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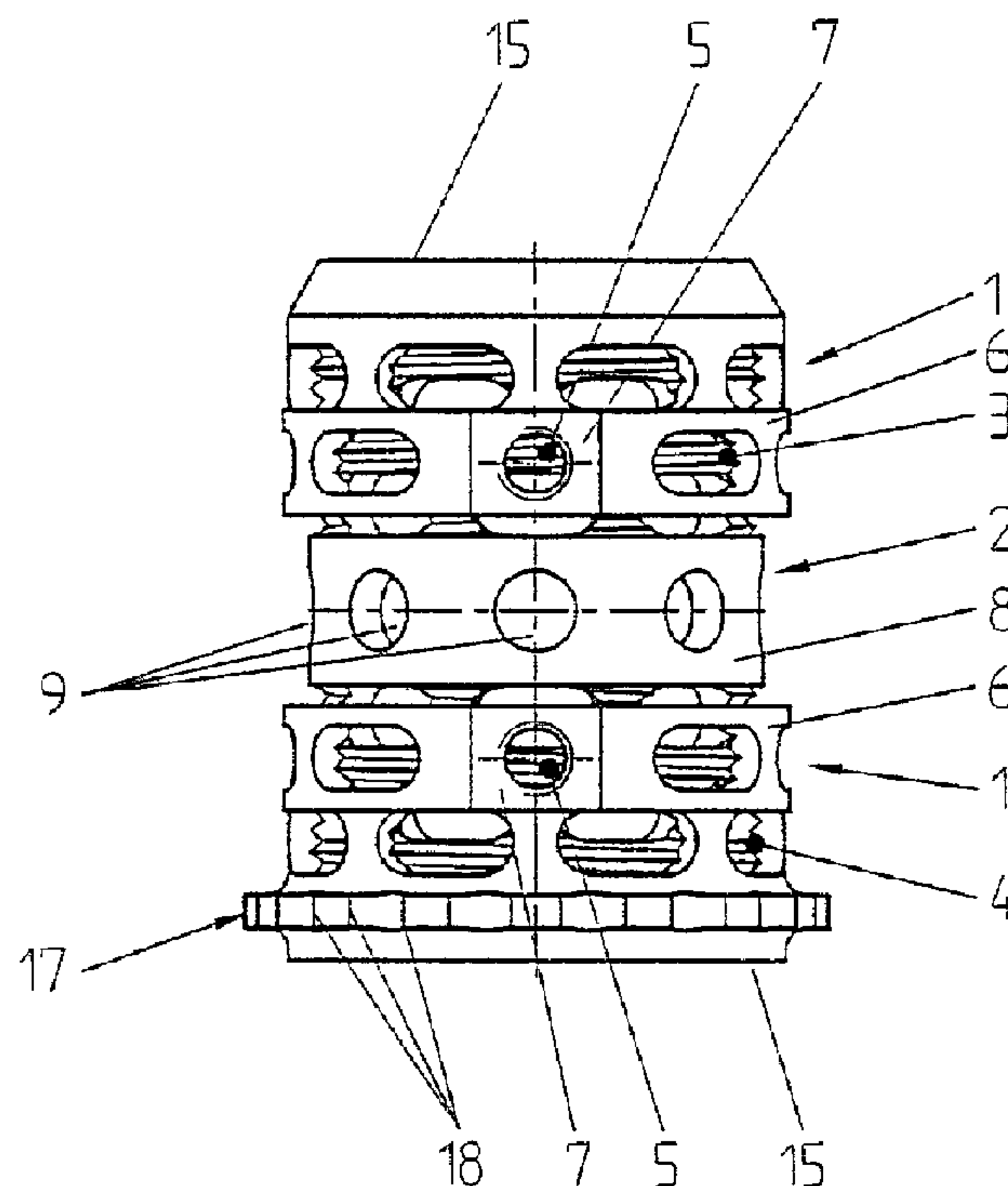
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(54) Titre : IMPLANT PERMETTANT DE MAINTENIR UN ESPACEMENT APPROPRIÉ ENTRE LES VERTEBRES DE LA COLONNE RACHIDIENNE

(54) Title: IMPLANT DEVICE FOR MAINTAINING PROPER SPACING BETWEEN VERTEBRAE OF THE SPINAL COLUMN



(57) Abrégé/Abstract:

The implant device consists of two end elements for anchoring to the abutting vertebrae and an intervening middle element, having a longitudinal axis, and which is connected to the end elements by means of two screwthreads, whereby the two screwthreads are arranged coaxially in the longitudinal direction and run in opposite directions to each other, so that when the middle element is rotated, the overall length of the implant device can be adjusted. All three elements of the device are designed in the shape of tubular casings with a circular cross-section, at least in the area of their screwthreads, and are threaded into each other along their axis. The walls of the casings are perforated with orifices.

Abstract:

The implant device consists of two end elements for anchoring to the abutting vertebrae and an intervening middle element, having a longitudinal axis, and which is connected to the end elements by means of two screwthreads, whereby the two screwthreads are arranged coaxially in the longitudinal direction and run in opposite directions to each other, so that when the middle element is rotated, the overall length of the implant device can be adjusted. All three elements of the device are designed in the shape of tubular casings with a circular cross-section, at least in the area of their screwthreads, and are threaded into each other along their axis. The walls of the casings are perforated with orifices.

Implant device for maintaining proper spacing between vertebrae of the spinal column.

The invention relates to an implant device for insertion between vertebrae of the spinal column to maintain proper spacing after removal of all or part of a vertebra, consisting of two end elements for anchoring to the abutting vertebrae and an intervening middle element, which is connected to the end elements by means of two screwthreads, whereby the two screwthreads are arranged parallel to the axis of the spinal column and run in opposite directions to each other, so that when the middle element is rotated, the overall length of the implant device can be adjusted.

Implant devices of this kind are known from US-PS 4 657 550, which allow the region of the spinal column containing the implant to be distended, by rotating the middle element. With the known implant, both end elements are arranged in two parts, whereby each consists of a pressure plate that is anchored to the abutting vertebra with prongs, and a threaded bolt that is inserted into the base and secured against rotation by means of a polygonally shaped head or tenon that fits into a receptacle or mortice in the base. The middle element of the implant is bored with threaded openings to receive the threaded bolts. This known implant has the disadvantage that after insertion of the implant, bone formation and regeneration is less than satisfactory. From DE 34 35 771 A1, an implant is known that avoids this disadvantage, through the provision of a number of orifices, but such an implant is not suitable to take the place of a vertebra or part thereof.

In EP 0 268 B1, a spacer to replace a vertebra is described that is designed as a sleeve-like element with openings in its sides, whereby the upper and lower rims of the sleeve are at least partially serrated, in order to create a connection between the vertebrae that is free from any risk of rotation. The element is singly or doubly wrapped with a perforated metal casing. As desired, the sleeve can be filled through these openings with material such as bone cement or bone fragments, in order to

promote faster binding of the implant. Such an implant however has the disadvantage that it does not allow any distension of the neighbouring vertebrae.

The purpose of the present invention is to create an implant as cited at the outset that is especially suited to inducing and stimulating bone formation, and thus will bond easily and quickly after implantation.

This goal is achieved in accordance with the invention by means of an implantable device, with the characteristics stated at the outset, whereby all three elements of the device are designed as tubular casings with, at least in the area of the screwthreads, a circular cross-section, and are threaded to each other along their common axis, and the walls of the casings are perforated with orifices.

More specifically, the present invention provides implant device for insertion between vertebrae of the spinal column to maintain proper spacing after removal of all or part of a vertebra, consisting of two end elements for anchoring to abutting vertebrae and an intervening middle element, having a longitudinal axis and which is connected to the end elements by means of two screwthreads, whereby the two screwthreads are arranged coaxially in the longitudinal direction and have mutually opposite screwthread directions, so that the overall length of the implant device is adjustable by rotation of the middle element, characterized in that all three elements of the device are shaped as tubular casings having, at least in the area of their screwthreads, a circular cross-section, and having a plurality of orifices, wherein the end elements of the device overlap an outer side of the middle element in the direction of the longitudinal axis, whereby the screwthreads are arranged as outer threadings on the middle element and as inner threadings in the end elements.

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The three-casing design of the implant of the invention allows for a hollow inner space running through the implant that is open to all areas of the outer surfaces of the casings through these orifices. Together with the possibility of filling the inner space with bone cement or bone shavings from the patient or another person, this allows the implant to become quickly and securely bonded. At the same time, it is still possible to distend the implanted device during the operation.

