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(71) Applicants
Danfoss A/S,
(Denmark),
6430 Nordborg,
Denmark
(72) Inventors
Erik Eriksen Andreson
Svend Peder Pedersen
(74) Agent and/or
Address for Service
Abel & Imray,
Northumberland House,
303-306 High Holborn,
London WC1V 7LH

(54) **Fluid flow valves with preset throughflow**

(57) A valve with presetting of the amount of throughflow, particularly a thermostatic valve for hot water central heating, comprises a cylindrical housing bore of which the base (8) comprises the valve seat (2) and the cylindrical circumferential surface comprises a fixed opening communicating with a connector. An insert (14) is guided only in the housing bore and is connected by way of a rotary coupling (38), which permits play, to a setting element (15) which serves for rotary adjustment. The circumferential wall (41) of the insert (14) abuts the base (8) with its end under spring force and circumferentially bounds a control passageway (46) which co-operates with the fixed opening. The control passageway is covered up to at least one residual throughpassage (45) to the valve chamber (4) by a skirt (44). This insert can be adjusted by small forces.

Fig.1

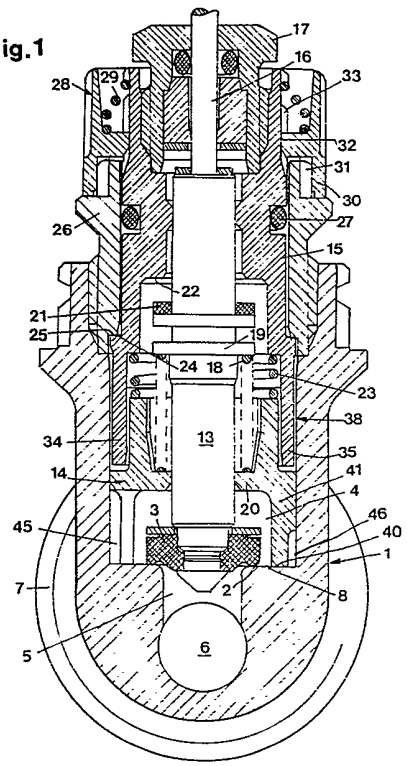

Fig.4

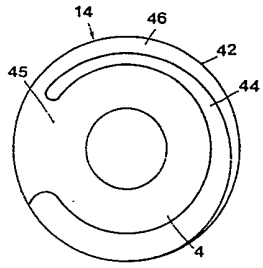

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Fig. 1

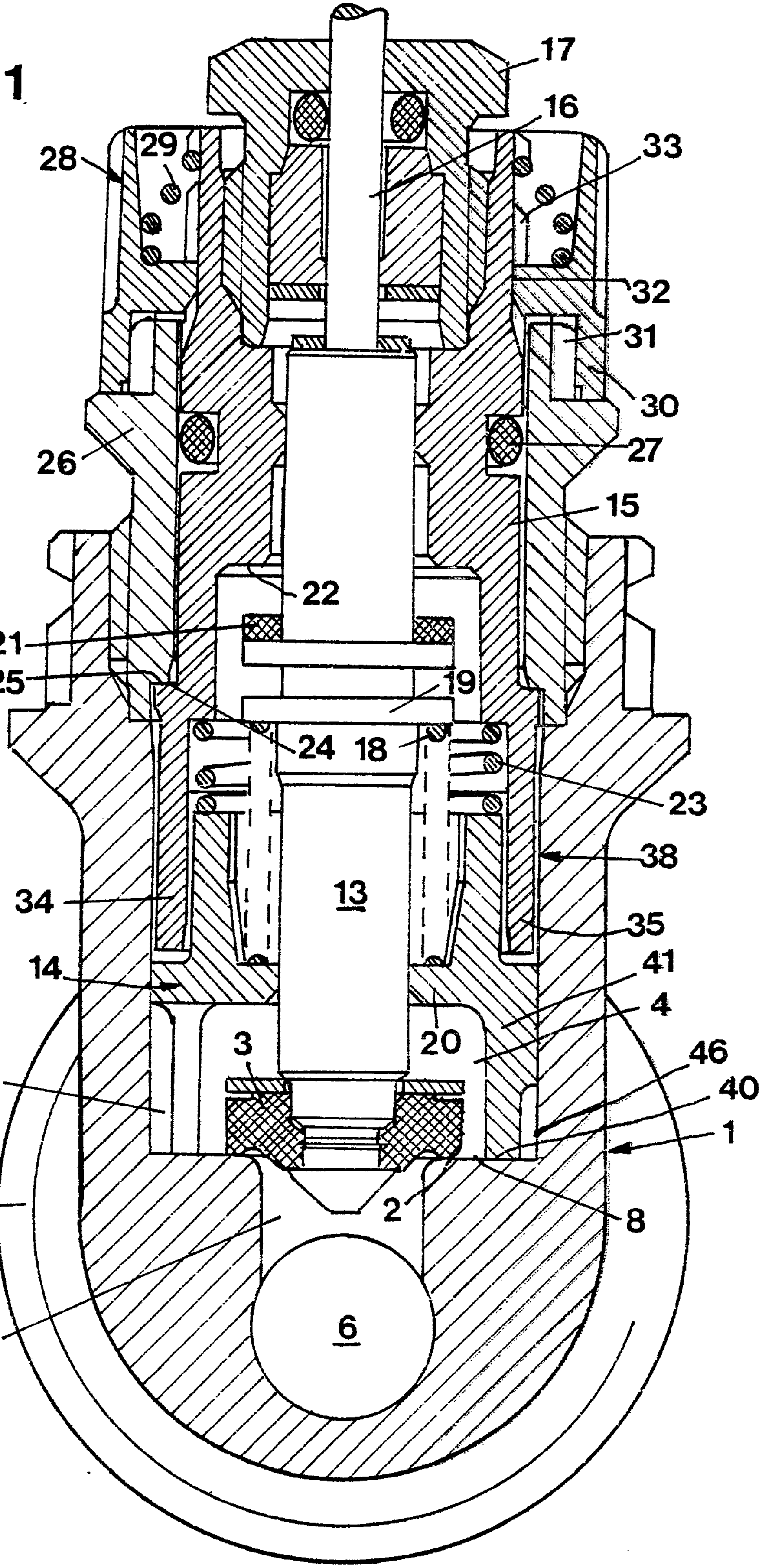
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Fig. 1 & 4

