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(54) **Szabályozó golyóscsap**

The invention relates to a control ball valve in accordance with the introductory section of claim 1. The control ball valve thus has a valve housing which is provided with an inlet and at least one outlet. Arranged inside the valve housing is a valve ball which can be rotated perpendicularly to a flow direction and has least one valve channel and can be moved into an angular position between an open position, in which the inlet and the outlet are fluidically connected to each other, and a closed position, in which the inlet and the outlet are separated from one another. The open position and the closed position are generally 90° apart. Arranged adjacent to the valve ball is at least one regulating wheel. On an outer side of the regulating wheel facing away from the valve ball is at least one perforated disk.

Such control ball valves are used to regulate the flow of liquid or gaseous media, such as water, gas or hot steam. In doing so a control ball valve allows pressure and quantity regulation to be carried out. Via the regulating wheel and the perforated disk, which act as throttling points, multiplestage pressure reduction takes place.

In the open position the inlet and the outlet of the valve housing are fluidically connected to each other by the valve channel. Here the control ball valve makes a connection possible in which only small flow losses occur. Starting from the open position, after turning the valve ball about 90 degrees, the control ball valve is in the closed position, wherein the flow path between the inlet and outlet is tightly closed by the outer sides of the valve ball and the valve channel is at right angles to the flow direction. In the possible angular positions between the open position and the closed position a defined part of a control contour in the regulating wheel overlaps the valve channel. In this way a smaller or larger flow cross-section is cleared. The shape of the regulating contour in the regulating wheel determines a control characteristic of the control ball valve. The regulating wheel operates as a regulated throttle point, which with different throughflow quantities allow a defined reduction to take place.

In DE 197 28 562 C2 a control ball valve is described in which one regulating wheel is arranged before and one after the valve ball. These regulating wheels act as regulated throttle points wherein each regulating wheel forms a pressure reduction stage. Through the regulating wheel arranged on both sides of the valve ball two-stage pressure reduction is brought about.

Depending on the nature of the medium used, a certain pressure difference per stage must not be exceeded. In the case of water, for instance, a pressure reduction of 30 bars per stage, per regulating wheel, is possible. A greater pressure reduction results in increased wear and thus a limited service life of the control ball valve.

In the case of great pressure differences the problem of cavitation can occur, i.e. the formation of vapour bubbles through falling below a vapour pressure, through which extreme wear damage occurs as a result of the implosion of the vapour bubbles.

In the case of large pressure differences, particularly in the case of gaseous media, in increases noise emissions can occur. Due to statutory requirements, certain limits, for example of more than 85 dB(a), must not be exceeded.

For these reasons multistage pressure reduction normally takes place in a control ball valve, as in DE 19 728 562 C2, for example through a regulating wheel before and after the valve ball, through which the pressure is reduced regulated in two stages. Additionally, at a distance from the regulating wheel rigid perforate disks can be arranged which bring about further pressure reduction.

The problem with such rigid disks, however, is that the surface through which a medium can flow is independent on the throughflow quantity. This means that a pressure reduction achievable with a perforated disk decreases quadratically with a falling throughflow quantity. For example, through halving the throughflow quantity only a quarter of the achievable pressure reduction is produced. A perforated disk has to be matched to the maximum permissible throughflow quantity, wherein in the case of a smaller throughflow quantity hardly any pressure reduction is still possible at the perforated disk. The result of this is that at the regulated throttle point, i.e. at the regulating wheel, a greater pressure has to be reduced which can then be in the hypercritical range in which, for example, noise emissions or cavitation occur.

US 20100258193 discloses a control ball in accordance with the preamble of claim 1.

The aim of the invention is to eliminate the drawbacks of the prior art and to provide a control ball valve which makes multistage regulated pressure reduction possible and can be used over a large throughflow quantity range.

The principal features of the invention are set out in the characterising section of claim 1. Embodiments form the subject matter of claims 2 to 8.