A preferred embodiment of the device of the invention is characterized in that the end elements of the implant overlap the exterior of the middle element along its axis, whereby the screwthreads are arranged on the outer surface of the middle element and on the inner surfaces of the end elements. This arrangement means that the screwthreads are substantially covered from the outside by the end elements of the device. In order to secure the several elements, once inserted, against contrary rotation, at least one of the end elements is provided with a radially bored, threaded opening in the area of the screwthreads, through which a setscrew can be inserted and tightened against

the middle element, which setscrew, when tightened, will hold both elements in fixed position. For immobilizing the casing walls in the area of the setscrew, it is recommended that the element containing the setscrew be provided with a locking ring on the axially inner rim of its casing, that has a greater wall thickness than the rest of the casing, and that the threaded opening for the setscrew be arranged in this locking ring. To ensure that the threaded hole is sufficiently long to accommodate the setscrew, it is best to have the ring seal provided with a radially outwards projecting extension, in the area of the threaded hole.

Preferably, the middle element of the implant has between its two screwthreads a thread-free portion, in which the orifices are evenly distributed over the surface of the casing and are designed as keyholes, so that a key can be inserted through them in order to rotate the middle element of the device.

With respect to the design and arrangement of the orifices elsewhere than in the thread-free portion of the middle element's casing, the invention allows a certain freedom of choice. On the one hand, the open area represented by the orifices should be as large as possible, on the other hand the orifices must not weaken the screwthread area in such a way as to jeopardize the stability of the threaded connection between the various elements of the device. An embodiment of the invention that satisfies all these demands especially advantageously, and is therefore the recommended embodiment of the invention, is characterized in that the orifices in the various elements are arranged in the screwthread areas, and are in the shape of slots, with their longer dimension lying in direction of the casing circumference. It is expedient to arrange the orifices so that their greater diameter is perpendicular to the axis of the casing. Typically, each screwthread area is provided with more than one row of orifices. In such cases, where there are several rows of orifices within the same screwthread area, it is expedient if the orifices of each row are circumferentially offset with respect to those in the

neighbouring row. When the orifices are offset in this way, it is preferable if the centres of each orifice in one row are in line with the mid-points between consecutive orifices in the next row. It is further recommended that the lengthwise dimension of each orifice should be greater than, and specifically more than twice as long as, the distance between its edges and those of the next orifices in the same row, and that the axial distance between the edges of the neighbouring rows of orifices should be smaller than, specifically about half as great as, the smaller diameter of each orifice. Such an arrangement of the orifices ensures that the screwthread area between neighbouring orifices is sufficiently large and continuous for the proper transfer of weight between the elements of the device.

Generally, the transfer of force between the implant and the abutting vertebra occurs solely through the rims of the casings of the end elements. However, should the specific force demands placed on the vertebra become too great, it is possible to widen the rim of the casing, or even to cover it with a transverse plate, which should then be perforated with as many orifices as possible. In addition, for anchoring the device to the vertebra, the rim of the casing runs essentially in one plane, that can be either perpendicular to, or at an incline to, the axis of the casing, depending on the specific requirements. It is also possible, of course, to have a casing rim that is not in a single plane.

The invention also allows the end elements of the device to be protected from undesirable shifting against the abutting vertebra, by providing one or more bevelled cutting edges or points on the axially terminal rim of at least one of the end elements so that it will penetrate into the vertebra. There are several possible ways of doing this. The cutting edge can be continuous all the way around the circumference of the rim, or it can be interrupted with gaps. The cutting edges can also be arranged radially as the tips of projections located consecutively around the circumference of the rim. The points can

also be formed from prongs arranged around the rim, and axially aligned. To prevent the cutting edges or points from penetrating too deeply into the abutting vertebra, it is recommended that the implant portion be equipped with a ring-shaped bridge or washer projecting either outwards or inwards from the casing, to limit the penetration depth of the cutting edges or points by acting as a stop against the vertebra. The radially outward surface of this washer can be provided with convex recesses facing generally outward radially, to anchor the implant device more securely.

The invention is further explained in the following illustrations of sample embodiments, which show:

Fig. 1 an implant according to the invention, from a side view;

Fig. 2 the middle portion of the implant as in Figure 1, from a side view;

Fig. 3 cross-section III-III as in Figure 2;

Fig. 4 a side view of an end element of the implant, in an embodiment that has a greater diameter than the device in Figure 1;

Fig. 5 cross section V-V in Figure 4;

Fig. 6 another embodiment of an end element of the device according to Figure 4;

Fig. 7 cross section VII - VII in Figure 6;

Fig. 8 cross-section VIII - VIII in Figure 6;

Fig. 9 cross section IX - IX in Figure 6;

Fig. 10 yet another embodiment of an end element of a device according to the invention in a representation corresponding to Figure 4 or 6;

Fig. 11 cross section XI - XI in Fig 10, and

Fig. 12 cross section XII - XII in Figure 11.

The implant shown in the illustrations is intended to be inserted as a spacer between vertebrae (not shown in the drawings) of the spinal column to replace a vertebra or part thereof that has been removed. The implant consists of two end elements 1 that are to

be anchored to the abutting vertebrae, and a middle element 2 located between these two end elements. The middle element is connected to each of the end elements by means of screwthreads 3, 4, so that both threadings are arranged parallel to the axis of the spinal column, and run in opposite directions to each other, as can be seen in Figure 2. This means that when the middle element 2 is rotated relative to the two end elements 1, the length of the implant is altered and thus, more specifically, the region of the spinal column where the implant is inserted can be distended.

The end elements of the implant 1 overlap the middle element 2 externally along its axis, whereby the screwthreads 3, 4 are designed as external threadings on the middle element 2 and as internal threadings in the end elements 1. Both end elements 1 of the implant also possess, in the threaded area, a radially bored, threaded opening 5, through which a setscrew is inserted for tightening against the middle element. (For the sake of clarity, this setscrew is not shown in the illustration.) By tightening these setscrews against the middle element 2, the elements 1, 2 can be secured against contrary rotation. In addition, the end elements 1 can be equipped, on the axially inner rim of their casings, with a locking ring 6, the body of which is thicker than the rest of the casing. In this case, the threaded opening 5 for the setscrew is located in this locking ring, which stabilizes the end element against the forces involved in tightening the setscrew. The locking ring 6 can also be provided with a radially outwards projecting extension 7, in the region of the threaded opening 5, so that the threaded opening 5 has sufficient length to accommodate the setscrew.

The middle element 2 has a thread-free casing surface area 8, between its two screwthreads 3, 4. This thread-free portion is perforated with orifices 9, distributed at regular intervals around the circumference, which allow a key (not shown) to be inserted for rotating the middle element 2. In the sample embodiment shown, these keyholes take the form of cylindrical

holes, so that the key, in an especially simple embodiment, can consist of a simple insertable cylindrical rod.

All other orifices 10 in the three elements 1, 2 are located in the area of their screwthreads 3, 4 and are designed as elongated
5 holes or slots, with their greater diameter 11 running circumferentially around the casing. The orifices 10 are arranged so that their greater diameter 11 runs perpendicular to the axis of the casing. In the sample embodiment according to Figures 1 and 2, two such rows of orifices are provided in each of the
10 screwthread areas 3, 4; while in the example shown in Figures 4 to 12, there are at least three rows of orifices. The orifices 10 of one row are offset in the circumferential direction with respect to those of the neighbouring row, with the orifices arranged so that the centre points of each orifice in one row is
15 axially in line with the mid-point between the centres of each orifice in the neighbouring row or rows. The lengthwise diameter 11 of the orifices 10 is more than twice as great as the distance 12 separating the edges of successive orifices in each row. The distance 13 along the axis separating the edges of the orifices
20 in neighbouring rows is approximately one half the value of the smaller diameter of the orifices 14.

In the sample embodiment shown in Figures 1, 4 and 10, the axially terminal rim 15 of the end element 1, which is intended to anchor against the abutting vertebra, is shaped so that its
25 plane lies perpendicular to the axis of the casing. In the example shown in Figure 6, on the other hand, this rim 15 lies at an incline to the axis of the casing; the angle of inclination in the example shown is 10° . This axially terminal rim 15 can be provided with a cutting edge, as in the examples shown in Figures
30 1, 10 and 12, or, as in Figures 4 and 6, it can have a series of consecutive projections 16 arranged around its circumference. The purpose of these cutting edges or projections is to secure the end elements 1 so that when they are anchored to the abutting vertebra they will not shift or move; the depth to which these
35 cutting edges or projections can be inserted into the abutting

vertebra is variable. Furthermore, the projections 16 can themselves be equipped with cutting edges, arranged either in the direction of the circumference or crosswise to it, to facilitate the penetration of the projections into the abutting vertebra.