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Fig.2

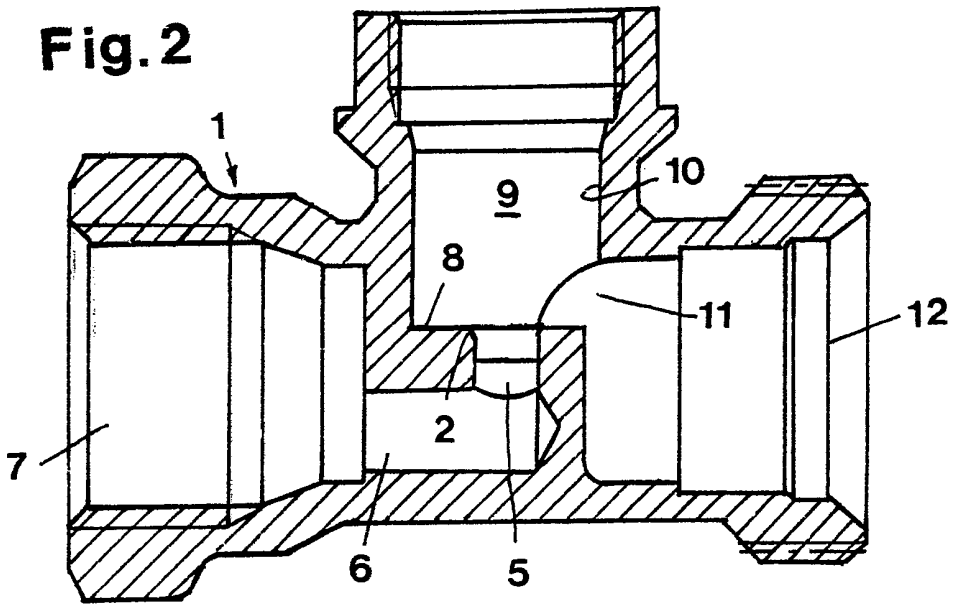


Fig.3

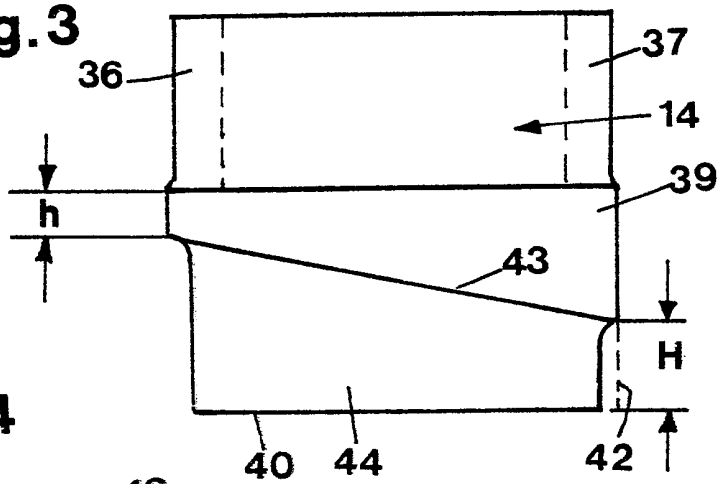


Fig.4

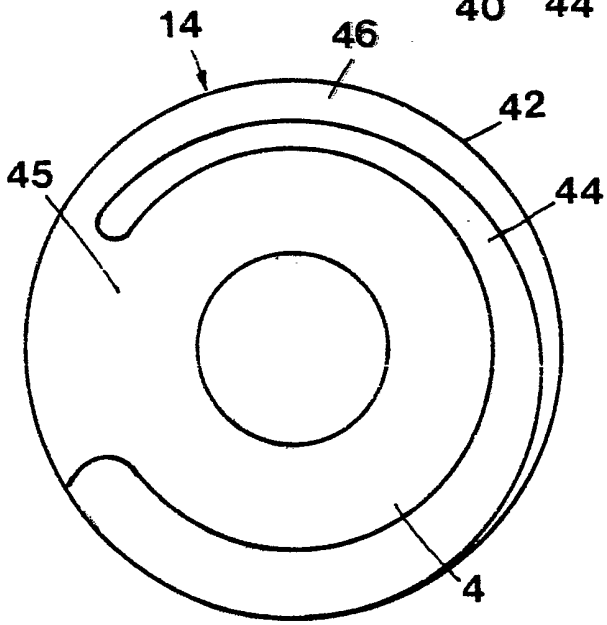
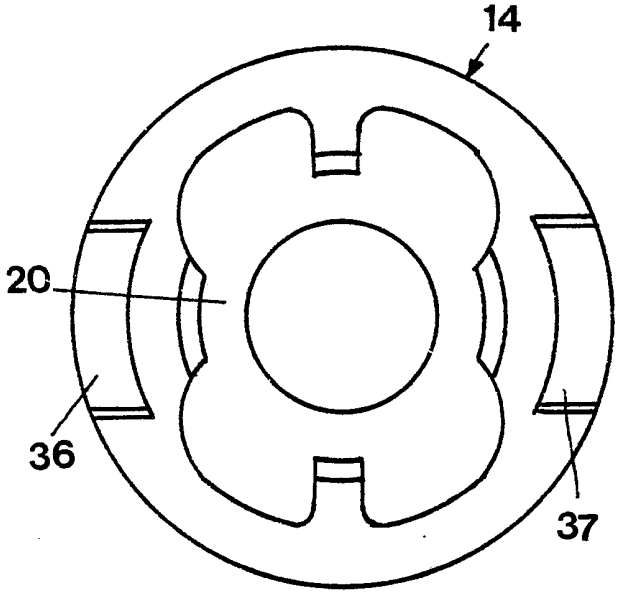


Fig.5



SPECIFICATION

Fluid flow valves with preset throughflow

This invention relates to fluid flow valves with preset throughflow.