In accordance with the invention it is thus envisaged not only to regulate the area of the regulating wheel through which a medium can flow, but also the area of the perforated disk through which a medium can flow. The area through which a medium can flow designates a total size of all the free openings of the regulating wheel/perforated disk. If the valve ball only allows a reduced throughflow, there is a reduction in area of the perforated disk through which a medium can flow, so that the required pressure reduction can be assured at the perforated disk. In the open position of the control ball valve the area of the regulating wheel and perforated disk through which a medium can flow is at a maximum and is reduced by turning the valve ball in the direction of the closed position. For this is, the regulating wheel has a generally concave inner side, facing the valve ball, the curvature of which matches the radius of the valve ball. In this way the valve ball only clears a defined portion of the area of the regulating wheel through which a medium can flow. A reduced overlap of the valve channel with the regulating wheel or regulating contour thus reduces the area of the regulating wheel through a medium can flow. The outer side of the regulating wheel can also be designed flat, and for example, extend at right angles to the direction of flow.

Arranged between the regulating wheel and the perforated disk are parallel chambers through which a medium can flow, wherein a number of chambers through which a medium can flow is dependent on the angular position of the valve ball. Access to the chamber through the regulating contour of the regulating wheel is then determined by the angular position of the valve ball. In a half-open position of the valve ball, for example, half of the valve channel overlaps with the regulating wheel so that the medium can flow through the thus open regulating contour and to the chambers formed on the other side of the regulating wheel, the inlets of which overlap the free regulating contour. Chambers with inlets overlapping the section of the regulating contour closed by the valve ball cannot admit a flow of medium. With further opening, the valve channel overlaps a larger area of the regulating contour of the regulating wheel and opens access to further chambers. The chamber guides the fluids to the perforated disk which covers the outlets of the chambers. The area of the perforated disk through which a medium can flow therefore increases with an increasing number of chambers through a medium can flow. Therefore the area of the perforated disk through a medium can flow is dependent on the angular position of the valve ball and a second throttle point for pressure reduction is obtained which is in the required ratio to the throughflow quantity.

In accordance with the invention an area of the perforated disk per chamber differs. Various characteristic curves of the control ball valve can thus be produced. In particular, it is possible to obtain a linear, progressive or degressive characteristic curve.

In another preferred form of embodiment the chambers are separated from each other by webs, which adjoin the regulating wheel and perforated disk in a fluid-tight manner and, in particular are bonded or formed in one piece with the regulating wheel or perforated disk. The chambers are therefore defined by the webs, the regulating wheel and the perforated disk. A force, for example a spring force, acting in one flow direction can act on the perforated disks so that the perforated disks are supported via the webs on the regulating wheel and a fluid-tight and play-free connection is obtained. The distance between the webs can be constant.

Preferably a distance between the webs is different, wherein the distance, particularly in a direction corresponding to the increasing opening angle of the valve ball, increases. In this way it is possible to produce, for example, a linear, progressive or degressive characteristic curve.

Preferably one end face of the web is round or pointed. The other end face of the webs is generally firmly attached to the perforated disk or regulating wheel or even formed in one piece with the perforated disk or the regulating wheel. Through a round or pointed embodiment of the end face of the webs a defined contact surface between the web and the regulating wheel or perforated disk is obtained, wherein recesses can be provided in the perforated disk or regulating wheel to ensure centring and further improved sealing.

In a preferred embodiment the webs are in parallel to the flow direction. The flow is thus only influenced by the webs to a very small degree and flow resistance can be kept low.

In an alternative embodiment the webs are at an angle of less than 90 degrees to the direction of low and thus produce turbulence and deflection of the direction of flow. In this way additional pressure reduction is achieved.

Preferably the webs are curved about an axis running parallel to the direction of flow. In particular, if the valve channel has a circular cross-section, a partially circular interface between the valve channel and the regulating wheel is produced. Through the curved design of the webs, the webs can be adapted to the shape of the regulating contour of the regulating wheel so that the medium always only flows through a defined number of chambers. This results in better regulating characteristics.

In a preferred embodiment, on a side of the perforated disk facing away from the regulating wheel, at least one further perforated disk is arranged, wherein there are webs arranged between the perforated disks between which chambers are formed. This produces a further pressure reduction step. The number of chambers through which a medium can flow is thus determined through the area of the perforated disk through which a a medium can flow facing the regulating wheel and is thus also dependent on the angular position of the valve ball. This throttle point is therefore also controlled and so is effective over a large throughflow quantity range.