5 The depth of penetration can be limited, as shown in the example in Figure 1, by providing a radially outward-projecting washer ring 17 on the lower end element that will strike against the abutting vertebra. The outer edge of the washer ring 17 is provided with outward-projecting, axially aligned ridges 18 that

10 form a series of convex recesses.

Claims:

1. Implant device for insertion between vertebrae of the spinal column to maintain proper spacing after removal of all or part of a vertebra, consisting of two end elements for anchoring to abutting vertebrae and an intervening middle element, having a longitudinal axis and which is connected to the end elements by means of two screwthreads, whereby the two screwthreads are arranged coaxially in the longitudinal direction and have mutually opposite screwthread directions, so that the overall length of the implant device is adjustable by rotation of the middle element, characterized in that all three elements of the device are shaped as tubular casings having, at least in the area of their screwthreads, a circular cross-section, and having a plurality of orifices, wherein the end elements of the device overlap an outer side of the middle element in the direction of the longitudinal axis, whereby the screwthreads are arranged as outer threadings on the middle element and as inner threadings in the end elements.
2. Implant device in accordance with Claim 1, characterized in that at least one of the end elements has a radially bored threaded opening in the area of the screwthreads, through which a setscrew is inserted that can be tightened against the middle element.
3. Implant device in accordance with Claim 2, characterized in that the element containing the setscrew has a locking ring on an axially inner edge of its casing, said ring having thicker walls than a wall of the rest of the casing, and the threaded opening for the setscrew is located in the locking ring.
4. Implant device in accordance with Claim 3, characterized in that the locking ring has a radially outward projecting extension in the area of the threaded opening.

5. Implant device in accordance with any one of Claims 1 to 4, characterized in that a portion of the middle element lying between the two screwthreads is an unthreaded casing, in which orifices are provided, which orifices are distributed regularly around the circumference of the casing and provide access for a key to be inserted for rotating the middle element of the device.

6. Implant device in accordance with any one of Claims 1 to 5, characterized in that the orifices in the end elements are located in the area of the screwthreads, and the orifices are designed as elongated holes, having a smaller diameter, and having a greater diameter lying in the direction of the circumference.

7. Implant device in accordance with Claim 6, characterized in that the orifices are arranged in at least one row whereby their greater diameters lie in a plane that is perpendicular to the axis of the casing.

8. Implant device in accordance with Claim 7, characterized in that, where there is more than one row of orifices in the same area of the screwthreads, the orifices of one row are offset with respect to those of the neighbouring row, in the direction of the circumference.

9. Implant device in accordance with Claim 8, characterized in that the orifices of any row are offset with respect to those of the next row in such a way that their centres are aligned with the mid-point between two orifices of the neighbouring row.

10. Implant device in accordance with any one of Claims 7 to 9, characterized in that the greater diameters of the orifices are longer than spaces between consecutive orifices in a single row.

11. Implant device in accordance with any one of Claims 7 to 10, characterized in that the axial distance between edges of the

orifices in neighbouring rows is smaller than the length of the smaller diameter of the orifices.

12. Implant device in accordance with any one of Claims 1 to 11, characterized in that an axially terminal rim of at least one of the end elements of the device lies in a plane that is at an incline with respect to the axis of the casing.

13. Implant device in accordance with any one of Claims 1 to 12, characterized in that the axially terminal rim of at least one of the end elements of the device is arranged with at least one cutting edge for penetrating into the abutting vertebra.

14. Implant device in accordance with Claim 13, characterized in that the cutting edge is continuous in the direction of the circumference of the rim.

15. Implant device in accordance with Claim 13, wherein the cutting edge is interrupted with gaps.

16. Implant device in accordance with Claim 13, characterized in that the cutting edges are designed as the ends of a series of consecutive projections around the rim.

17. Implant device in accordance with Claim 13, characterized in that the points are designed as axially oriented prongs arranged around the rim.

18. Implant device in accordance with any one of Claims 13 to 17, characterized in that a radially inward projecting washer ring is provided on the end element of the device, to control the depth of penetration of the cutting edges.

19. Implant device in accordance with any one of Claims 13 to 17, wherein a radially outward projecting washer ring is provided on the end element of the device, to control the depth of penetration of the cutting edges.

20. Implant device in accordance with Claim 10, wherein the greater diameters of the orifices are more than twice as long as the spaces between consecutive orifices in a single row.

5 21. Implant device in accordance with Claim 11, wherein the axial distance between edges of the orifices in neighbouring rows is half the length of the smaller diameter of the orifices.

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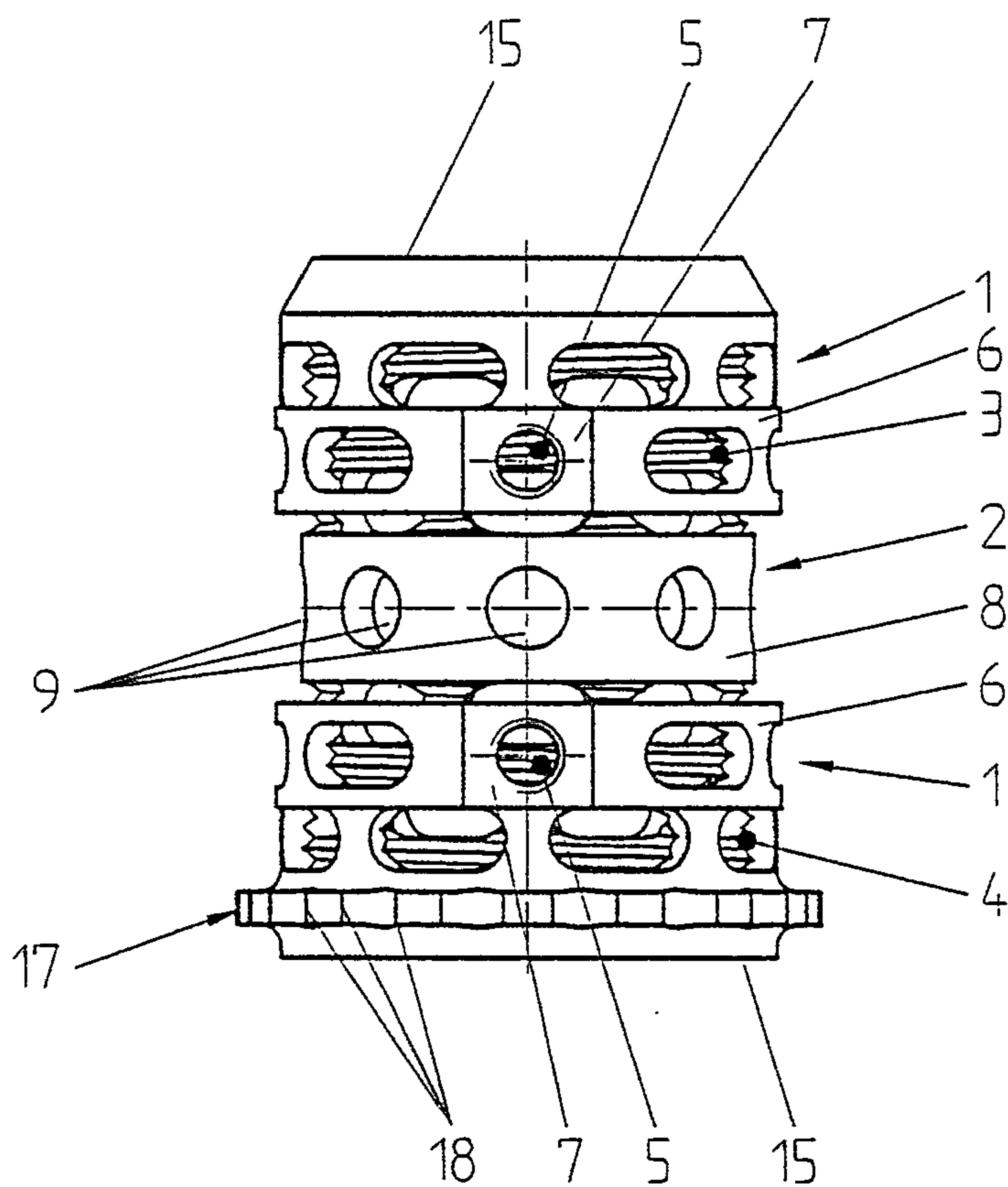


