(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
14 May 2010 (14.05.2010)

PCT

(10) International Publication Number
WO 2010/053382 A1

(51) International Patent Classification:
F16K 17/34 (2006.01) *G05D 7/01* (2006.01)

(21) International Application Number:
PCT/NZ2009/000239

(22) International Filing Date:
4 November 2009 (04.11.2009)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
572607 5 November 2008 (05.11.2008) NZ

(71) Applicant *(for all designated States except US)*: **HART, David, Stanley** [NZ/NZ]; Unit 131, 30 Ruakura Road, Hamilton, 3216 (NZ).

(72) Inventor; and
(71) Applicant : **GREEN, John, William** [NZ/NZ]; 36 Wallace Road, Hamilton 3289 (NZ).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: **MORAN, Ian** [GB/NZ]; 20 Nixon Street, Hamilton East, Hamilton 3216 (NZ).

(74) Agents: **ADAMS, Matthew, D.** et al.; A J Park, 6th Floor Huddart Parker Building, PO Box 949, Wellington 6015 (NZ).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) **Title**: FLOW REGULATING DEVICE

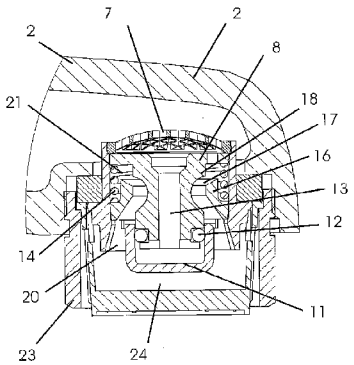

FIGURE 3

(57) **Abstract**: The flow regulator device of the present invention provides a compact device capable of normalizing flow rates across a wide range of inlet pressures, particularly suitable for domestic applications. The flow regulating device includes a piston moveably mounted in the body biased by a spring. Changes in inlet pressure result in movement of the piston thereby changing the area of a throttle opening to normalise the flow rate.

WO 2010/053382 A1

FLOW REGULATING DEVICE

FIELD OF THE INVENTION

The present invention relates to a flow regulator device. In particular the invention relates to a compact flow regulating device suitable for domestic applications.

BACKGROUND TO THE INVENTION

In the field of domestic plumbing there is a growing demand to conserve water. In some countries, legislation has been introduced to limit the allowable flow rate from outlets with this aim. One method of reducing flow from a domestic tap or mixer is to include a fixed restriction. This method is widely used and is commonly achieved by fitting an aeration device to domestic outlets which serve a dual purpose of reducing flow and inducing air into the water stream. Aeration devices give a pleasant soft feel to the water. The flow rate may be perceived by a user as a higher flow rate than is actually flowing. Aeration devices may also reduce noise and splashing.

However, a draw back of flow restrictors in the prior art is that the rate of flow achieved at the outlet may also vary considerably as a function of inlet pressure. This can result in the significant disadvantage of the outlet device delivering too little water at low inlet pressure and too much water when the inlet pressure is high.

Further, it is common for inlet pressure in domestic water delivery pipes to vary from location to location, and the water pressure may also decrease considerably during peak use hours such as early in the morning when much of the population is washing in preparation for their day. During these peak times, the inlet pressure and water flow rate may be considerably reduced. The addition of a flow restrictor can result in further significant reductions in flow rate, and this can lead to unacceptable rates of flow being available for showers etc.

One method of attempting to address this problem is to use a flexible or deformable element which progressively reduces the flow orifice as the inlet pressure increases, thereby maintaining an approximately uniform flow rate over a wider inlet pressure range. In this type of regulator device the deformable element is typically an O-ring,

specifically sized and constructed from a material having carefully selected material properties. For this type of device, only relatively small movements and variations of the flow orifice are possible. As a result, the device is only capable of maintaining a uniform flow rate across a relatively small inlet pressure range. For typical domestic installations such devices are fairly insensitive to pressure differentials below approximately 120 kPa. At pressures below this, the deformable element deforms very little, and the device essentially acts as a fixed restriction.

A flow regulator device that is sensitive to smaller pressure differentials and therefore capable of normalizing flow rate across a wider range of inlet pressures would be useful.

In this specification where reference has been made to patent specifications, other external documents, or other sources of information, this is generally for the purpose of providing a context for discussing the features of the invention. Unless specifically stated otherwise, reference to such external documents is not to be construed as an admission that such documents, or such sources of information, in any jurisdiction, are prior art, or form part of the common general knowledge in the art.

It is an object of the present invention to provide an improved flow regulating device or to at least provide a useful choice.

SUMMARY OF THE INVENTION

In one aspect, the present invention broadly consists in a flow regulator comprising:

a body adapted to be mounted in a fluid conduit;

a piston moveably mounted within said body and having an up-stream surface and a down-stream surface;

a first fluid passageway from said up-stream surface to a throttle opening, said throttle opening restricting said flow through said body and wherein said opening varies in size as said piston moves such that said opening decreases in size as said piston moves in the direction of said flow;

a chamber defined by said down-stream surface of said piston and a chamber wall such that said movement of said piston varies the volume of said chamber;

a biasing element biasing said piston against the direction of said flow;

a second passageway through said piston from said up-stream surface to said down-stream surface opening into said chamber.

