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(54) **Homogenization valve with rotatable intermediate seat element**

(57) Homogenization valve for homogenizing a fluid, comprising a fluid inlet (7) for supplying the fluid under pressure, a fluid outlet (8) for discharging homogenized fluid, a first seat element (2), and at least one intermediate seat element (5), which seat elements together leave clear a feed-through channel that is situated around an axis (12) of the homogenization valve and connects to the fluid inlet (7) or fluid outlet (8), and a valve element (3) that is positioned opposite the intermediate seat element (5), in which at least during operation homogenization passage gaps (10) are present

between wall surfaces of opposite seat elements (25), and between wall surfaces of the valve element (3) and the intermediate seat element (5) situated opposite it, which passage gaps (10) are in fluid communication with the fluid inlet (7), on the one hand, and the fluid outlet (8), on the other hand.

At least one intermediate seat element (5) is rotatably mounted in such a way that during operation a fluid flow causes the intermediate seat element (5) to rotate relative to the valve element (3) and the first seat element (2) respectively.

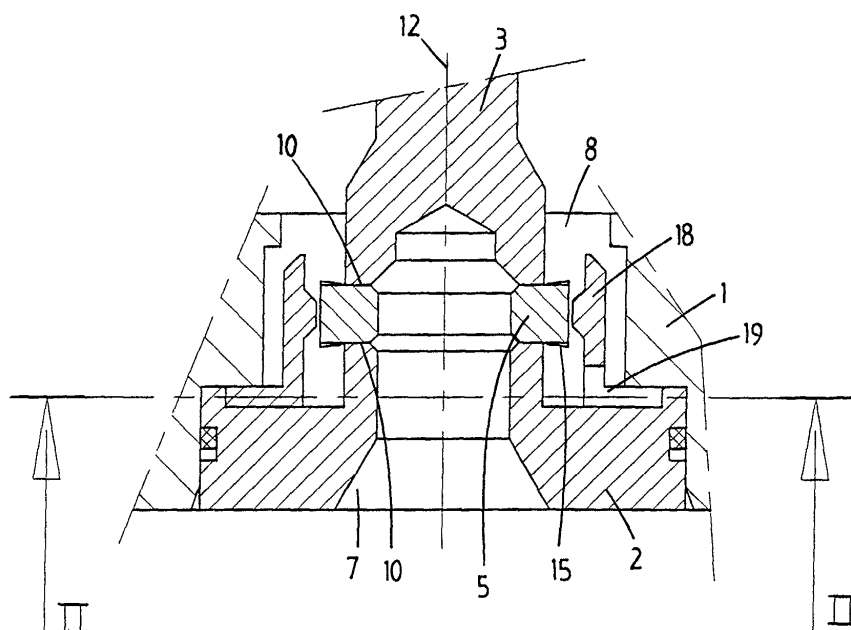


Fig. 1

Description

[0001] The invention relates to a homogenization valve for the homogenization of a fluid.

[0002] Such a homogenization valve is known, for example from WO 98/40156. The homogenization valve disclosed in this publication comprises a housing in which a treatment area is provided, in which area several annular seat elements, stacked on top of one another, have been placed. The seat elements comprise central holes that together form an internal chamber, which is connected to a fluid inlet. Passage gaps that are in fluid communication with the internal chamber are left clear between the wall surface parts of opposite seat elements situated furthest inwards. Each passage gap opens into an annular groove that is cut into a central part of the wall surfaces of the opposite seat elements. The annular grooves of all seat elements together are in communication with each other by means of ports in the groove walls, and are in fluid communication with a fluid outlet. Homogenization of the fluid occurs substantially in the passage gaps, through which the fluid is passed at high speed.

[0003] A disadvantage in the case of the known homogenization valve with several seat elements is that the latter have the tendency to chatter relative to each other. This considerably shortens the service life of the seat elements. The quality of homogenization also suffers from the chattering. From time to time the large fluid particles can pass undisturbed through the passage gaps. For this purpose, it is necessary to provide means that minimize the chattering and also keep the seat elements in line with each other. In the case of WO 98/40156 these means are formed by corrugated spring strips, which are accommodated in annular grooves that are cut into outermost parts of the wall surfaces of the opposite seat elements. This makes the known homogenization valve expensive to manufacture. Furthermore, it has been found in practice that a relatively large number of seat elements is necessary to obtain a sufficiently high production of homogenized fluid.