fig. 1

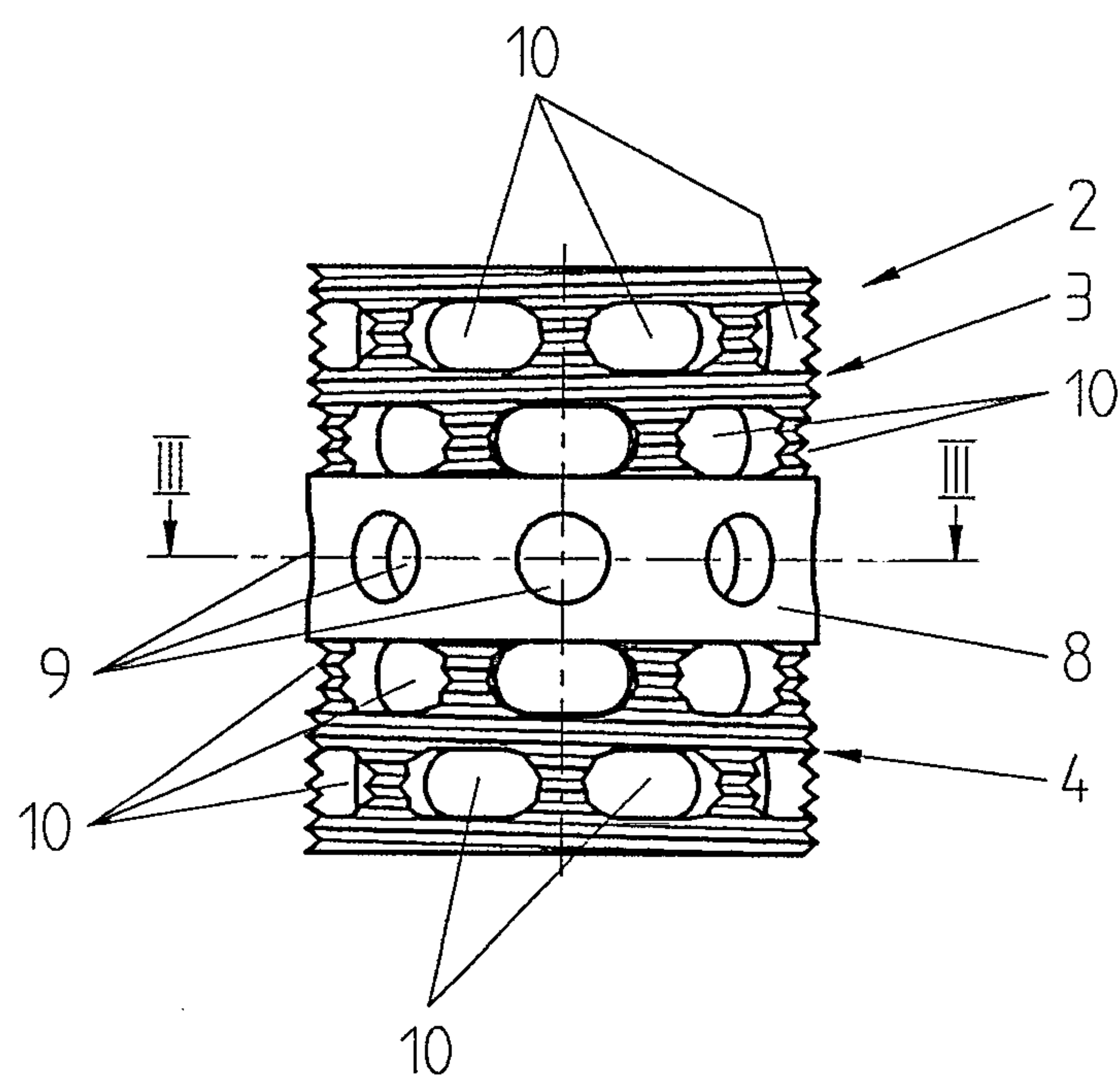


fig.2

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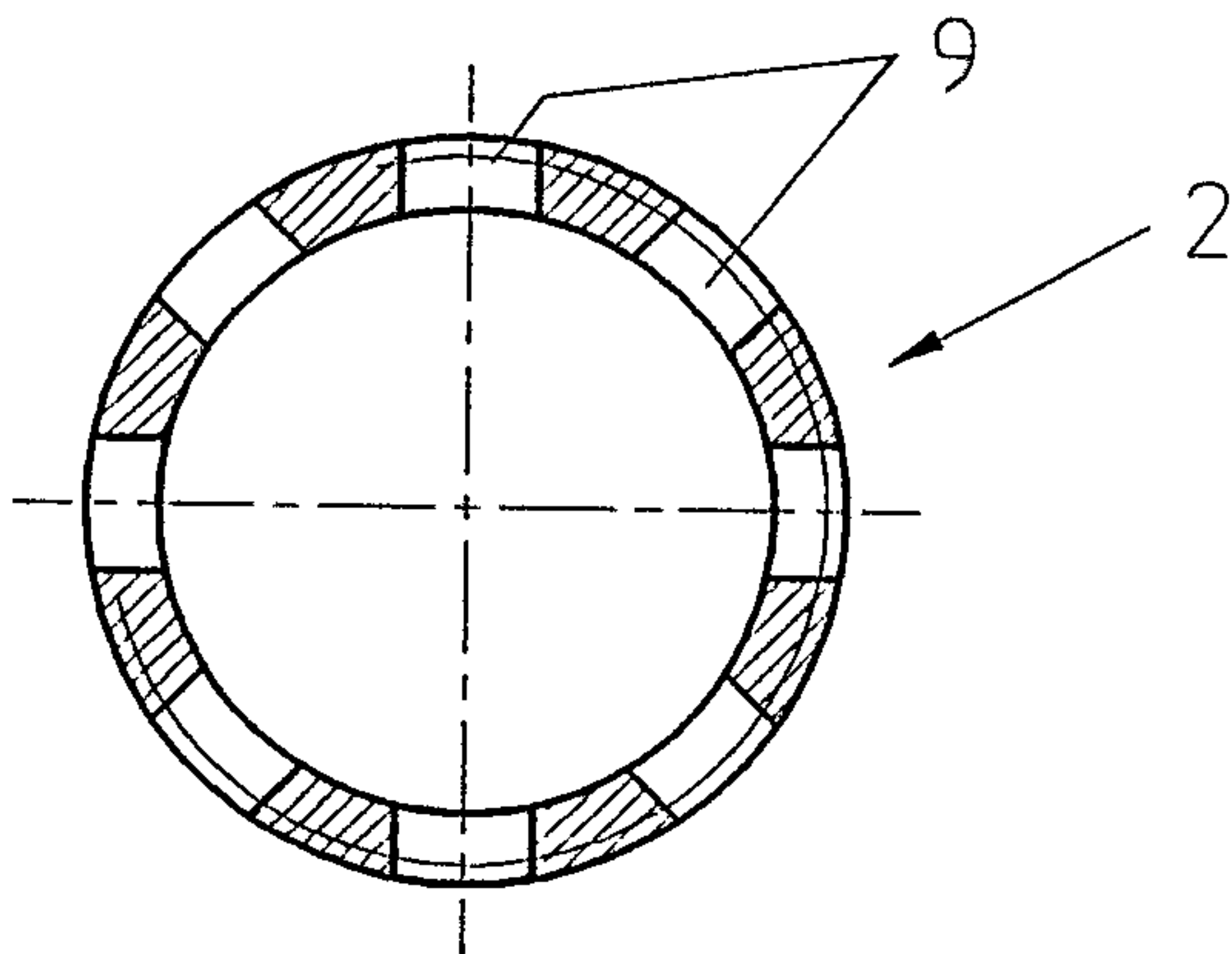


