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FLOW LIMITER

The invention relates to a device for arranging in a liquid conduit for limiting a liquid flow in this conduit, which device comprises a base part with a through-flow opening and a closing part which is arranged on the base part via spring means and which is displaceable with at least a substantial axial component for partially closing the through-flow opening against a closing surface on the base part, wherein the device can be fixed at a fixed position in the conduit by means of fixation means such that the liquid can pass through the device only via the through-flow opening and wherein the base part and the closing part are arranged relative to each other such that in a rest position defined by the spring means a gap is formed between the base part and the closing part, which gap is made smaller counter to the spring action by bending under the influence of the liquid pressure difference over the device. Such a device is known from US-A-3 523 559.

Good-quality drinking-water can be obtained by treating water obtained by means of surface abstraction (rivers and lakes) and depth abstraction (groundwater). When the water has been purified to good-quality drinking-water, it must then be transported to the customer. This transport is very expensive because of the very finely branched supply system. Groundwater abstraction has the further drawback that the groundwater level falls through the abstraction of the water, and this can have adverse consequences for the environment.

Saving good-quality drinking-water is a good idea in order to prevent, among other things, a fall in the groundwater level and to reduce the consumption of energy for transport, purification and heating.

Water utility companies attempt to reduce the consumption of good-quality drinking-water in three ways. First of all, efforts are made to make the mains system as watertight as possible. Secondly, water-saving
5 equipment is used and rainwater can for instance be used to do the washing, for the toilet and to water the garden. Thirdly, taps which are not used specifically for drawing a quantity of water, such as the tap of a wash-basin, are provided with a device as stated in the
10 preamble. With such a device as according to the preamble the flow rate of such taps is limited to about 7-8 litres per minute.

NL-A-1001810 describes a flow limiter which comprises a hat-shaped part, wherein two slots are
15 arranged in the upper side of the part. These slots bound a flexible bridge part which bends under the influence of the pressure difference over the hat-shaped part such that the slots are made smaller. This device has the drawback that due to the small dimensions of the gaps the
20 operation of the device is adversely affected by small variations, for instance due to swelling of the material. This device has the further drawback that during limiting of warm or hot liquid flows the device deforms, whereby the operation is adversely affected. Because of the
25 geometry of the bridge part it is moreover not possible to manufacture the device at a reasonable cost. In addition, it is extremely difficult to find a combination of material properties and shape and dimensions wherein
the device functions over the whole operating range.

30 It is an object of the invention to prevent the above stated drawbacks.

It is a further object of the invention to provide a device which limits the flow such that the flow rate remains virtually the same irrespective of the
35 pressure of the supply.

The above stated objectives are achieved with a device according to the invention, which is characterized in that the gap has a stepwise progression.

In yet another embodiment of the device the gap has a stepped wedge shape. The choking action of the device will hereby proceed in two stages. The first stage can thus be adapted to the requirements for a constant
5 flow rate at a low pressure. The second stage can then be adapted to the requirements for a constant flow rate at high pressure.

An advantage of a device according to the invention is that the closing part closes off the
10 through-flow opening as far as necessary and the size of the gap depends on the liquid pressure difference. The relation between the closing part and the liquid pressure difference results in practically the same outflow being obtained irrespective of the supply pressure of the
15 liquid. In a preferred embodiment of the invention the base part comprises an annular flange part and a standing wall along the inner periphery of the annular flange part, and the closing part is arranged on the end of the wall remote from the annular flange part. This embodiment
20 can be readily incorporated into a conduit and because the base part comprises an annular flange part the liquid can flow easily through the gap without the liquid encountering resistance from the base part.

In another embodiment of the invention the gap
25 is wedge-shaped. This embodiment of the gap results in a very preferred limiting characteristic.

In yet another embodiment of the invention the gap comprises a constriction on both ends. A practically
30 constant flow rate is hereby obtained over the whole operating range of the device.

In another preferred embodiment of the invention the flexible part comprises a plate part and at least one spring element connecting the plate part to the base part. The flow-limiting characteristic is hereby
35 determined wholly by the spring element. The preferred limiting characteristic is obtained by a suitable choice of the spring characteristic of the spring element. The spring element is preferably helical.

In yet another embodiment the device is monolithic. The device is herein preferably manufactured by injection moulding, whereby the cost can be kept low.

5 In yet another embodiment of the device the closing surface comprises a protrusion for preventing complete closure of the gap. This prevents the device closing the conduit completely if the liquid pressure rises too high.

10 In another further embodiment the device comprises an opening for ensuring a minimal flow. This likewise prevents the gap from being completely closed by the closing part in the case of too high a liquid pressure.

15 In a preferred embodiment of the device the gap opening extends in radial direction. The advantage hereof is that a back-pressure is created under the closing part, whereby bending of the closing part progresses in smooth and damped manner as the pressure rises.

20 These and other features of the invention will be further elucidated with reference to the annexed drawings.

Figure 1 shows a perspective view of a tap in which a flow limiter is applied.

25 Figure 2 shows a cross-section of the outlet opening of the tap shown in figure 1.

Figures 3-7 show embodiments of flow limiters.

Figure 8 shows an embodiment of a flow limiter according to the invention.

30 Figure 1 shows a tap 1 comprising a housing 2 with an operating handle 3. On the underside of housing 2 is arranged an outlet opening 4, in which outlet opening 4 is arranged a screw-in part 5.

35 Figure 2 shows a cross-section of outlet opening 4 and screw-in part 5. This latter consists of a bush 6 provided with screw thread and a filter device 7 as known from the prior art. A device 8 for limiting the liquid flow is further arranged on the filter device 7 in bush 6. This device 8 according to the invention

comprises an annular flange part 9, a standing wall 10 along the inner periphery of the annular flange part and a flexible closing part 11 arranged on the standing wall. Closing part 11 and standing wall 10 are arranged

5 relative to each other such that in the rest position the gap 12 is formed between the closing part and the standing wall. The part of standing wall 10 adjoining gap 12 forms the closing surface 13.