It is particularly preferred if the area of the further perforated disk through which a medium can flow is larger, at the same angular position of the valve ball, than the area of the perforated disk, through which a medium can flow, which is adjacent to the regulating wheel. This can be realised, for example, in that the webs between the perforated disks are a greater distance from each other than the webs between the perforated disk and the regulating wheel. Such a design takes into consideration the increase in volume in the depressurisation of gaseous media. In this way noise emissions are reduced.

Further features, details and advantages of the invention are set out in the wording of the claims, as well as in the following description of examples of embodiment with the aid of the drawings. In these:

Fig. 1 shows a longitudinal section of control ball valve in accordance with the prior art,

Fig. 2 shows a cross-section of a control ball valve in accordance with the invention,

Fig. 3 shows a section from fig. 2,

Fig. 4 shows a further section from fig. 2,

Fig. 5 shows a further form of embodiment of the control ball vale in accordance with the invention.

Fig. 1 shows a control ball valve 1 known from the prior art. The control ball valve 1 comprises a valve casing 2 with an inlet 3 and an outlet 4, wherein the valve casing 2 is in three parts. In the flow path between inlet 3 and outlet 4 a valve ball 5 is arranged which is rotatably borne around an axis. The axis runs at right angles to a direction of flow.

For this the valve ball 5 is rotatably held in the casing 2 via a selector shaft 6.

For sealing the valve ball 5 spring-loaded seat rings 7, 8 are provided. In the direction of flow, behind the valve ball 5 a regulating wheel 9 is arranged, which has a level outer side 10 and a concave inner side 11. A curvature of the inner side 11 corresponds to a radius of the valve ball 5, so that the inner side 11 can rest against the surface of the valve ball 5.

The valve ball 5 has a vertical channel 12 which in this example of embodiment has a circular cross-section and diameter which is only slightly smaller than that of the inlet 3 and outlet 4. Thus, on complete opening of the control ball valve 1 only a small pressure loss occurs. Shown in fig. 1 is an angular position of the valve ball 5 corresponding to the closed position in which flow from the inlet to the outlet is blocked by the valve ball.

To reach the open position the valve ball 12 is turned via the selector shaft 6 by 90 degrees in relation to the shown position. The vertical channel 12 becomes flush with the flow path between the inlet 3 and outlet 4.

Depending on the angular position of the valve ball 5 the regulating wheel 9 is cleared to a greater or lesser extent in that the valve channel 12 overlaps the regulating wheel 9. This regulating wheel 9 has a regulating contour in the form of throughflow openings 13 via which a regulating characteristic curve of the control ball valve 1 is defined. By interchanging the regulating wheel 9 the regulating characteristics and regulating characteristic curve can be changed.

As the area through which a medium can flow of regulating wheel 9 or the regulating contour is directly dependent on the valve ball 5, the regulating wheel 9 forms a regulated throttle point. Irrespective of the throughflow quantity of the medium a defined pressure reduction can be achieved.

In figure 2 a further development in accordance with the invention of the control ball valve 1 is shown, wherein elements corresponding to each other are given the same reference numbers. In this example of embodiment on the each of the inlet side and outlet side a regulating wheel 9, 14 is assigned to valve ball 5. On the outer sides 10, 15 of each of the regulating wheels 9, 14 a perforated disk 16, 17 is arranged which is provided with holes 18, which form areas of the perforated disks through which a medium can flow. Webs 19, 20 are provided between the regulating wheels 9, 14 and the corresponding perforated disk 16, 17 which are supported via the perforated disks 16, 17 on the regulating wheels 9, 14. Between the webs 19, 20 fluid-tight chambers which are separated from each other are formed through which a medium can flow, depending on the position of the valve ball 5, from the regulating wheel 9,14 through the perforated disks 16,17. The number of chambers through which a medium can flow is dependent on the angular position of the valve ball 5, so that the area of the perforated disk 16, 17 through which a medium can flow is also dependent on the angular position of the valve ball 5.