fig.3

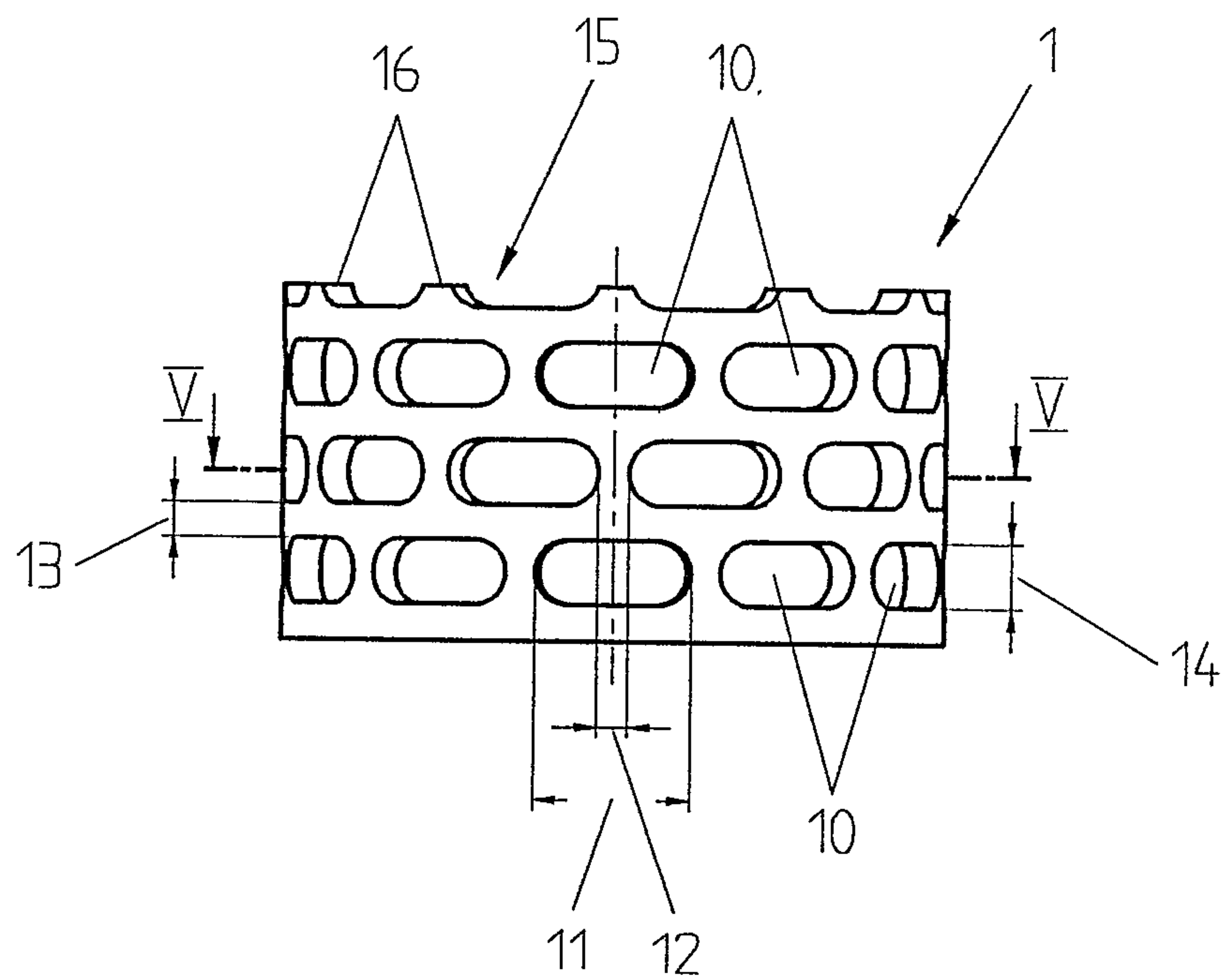


fig.4

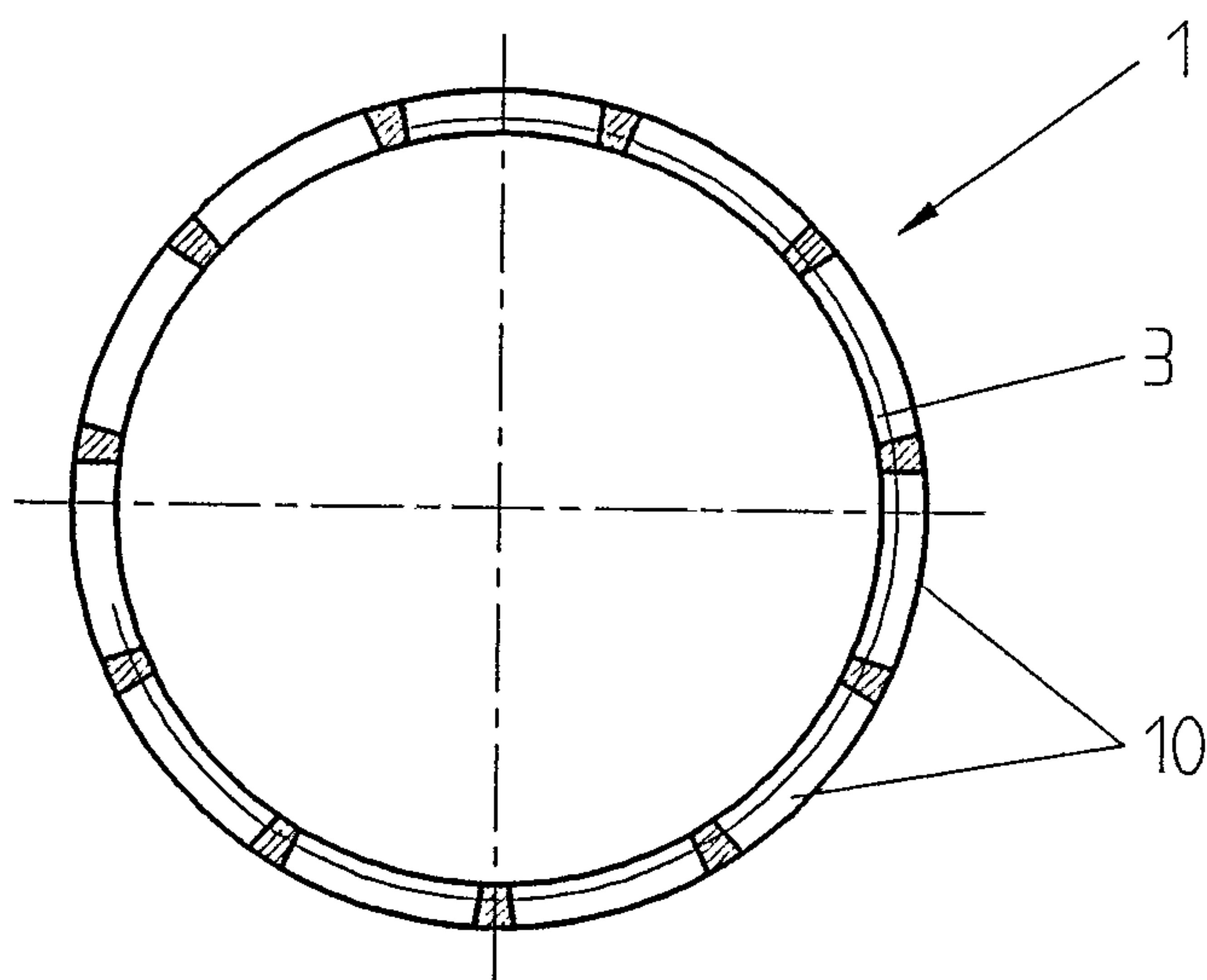


fig.5

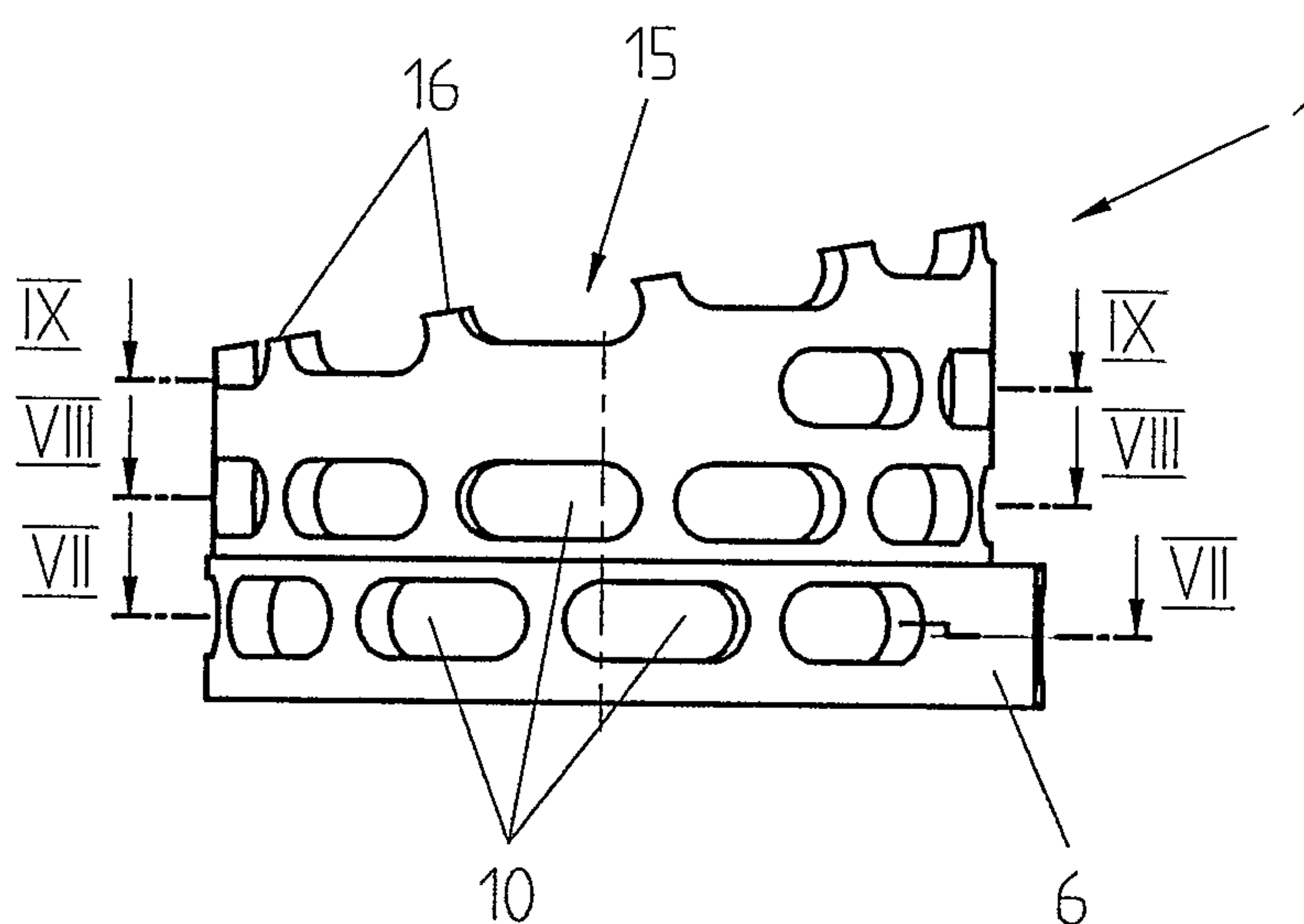


fig.6