When operating handle 3 of tap 1 is operated a
10 liquid, for instance water, will flow out through outlet opening 4 via screw-in part 5 (see figure 1). When there is a small pressure difference between the water pressure in outlet opening 4 and the outside pressure, the flexible closing part 11 will not bend and the water will
15 flow through filter device 7 via gap 12. As the water W flows through filter device 7 air L is drawn in at the side of the device, thereby creating a "foamed" jet of water. When the pressure in tap 1 increases, the pressure difference over device 8 will increase and this pressure
20 P will bend the flexible closing part 11. Gap 12 hereby becomes smaller, whereby the outflow of water W is limited. At a maximum pressure difference the flexible closing part 11 will come to lie against closing surface 13. Due to its form the gap 12 will not be completely
25 closed, thereby ensuring a minimum water flow.

Figure 3 shows a perspective view of a flow limiter as applied in the tap 1 of figures 1 and 2.

Figure 4 shows a second embodiment. Here the gap 14 is wedge-shaped and, in order to prevent complete
30 closure of the gap, a protrusion 15 is arranged on closing surface 13 which ensures a minimum flow of water.

Figure 5 shows a perspective view of a third embodiment. Here the gap 14 is likewise wedge-shaped but in order to ensure a minimum flow two holes 16 are
35 arranged on the outer ends of gap 14. These holes are not closed by bending of closing part 11, whereby a minimum flow remains ensured.

Figure 6 shows a fourth embodiment, wherein device 8 comprises an annular flange part 9 and a standing wall 10. On standing wall 10 are arranged helical spring elements 17 which support a plate part 18.

5 A uniform closure of the gap is obtained with these spring elements 17. A practically constant flow can hereby be obtained irrespective of the pressure difference over the device.

Figure 7 shows a fifth embodiment. This
10 embodiment largely corresponds with the embodiment of figure 3. Gap 14 however comprises constrictions 19 at both ends, whereby the start of the flow characteristic is influenced such that a constant flow is obtained even in the case of a small pressure difference over the
15 device.

It is further possible to provide the flexible part of the device with ribs which influence the flow characteristic. The form of the gap also contributes towards this.

20 Figure 8 shows an embodiment of the invention. This embodiment also corresponds by and large with the embodiment of figure 3. The gap has a stepwise progression, however. A gap consisting of a first gap part 21 and a second gap part 22 is therefore arranged in
25 cylindrical part 20. First gap part 21 is narrower than second gap part 22. When pressure is applied from above on closing part 23, it will then bend as the pressure increases. Closing part 23 will herein bend along the
* whole length of first gap part 21 and second gap part 22
30 during the first stage of pressure increase. When the pressure rises to a determined level, closing part 23 will contact edge 24, this at the location where first gap part 21 transposes into second gap part 22. If the pressure is now increased further, only the part of
35 closing part 23 located above second gap part 22 will then bend. It is thus possible to cause the degree of closure of the gap to be adjusted in controlled manner. A

constant flow rate is hereby obtained over a wide pressure range.

5 The maximum supply pressure may differ from place to place. In order to provide the best possible operation of a flow limiter, a flow limiter would have to be designed for each supply pressure. It is however also possible to place a sleeve round the standing wall of the device, whereby the supply of water towards the gap is limited. At a high supply pressure this pressure can thus
10 be reduced, whereby a flow limiter suitable for lower pressures can still be used.

CLAIMS

1. Device (8) for arranging in a liquid conduit for limiting a liquid flow W in this conduit, which device (8) comprises a base part (10) with a through-flow opening (12;21,22) and a closing part (11;23) which is
5 arranged on the base part via spring means and which is displaceable with at least a substantial axial component for partially closing the through-flow opening (12;21,22) against a closing surface (13) on the base part (10), wherein the device (8) can be fixed at a fixed position
10 in the conduit by means of fixation means (9) such that the liquid can pass through the device (8) only via the through-flow opening (12;21,22) and wherein the base part (10) and the closing part (11;23) are arranged relative to each other such that in a rest position defined by the
15 spring means (11;23) a gap (12;21,22) is formed between the base part (10) and the closing part (11;23), which gap (12;21,22) is made smaller counter to the spring action by bending under the influence of the liquid pressure P difference over the device (8);

20 characterized in that

the gap (12;21,22) has a stepwise progression.

2. Device (8) as claimed in claim 1, wherein the gap (12) has a stepped wedge shape.

3. Device (8) as claimed in claim 1 or 2,
25 wherein the base part (10) comprises an annular flange part (9) and a standing wall (10) along the inner periphery of the annular flange part (9), and wherein the closing part (11) is arranged on the end of the wall (10) remote from the annular flange part (7).

30 4. Device (8) as claimed in claim 1 or 2, wherein the closing part (11) comprises a plate part (18) and at least one spring element (17) connecting the plate part (18) to the base part (10).

5. Device (8) as claimed in claim 4, wherein the spring element (17) is substantially helical.

6. Device (8) as claimed in claim 1 or 2, wherein the device (8) is monolithic.

5 7. Device (8) as claimed in claim 1 or 2, wherein the closing surface (13) comprises a protrusion (15) for preventing complete closure of the gap (14).

10 8. Device (8) as claimed in claim 1 or 2, wherein the device (8) comprises an opening (16) for ensuring a minimal flow.

9. Device (8) as claimed in claim 1 or 2, wherein the gap (14) comprises a constriction (19) on both its ends.

15 10. Device (8) as claimed in claim 1 or 2, wherein the gap opening (14) extends in radial direction.