein and one or more radial projections subdividing the bore into an upstream portion and a downstream portion; and
- b. an upstream radial plate member mounted for axial movement in the upstream portion of the longitudinal bore; and
- c. a downstream radial plate member mounted for axial movement in the downstream portion of the longitudinal bore and linked to the upstream plate

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member by an axial member whereby the two plate members move as a unitary member; and

d. a bias spring acting between one of said plate members and said radial projection(s) so as to urge the plate members towards an upstream rest position; and

e. fluid flow apertures in said upstream plate member for the flow of fluid across the plane of said plate member, the apertures being sized so that a back pressure acts upon the upstream face of the upstream plate member in opposition to the bias spring and moves the upstream plate member and its associated downstream plate member axially towards an operative position against the bias spring once a predetermined back pressure has been exceeded; and

f. the total fluid flow path cross sectional area across the plane of the downstream plate member when in its operative position exceeds that of the upstream plate member.

13. A device as claimed in any one of the preceding claims, characterised in that the total cross sectional area of the flow path across the plane of the downstream flow regulation member when in its extreme operative position is from 110 to 200% of that across the plane of the upstream flow regulation member in its extreme operative position.

14. A device as claimed in any one of the preceding claims, characterised in that it is provided with a radially expansible means for securing the device to the outlet of an apparatus for discharging fluid to a locus.

15. A device as claimed in claim 14, characterised in that the securement means comprises two relatively moveable members, at least one of which has an axial



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taper, and an annular member adapted to be moved with respect to that taper by the other member so as radially to expand the annular member.

16. A device as claimed in claim 1, substantially as hereinbefore described with respect to and as shown in any one of the accompanying drawings.

17. A tap, shower head or other fluid dispensing apparatus having an outlet through which a fluid is to be discharged, characterised in that a device as claimed in any one of the preceding claims is secured on or in the outlet to the apparatus.

18. Apparatus as claimed in claim 17, characterised in that it is connected to a source of water.

19. A method for reducing the usage of water at a tap which comprises fitting a device as claimed in any one of claims 1 to 15 to apparatus for discharging the water to a locus.



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