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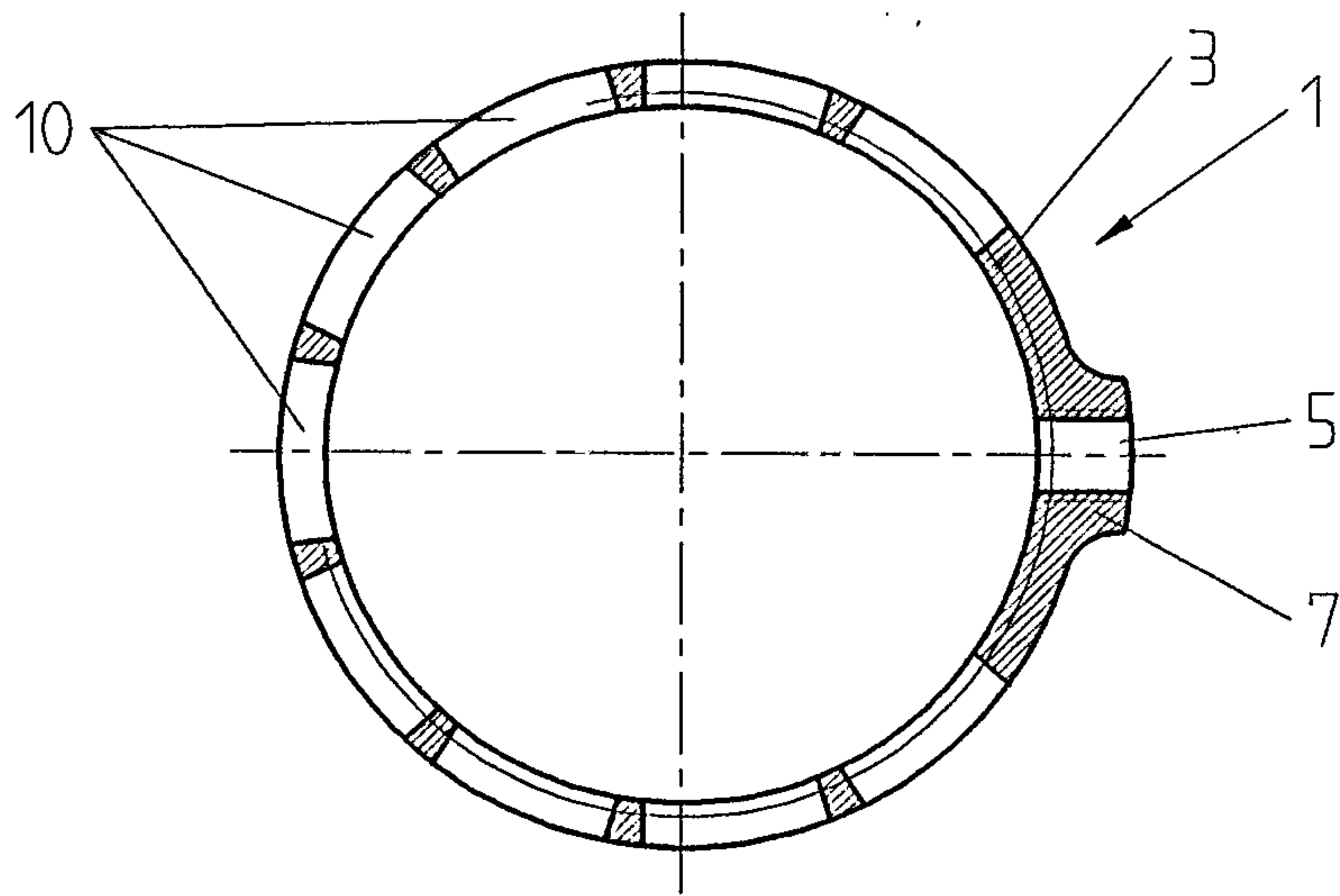


fig. 7

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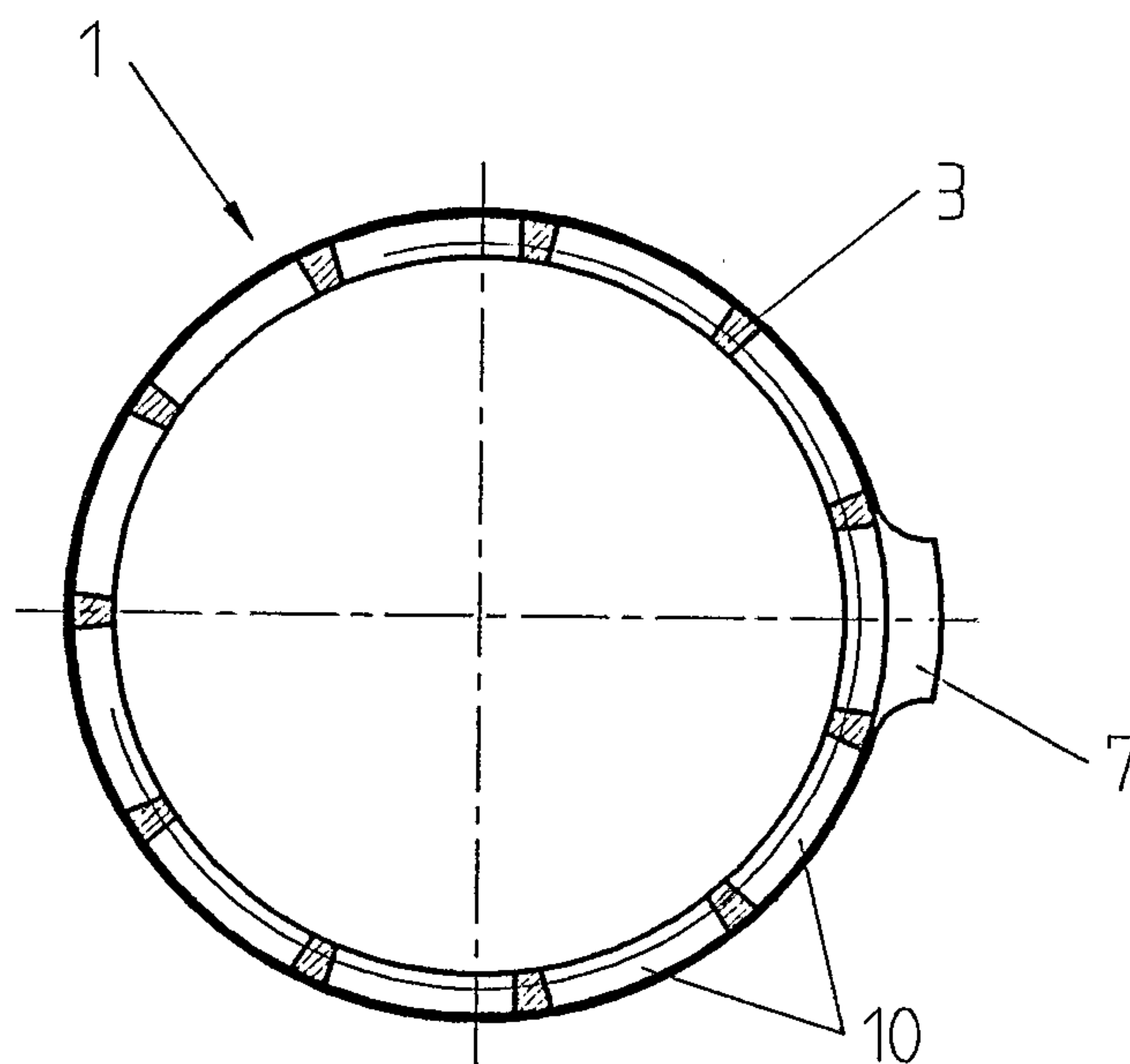