Through the further development in accordance with the invention a four-stage regulated pressure reduction is produced. Not only is the area of the regulating wheels 9, 14 through which a medium can flow dependent on the angular position of the valve ball 5, but also the area of the perforated disks 16, 17 through which a medium can flow. Independently of the set throughflow quantity, effective pressure reduction via the perforated disks 16, 17 is possible.

In fig. 3 and 4 a detailed extract from fig. 2 is shown from two different viewpoints. The valve ball 5 is in a slightly opened position so that a medium, for example water or gas can pass through the valve channel 12. Here the valve ball 5 only clears a small part of the regulating contour of the regulating wheel 9, through the openings 13 through which the medium flows. In the angular position of the valve ball 5 shown in fig. 3 and 4 the medium can only reach one single chamber 21 formed between two webs 19 and thus only flow through a relatively small area of the perforated disk 17. The size of this area through which a medium can flow corresponds to the size of cross-section of the chamber 21.

On turning the valve ball 5 in the opening direction the regulating contour of the regulating wheel, through which a medium can flow, increases, so that the medium can reach further chambers. In this way the area of the perforated disk through which a medium can flow also increases.

In the embodiment according to fig. 5, on the side of the perforated disk 17 facing away from the regulating wheel 9 a further perforated disk 22 is arranged. The further perforated disk 22 is supported via webs 23 on the perforated disk 17, wherein chambers 24 are located between the webs 23. In the same way as in the first perforated disk 17 adjustment of the area of the perforated disk 22 through which a medium can flow takes place in dependence on the angular position of the valve ball 5. The chambers 24, formed between the perforated disks 17, 22 can have a larger cross-section than the chambers 21 between the perforated disk 17 and the regulating wheel 9 in order to even out the expansion behaviour, more particularly of gaseous media as a result of pressure reduction.

In the shown examples of embodiment, the webs 19, 20, 23 are formed in one piece with the perforated disk 16, 17, 22. The perforated disks 16, 17, 22 are supported on the webs 19, 20, 23. The webs extend in a semicircular manner from one edge of the perforated disk to the opposite edge, so that chambers separated from one another are formed. The webs are curved in order to match the geometry of the area of the regulating wheel cleared by the valve ball.

Through the design in accordance with the invention multistage pressure reduction can be brought about in the control ball valve, wherein even in the case of partial loading multistage regulated pressure reduction takes place. This is achieved in that an area of the perforated disk through which a medium can flow is dependent on the angular position of the valve ball. For this, the number of channels forming, for example, a flow path between the regulator wheel and the perforated disk, is dependent on the angular position of the valve ball. In this way the control ball valve can be used to regulate fluid and gaseous media, through which, on the basis of the multistage pressure reduction cavitation can be avoided and wear kept to a minimum, while at the same time noise emissions are kept within small limits. The valve ball 15 is brought into the required angular position with which the throughflow quantity of the flowing medium is adjusted. The medium then flows through the regulating contour of the regulating wheels so that they overlap the valve channel, and through a corresponding number of chambers the perforated disks, wherein through the webs a flow through the entire area of the perforated disks is prevented as long as the valve ball is not completely in the open position. In the case of incomplete opening of the control ball valve the area of the perforated disk through which a medium can flow is reduced. The required throughflow quantity can therefore be restricted in relation to the load situation to be regulated and at the same time additional pressure reduction can take place in the openings/throttle points of the downstream perforated disk(s). These can be dimensioned in accordance with the known state of the art. On the inlet side and also the outlet side any number of perforated disks can be used so that the number of throttle points and thus the multistage nature of the pressure reduction is unlimited. Even in the case of partial loading, i.e. a reduced throughflow quantity, adequate pressure reduction is assured in the downstream perforated disks.

The invention is not restricted to the above-described embodiments, but can be modified in many ways.

All features and advantages evident from the claims, the description and the drawings, including design details, spatial arrangement and process stages can be essential to the invention in themselves and in the most varied of combinations.