As described in DE-PS 1,261,722, a valve with presetting of the amount of throughflow, particularly a thermostatic valve for hot water central heating, comprises a cylindrical housing bore of which the base comprises the valve seat and the cylindrical circumferential surface comprises a fixed opening communicating with a connector, and an insert rotatable by an externally operable setting element and comprising a peripheral wall surrounding a valve chamber which abuts the base of the housing bore which its end under spring force and circumferentially bounds a control orifice which co-operates with the fixed opening and extends from the base of the housing bore through a circumferentially decreasing height.

In the known valve of this kind, the peripheral wall is a hollow cylindrical sleeve the said end of which has been cut off obliquely to form the control orifice of variable height. In this way, the fixed opening can be covered to a larger or smaller extent to set a desired k_v value. The insert is comparatively long axially because is reaches to near the upper edge of the housing where it is fixed to a gland insert serving as a setting element. The insert is guided not only in the housing bore but also in an adjoining enlargement. In this construction, jamming takes place occasionally and prevents rotary adjustment of the insert.

The invention is based on the problem of providing a valve of the aforementioned kind in which comparatively small forces suffice for the adjustment and the danger of jamming is slight.

The present invention provides a fluid flow valve comprising: a valve chamber with a valve seat against which, in use, a closure member of the valve acts, the valve seat being at the base of a cylindrical bore in the housing of the valve, a flow opening passing through the circumferential wall of the housing, a flow presetting insert which can be rotated in order to preset flow through the valve, the insert being located within the bore, being mounted by the bore for its rotational movement, and having a peripheral wall, the base of which encircles the valve chamber and is seated on the base of the bore, and a flow control passageway located in the circumference of the peripheral wall and co-operating, in use, with the said flow opening to preset the flow through the valve in accordance with the angular position of the insert.

The above-mentioned problem is solved according to the invention in that the circumferential wall carries a skirt which reaches to the base of the housing bore and covers the control orifice up to at least one residual through passage to the valve chamber, and that the insert is guided only in the housing bore and is connected to the setting element by way of a rotary coupling which permits play.

In this construction, the skirt enables the insert to be supported not only at one side at the base of the housing bore but also substantially all round. Consequently, it cannot be tilted by the spring acting thereon. Instead, it will always retain an accurate axial alignment. By separating the insert and the setting element, one prevents the exertion, for example by an adjusting tool, of transverse forces on the insert that might lead to tilting. There is therefore also no need to guide the insert over an extensive length. A comparatively short guide soley within the housing bore will suffice. By reducing the area of the guide faces, one also reduces the frictional forces so that the adjusting forces as a whole can be reduced. Since the setting element can be mounted comparatively loosely, its bearing friction is practically unimportant. Since the insert is not subjected to transverse forces, one can also select a much closer fit than hitherto. This, in turn, enables one to use shorter sealing distances so that the insert as a whole can be kept small.

It is particularly favourable if only one throughpassage is provided and is disposed at one end of the control orifice. Since in this case the skirt is closed over most of its length, a completely closed passage is formed between the fixed opening and the throughpassage and can bring about all or some of the desired throttling.

It is favourable for the throughpassage to be disposed at the end where the control orifice has its largest height. As a result, when the effective section of the passage becomes longer, the part of the fixed opening left free by the control orifice also becomes smaller. The throttling effects at the co-operating apertures and in the passage therefore change in the same sense.