Preferably in use, the pressure in said chamber is substantially the pressure at said upstream surface.

Preferably said up-stream surface has a greater area than said down-stream surface

Preferably the only opening in said chamber is said second passageway so that said chamber is otherwise sealed.

Preferably the inlet flow to said regulator and the outlet flow from said regulator are substantially parallel with said movement of said piston.

Preferably said inlet flow and said outlet flow are substantially co-axial with said movement of said piston.

Preferably said throttle opening is an annular opening formed between a valve portion or shoulder of said piston and a stationary valve seat.

Preferably the area of the valve seat is substantially the same as the area of said down-stream surface of said piston.

Preferably the opening of said second passageway is substantially in the full path of the fluid flowing through said regulator.

Preferably the diameter of said upstream surface of said piston is substantially as large as the diameter of said body.

Preferably said device includes a plurality of passageways from said up-stream surface to said throttle opening and said plurality of passageways are spaced about the axis of said piston.

Preferably said device including an aerator down-stream of said regulator.

Preferably said aerator includes a fluid inlet, at least one air inlet, a flow screen downstream of said fluid inlet to straighten the flow passing through it, and a baffle plate upstream of said screen to disrupt said flow before it impinges onto said screen.

Preferably said baffle plate is an annular ring having a flow orifice and a plurality of inward facing protrusions extending into said flow orifice.

In a further aspect, the present invention broadly consists in an aerator assembly comprising:

a fluid inlet;

at least one air inlet;

a flow screen downstream of said fluid inlet to straighten the flow passing through it; and

a baffle plate located upstream of said screen to disrupt said flow before it impinges onto said screen.

Preferably said baffle plate is an annular ring having a flow orifice and a plurality of inward facing protrusions extending into said flow orifice.

Preferably said baffle plate is spaced from said screen.

In a further aspect the invention consists in a fixture including a flow regulator as above.

In a further aspect the invention consists in an aerator as above.

The term "comprising" as used in this specification and claims means "consisting at least in part of". When interpreting each statement in this specification and claims that includes the term "comprising", features other than that or those prefaced by the term may also be present. Related terms such as "comprise" and "comprises" are to be interpreted in the same manner.

The invention consists in the foregoing and also envisages constructions of which the following gives examples only.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention will be described by way of example only and with reference to the drawings, in which:

Figure 1 is a perspective cut away view of a flow regulator according to one embodiment of the present invention shown with an aerator.

Figure 2 is a perspective view of the device of Figure 1 shown without an aerator.

Figure 3 is a cut away view of the device of Figure 1 shown installed in a tap fitting and with the piston undisplaced.

Figure 4 is a sectioned view of the flow regulator device of Figure 3 shown with the piston displaced downwards.

Figure 5 is a close-up cut-away view of a flow regulating device according to the present invention shown with the upper filter mesh, outer seal and aerator removed.

Figure 6 is a perspective cut away view of the device shown with an optional baffle included in the aeration assembly.

Figure 7 is a perspective view of the aerator assembly of Figure 6.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

It will be appreciated that the flow regulator device of the present invention may be used in conjunction with an aerator device as described, or may be used without an aerator. It is most preferred that the flow regulator according to the present invention is compact enough for use in domestic tapware and shower mixers/fixtures and can be fit into the widely used M24 standard threaded hole commonly found in mixer spouts and shower head inlets etc. It will be appreciated that the device can be used in many applications where flow regulation is desired. Further examples could include mixing or non-mixing tapware and direct type water heating systems which may benefit from controlled maximum flow to maintain an acceptable delivery temperature. However it will also be appreciated that other embodiments of the present invention are contemplated in which the components of the flow regulator may be scaled up or down in size to make it suitable for other applications.

With reference to the Figures, a preferred form of the present invention will now be described in more detail. Flow regulator 1, is preferably adapted to be installed into a fixture such as a typical spout 2, via complementary screw threads (typically M24). Compressible seal 3 is provided to seal between the spout 2 and the body of the regulator device 4. Aerator device 5 is located downstream of the regulator body 4 and in use, draws air through inlets 6 which then becomes entrained in the flow of water. Filter mesh 7 is preferably provided to protect the regulator assembly 1 from debris.

Piston 8 is moveably located within the body 4 of the regulator device. Piston 8, has an upper surface 9 which is exposed to the inlet stream, and a lower surface 10 which defines the upper surface of chamber 11. Piston 8 is moveably mounted with body 4, such that movement of the piston 8 varies the volume of the chamber 11. An O-ring type seal 12 is provided between the chamber wall 11 and the piston 8 to seal the chamber. There is a passageway 13 between the upstream surface 9 and the downstream surface 10 of piston 8, connecting chamber 11 to the upstream inlet pressure. The upper surface 9 of piston 8 is preferably flanged as shown in the figures to present a large

surface area to the inlet pressure. The upper surface 9 of piston 8 is provided with flow apertures 15 to allow fluid flow through the device.