List of references

1	Control ball valve
2	Valve housing
3	Inlet
4	Outlet
5	Valve ball
6	Selector shaft
7	Seat ring
8	Seat ring
9	Regulating wheel
10	Outer side
11	Inner side
12	Valve channel
13	Through opening
14	Regulating wheel
15	Outer side
16	Perforated disk

17	Perforated disk
18	Holes
19	Webs
20	Webs
21	Chamber
22	Perforated disk
23	Webs
24	Chamber

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SZABADALMI IGÉNYPONTOK

SZABÁLYOZÓ GOLYÓSCSAP

1. Szabályozó golyóscsap (1) egy szelepházzal (2) amelynek egy bemenete (3) és egy kimenete (4), valamint egy áramlás irányára merőlegesen elforgatható szelepgolyóval (5) legalább egy szelepcsatornája (12) van, és egy, a bemenetet (3) és a kimenetet (4) összekötő nyitott állás és egy a bemenetet (3) és a kimenetet (4) egymástól elválasztó zárt állás közötti kívánt szögállásokba mozgatható, ahol legalább egy szabályozó korong (9, 14) szomszédos a szelepgolyóval (5) és egy a szabályozó korong (9, 14) szelepgolyóval (5) átellenes külső oldala (10) egy perforált koronghoz (16, 17, 22) van elrendezve, ahol a perforált korong (16, 17, 22) átáramló keresztmetszete a szelepgolyó (5) szögállásától függ, ahol a szabályozó korong (9, 14) és a perforált korong (16, 17) párhuzamos átáramlást biztosító kamrákat (21) alkotnak, ahol az átáramlást biztosító kamrák (21) száma a szelepgolyó (5) szögállásától függ, azzal jellemezve, hogy a perforált korong (16, 17, 22) átáramló keresztmetszete minden kamra (21) esetén különböző.

2. Az 1. igénypont szerinti szabályozó golyóscsap, azzal jellemezve, hogy a kamrák (21) bordákkal (19, 20) vannak egymástól elválasztva, amelyek folyadékot tömítő módon a szabályozó korongon (9, 14) és a perforált korongon (16, 17) helyezkednek el és a szabályozó koronggal (9, 14) vagy a perforált koronggal (16, 17) egy darabként vannak kialakítva.

3. A 2. igénypont szerinti szabályozó golyóscsap, azzal jellemezve, hogy a bordák (19, 20) közötti távolságok különbözőek.

4. A 2. vagy a 3. igénypont szerinti szabályozó golyóscsap, azzal jellemezve, hogy a bordák (19, 20) legalább egyik első oldala lekerekítve vagy elvékonyodóan van kialakítva.

5. A 2-4. igénypontok egyike szerinti szabályozó golyóscsap, azzal jellemezve, hogy bordák (19, 20) az áramlási iránnyal 90°-nál kisebb szögben vagy párhuzamosan futnak.

6. A 2-5. igénypontok egyike szerinti szabályozó golyóscsap, azzal jellemezve, hogy a bordák (19, 20) egy, az áramlási iránnyal párhuzamos tengelyre nézve ívelten helyezkednek el.

7. Az előző igénypontok egyike szerinti szabályozó golyóscsap, azzal jellemezve, hogy a perforált korong (16, 17) szabályozó koronggal (9, 14) határos oldalán legalább egy további perforált korong (22) van elrendezve, ahol a perforált korongok (7, 22) között bordák (23) vannak elrendezve, amelyek között kamrák (24) vannak kialakítva.

8. A 7. igénypont szerinti szabályozó golyóscsap, azzal jellemezve, hogy a golyószelep (5) azonos szögállása esetén a további perforált korong (22) átáramló keresztmetszete nagyobb, mint a szabályozó koronggal (9, 14) szomszédos perforált *korong (16, 17) átáramló keresztmetszete.*

A meghatalmazott:

SBGK Szabadalmi Ügyvivői Iroda

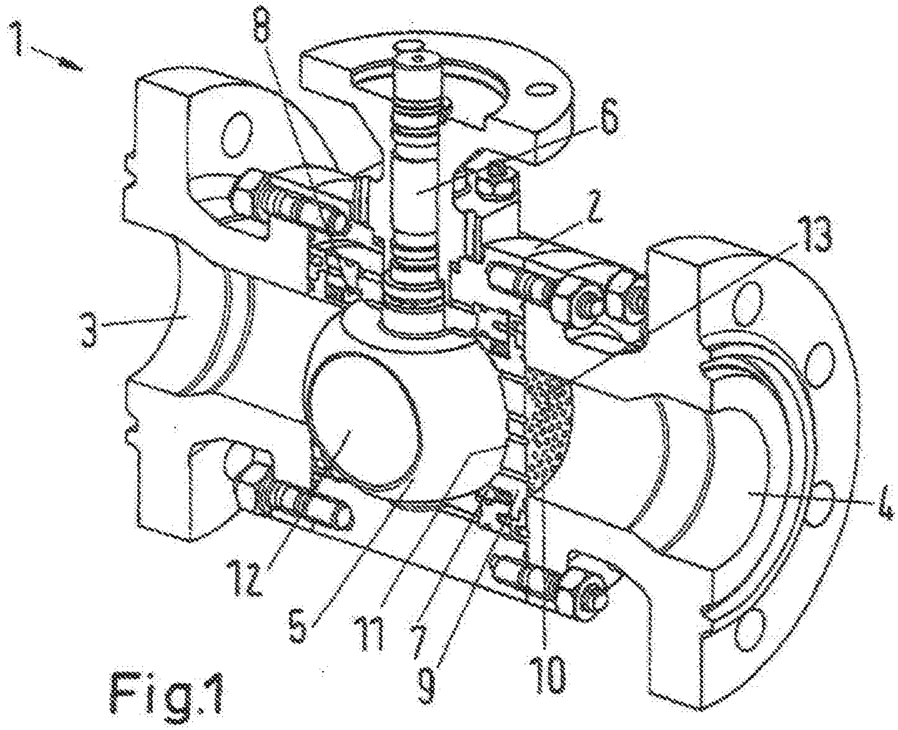

Fig.1