[0004] A homogenization valve according to the preamble of claim 1 is known from DE-C-227 225. This document discloses a homogenization device having multiple lenses grinded on each other. Two different types of lenses can be distinguished, namely inner and outer lenses, which are mounted one after the other in an alternating arrangement in an cutout of a mouthpiece. The inner lenses are mounted on a spindle. The spindle can be rotated by means of a separate turbine-like device and can thereby cause the inner lenses to rotate as well. The turbine-like device can be rotated by the fluid which is to be homogenized.

[0005] A drawback thereof is that the operation is unsatisfactory. Providing a separate turbine-like device as well as a drive spindle renders the homogenization device expensive and complex. Furthermore a drawback is that the lenses are not free to assume their optimal

position during operation of the device or to rotate at their own optimum speed. A constant gap height between the lenses is thus often not present.

[0006] The object of the present invention is to overcome the abovementioned disadvantages at least partially or provide a useful alternative, and in particular to provide an efficiently operating homogenization valve with a long service life, and by means of which a very high degree of homogenization can be achieved.

[0007] This object is achieved according to the invention by a homogenization valve according to claim 1. The homogenization valve in this case comprises a first seat element, a valve element, and at least one intermediate seat element situated between them. The seat elements together bound a feed-through channel that connects to a fluid inlet or fluid outlet. The seat elements and the valve element have the freedom relative to each other during operation, as a result of fluid pressure, to produce homogenization passage gaps between the opposite elements. The passage gaps are in fluid communication with the fluid inlet, on the one hand, and with the fluid outlet, on the other hand. The at least one intermediate seat element is rotatably mounted, in other words it has the freedom to rotate about its axis relative to the elements situated below and above it. In addition drive wall parts are provided on the rotatable intermediate seat element, which at least partly extend under such an angle with respect to the direction of the flow of the passing fluid that a fluid flow that during operation flows along the drive wall parts of the rotatably mounted intermediate seat element sets said intermediate seat element in the abovementioned rotating motion.

[0008] The rotation of the intermediate seat element advantageously ensures stabilization of said intermediate seat element relative to the elements situated below and above it. Chattering is consequently prevented in an efficient manner. Any unevenness in the wall surfaces of the elements that bound the passage gaps is automatically evened out as a result of the rotation. This produces passage gaps with substantially constant gap heights, viewed over the entire periphery. The substantially constant gap height ensures a considerable increase in the quality of the homogenization. In addition, the rotation of the seat element itself contributes to an improvement of the homogenization treatment. Rotational forces are exerted upon the fluid flowing through the passage gap and ensure that the fluid is better homogenized. This makes it possible to use a smaller housing to obtain a certain production capacity, or to achieve a higher production capacity.

[0009] In a preferred embodiment, the rotation of the intermediate seat element is achieved by providing the rotatably mounted intermediate seat element with drive vanes, each provided with at least one drive wall part directed at an angle relative to the direction of flow of the fluid flowing along. Depending on the direction of slant, the fluid flowing along will cause the intermediate seat element to rotate to the left or to the right. In addition

to this, or in replacement of it, means can also be provided for making the fluid flow in a whirling manner along the rotatably mounted intermediate seat element. An example is spiral-shaped grooves in housing walls of the homogenization valve. The whirling of the fluid flow will exert forces upon the rotatably mounted intermediate seat element and cause the latter to rotate.

[0010] The drive wall parts are in particular provided on an outer peripheral wall of the rotatably mounted intermediate seat element. This has the advantage that it does not impede the ingoing fluid flow and consequently does not adversely affect the homogenization treatment. In a variant, or in addition to this, the drive wall parts can be provided on one or both wall surfaces of the rotatably mounted intermediate seat element bounding the passage gaps. In another variant, or in addition to this, the drive wall parts can be provided on an inner peripheral wall of the rotatably mounted intermediate seat element.