A spring 14 is provided to bias moveable piston 8 against the direction of flow through the device (biased upwards as shown in the figures). Down stream of the upper surface 9 of piston 8 is seat 16. A variable throttle opening 17 is formed between the seat 16 and a shoulder portion 18 of piston 8. Downward displacement of the piston 8, results in the restriction opening 17 becoming smaller. Similarly, upwards displacement of the piston 8 (via spring 14) results in the restriction opening 17 becoming larger. Piston 8 also includes hollow 19 to allow fluid flowing through the throttle opening 17 to exit the device without being further impeded.

With particular reference to Figure 2, body 4 includes exits 20 to allow fluid to leave the regulator device. At this point, the device may also include an aerator 5 as previously described to entrain air into the fluid stream.

The operation of a preferred flow regulator device will now be described in more detail with reference to the Figures and in particular Figures 3 & 4. The flow regulator of Figure 3 & 4 is shown attached to a typical spout 2, by means of an aerator 5. When there is no water flowing through the device, it is in the "rest" position shown in Figure 3. The piston 8 is biased upwards to stop against the upper mesh member 7, by the spring 14. In this position, the shoulder 18 of piston 8 is maximally displaced from the seat 16 and the variable throttle orifice 17 is at its maximum.

When a small flow enters the flow regulator device 1 through the mesh 7, it flows onto the upper surface 9 of piston 8, and through flow apertures 15. From there, the flow goes through the variable throttle opening 17, and flows out of the flow regulating device through exits 20, and through the aerator (if present). The incoming water flow also fills chamber 11 via passage 13. In this case the flow encounters minimal resistance and flows substantially unimpeded through the device.

As flow increases, it exerts a greater pressure on the upper surface 9 of piston 8. As the increasing pressure builds, the downwards force acting on piston 8 also increases until

piston 8 begins to be displaced downwards by compressing spring 14. As the increasing flow approaches a predetermined level, the shoulder 18 begins to throttle the opening 17.

As the predetermined set flow rate is reached, the throttling effect creates back pressure in chamber 21 under the piston upper surface. The downward force on the piston from the inlet pressure acting on the upper surface 9, reaches an equilibrium with the upward forces from spring 14, and the forces from the pressures in chambers 11 and 21. This situation is shown in Figure 4, where the piston 8 is displaced downwards and the restriction orifice 17 has closed somewhat.

Any increase in inlet pressure beyond this equilibrium point, which would usually tend to increase flow, is counter-acted by the piston 8 moving downwards slightly closer to the seat 16, thereby further closing the throttle opening 17. This in turn, further increases the back pressure in chamber 21 so that the pressure differential between upper surface 9 and chamber 21 remains substantially the same as before. As a result, the flow is regulated and remains substantially uniform as the inlet pressure increases. The flow remains substantially uniform at inlet pressures above the minimum required to move piston 8 downwards to the begin flow regulation as described above.

Two opposing factors that maintain constant flow are the pressure differential between the upper face 9 of the piston and the chamber 21 vs. the spring force from spring 14. To ensure that the flow rate is substantially independent of the inlet pressure, passageway 13 transmits the inlet pressure to sealed chamber 11. Whatever change occurs in inlet pressure is therefore transmitted to chamber 21 which helps balance the forces on the piston.

Chamber 21 is preferably the same diameter as orifice 22 in seat 16 so that a balancing force is generated. It is preferable to balance the force so that the device does not shut off the flow when the inlet pressure generates a force greater than the spring force.

After the water passes through seat orifice 22, it flows through channels exits 20 around the outside of body 4 as shown in Figure 5 by arrow 25. As the water discharges from the exits at relatively high velocity, it creates a low pressure zone in the narrow annular space immediately on the inside of the aerator inlet ports 6. These are open to

atmosphere via the clearance between the outside diameter of aerator body 5 and the inside diameter of the aerator shell 23. Air is drawn up this clearance, through ports 6 and then mixes with the water in chamber 24. This aerated water then flows through a flow screen grid to ensure that the discharge stream maintains a straight, smooth shape for as long as possible.

A further improvement to the shape of the discharge stream can be achieved by inserting a baffle plate 26 in chamber 24, to create extra turbulence and spread the flow more evenly across the screen. Plate 26 has a generally annular shape with a flow orifice for the flow to flow through. A plurality of inwardly extending protrusions act on the fluid as it flows through the baffle plate 26. It has been found that the "toothed" baffle plate 26 can improve the performance of the aerator.

In order to tailor the regulator of the present invention to achieve differing preset flow rates, spring 14 can be substituted with a spring having a different spring constant. For example, a stronger spring will give more flow through the regulator. Similarly, a weaker spring will result in a lower preset flow rate.

Alternatively, the number and/or size of inlet ports 15 in the piston 8 can be varied. Larger total port area will give more flow, and smaller port area with result in a lower pre-set flow rate.

The flow regulator of the present invention also operates with a very short working stroke which contributes to the compact nature of the device. For example, embodiments of the invention suited to typical domestic plumbing applications may typically have a stroke as small as approximately 1- 1.5mm. Despite the compact dimensions, the device can function with a small pressure differential thereby enabling the device to work with low inlet pressures. For example the flow regulator can operate with an inlet pressure range between approximately 50 – 500 kPa. This performance is aided by the large upper piston surface area (in relation to the throttling element) which maximises the force exerted on the piston by the inlet pressure and improves the sensitivity of the device.