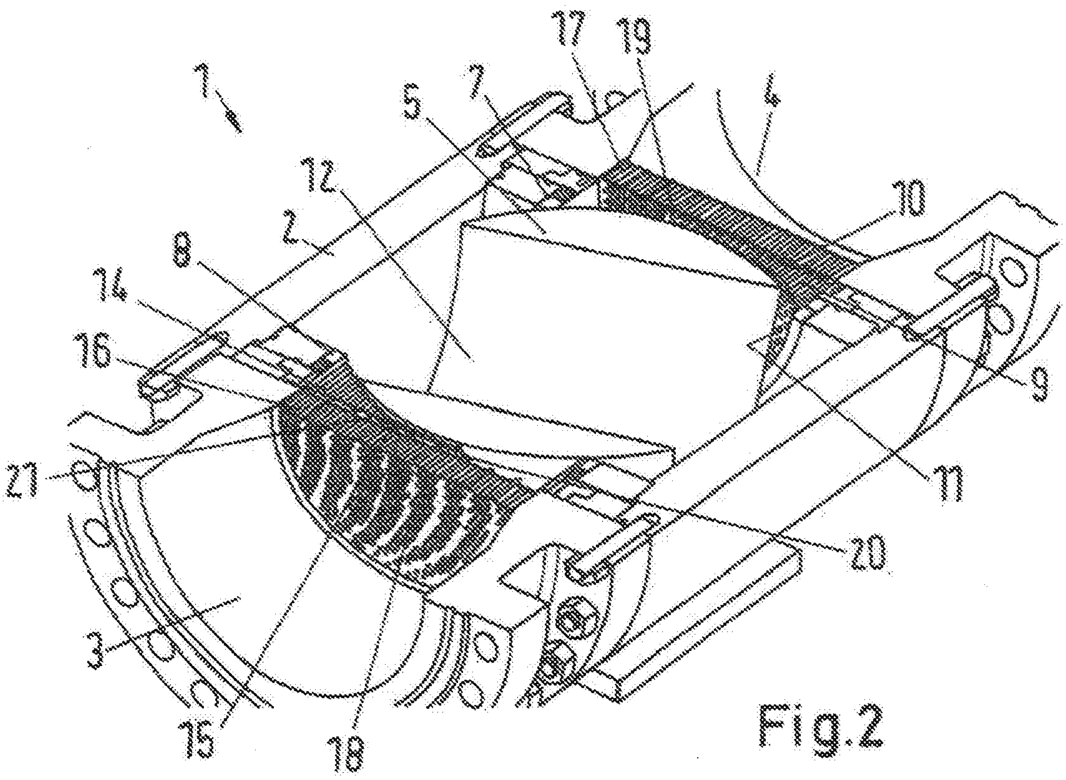

Fig.2

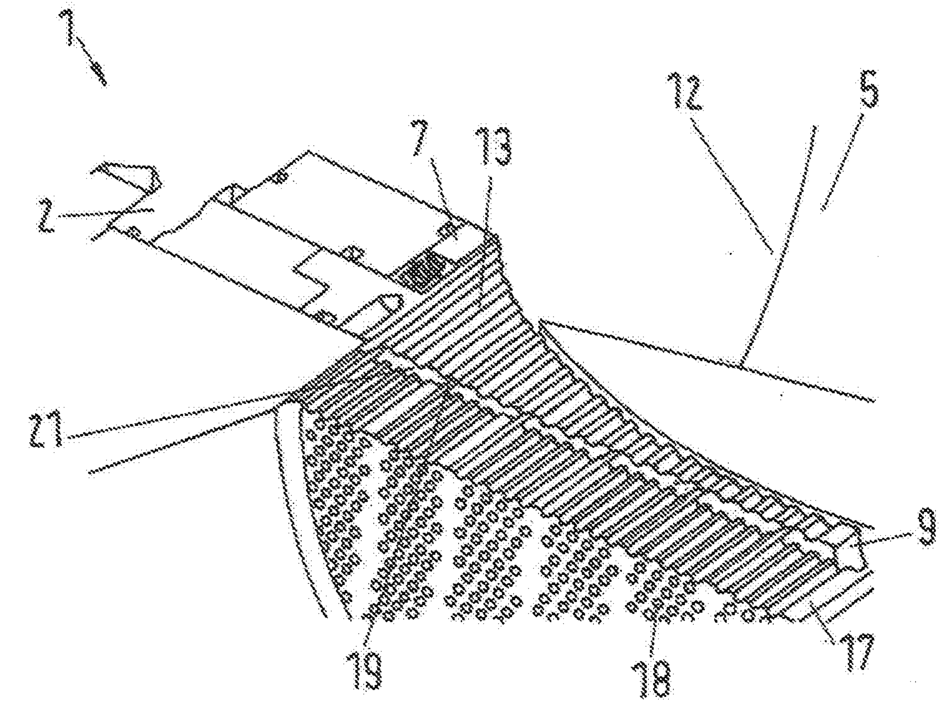

Fig.3