[0011] In particular, at least two rotatably mounted intermediate seat elements are provided, in which case the fluid flow during operation makes the intermediate seat elements rotate in opposite directions. This can be achieved by making the drive wall parts on the one intermediate seat element slant towards the one side relative to the direction of flow of the fluid and making the drive wall parts on the other intermediate seat element slant towards the other side relative to the direction of flow of the fluid. The opposed directions of rotation help to achieve a further improvement of the homogenization treatment and a further increase in the production capacity. It is also possible here to make the seat elements have the same or different speeds of revolution relative to each other, for example by varying the number, the slanting position and/or the positioning of the drive wall parts.

[0012] Further preferred embodiments are set out in the subclaims.

[0013] The invention also relates to a method for operating a homogenization valve according to claim 9.

[0014] The invention will be explained in greater detail with reference to the appended drawing, in which:

Fig. 1 is a diagrammatic view in cross section of an embodiment of a homogenization valve according to the invention;

Fig. 2 is a view along the line II-II in Fig. 1;

Fig. 3 is a top view of the intermediate seat element in Fig. 1;

Fig. 4 is a diagrammatic partial view, corresponding to Fig. 1, of a variant;

Fig. 5 is a view along the line V-V in Fig. 4;

Fig. 6 shows a preferred embodiment of an intermediate seat element; and

Figs. 7 and 8 show diagrammatic views in cross section of homogenization valves with self-centring rotatably mounted intermediate seat elements.

[0015] In Fig. 1 a housing of the homogenization valve is indicated by the reference numeral 1. A first seat element 2 and a valve element 3 are accommodated in the housing 1. An intermediate seat element 5 is situated between the first seat element 2 and the valve element 3. The first seat element 2 and the intermediate seat element 5 together bound a centrally situated feed-through channel 7, which is connected to a fluid inlet. The valve element 3 is provided with a stepped conical recess with a maximum diameter that is substantially equal to the minimum diameter of the feed-through channel 7. Around the elements 2, 3, 5 a space 8 is left clear in the housing 1, which space is connected to a fluid outlet. Sufficient space is left clear between the first seat element 2 and the valve element 3 to accommodate the intermediate seat element 5 between them with so much play that during operation, as a result of fluid pressure, homogenization passage gaps 10 are produced both at the top and at the bottom side of the intermediate seat element 5. In a variant, the valve element 3 is pressed in the direction of the intermediate seat element 5 under a low spring tension that is such that during operation, as a result of fluid pressure, homogenization passage gaps 10 are produced both at the top and at the bottom side of the intermediate seat element 5.

[0016] On the inside each passage gap 10 is in fluid connection with the fluid inlet by way of the feed-through channel 7, and on the outside is in fluid connection with the fluid outlet by way of the chamber 8.

[0017] According to the invention, the intermediate seat element 5 is rotatably mounted, in other words it has the freedom, without significant forces having to be exerted upon it, to rotate about an axis 12 relative to the first seat element 2 and relative to the valve element 3. The freedom to rotate in the case of the embodiment shown is related to the freedom to produce passage gaps 10 at the top and bottom side as a result of fluid pressure. The intermediate seat element 5 is ultimately, as it were, in a suspended floating position, balancing between fluid flows at the top and bottom side between the first seat element 2 and the valve element 3.

[0018] The intermediate seat element 5 is provided with drive vanes 15. The drive vanes 15 are provided both on the bottom and on the top wall surface of the intermediate seat element 5. As can be seen in Fig. 2, each of the drive vanes 15 is provided with an upright drive wall surface that is disposed at an angle relative to the radial. Said slanting drive wall surfaces ensure that a fluid flowing out of the passage gaps 10 at high speed during operation pushes the vanes 15 aside and makes the intermediate seat element 5 rotate relative to the first seat element 2 and the valve element 3.