The design of the present invention also allows friction to be minimized allowing the valve to respond quickly and smoothly to inlet pressure changes. The only significant source of friction is the seal 12 on the lower end of the piston as it slides in chamber 11. This feature is particularly important when the flow regulator is small and the actuating force is also small.

A common problem with conventional restriction designs (such as the deformable O ring) is instability during the transition from fully open when the inlet pressure is lower than the minimum working pressure. The preferred device of the present invention has been found to be stable due to there being only minimum restriction immediately down stream of the throttle area.

The device of the present invention is simple enough to lend itself to inexpensive mass production, thereby allowing the unit cost to be low. In particular most of the components can be constructed from plastic, for example acetal copolymer (POM), polyphenylene oxide (PPO) or ABS. Typically the material used should be approved by a relevant authority for the type of application envisaged.

Alternatively, it is anticipated that some applications may benefit from metallic construction, for example from brass or stainless steel etc. In some applications, ceramic components may be particularly suitable.

In addition the device may be configured for snap-fit assembly, which is very quick, and may save space compared to screwed or bolted assembly.

It will be appreciated that the flow regulator device may be used in many different locations. For example, the spout of a basin or the outlet of a shower mixer. In this type of application, the device typically would also incorporate an aerator. Non-aerator versions may be used in in-line applications either within the end use fitting or located up-stream of it.

The foregoing description of the invention includes preferred forms thereof. Modifications may be made thereto without departing from the scope of the invention.

CLAIMS

1. A flow regulator comprising:

a body adapted to be mounted in a fluid conduit;

a piston moveably mounted within said body and having an up-stream surface and a down-stream surface;

a first fluid passageway from said up-stream surface to a throttle opening, said throttle opening restricting said flow through said body and wherein said opening varies in size as said piston moves such that said opening decreases in size as said piston moves in the direction of said flow;

a chamber defined by said down-stream surface of said piston and a chamber wall such that said movement of said piston varies the volume of said chamber;

a biasing element biasing said piston against the direction of said flow;

a second passageway through said piston from said up-stream surface to said down-stream surface opening into said chamber.

2. A flow regulator as claimed in claim 1, wherein in use, the pressure in said chamber is substantially the pressure at said upstream surface.

3. A flow regulator as claimed in claim 1 or claim 2, wherein said up-stream surface has a greater area than said down-stream surface

4. A flow regulator as claimed in any one of claims 1 to 3, wherein the only opening in said chamber is said second passageway so that said chamber is otherwise sealed.

5. A flow regulator as claimed in any one of claims 1 to 4, wherein the inlet flow to said regulator and the outlet flow from said regulator are substantially parallel with said movement of said piston.

6. A flow regulator as claimed in claim 5, wherein said inlet flow and said outlet flow are substantially co-axial with said movement of said piston.

7. A flow regulator as claimed in any one of claims 1 to 6, wherein said throttle opening is an annular opening formed between a valve portion or shoulder of said piston and a stationary valve seat.

8. A flow regulator as claimed in any one of claims 1 to 7, wherein the area of the valve seat is substantially the same as the area of said down-stream surface of said piston.

9. A flow regulator as claimed in any one of claims 1 to 8, wherein the opening of said second passageway is substantially in the full path of the fluid flowing through said regulator.

10. A flow regulator as claimed in any one of claims 1 to 9, wherein the diameter of said upstream surface of said piston is substantially as large as the diameter of said body.

11. A flow regulator as claimed in any one of claims 1 to 10, wherein said device includes a plurality of passageways from said up-stream surface to said throttle opening and said plurality of passageways are spaced about the axis of said piston.

12. A flow regulator as claimed in any one of claims 1 to 11, including an aerator down-stream of said regulator.

13. A flow regulator as claimed in claim 12, wherein said aerator includes a fluid inlet, at least one air inlet, a flow screen downstream of said fluid inlet to straighten the flow passing through it, and a baffle plate upstream of said screen to disrupt said flow before it impinges onto said screen.

14. A flow regulator as claimed in claim 13, wherein said baffle plate is an annular ring having a flow orifice and a plurality of inward facing protrusions extending into said flow orifice.

15. An aerator assembly comprising:

a fluid inlet;

at least one air inlet;

a flow screen downstream of said fluid inlet to straighten the flow passing through it; and

a baffle plate located upstream of said screen to disrupt said flow before it impinges onto said screen.

16. An aerator assembly as claimed in claim 15, wherein said baffle plate is an annular ring having a flow orifice and a plurality of inward facing protrusions extending into said flow orifice.

