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(54) **BRUSH RING AND BRUSH**

(57) An object of the invention is a brush ring (10, 10'), which includes a bristle part (11), which includes bristles (13), an annular base part (12), arranged to be corrugated axially (A) on both sides, formed as a combining structure with bristle part, and arranged to connect the radial (R) bristles (13) fitted to its outer circumference (15), which base part further includes retention elements (14) on the inner circumference (16) of the base part, to prevent the rotation of the brush ring on the brushing machine's brush body (17), contact surfaces (18), by which the brush ring is arranged to settle against the adjacent brush rings (10') when set on the brushing machine's brush body, and on at least some of the said

contact surfaces, a locking-element pair (19) arranged to form axial locking between the brush rings, which includes a protrusion (21) and recess (23) arranged compatibly with a corresponding locking-element pair (19') of the adjacent brush rings. Between the protrusion and recess of the locking-element pair arranged to form axial locking there is a bevel (20) arranged to form a wedge effect in connection with the contact surface with the corresponding locking-element pair of the adjacent brush ring which is to be arranged with the brush ring against its contact surface. In addition, the invention also relates to a brush assembled from brush rings.

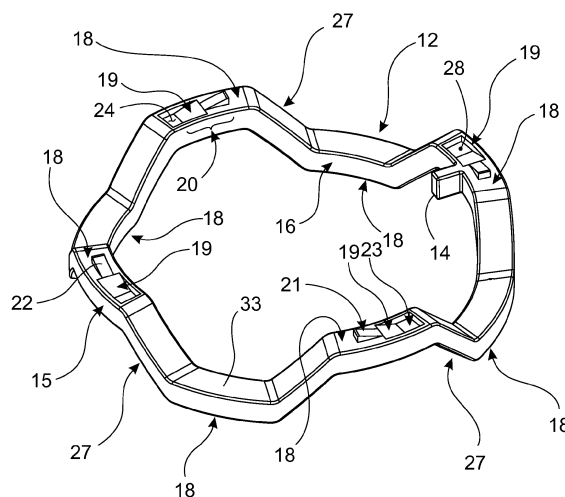


Fig. 4

Description

[0001] The invention relates to a brush ring, which includes

- a bristle part, which includes bristles,
- an annular base part, arranged to be corrugated axially on both sides, formed as a combined structure with bristle part, and arranged to connect the radial bristles fitted to its outer circumference, which base part includes,
 - retention elements on the inner circumference of the base part, to prevent the rotation of the brush ring on the brushing machine's brush body,
 - contact surfaces, by which the brush ring is arranged to settle against the adjacent brush rings, when set on the brushing machine's brush body,
 - on at least some of the said contact surfaces, a locking-element pair arranged to form axial locking between the brush rings, which includes a protrusion and recess arranged compatibly with a corresponding locking-element pair of the adjacent brush rings.

In addition, the invention also relates to a brush, which is assembled from brush rings.

[0002] Various brush rings are known, which are intended, particularly with several corresponding brush rings, to be used in a brushing machine, for example as a brush rotating around its longitudinal axis. Such brush rings are used to form brushes in the most various sweep- ing devices and brushing machines.

[0003] The brush rings can be essentially planar, or they can have a construction deviating from the planar and thus deformed structure possessing an axial dimension. Examples of these are brush rings with an axially angular zig-zag, or round shape or otherwise smoothly corrugated shape. In these, when set on the work device's rotation shaft, the brush rings are, in their circumferential direction, on both sides alternately in contact and without contact with the adjacent brush rings of their contact surfaces. Then, for example in the case of a zig-zag-shaped brush ring, the brush rings can together form honeycombl like brush parts on the rotation shaft. By means of a brush ring like those referred to above, de- formed axially, i.e. with a lateral deviation, mainly continuous contact is achieved with the object being brushed in the axial direction of the brushing device, thus leading to an improved brushing result. In addition, the brush rings then also better withstand, for example, strain, com- pared, for example, to brush rings that possess an en- tirely planar shape.

[0004] The free rotation of the brush rings around the rotation axis is prevented by a retention element fitted to the inner circumference of their base part. The retention element can be, for example, a radially protruding pin

arranged on the inner circumference of the brush ring's base part, or some other protruding (or also recessed) shape, for which a counterpart is arranged on the rotation shaft. In the case of a pin, it can be an elongated axial groove. The groove permits the brush rings to be thread- ed onto the shaft and to be positioned correctly relative to the other brush rings.

[0005] Sometimes the retention element can, howev- er, break. This gives the brush ring an opportunity to ro- tate freely on the rotation shaft. The rotation would, in turn, result in the brush ring in question losing contact with its adjacent brush rings due to the circumferential rotation of the relevant broken brush ring. This would, in turn, result in the brush-ring bundle formed on the shaft being able to loosen axially and this would cause the brush-ring bundle to loosen on the rotation shaft. The results of this chain of events would include a poorer brushing result and, in addition, also the other brush rings too being damaged, for example by their becoming twist- ed.