[0019] The intermediate seat element 5 is preferably designed with a diameter that is greater than that of the first seat element 2 and the valve element 3. The drive vanes 15 are provided here on the outermost wall surface parts of the intermediate seat element 5 that extend past the passage gaps 10. This has the advantage that

the homogenization process in the passage gaps 10 is subject to little or no influence from the play of forces occurring between the outgoing fluid flow and the drive vanes 15.

[0020] The intermediate seat element 5 is bounded laterally by an outer ring 18, a small space being left free between the ring 18 and the intermediate seat element 5. This gives the intermediate seat element 5 to some extent the freedom while already rotating to seek its optimum position between the elements 2, 3 situated above and below it, in other words the position at which the top and bottom passage gaps 10, viewed over the entire periphery, have substantially an equal gap height. A sort of fluid bearing can also occur between the outer ring 18 and the intermediate seat element 5.

[0021] Three holes 19 are provided in the outer ring 18, which holes open into a space behind the outer ring 18. Fluid emerging from the bottom passage gap 10 does not flow directly upwards, but passes through the holes 19 into the space behind the outer ring 18, and flows from there upwards into the chamber 8 in the direction of the fluid outlet.

[0022] In the case of the variant in Fig. 4, the homogenization valve comprises a housing 41 containing a first seat element 42, a valve element 43, and an intermediate seat element 45 situated between them. The first seat element 42 is provided with a number of feed-through channels 47, which are situated around a central axis of the homogenization valve and are in communication with a fluid inlet. In addition, a chamber 48, surrounding the elements 42, 43, 45 is provided in the housing, which chamber 48 is connected to a fluid outlet 49. During operation, homogenization passage gaps 50 can be produced between the elements 42, 43, 45. The first seat element 42 comprises an integral upward-projecting shaft part 51, around which the intermediate seat element 45 is freely rotatably mounted. The intermediate seat element 45 is provided with six feed-through channel apertures 53. In addition, a collision plate 55 is provided around the intermediate seat element 45, which collision plate 55 reinforces the homogenization effect during operation by the fact that fluid flowing out of the passage gaps 50 collides with said plate. The collision plate 55 also ensures that the fluid coming out of the bottom passage gap 50 flows in the direction of the fluid outlet 49.

[0023] The intermediate seat element 45 is provided with drive vanes 58 on its outside peripheral edge. Said drive vanes 58 are mounted at an angle relative to the vertical. The fluid flowing out of the bottom passage gap 50 is then forced to pass the drive vanes 58. The forces occurring in the process cause the intermediate seat element 45 to rotate about the shaft pin 51.

[0024] Fig. 6 shows a variant of an embodiment of an intermediate seat element 60, which can be used, for example, in the homogenization valve in Fig. 4. As can be seen, the intermediate seat element 60 is again provided on its outside with drive vanes 61. The innermost

part of the intermediate seat element 60 is, however, left fully clear in this case. This element 60 is designed to function without bearing around a central bearing pin, and to centre itself during operation.

[0025] A self-centring of an intermediate seat element of a homogenization valve according to the invention will now be explained with reference to Fig. 7. The homogenization valve comprises a first seat element 70, an intermediate seat element 71 and a valve element 72 whose inside peripheral edges are chamfered at the position of homogenization passage gaps 73 situated between them. The chamfers together ensure that during operation, in other words under the influence of fluid pressure, and in particular under the influence of fluid that is forced through the passage gaps, a centring in the horizontal plane of the rotatably mounted intermediate seat element 71 is promoted. Should, for example, the intermediate seat element 71 slip to the left, then the inflow resistance of the fluid in the parts of the passage gaps 73 situated on the right will become considerably greater than that in the parts situated on the left, and will consequently push the intermediate seat element 71 back to the right. It is also so that should, for example, the intermediate seat element 71 come to rest too far down, then the inflow resistance in the bottom passage gap 73 would become greater than that in the top passage gap 73, and would consequently push the intermediate seat element 71 back up again. In this way, the intermediate seat element 71 is fully centred automatically without an additional bearing being necessary. As a result of this, the element is given the optimum freedom to rotate under the influence of fluid flowing along. For this purpose, in the case of the variant shown in Fig. 7 drive vanes 74 are provided on the inside peripheral wall of the element.