17. An aerator assembly as claimed in claim 15 or claim 16, wherein said baffle plate is spaced from said screen.

18. A fixture including a flow regulator as claimed in any one of claims 1 to 14.

19. A fixture including an aerator as claimed in any one of claims 15 to 17.

20. A flow regulator as herein described and with reference to Figures 1 to 5.

21. An aerator assembly as herein described with reference to Figure 6 and Figure 7.

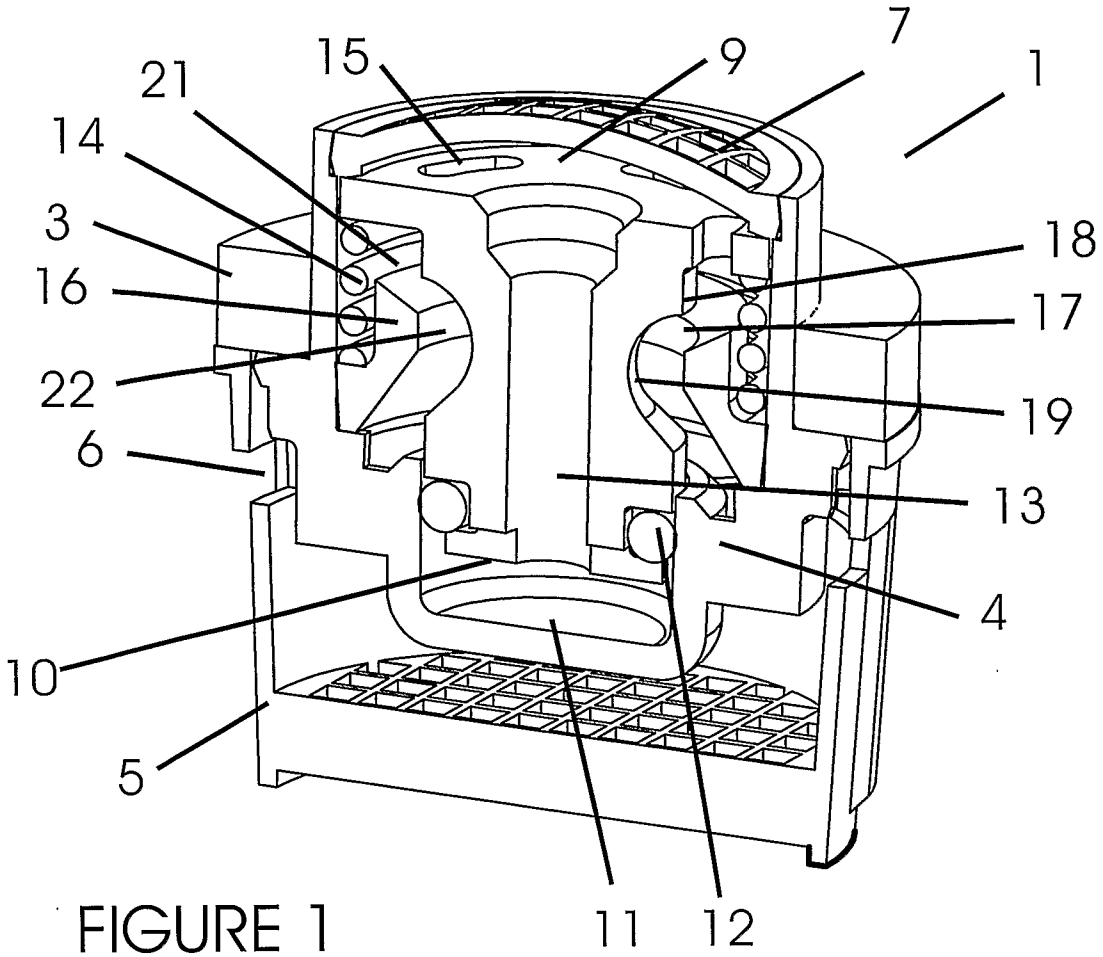

FIGURE 1

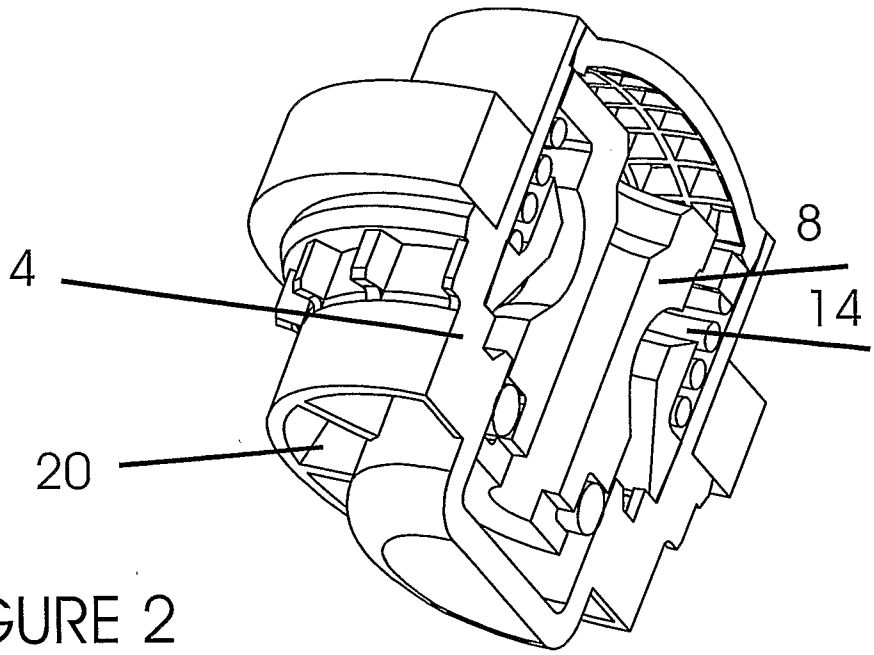

FIGURE 2

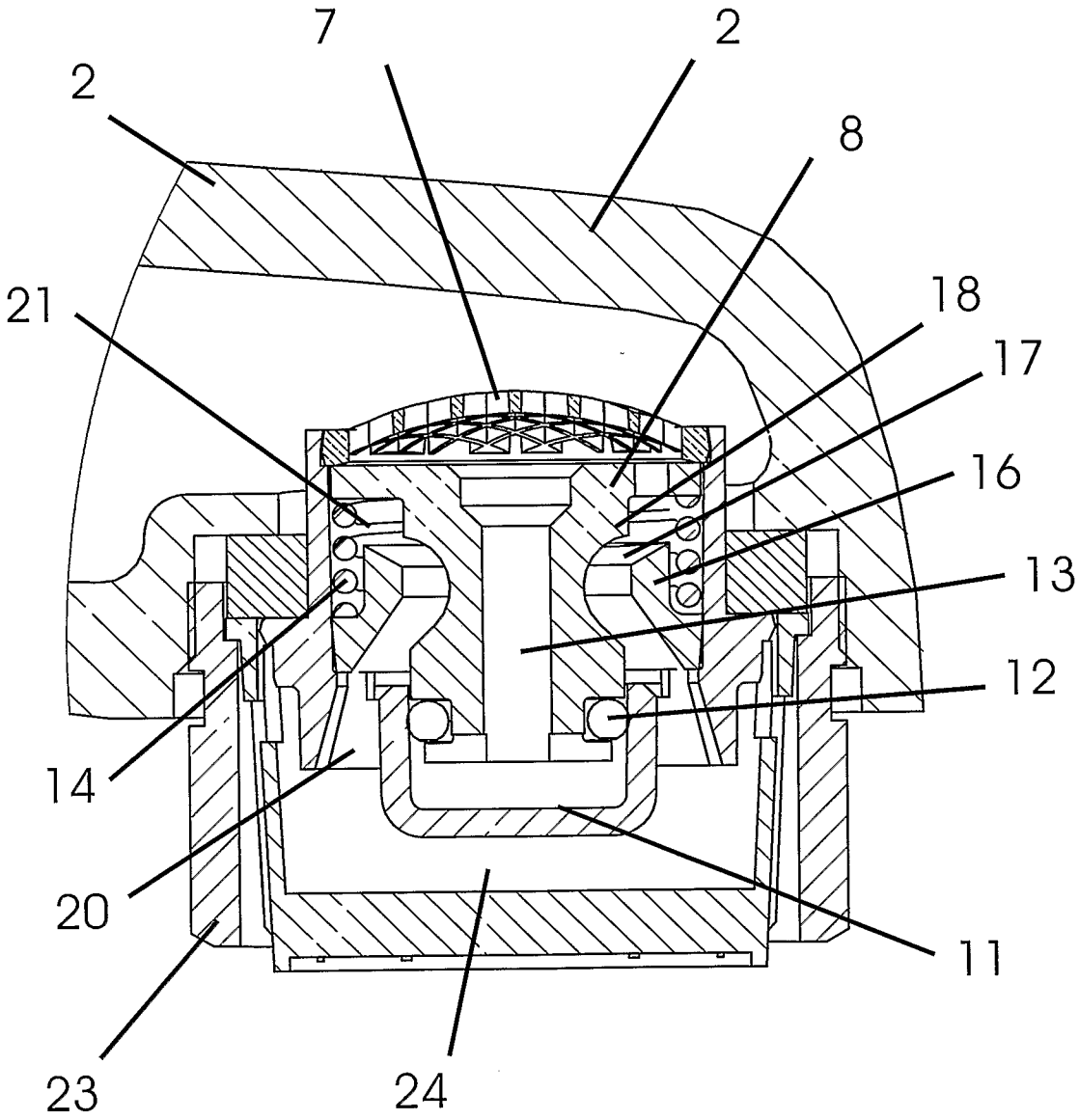

FIGURE 3

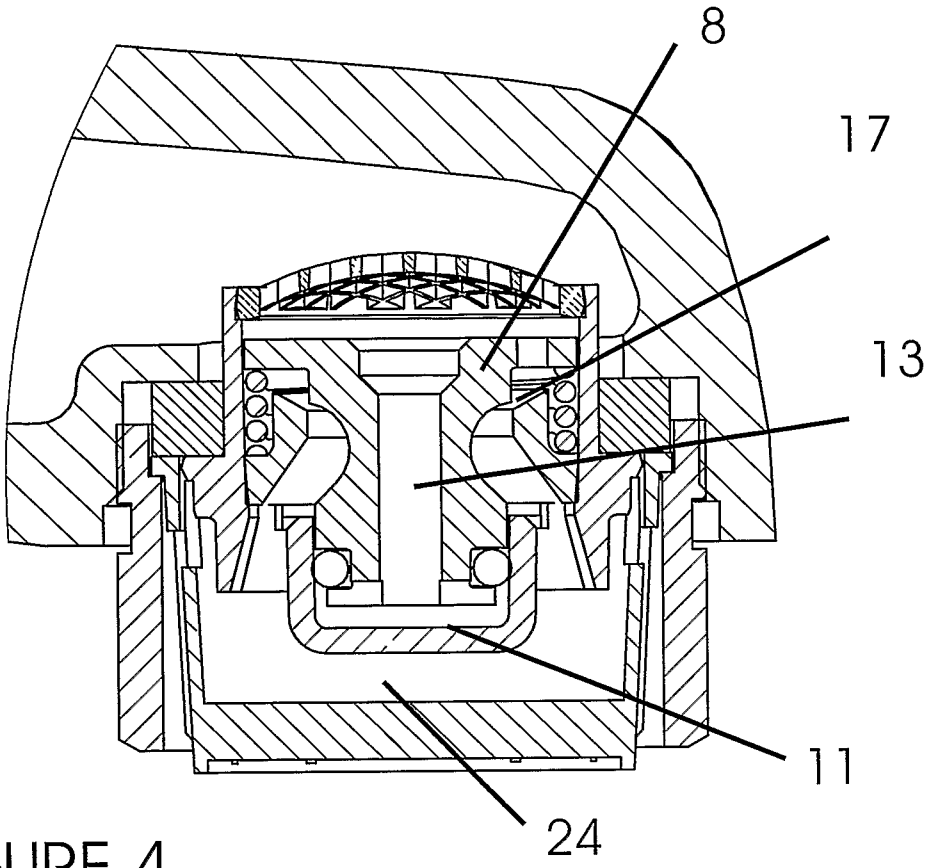

FIGURE 4

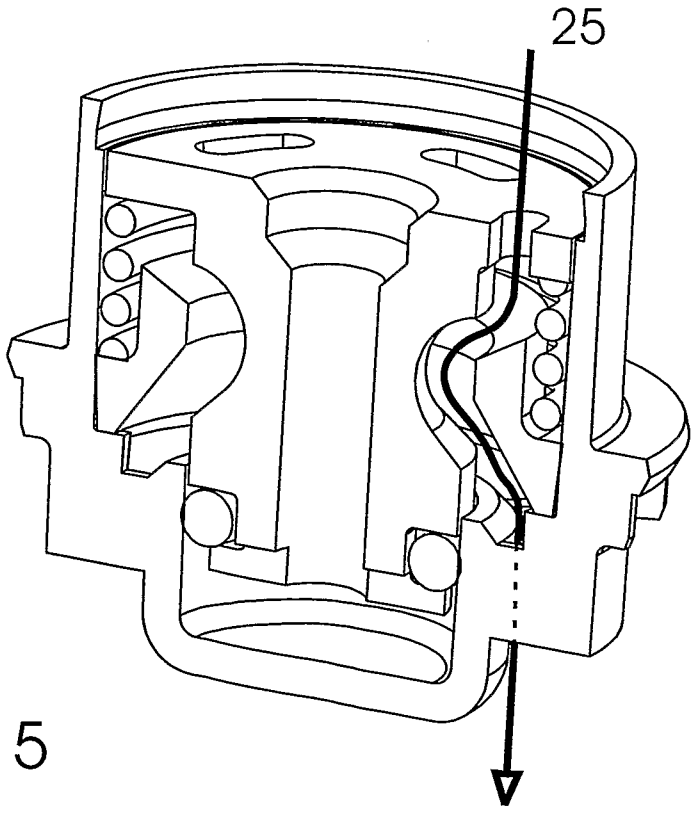

FIGURE 5

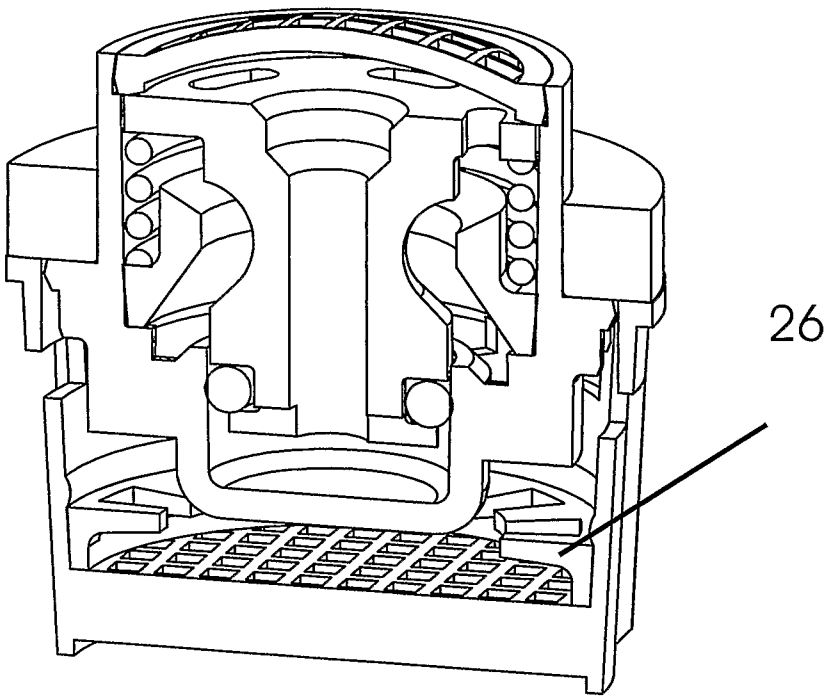

FIGURE 6

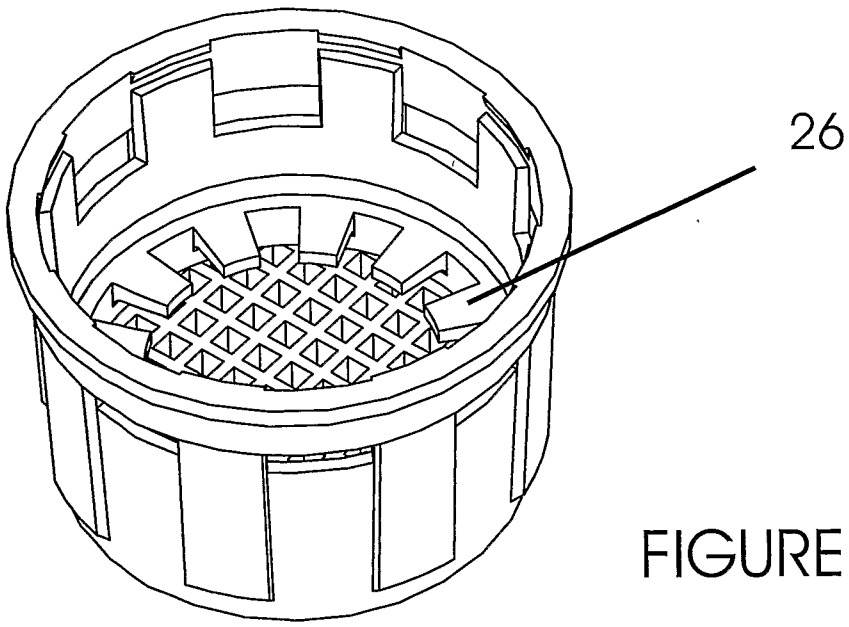

FIGURE 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ2009/000239

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