Preferably, the guide face of the insert already terminates just above the control orifice. The narrowest portion of the guide face, which is located in the region of the largest height of the control orifice, need merely have a height corresponding to the required sealing distance. Since a good fit is possible, a height of less than 5 mm or even less than 2 mm will be sufficient for the usual pressures.

Further, the insert can be of a different material from that of the setting element. In this way, one can take account of the special conditions of the insert (good sealing, low friction, high resistance to flow) independently of the properties required for the setting element (mechanical strength, wear resistance to the setting tool).

In particular, the insert may be of plastics material. Amongst the many plastics that are usuable, polyphenylene sulphide with a glass fibre reinforcement is particularly recommended.

Other advantages are obtained if the insert is an extruded, cast or injected moulding. The insert can then be produced without any machining, the control orifice extending over part of the circumference then being in the form of a groove extending from the end. In this way, one can also produce configurations for the groove that are in no way possible with the aid of a machine tool. In many cases, this facilitates an extremely accurate adaptation to the particular throttling requirements.

In a further embodiment of the invention, the skirt has a constant internal diameter but becomes thicker with increasing height of the control orifice. The cross-section of the throttling passage is therefore not only influenced by a change in height but also be a

change in width so that the throttling effect can be influenced even more strongly.

It is favourable for the height of the control orifice to be selected to that the k_v value changes linearly upon rotation of the insert. In this way, the k_v value can be very accurately set to the desired intermediate value with the aid of a scale on the housing. To achieve this, it may be necessary to compose the height of the control orifice of sections of different mathematical functions.

A particularly simple kind of rotary coupling permitting play is obtained if the insert comprises axial grooves in which the axially extending fingers of the setting element engage with play. In this way, it is even possible to keep the external diameter of the setting element smaller than the diameter of the guide face of the insert, so that the coupling and insert can be accommodated in the same housing bore.

A fluid flow valve constructed in accordance with the invention will now be described by way of example only with reference to the accompanying drawings, in which:

Fig. 1 is a cross-section through the valve according to the invention;

Fig. 2 is a longitudinal section through a housing of the valve and is at a scale smaller than that of Fig. 1;

Fig. 3 is a side elevation of an insert of the valve;

Fig. 4 is a view from the underneath of the insert, and

Fig. 5 is a plan view of the insert.

Referring to the drawings, a valve housing 1 comprises a valve seat 2 and a co-operating closure member 3. In the closed condition, this closure member 3 blocks a first valve chamber 4 from a second valve chamber 5, which second valve chamber is connected to a connector 7 by a passage 6. The valve seat 2 is disposed at the base 8 of a bore 9 in the housing and the circumferential surface 10 of the bore is provided with a fixed opening 11. This communicates with a second connector 12.

The closure member 3 is carried by a valve shank 13 which passes through an insert 14 in the housing bore 9 and through a setting element 15. A pin 16 engaging the upper end of the valve shank 13 is provided for actuation by a thermostatic actuator unit (not shown) and passes through a sealing member 17 screwed into the setting element 15. A return spring 18 engages a collar 19 of the valve shank 13 and acts on an inner annular flange 20 of the insert 14. The valve shank 13 also carries a return seal 21 which cooperates with a step 22 on the setting elemnent 15.

The axial position of the setting element 15 is determined by the fact that a spring 23 having one end abutting the insert 14 causes a step 24 of the setting element to be pressed against a step 25 of a retainer 26 screwed into the housing 1. The setting element 15 is sealed from this retainer by means of a sealing ring 27. With the aid of a setting ring 28, the setting element 15 can be turned when the ring is moved axially outwardly against the force of a spring 29. In this case, multiple teeth 30 on the setting ring 28 disengage complementary formations 31 on the retainer 26 whilst different multiple teeth 32 on the setting ring 28 remain engages with complementary formations 33 on the setting element 15 so that rotary adjustment is possible.