[0026] Fig. 8 shows a variant of self-centring with a first seat element 80, an intermediate seat element 81, and a valve element 82, in which the opposite wall surfaces of the elements 80, 81 and 82 are mounted at an angle relative to the horizontal. This produces bottom passage gaps running at an angle upwards and top passage gaps 83 running at an angle downwards. This slanting arrangement of the passage gaps 83 also promotes self-centring of the intermediate seat element 81. Should the intermediate seat element 81, for example, slip to the left, then the gap height of the passage gaps 83 would immediately become smaller on this left side, while the gap height of the passage gaps 83 would immediately become larger on the right side. This will cause the flow resistance of the fluid through the left part of the passage gaps 83 to become greater than that on the right side, which in turn results in the intermediate seat element 81 being pushed to the right.

[0027] Many variants are possible in addition to the embodiment shown. Therefore, several intermediate seat elements stacked on top of one another, for example, can be used. It is also possible to provide combinations of drive vanes on the inner peripheral wall, the wall

surfaces and/or the outer peripheral wall. Apart from fluid bearing, other types of bearings are also conceivable. Moreover, the homogenization valve can be driven in such a way that the fluid flow is pumped in the radial direction from the outside to the inside through the homogenization passage gaps. The fluid inlet and fluid outlet shown in the figures are then, as it were, swapped round. It is also possible to provide parts of the housing bounding the fluid flow with means for setting the fluid flow in a whirlpool motion. This makes it possible to dispose the drive vanes at less of an angle relative to the direction of flow of the fluid flowing past. The valve element can be vertically adjustable, so that the heights of the passage gaps can be varied. Instead of the drive vanes shown here, the drive wall parts can also form part of cavities or grooves that are provided in the rotatable intermediate seat element.

[0028] In this way, according to the invention a very efficiently working homogenization valve with one or more intermediate seat elements, rotating in opposite directions or in the same direction, is provided. The homogenization valve advantageously combines a high homogenization production capacity with very good quality of homogenization. Thanks to the automatic self-centring of the freely rotatably mounted intermediate seat elements, there is no longer any question of noise nuisance as a result of chattering of the intermediate seat elements. Wear is consequently considerably reduced, as a result of which an advantageous extension of the service life is achieved.

Claims

1. Homogenization valve for homogenizing a fluid, comprising:
 - a fluid inlet (7) for supplying the fluid under pressure;
 - a fluid outlet (8) for discharging homogenized fluid;
 - a first seat element (2) and at least one intermediate seat element (5), which seat elements together leave clear a feed-through channel that is situated around an axis (12) of the homogenization valve and connects to the fluid inlet (7) or fluid outlet (8);
 - a valve element (3) that is positioned opposite the intermediate seat element (5);

in which at least during operation homogenization passage gaps (10) are present between wall surfaces of opposite seat elements (5), and between wall surfaces of the valve element (3) and the intermediate seat element (5) opposite it, which passage gaps (10) are in fluid communication with the fluid inlet (7), on the one hand, and the fluid outlet (8), on the other hand, and

in which at least one intermediate seat element (5) is rotatably mounted, **characterized in that** the rotatable intermediate seat element (5) is provided with drive wall parts (15) that are at least partially positioned at an angle relative to the direction of flow of the fluid flowing along, in such a way that during operation a fluid flow by engaging on said drive wall parts (15) causes the intermediate seat element (5) to rotate relative to the valve element (3) and the first seat element (2) respectively.