fig.8

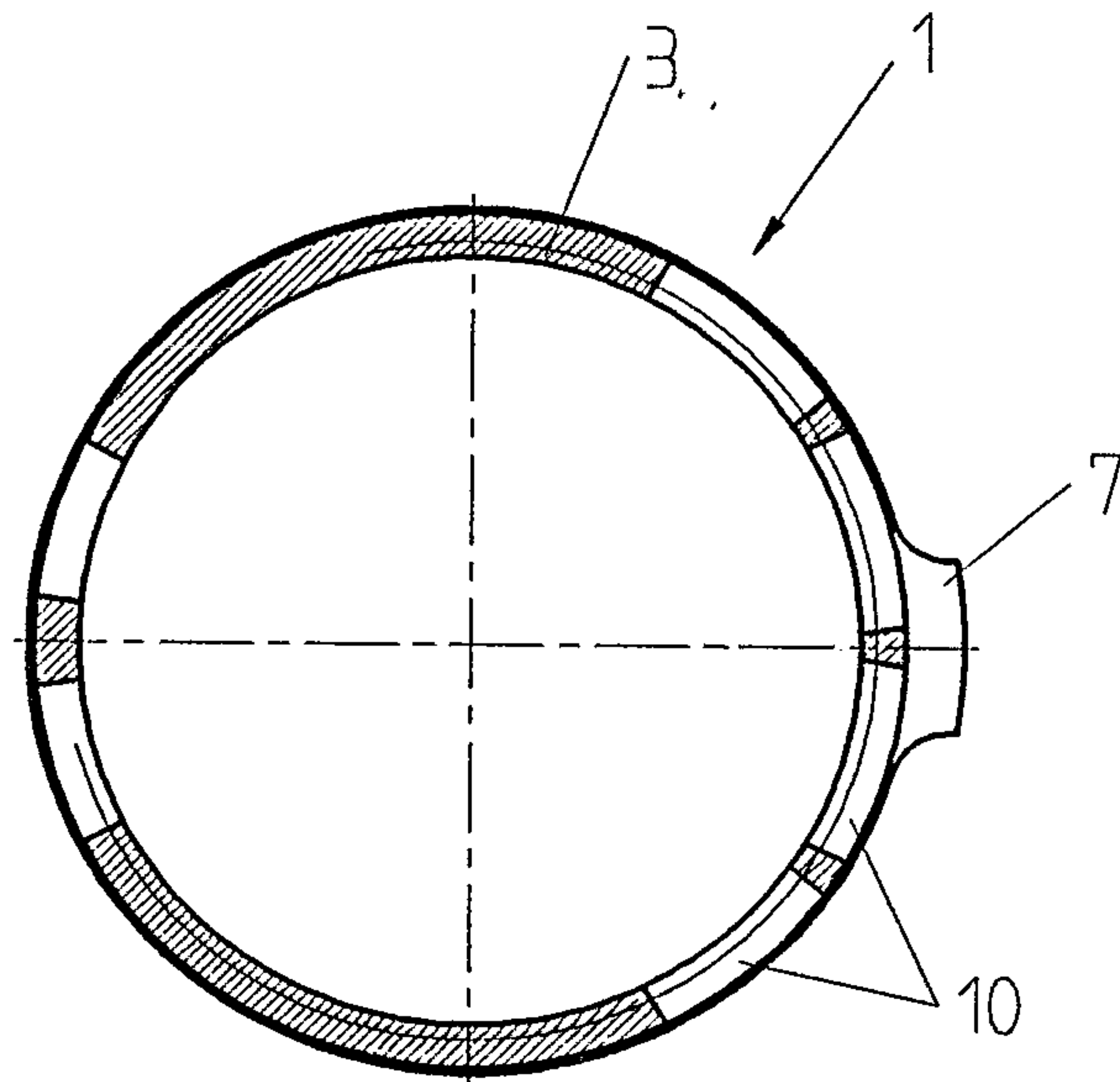


fig. 9

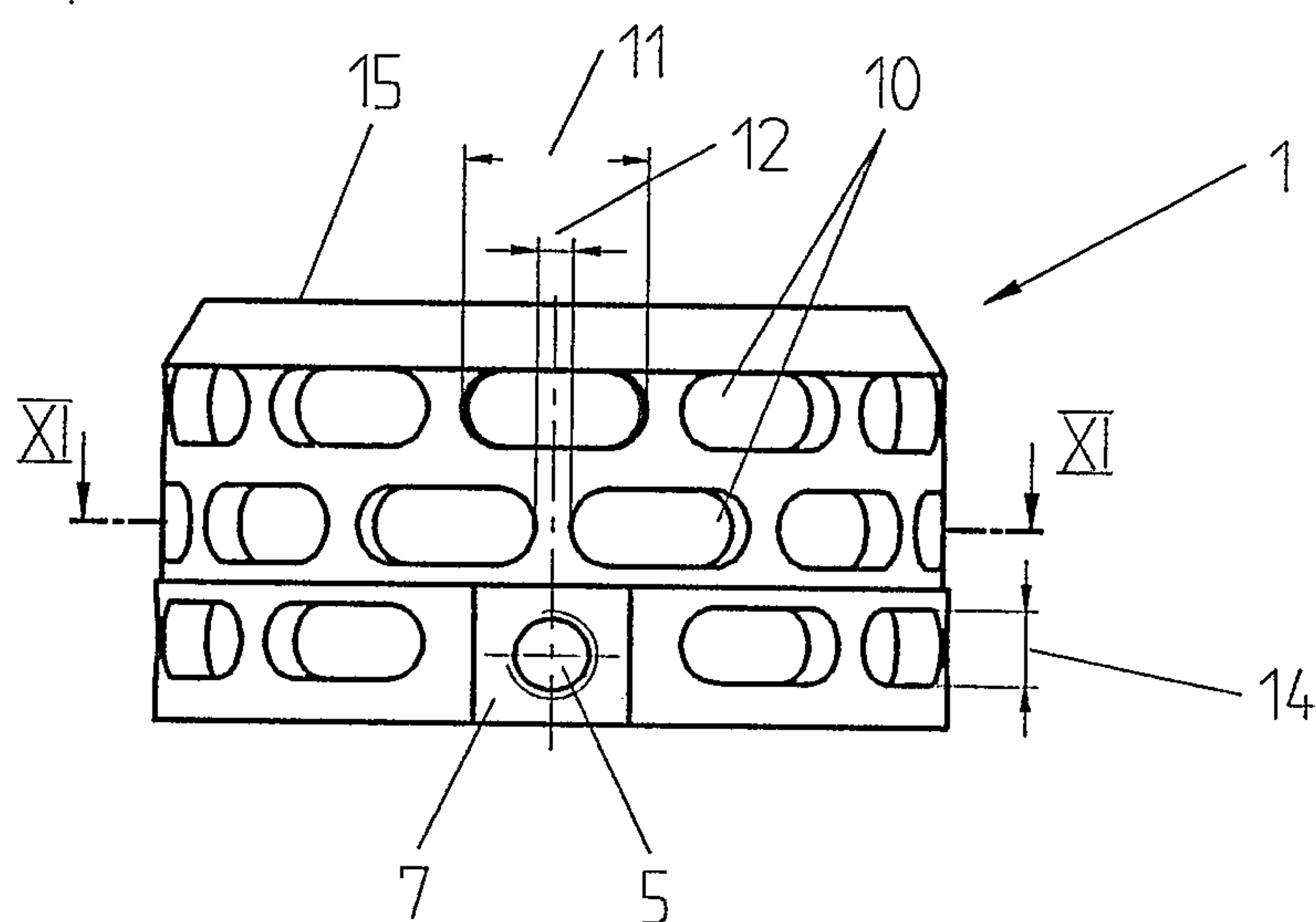


fig. 10