F16K 17/34 (2006.01) ***G05D 7/01*** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Derwent WPI, EPODOC - IPC as above and keywords - piston, throttle, constrict, reduce, narrow, decrease and like terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9946652 A1 (FLOW DESIGN INC) 16 September 1999. See figs 4, 5.	1,2,3,5,6,7,10.
X	US 5971012 A (SKOGLUND) 26 October 1999 See fig 2.	1,2,3,4,7,8,9.
X	SU 601986 A2 (KOTOV et al.) 20 May 1996. See figure.	1.

Continued .....

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 March 2010	16 MAR 2010
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. +61 2 6283 7999	Authorized officer **DAVID LEE** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : +61 2 6283 2107

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ2009/000239

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 1353254 A2 (FLOW DESIGN INC) 15 October 2003. See figures 2A, 2B, 3A, 3B	1.
Y	AU 746568B B2 (1999/21317) (GSA IND AUST PTY LTD) 02 May 2002. See figures 1, 2.	1-11.
Y	US 5904177 A (MULLIN et al.) 18 May 1999. See figs 2-4, 12, 13.	1,2,4,5,6,7,9.
Y	CH 676384 A5 (MARAVIC) 15 January 1991. See figs 1-4.	1.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ2009/000239

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
Please see extra sheet.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: 1-14

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

Supplemental Box
(To be used when the space in any of Boxes I to IV is not sufficient)

Continuation of Box No:

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

In assessing whether there is more than one invention claimed, I have given consideration to those features which can be considered to potentially distinguish the claimed combination of features from the prior art. Where different claims have different distinguishing features they define different inventions.

This International Searching Authority has found that there are different inventions as follows:

- Claim 1 is directed towards a **flow regulator** characterised by
  (a) a moveable piston, and
  (b) a throttle opening (17)It is considered that the features of
  (a) a moveable piston, and
  (b) a throttle opening (17)omprises a first distinguishing feature.

- Claim 15 is directed towards an **aerator** characterised by a flow screen and a baffle plate. It is considered that the flow screen and baffle plate comprises a second distinguishing feature.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

Each of the abovementioned groups of claims has a different distinguishing feature and they do not share any feature which could satisfy the requirement for being a special technical feature. Because there is no common special technical feature it follows that there is no technical relationship between the identified inventions. Therefore the claims do not satisfy the requirement of unity of invention *a priori*.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/NZ2009/000239

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
WO	9946652	AU	30756/99	CA	2323485	US	6196259
US	5971012	AU	56630/96	US	5301713	US	5487405
		US	5622204	US	5878777	WO	9631816
SU	601986	NONE					
EP	1353254	US	6688319	US	2003192597		
AU	746568	AU	21317/99				
US	5904177	NONE					
CH	676384	NONE					

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX