

VALVE WITH REGULATING FUNCTION

The present invention relates to a valve, preferably a terminal valve, in a heating or cooling system – and in which the main function is to regulate a suitable flow through the valve / the system, which
5 flow can be maximized, regulated and controlled.

The new features of this construction in comparison to known technology are, that a completely new cone and a new seat has been developed, which offer several advantages compared to existing constructions. The cone/seat cooperates also with a veil, which means, that the passage in the valve
10 can be preadjusted, i.e. it is possible to choose a maximum flow, when the cone is in its upper position – what the artisans call a Kvs-value – and with this chosen Kvs-value as an initial value it is also possible to regulate the flow from 0 and up to Kvs, this flow having a desirable feature, because the cone has a newly developed shape and also preferably is made of a polymer.

15 The construction offers the following advantages in comparison to existing construction solutions:

- a guaranteed reproduction of dimensions of the cooperative parts and then in particular of the cone and the seat;
- a regulating function, the flow as a function of the percentage opening of the cone having a desirable, preferably modified, logarithmic feature;
- 20 - the regulatory function being combined with a variable Kvs-value and with a maintained feature according to what has been stated above;
- the tightness between the cone, the valve seat and the valve body being secured by means of a newly developed packing and seat ring; and
- the requirements as to the cutting machining of the seat and the cone can be reduced, with a
25 maintained, secured function.

These above-mentioned advantages of the novel construction are realized according to the present invention, because the construction according to the type set forth in the introduction mainly will be designed in the way set forth in the characterizing clause of claim 1. Additional characterizing
30 features and advantages of the present invention will be set forth in the following description, reference being made to the enclosed drawings, which depict a preferred but not limiting embodiment of the invention.

In detail is shown in diametrical, partially schematic sections or in perspective views:

Fig. 1 an assembly of an embodiment of a valve according to the invention;

Fig. 2 a sectional view of a cone, a seat ring and a veil;

Fig. 3 a sectional view of the seat/the cone;

Fig. 4 an external and sectional view of the seat ring; och

5 Fig. 5 an external and sectional view of the cone.

Fig. 1 exemplifies, how a complete valve, based on the novel construction elements may be designed.

10 Thus, the complete valve may be designed with variations as to e.g. the valve body, which can be designed in a special way; and as another variation the valve may e.g. be provided with other adjustment means than the hand wheel, shown in the figure, and still be inside the scope of the inventive idea.

15 In Fig. 1 valve body 1 is provided with two measuring nipples 2 and with a knee 3, in which a complete valve case 4 is mounted.

Through the measuring nipples a present fall of pressure in the valve can be measured, from its inlet side 5 to its outlet side 6, and in this way the present flow through the valve can be measured and be
20 known, since during the development of the valve its features have been tested and verified, i.e. the relationship between the fall of pressure across the valve and the volume of the passing medium/flow.

In Fig. 1 a hand wheel 7 is mounted, which can actuate spindle 8, the spindle, with a mounted cone
25 9, being allowed to be pressed downwards towards valve seat 10, when the flow through the valve is to be cut down/stopped. When the valve is to be opened up, the hand wheel is to be turned in the opposite direction; and cone 9 is then moved upwards from valve seat 10, valve case 4 having a spring 11, which always strives to move the cone/the spindle upwards and away from the seat.

30 In order to be able to regulate the maximum flow through the valve, which flow the artisans call the Kvs-value, the valve case is provided with a screen wall, a veil which can be pivoted in relation to the valve body and its passage 13, passage 13 being machined in the front part of the valve body, between the area above the seat and outwards towards outlet side 6. In Fig. 1 this passage 13 has a limited free height, called "a" between plane 14, which is located in the valve body and which is in

the same plane as valve seat 10 and lower edge 15 of the veil. The veil is at its lower edge provided with a "staircase" design, which means, that the free height "a" gradually increases stepwise from being 0, i.e. being completely in the same plane as plane 14, and to a maximum "a-value", the various "a-values" all of them being researched in order to obtain the suitable Kvs-flows through the valve.

In order to obtain a certain Kvs-value veil 12 must be turnable. The veil is turned in order to obtain a certain fall of pressure across the valve and since the features of the valve are known, every fall of pressure will correspond to a certain flow - a certain Kvs-value and this adjustment is always done with the cone in its entirely open position.

Also, the position of the veil, i.e. its turning position, is known, since valve case 4 only can be mounted in a rotational position in relation to knee 3 and at the same time the mounting position of the veil in valve case 4 is given, since veil 12 also has a certain rotational position in the complete valve case 4. The change of the position of the veil is done with a preadjustment tool or the like - not described or shown in the present description. This preadjustment tool preferably is provided with an index disc, which shows a numerical value, which can be read against a stationary index on valve body 1. A certain adjusted index value means, that the valve then has a Kvs-value, which is known and which consequently always can be controlled through measuring the fall of pressure in measuring nipples 2, not only when aligning a construction but also in a later specific situation and consequently it is always possible to examine a construction in order to see, which flows are used and whether they correspond to the values, which are supposed to be valid. In order to facilitate the tightening of the valve, when the cone is lowered and seals against the seat, a gap 17 is used, in which the pressure level, which is present on the return side, is forwarded upwards to cavity 18 above and around the spindle, and in this way a counter force is obtained, a force directed downwards towards the seat and this will lower the required force, the tightening force required to keep the cone in its lowermost closed position.

The design of the cone and the seat is described in detail in connection with Figs. 2-5 .

Fig. 2 shows, how cone 9, seat ring 19 and veil 12 are cooperating.

Cone 9 is mounted on spindle 8 with a screw 23, which forces an inner cylinder plane 38 on the cone upwards and towards the spindle, at the same time as screw 23 is threaded onto the spindle

from below. In order to position the cone at right angles to the longitudinal axis of the spindle the cone is in its upper part provided with a neck 29, which extends preferably 1-3 mm upwards from the upper cylinder plane 30 of the cone. The neck has an outer diameter, which preferably is roughly the same or slightly larger than the outer diameter of spindle 8 and the neck has in its upper
5 part an inner part 25, which is designed in such a way, that an O-ring 28 preferably can be mounted in part 25 and also neck 29 has an upper end surface 24, against which the spindle is stopped, when screw 23 is tightened, and this also allows a correct mounting position, the correct prestressing in O-ring 28. As an alternative to an O-ring 28 cone 9 can be designed with one or several wave crests on the inner cylindrical plane 38 of the cone in order to, when screw 23 is tightened, obtain a
10 tightening between the screw head and the inner surface of the cone. The function of O-ring 38 or alternatively the tightening between the screw and the waved inner plane 38 is to present an unintentional leakage from the bottom side of the cone outwards towards its upper side and consequently outwards towards return side 6.

15 In Fig. 2 veil 12 has been turned, a marginal "a"-measurement being shown between lower edge 15 of the veil and plane 14, which is positioned in valve body 1, this plane 14 being positioned at the same level as the upper side on seat ring 19.

In Fig. 3 seat ring 19 is mounted in valve body 1 and in this figure cone 9 is positioned in its lower
20 closed position.

Seat ring 19 preferably is made of, e.g. molded from a suitable plastic or rubber material, and with a form stability, which meets the functional requirements, which are valid for the seat ring.

25 An alternative design of seat ring 19 is to use a core, which suitably is a metal core or a plastic core. Around this core a suitable rubber material is mounted, which through a cure or the like binds the cone and the rubber parts together into a unit, to seat ring 19.

The mounting of the seat ring is done from the side of valve case 4 by compressing the seat ring
30 downwards into the machined zone, which is obtained in the valve body, outer diameter 31 of the seat ring being coordinated with the diameter, which machining 32 in the valve body has obtained. Also, this machining has a second machining 33, which means, that the diameter of machining 32 is increased with preferably 0.5 – 2 mm, this machining having an axial depth of preferably 1-5 mm and being coordinated with seat ring 19 in such a way, that outer diameter 31 of the seat ring also is

increased in the zone, which cooperates with machining 33. The measurements of machining 33 is only one example and of course depends on the value dimension, which is used. When the seat ring is mounted downwards into the valve body, the outer lower part 34 of the seat ring will snap into machining 33 and in this way the seat ring will be firmly anchored in valve body 1. In order to prevent an unintentional leakage between the valve body and the seat ring the seat ring is provided with a sealing edge 44, which seals against machining 32.

The upper side of the seal ring is valve seat 10 according to the present invention, and this valve seat is positioned in the same plane as plane 14 of the valve body.

The design of the seat ring provides several functions.

Seat ring 19 functions as a combined sealing element and a valve seat 10. The seat ring has an inner diameter 36, which preferably is slightly larger than cone 9 and its outer diameter 20. However, the seat ring will seal against outer diameter 20 of the cone and consequently the seat ring has a sealing lip 22, which extends from inner diameter 36 of the ring and slightly further than into outer diameter 20 of cone 9. In connection with the arriving of cone 9 into its closed position flange 39 of the cone and its lower side will exert a pressure against the upper side of the seat ring.

The flange portion of the cone is provided on its lower side with a few wave crests/valleys 42 and a wave crest has the same mean diameter as a groove, a recess 45, preferably a width of 0.2 – 1 mm and a length of 0.5 – 2 mm, in the upper outer part of the seat ring, valve seat 10 and which constitute the delamination between sealing lip 22 and the upper part of the seat ring, and where wave crest 56 of the cone partially reaches downwards into recess 45 – the wave length preferably being about 1.5 – 3 times the length of the width of recess 45 – sealing lip 22 being pressed inwards towards the outer diameter 20 of the cone with a better sealing function as a result. The above-mentioned measurements of recess 45 are only one example, the measurement of seat ring 19 of course depending on the size of the valve, into which the seat ring is to be mounted.

The seat ring also is provided with a wave-shape design, a sealing edge 40 in its lower surface 43, namely the surface, which after the mounting of the seat ring is pressed against bottom 37, which constitute the lower part of swing machining 33 and where this bottom as to its diameter preferably has the same inner diameter 36 as the seat ring. Since the seat ring is pressed against bottom 37 an unintentional leakage from inlet side 5 of the valve to outlet side 6 via outer diameter 31 of the seat

ring is prevented. As a complement to the sealing at bottom 37 the seat ring also is provided with a sealing edge 44 on its outer diameter 31, which seals against machined surface 32.

Fig. 4 shows seat ring 19 in one external and one sectional view.

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The seat ring preferably is made of a plastic or rubber material, which allows a reproduction of the detail with small measurement tolerances and with a certain degree of elasticity, those parts, which constitute sealing zones, i.e. sealing lip 22 and the wave-formed sealing edges 44 on outer diameter 31 and 40 of the ring on lower surface of the ring obtaining a certain elasticity. Groove or recess 45 in the upper surface of the ring, in seat 10, is a requirement for the mobility of sealing lip 22, the starting position of which being, that the lip has an inner diameter, which is the same or slightly smaller than outer diameter 20 of the cone. In a normal operational position, when the cone is slightly drawn out or raised from seat 10, sealing lip 22 seals against the outer diameter of the cone, in order to in the operational position, when the cone is completely closed, obtain a stronger sealing effect thanks to the wave-shaped part 42 of the cone, and when a slightly higher wave crest 56 partly extends downwards into recess 45 and consequently compresses sealing lip 22 further towards the outer diameter of the cone.

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Fig. 5 shows cone 9 in an external and a sectional view.

The cone preferably is made of a shape-stable plastic material, but it can also be made of a metallic material, e.g. brass.

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The cone comprises a flange part 39, a central neck part 29 as well as a lower cylindrical part 46.

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Flange 39 of the cone is provided on its lower side with a few wave crests/wave valleys 42 and also two ears 47 in its outer periphery, positioned diagonally on the flange to allow the cone, when mounted, to always be mounted in a certain rotational position. The lower cylindrical part 46 of the cone has an outer diameter 20 and this diameter is transformed in its lower part into four, slightly diametrically reduced terminations or legs 48, which are positioned with the same division around the periphery. Cylindrical part 46 has two different slits or recesses. There are four slits altogether. Two slits have a design, which is deeper than in the two other. The deep slits 49 extend from the lower edge on cylindrical portion 46 all the way up to the same level as the lower side of flange 39. The deep slits are positioned with a 180° division, i.e. diagonally just opposite each other. Between

these slits there are two other more shallow slits 50. These slits extend only a small distance upwards towards flange 39.

The design of the slits has been researched in order to obtain the desirable flow characteristics of the valve. Thus, deep slits 49 are designed in such a way, that the flow really corresponds to the connection, which is valid for the flow as a function of the lifting height of the cone and that this connection obtains a preferably modified logarithmic feature. In order to render this possible only two slits are required, the deep ones, those which allow the medium to pass, when the cone starts opening up. Through this division of the flow outlets from inlet side 5 of the valve to outlet side 6 the flow increase will be controlled in a better way, than if all four slits were opened up from the start. With just two slits, which open up in the starting position, this results also in, that width 51 of the slit at its upper part obtains an extension, which results in, that it will be easier for the slot to stay free from coatings and dirt. Flank 52 of deep slit 49 has a design, which has been researched and has a slightly convex shape.

The shallow slits 50 have a design, which will allow the valve in connection with the situation, that it approaches a more open position, i.e. when the cone has come a relatively long distance upwards from the seat, to only then start letting a flow pass. Flank 53 of the shallow slit is only slightly convex and the two flanks meet each other in a central point, which is positioned only a small distance upwards from cylindrical plane 46 and its lower part.

Thanks to ears 47 on flange 39 the cone has obtained a rotational indication, which means, that the cone always will be mounted in such a way, that one of deep slits 49 always will end up in front of passage 13 in the valve and is necessary to allow the same flow resistance to always be obtained and consequently the characteristics, when the valve is manufactured and controlled and during the separate installation.

The central part of the cone comprises a neck 29, which extends upwards from flange 39, and this neck has an inner part 25, which is designed in such a way, that an O-ring preferably can be mounted in the neck, and the neck has an upper interface 24, against which the cooperating spindle stops, when the cone is mounted on it. In the central part there is a hole 54 to render it possible to mount a screw or the like from below in order to fasten the cone to cooperating spindle 8. As an alternative to an O-ring the cone can be designed with one or several wave crests on inner

cylindrical plane 38 of the cone in order to, when a screw is mounted, obtain a sealing between the screw head and the inner surface of the cone.

ELEMENT LIST :

	1= valve body	2= measuring nipple	3= knee
	4= valve case	5= inlet side	6= outlet side
5	7= hand wheel	8= spindle	9= cone
	10= valve seat	11= spring	12=veil
	13= passage opening		14= plane
	15= lower edge	16= index	17= gap
	18= cavity	19= seat ring	20= outer diameter
10	21= sealing plane	22= sealing lip	23= screw
	24=upper end surface	25= inner part	26= end surface
	28= O-ring	29= neck	30= cylindrical plane
	31= outer diameter	32= machining	33= swing machining
	34= outer part	35= core	36= inner diameter
15	37= bottom	38= inner plane	39= flange
	40= sealing edge	41=	42= wave shape
	43= lower surface	44= sealing edge	45= recess
	46= cylindrical portion	47= ear	48= leg
	49= deep slit	50= shallow slit	51= slit width
20	52= flank	53= flank	54= hole
	55= -	56= wave crest	

CLAIMS

1. A device designed to regulate and control the flow through a valve in a heating and cooling system, these functions being obtained by means of a valve house (1), comprising an inlet side (5) and an outlet side (6), the valve house being provided with a knee (3), which is machined and in which a valve case (4) is mounted, and on the inlet side (5) of the knee a measuring nipple (2) being provided for measuring the pressure level on the inlet side and a measuring nipple also being provided on the outlet side (6), this being provided to be able to register the fall of pressure, which occurs in the valve body (1) at different adjustments of a cone (9) in relation to a valve seat (10) and at different adjustments of a veil (12), the valve body (1) also being provided with a seat ring (19), which is a sealing device against the valve body (1) as well as the valve seat (10), the seal ring (19) cooperating with a cone (9) and the seat ring (19) being mounted in the valve body (1) in a first machining (32) and a second machining (33) respectively, the second machining having a slightly larger diameter than the first machining (32), the seat ring cooperating with the cone (9) and the cone having a cylindrical portion (46), which is provided with two deep slits (49) and two other slits (50), which are smaller, these slits providing a regulation capability of the valve, when the cone changes from a closed to an open position, the cone being mounted on a spindle (8), which is moveable in an axial direction via preferably a hand wheel (7), the cone having a flange (39), the lower side of which sealingly cooperating with the valve seat (10) of the seat ring (19) in the closed position of the cone, the veil (12) in the valve body (1) limiting the maximum flow through the valve, when the cone (9) is in its upper position, since the veil is a screening wall, which surrounds the seat and the cone and can be turned in relation to a passage (13) in the valve body, the size of the free flow at the passage (13) varying with the chosen turning position of the veil, the variation of the flow being obtained, when the lower edge of the veil is staircase-shaped, which provides a successive increase of the flow, the flow being controlled via a pressure fall measurement at the measuring nipple (2) on the inlet side (5) and at the corresponding measuring nipple (2) from the outlet side (6) of the valve, **characterized in that** the seat ring (19) is a combined sealing element and valve seat, the sealing function being obtained with a sealing lip (22), which seals against an outer diameter (20) of the cone (9) as well as with a first sealing edge (40), which seals against a lower surface, a bottom (37) of the the machining (33) and with a second sealing edge (44), which seals against an outer diameter (31) of the machining (32) in the valve body (1), at the same time as the seat ring (19) in its upper portion, the one which cooperates with the cone (9), constitutes the valve seat (10).

2. A device according to claim 1, **characterized in that** the seat ring (19) is mounted in the valve body (1) and in the machining (32), which is its lower part has a machining (33) with a larger diameter than the machining (32), this machining (33) fastening an outer, lower part (34) of the seat ring (19), which lower part (34) snaps into the machining (33), the seat ring (19) in this way being
5 fastened in the valve body (1).

3. A device according to claim 1, **characterized in that** the seat ring (19) and its upper side form the valve seat (10), this valve seat being in the same plane as a plane (14), which has been machined in the knee (3) in the valve body (1).

4. A device according to claim 1, **characterized in that** the seat ring (19) in its upper part has a recess (45), which divides the upper surface of the seat ring into an outer zone, which constitutes the valve seat (10), and an inner part, which constitutes the sealing lip (22).

5. A device according to claim 1, **characterized in that** the seat ring (19) in its upper, inner part has a sealing lip (22), which extends from an inner diameter (36) of the seat ring and into or slightly further than to an outer diameter (20) of the cone (9) and that in this way a leakage between the inner part of the seat ring and the cone can be prevented.

6. A device according to claim 1, **characterized in that** the lower surface (43) of the seat ring (19) has a wave-shaped design together with the sealing edge (40), which after the mounting of the seat ring in the machining (33) is pressed against the bottom (37), which constitutes the lower part of the machining (33) in the valve body (1) and in this way an unintentional leakage from the inlet side (5) of the valve body to its outlet side (6) will be prevented.

7. A device according to claim 1, **characterized in that** the sealing edge (44), positioned on the outer diameter (31) of the seat ring (19) is pressed against the cooperating outer diameter of the machining (32) in the valve body (1) and that in this way the outer sealing against an unintentional leakage from the inlet side (5) of the valve body to the outlet side (6) will be improved.

8. A device according to claim 1, **characterized in that** the seat ring (19) and its sealing zones, the sealing lip (22) and the wave-shaped sealing edges (44) on the outer diameter (31) and (40) of the seat ring on the lower surface (43) of the seat ring are elastic and consequently they have an elasticity, which means, that the sealing function is maintained.

9. A device according to claim 1, **characterized in that** the cone (9) has a flange (39), the lower side of which has a few wave crests/wave valleys, namely a wave shape (42).

10. A device according to claims 1 and 9, **characterized in that** a wave crest (56) of the cone (9) and its flange (39), in connection with the situation, that the cone (9) reaches its lower closed, or substantially closed position, said wave crest (56) partially comes down into the recess (45) and consequentially compresses the sealing lip (22) towards the cone (9) and its outer diameter (20) and in this way improves the sealing between the sealing lip (22) and the cone (9).

11. A device according to claims 1 and 10, **characterized in that** the recess (45) on the upper surface of the seat ring gives the sealing lip (22) a flexibility, which means, that the improved sealing between the sealing lip (22) and the cone (9) is obtained, when the cone approaches its closed position, this being done already with small forces with small axial forces, from a hand wheel (7) or an electric adjustment device, via the spindle (8) to the cone (9).

12. A device according to claim 1, **characterized in that** the cone (9) has a cylindrical portion (46) with two pairs of slits, one pair with deep slits (49) and one pair with shallow slits (50) and in case these slits are arranged as a pair, positioned with a 180° displacement around the periphery and with a 90° displacement between the respective slit (49) and the slit (50), the slits (49) and (50) will extend from the lower edge of the cylindrical portion (46) upwards towards the flange (39).

13. A device according to claims 1 and 12, **characterized in that** the deep slits (49) extend from the lower edge of the cylindrical portion (46) all the way upwards to the level of the lower side of the flange (39), and in that the two flanges (52) are designed with a slight convex shape and a width of its base and a slit width (51) at its upper part respectively, which has been researched to give it a passage area, which in its turn gives a flow, which means, that the flow, in cooperation with the slits (50) preferably corresponds to a modified logarithmic function.

14. A device according to claims 1 and 12, **characterized in that** the shallow slits (50) extend from the lower edge of the cylindrical portion (46) and only a partial distance upwards towards the flange (39) and with a design, which is adjusted to start letting a flow pass, but only when the cone (9) comes close to an open position, the shallow slits (50) being designed with a flank (53), which only is slightly convex, and the flanks (53) meeting each other in a central point, positioned a slight

distance upwards from the cylindrical plane (46) and its lower part, and the slits (50) in cooperation with the slits (49) causing a modified logarithmic flow characteristic regardless of the opening degree of the cone.

- 5 15. A device according to claim 1, **characterized in that** the cone has two ears (47), positioned diametrically on the flange (39) and with a certain position in relation to the slits (49) and (50), a rotational indication of the cone in relation to a passage area (13) in the valve body (1) consequently being obtained, and in this way it is secured, that the slits (49) and (50) always will appear in the same position in relation to the passage opening (13), which results in, that the flow resistance
- 10 across the seat ring/ the cone always will be the same.