2. Homogenization valve according to claim 1, in which the drive wall parts (15) form part of drive vanes with project from at least one of the outer walls of the intermediate seat element (15) along which the fluid flows.
3. Homogenization valve according to claim 1 or 2, in which the drive wall parts (58) are provided on an outer peripheral wall of the intermediate seat element (45).
4. Homogenization valve according to one of the claim 1 - 3, in which the drive wall parts (15) are provided on at least one of the two wall surfaces of the intermediate seat element (5) bounding the passage gaps (10).
5. Homogenization valve according to one of the preceding claims, in which the drive wall parts (74) are provided on an inner peripheral wall of the rotatable intermediate seat element (71).
6. Homogenization valve according to one of the preceding claims, in which at least two intermediate seat elements are rotatably mounted and are both provided with drive wall parts that are positioned relative to the direction of flow of the fluid flowing along at an angle that is such that during operation a fluid flow causes the intermediate seat elements to rotate in opposite directions to each other.
7. Homogenization valve according to one of the preceding claims, in which the intermediate seat element (5) has a cylindrical outer peripheral wall that by means of fluid bearing, in particular coming from fluid flowing along, is supported relative to a housing part (18) surrounding the intermediate seat element (5).
8. Homogenization valve according to one of the preceding claims, in which means are provided for self-centring of the intermediate seat element (5) relative to the elements (23) situated above and below it, which means, being positioned at an angle relative to the axis (12), comprise the wall surface parts bounding the passage gaps (10).

9. Method for operating a homogenization valve according to one of the preceding claims, comprising the steps:

- supplying a fluid under high pressure; 5
- feeding the fluid at high speed through the homogenization passage gaps (10);
- in the course of doing so, setting one or more rotatable intermediate seat elements (5) in rotation; and 10
- discharging homogenized fluid.

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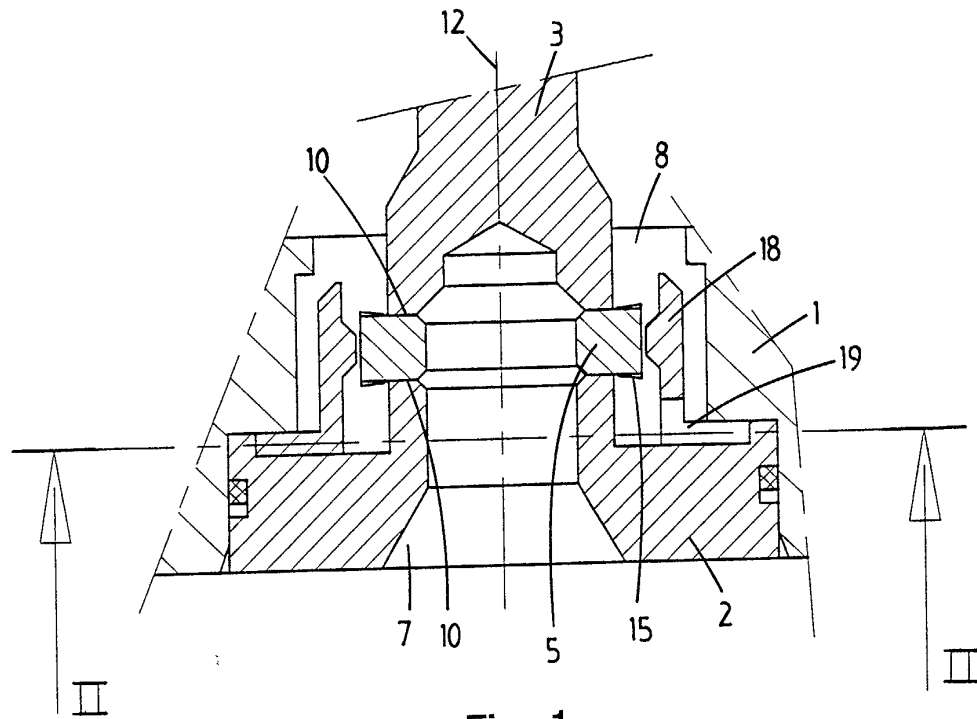


Fig. 1

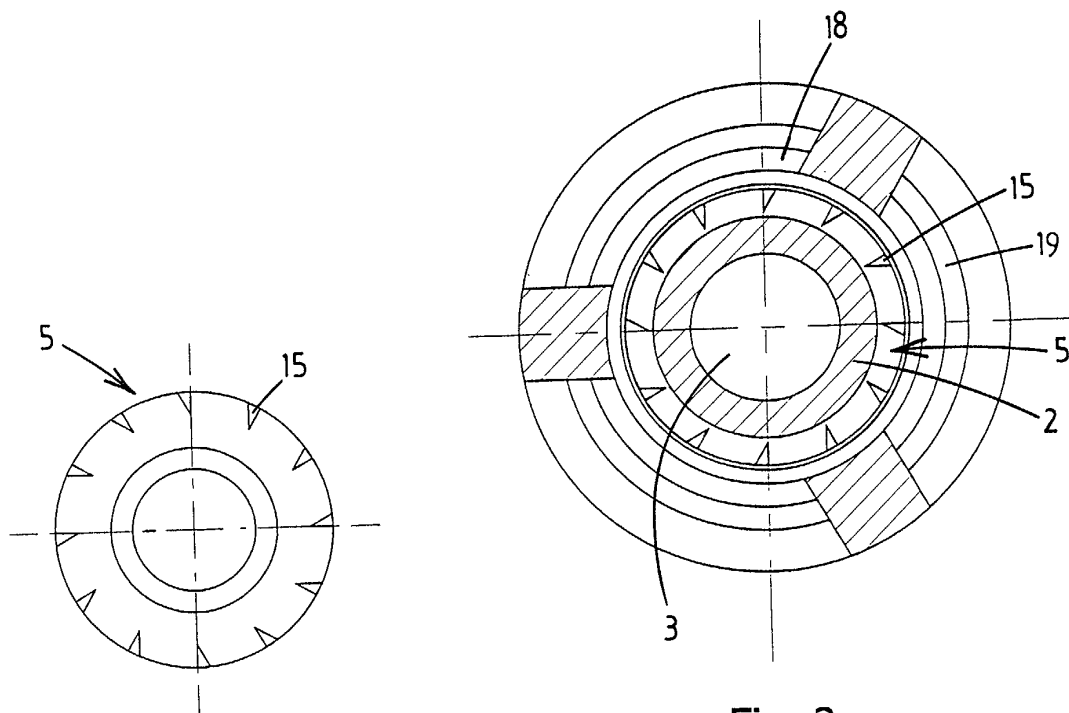


Fig. 2

Fig. 3

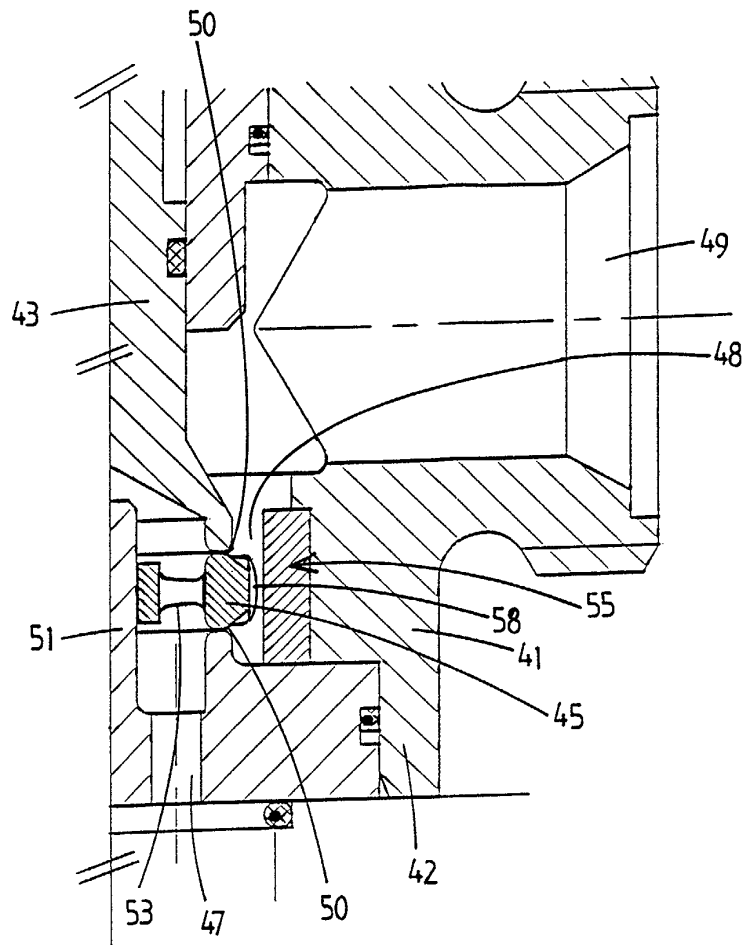


Fig. 4

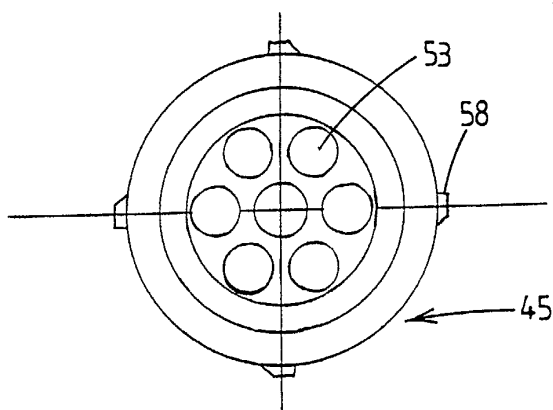


Fig. 5

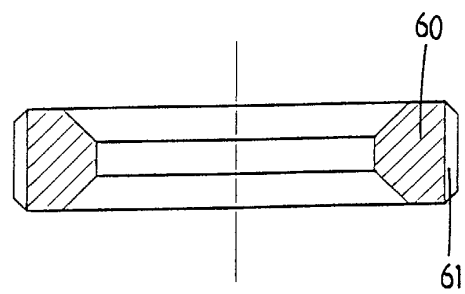


Fig. 6

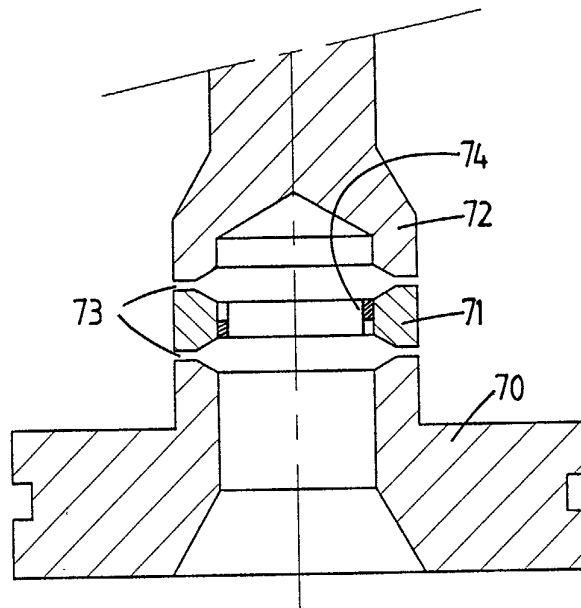


Fig. 7

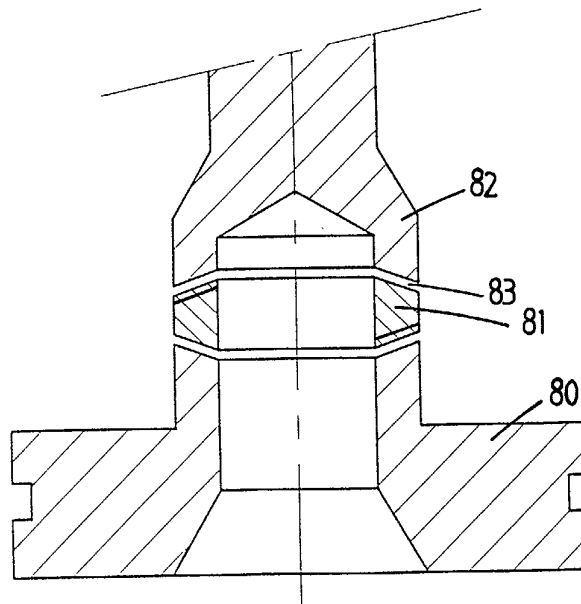


Fig. 8



European Patent
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EUROPEAN SEARCH REPORT

Application Number
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Place of search		Date of completion of the search	Examiner
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 02 07 7806

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