[0006] Solutions from the prior art are known to the problems caused by the breaking of a retention element, in which axial locking is arranged in the contact surfaces of the base parts of the brush rings in order to eliminate the problems caused by the breaking of the said retention element. Owing to the axial locking, it is ensured that, in the event of the breaking of the retention element, the brush rings of a brush-ring bundle still remain in the cor- rect position relative to each other in the circumferential direction, and, for example, their free rotation on the shaft is prevented. The entire brush-ring bundle then still re- mains as a tight package on the shaft.

[0007] One way to implement the aforementioned axial locking is to arrange a pin on the contact surface of the brush ring, and an opening or recess for the pin in the corresponding contact surface of the other brush ring ly- ing against it. For example, such a solution is known from US patent number 9, 289, 053 B2. In it, axial locking is implemented by a pin-hole or alternatively by the locking- element pair formed by toothing. In this disclosed solu- tion, if the retention element breaks, increased strain is placed on the brush rings adjacent to the brush ring with a broken retention element, and particularly on their re- tention elements. Through them, the force of the brush ring with a broken retention element is also transmitted to the shaft. This also leads to the possibility of the ad- jacent brush rings' retention elements breaking. In addi- tion, the alignment demand relative to each other of the brush rings forming the brush-ring bundle is also another drawback of such an implementation. If, while assem- bling the bundle, the ridges of the toothing of adjacent brush rings remain next to each other, then the ridges settle into the depressions only once the assembled brush is being used. As a result, the tightly formed as- sembled brush-ring bundle can loosen. On the other hand, carefully assembling the brush-ring bundle to allow for the alignments will slow the ring bundle's assembly.

[0008] The axial locking pin can also equally well

break, as can the retention element. This implementation is also not a possible solution, for example, to the strains acting on the brush rings when the brush-ring bundle is rotated and/or during brushing, which can cause, for example, undesirable vibrations in the brush.

[0009] Use of the aforementioned solution also does not prevent radial expansion of the brush ring on the brush body from taking place in certain situations. If the brush rings are assembled in a tight bundle on the brush body, then radial expansion of the brush rings can appear in them, most particularly in their base part. Possible expansion is emphasized when the brush is stressed. As a result, the brush ring's base part can lose contact with the adjacent brush rings as described above. In addition, as a result of the radial expansion, the bristles of the brush ring in question wear and thus shorten more rapidly relative to the other brush rings on the brush body.

[0010] The invention is intended to create a brush ring and brush with improved functionality. The characteristic features of the brush ring according to the invention are stated in Claim 1 and of the brush in Claim 15.

[0011] By means of a bevel arranged in connection with the contact surfaces a wedge effect is arranged to be formed in connection with the brush ring's contact surface with the corresponding bevel of the adjacent brush ring which is to be arranged with the brush ring against its contact surface. In the axial direction of the brush ring, the bevel protrudes from the contact surface and, in addition, also withdraws relative to the contact surface. A locking pin and a locking hole for the locking pin of the adjacent brush ring can then also be integrated in connection with the bevel. Correspondingly, a locking-element pair is implemented on the same principle in the adjacent brush ring. Several significant improvements are achieved in this way in the brush ring, relating to both its operation and, for example, its durability.

[0012] When the retention element of one brush ring breaks, by means of the bevels of the brush rings set against each other and, even more particularly, by the protrusions arranged in them, the circumferential position of the brush ring is retained relative to the brush rings located adjacently to it. At the same time, the broken brush ring is, in addition, made to continue to rotate with the ring bundle owing to the rotational movement transmitted through the adjacent brush ring's axial locking.

[0013] A bevel in both brush rings, in turn, achieves, for example in the direction opposite to the direction of rotation of a brush assembled from brush rings, a small mutual movement of the brush rings relative to each other in the opposite directions. Owing to this, the brush bundle better tolerates, for example, axial loadings causing its rotation and/or strain. Particularly the vibration causing them can be avoided thanks to the bevel and small circumferential movement the bevel permits. In addition, a self-tightening brush-ring bundle is created by the bevels forming a wedge, should some deviation occur in its operation. Thanks to the bevels, if an exceptional situation appears in one or more of the brush rings, the strain

caused as a result can be distributed more evenly over the entire area of the brush-ring bundle and through the end flanges on to the brush body.

[0014] The use of the invention permits not only sure axial locking, but also radial locking of the brush rings. Forming a locking-element pair according to the invention on the pin-hole principle also prevents the radial expansion of the brush rings around the brush body. Other additional advantages achieved by the invention appear in the description portion and specific features in the accompanying Claims.