The setting element 15 comprises two axial fingers 34 and 35 which engage is corresponding axial grooves 36 and 37 of the insert 14 with such play that both parts can turn relatively to each other to a small extent. In this way, one obtains a rotary coupling with which a torque can be transmitted from the setting element 15 onto the insert 14 yet without giving rise to a transverse force that might cause jamming.

The insert 14 comprises a cylindrical guide surface 39 which sealingly co-operates with the circumferential surface 10 of the housing bore 9. The smallest height h of this guide surface is chosen so as to provide sufficient sealing having due regard to the tightness of the fit of the insert. A second sealing surface is formed by the end 40 of the insert 14 which the spring 23 causes to be pressed against the base 8 of bore 9. Since no extraneous, transverse or tilting forces can occur, the surfaces 39 and 40 lie against their corresponding backing surfaces so well that short sealing paths will suffice.

The insert 14 comprises a circumferential wall 41 which surrounds the valve chamber 4 and the external circumferential surface of which is partially bounded by the guide surface 39. Beneath this guide surface there is a control opening defining portion 42 which extends between a set back portion 43 at the underside of the guide surface 39 and the base 8 of the housing bore 9. The height H of the control opening defining portion 42 increases in one sense in the circumferential direction. Between the control opening defining portion 42 and the valve chamber 4, a skirt 44 provided over the greater part of the circumference likewise reaches to the base 8. The thickness of the skirt 44 increases towards the smaller height H of the control orifice 42, as will be evident from Fig 4. At the region of the largest height H, there is a throughpassage 45.

When the insert 14 is in position in the housing bore, a passage 46 is formed between the circumferential wall 10, the base 8, the set-back portion 43 and the skirt 44. This passage 46 leads from the fixed opening 11 in the housing 1 to the through passage 45. This passage serves to produce a throttling effect which depends on the transitional cross-section between the fixed opening 11 and the control orifice 42, the effective length of passage 46, and the cross-section of the passage determined by the height and breadth.

If the insert 14 is turned by the setting element 15, all the parameters change in the sense of a like change in the throttling effect. For example, if a zone of smaller height H of the control orifice 42 is brought into registry with the fixed opening 11, the passage 46 is simultaneously extended and a section of smaller cross-section is made operative. By appropriately selecting the course of the height H, it is possible to change the k_v values determining the amount of throughflow over such a large range that equal differences in the angle lead to equal differences in the k_v value.

As shown in Fig. 2, the fixed opening 11 extends into the base 8 of the housing bore 9 so that the passage 46 can be filled from both side and base. This feature, which is not essential, is sometimes desired when, with the shallowest possible structural height of the

housing, the fixed opening is to have as large a cross-section as possible.

In the present example, the throttling insert 14 is of plastics material whereas the housing 1, setting element 15, sealing member 17, retainer 26 and adjusting ring 28 are of brass.

The diameter of the insert 1 and of the housing bore 9 is only 14.5 mm and the height of the insert only 13.5 mm.

If the throttling effect is to be brought about primarily by the overlapping cross-section between the free opening 11 and the control orifice 42, the skirt 44 may, instead of the single throughpassage 45 at one point, provide a plurality of throughpassages distributed over its length.

Although the described valve is primarily intended for use with a themostatic actuator unit as a thermostatic valve for a hot water central heating installation, so that presetting of the desired k_v valve permits uniform distribution of the heat carrier in the installation, the presetting arrangement is also suitable for other valves, for example for manually operated radiator valves or water valves.

The k_v-value or factor represents the quantity of fluid (Q) flowing through the valve per unit time at a given pressure drop (Δp) across the valve: $k_v = Q/\sqrt{\Delta p}$.