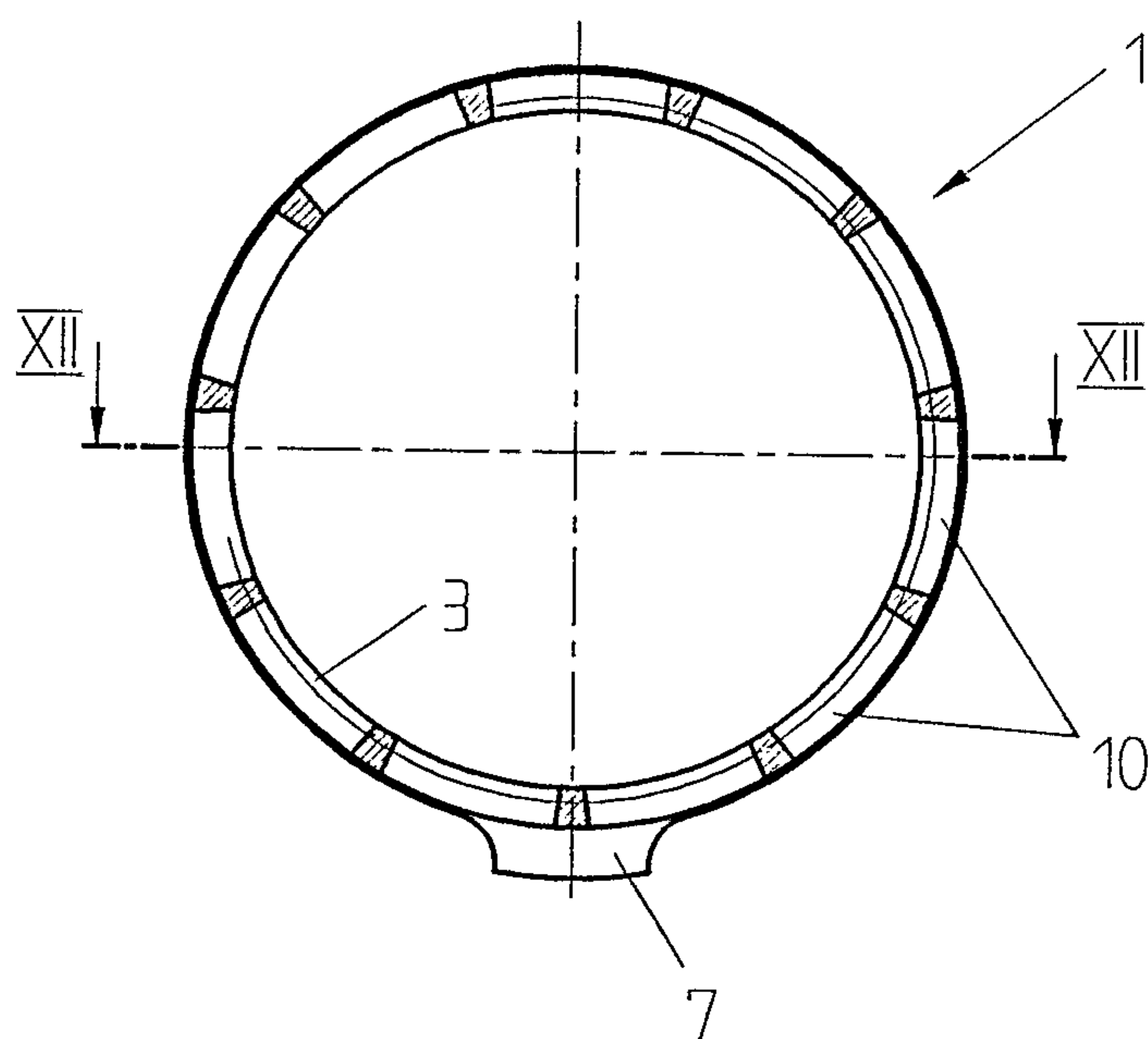


fig. 11

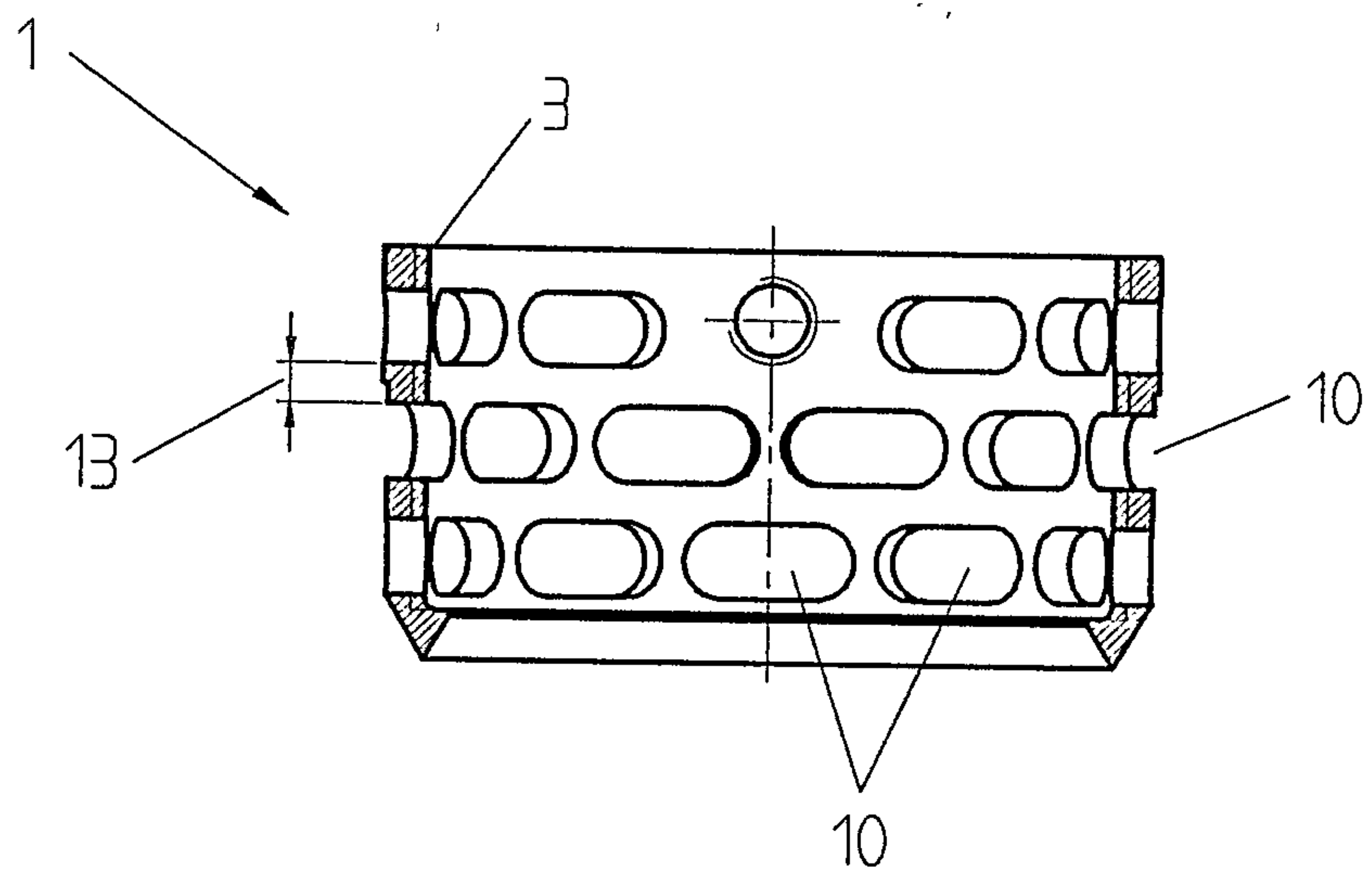


fig. 12