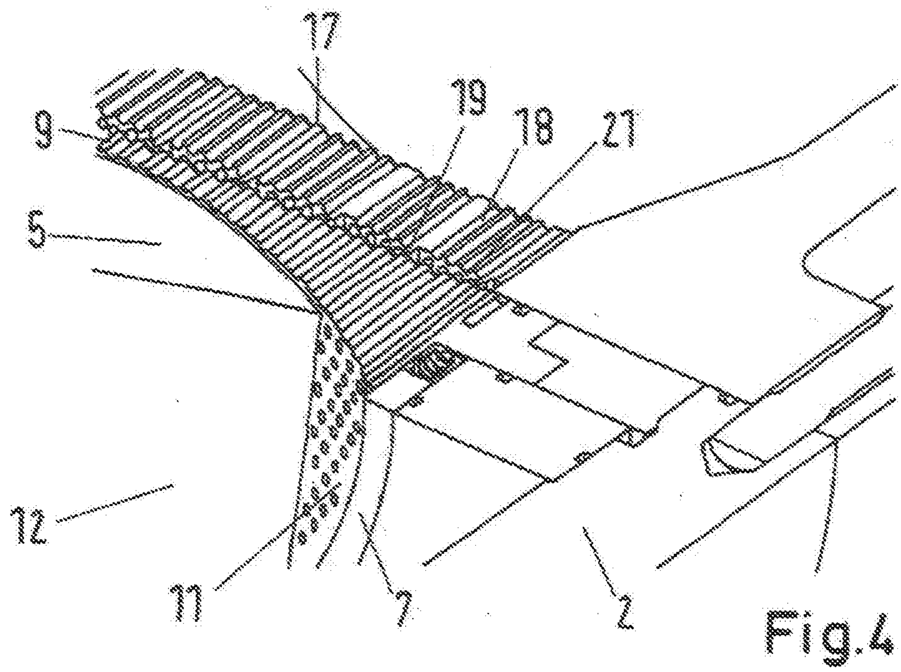

Fig.4

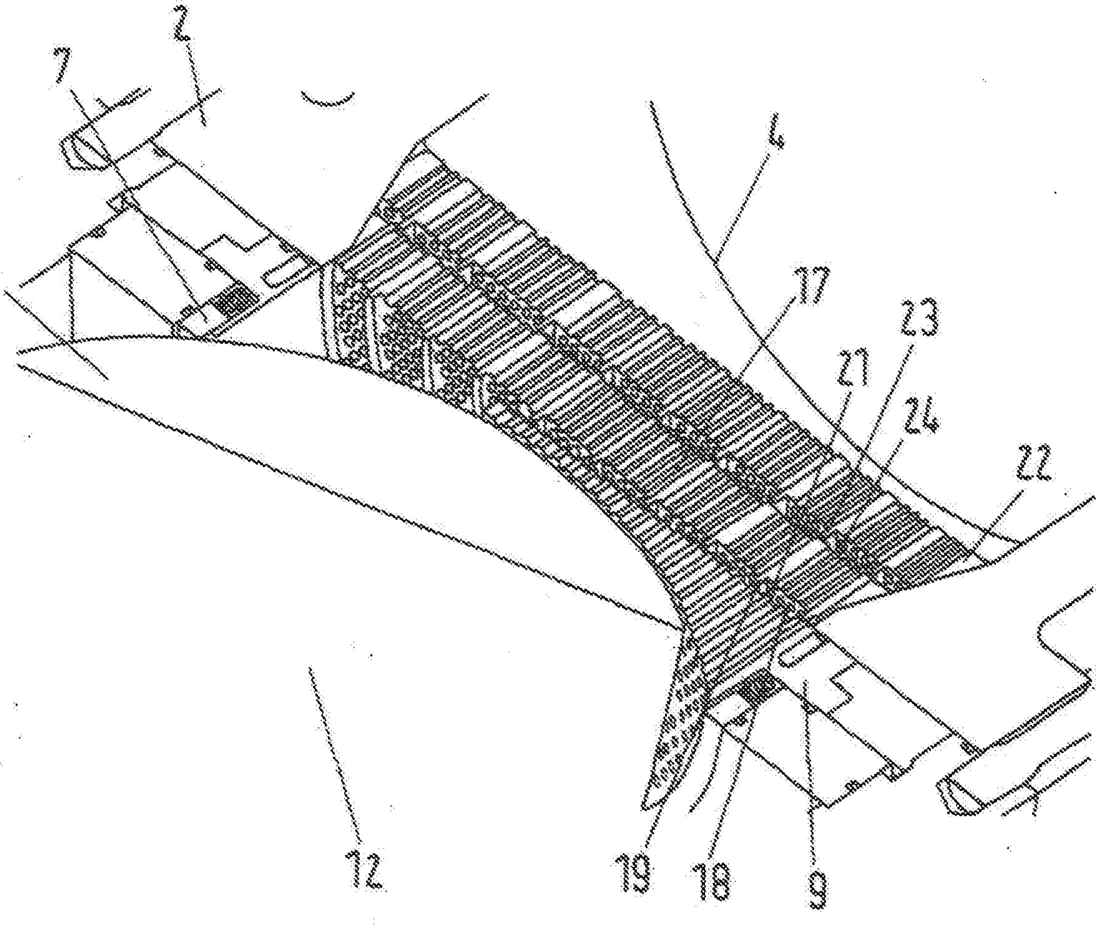

Fig.5