CLAIMS

1. A fluid flow valve comprising: a valve chamber with a valve seat against which, in use, a closure member of the valve acts, the valve seat being at the base of a cylindrical bore in the housing of the valve, a flow opening passing through the circumferential wall of the housing, a flow presetting insert which can be rotated in order to preset flow through the valve, the insert being located within the bore, being mounted by the bore for its rotational movement, and having a peripheral wall, the base of which encircles the valve chamber and is seated on the base of the bore, and a flow control passageway located in the circumference of the peripheral wall and co-operating, in use, with the said flow opening to preset the flow through the valve in accordance with the angular position of the insert.

2. A valve as claimed in Claim 1, wherein the flow control passageway runs along the circumference of the peripheral wall, and at least one through passage is provided passing through the peripheral wall and connecting the flow control passageway to the valve chamber.

3. A valve as claimed in Claim 1 or Claim 2, wherein a setting member is provided for setting the angular position of the insert, and the setting member is so coupled to the insert as to allow some freedom of rotational movement between the setting member and the insert.

4. A valve as claimed in an preceding Claim, wherein a spring is provided to urge the insert against the base of the cylindrical bore.

5. A valve as claimed in Claim 2 or either of Claims 3 and 4 when dependent on Claim 2, wherein the height of the flow control passageway changes progressively from one end of the passage to the other.

6. A valve as claimed in Claim 2 or any of Claims 3 to 5 when dependent on Claim 2, wherein the peripheral wall is a skirt abutting the base of the bore and the skirt defines the flow control passageway.

7. A fluid flow valve with presetting of the amount of throughflow, comprising a cylindrical housing bore of which the base comprises the valve seat and the cylindrical circumferential surface comprises a fixed opening communicating with a connector, and an insert rotatable by an externally operable setting member and comprising a peripheral wall surrounding a valve chamber which peripheral wall abuts the base of the housing bore with its end under spring force and circumferentially defines a control passageway which co-operates with the fixed opening and extends from the base of the housing bore with a circumferentially decreasing height, wherein the peripheral wall has a skirt which reaches to the base of the housing bore and covers the control passageway as far as at least one residual through passage to the valve chamber, and wherein the insert is guided only in the housing bore and is connected to the setting member by way of a rotary coupling which permits play.

8. A valve as claimed in Claim 2, 5, 6 or 7 or Claim 3 or 4 when dependent on Claim 2 wherein only one throughpassage is provided and disposed at one end of the control passageway.

9. A valve as claimed in Claim 8 wherein the throughpassage is disposed at that end where the control passageway has the largest height.

10. A valve as claimed in any preceding Claim wherein the insert has a guide face terminating shortly above the control passageway.

11. A valve as claimed in Claim 3, any of Claims 4 to 6 when dependent on Claim 3, Claim 7, or any of Claims 8 to 10 when dependent on Claim 3 or 7, wherein the insert is of a material different from that of the setting member.

12. A valve as claimed in any preceding Claim, wherein the insert is of plastics material.

13. A valve as claimed in any preceding Claim, wherein the insert is an extruded, cast or injection moulded member.

14. A valve as claimed in Claims 5 and 6, Claim 7, or any of Claims 8 to 13 when dependent on both of Claims 5 and 6 or on Claim 7, wherein the skirt has a constant internal diameter but becomes thicker as the height of the control passageway decreases.

15. A valve as claimed in Claim 6, Claims 5 and 6, Claim 7, or any of Claims 8 to 14 when dependent on Claim 5 or Claim 7, wherein the variation in height of the control passageway is such that the k_v value changes linearly upon rotation of the insert.

16. A valve as claimed in Claim 3, any of Claims 4 to 5 when dependent on Claim 3, Claim 7, or any of Claims 8 to 15 when dependent on Claim 3 or Claim 7, wherein the insert has axial grooves in which axially extending fingers of the setting element engage with play.

17. A valve as claimed in any preceding Claims wherein the valve is for actuation by a thermostatic actuator unit.

18. A valve as claimed in any preceding Claim wherein the valve is a radiator valve for a central heating system.

19. A fluid flow valve substantially as herein described with reference to and as illustrated by the accompanying drawings.

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