[0015] The invention, which is not restricted to the embodiment presented in the following, is described in greater detail with reference to the accompanying figures, in which

Figure 1 shows an example of the brush ring,
 Figure 2 shows an example of the placing of adjacent brush rings against each other, the brush rings being assembled on the brush body of a brushing machine,
 Figure 3 shows an example of brush rings shown without a bristle part, assembled on the brush body,
 Figure 4 shows an example of one base part of a brush ring,
 Figure 5a shows the base part of the brush ring shown in Figure 4,
 Figure 5b shows an inset from Figure 5a of the axial locking-element pair arranged in the base part,
 Figure 6 shows a side view of the base part of the brush ring shown in Figures 4 and 5a,
 Figure 7 shows a cross-section of the base parts of the brush rings shown in Figure 6, when brush formed of brush rings operating normally,
 Figure 8 shows an inset formed from Figure 7 of the axial locking-element pair arranged in the base part, when the brush ring is operating normally,
 Figure 9 shows a cross-section of the base part of the brush ring shown in Figures 7 and 8, when the brush rings are separate from each other, and
 Figure 10 show a cross-section of the base parts of the brush rings shown in Figure 6, when the brush formed of brush rings is under strain.

[0016] Figure 1 shows an example of a brush ring 10, 10'. The brush ring 10 is intended, as shown in Figure 2, to be used, particularly together with several similar brush rings 10', as a brush rotating in a brushing machine around the longitudinal axis A, for example in the direction 29. Thus Figure 2 shows in principle the position of the adjacent brush rings 10, 10' relative to each other, when they are on the brushing machine's brush body (reference number 17 in Figure 3).

[0017] Generally, the brush ring 10, 10' can be said to include a bristle part 11, which includes bristles 13. The brush ring 10, 10' also includes a base part 12, formed annularly and here now arranged to be corrugated axially A from one side to the other. Thus the base part 12 is arranged to deviate essentially from a planar form in the axial A direction of the brush ring 10, 10'. The base part 12 is arranged to connect endlessly the radial R bristles 13 arranged on its outer circumference 15. The bristle part 11 and the base part 12 can also be said to be made to form a combined structure. In the case of the bristle part 11 and the base part 12, the brush ring's 10, 10' material can be throughout of the same, for example, a recyclable plastic-based material, such as, for example, polypropylene or similar.

[0018] The base part 12, which in the embodiment shown has, for example, an annular shape, includes retention elements 14. The retention elements 14 are arranged on the inner circumference 16 of the base part 12. The retention elements 14 are intended to prevent the rotation of the brush ring 10 when it is set in place consecutively with the other brush rings 10' in the longitudinal direction A, on the brush body 17 of brushing machine, as shown in Figure 3. The brush rings 10, 10' then form a brush-ring bundle 32 and thus also a brush. The retention elements 14 comprise one or more shoulder arrangement 14' to connect the brush ring 10, 10' non-rotatingly against the corresponding counter-surface in the brushing machine's brush body 17. Now the counter-surface is a groove 26 in the brush body 17. The whole brush package, i.e. the brush-ring bundle 32, assembled from brush rings 10, 10' on the brush body 17, is closed by end flanges 30 at the end of the brush body 17. For clarity, Figure 3 does not show the bristle parts 11 arranged on the outer circumference 15 of the base parts 12, and thus does not also show the bristles 13.

[0019] Figure 4 shows an example of the base part 12 of a brush ring 10, without the bristle part 11 shown, for example in Figures 1 and 2, and thus also the bristles 13. The base part 12 also includes contact surfaces 18. The contact surfaces 18 are oriented in the axial direction A on both sides of the base part 12. Thus the contact surfaces 18 are side surfaces of the base part 12, oriented in the axial direction A of the base part 12. From the contact surfaces 18 the brush ring 10 is arranged to settle against the adjacent brush rings 10', when installed on the brushing machine's brush body 17, as shown, for example, in Figure 3. The brush rings 10, 10' immediately consecutively stacked against each other are then additionally in contact with each other through their contact surfaces 18 forming, for example, planar surfaces. Thanks to the arrangement, the brush rings 10, 10' cannot, for example, "wobble" relative to each other. Thus the side surfaces immediately in contact with the adjacent brush rings 10' at the front and rear edges of the base part 12, acting in the present embodiment as contact surfaces 18, are now arranged to form planar surfaces.

[0020] As already stated above, the brush ring's 10,

10' base part 12 includes axial A displacements oriented alternately to the opposite sides of the brush ring 10, 10'. Then between the displacements there are displacement portions 27 creating the axial A displacement. By means of the displacement portions 27, the location of the contact point of the radial R periphery of the brush ring's 10, 10' bristle part 11, i.e. the tip of the bristles 13 is arranged to be altered over the whole width of the brush ring 10, 10', to maintain, in the longitudinal direction A of the brushing machine's brush, a mainly or entirely unbroken brushing contact continuously with the object being swept, irrespective of the bristles' 13 length, as the brush rings 10, 10' forming the brush rotate around the longitudinal axis A in the direction 29 (Figures 2 and 3). Figure 3 in particular shows clearly the construction of the axial A displacement formed by the base part 12 and also the honeycomb structure arranged to be formed by them in the brush. Between the displacement portions 27 there are straight portions 33. By the contact surface 18 arranged in these, the brush rings 10, 10' can be fitted against each other, thus forming a brush-ring bundle 32. The displacement portions 27 and the straight portion 33 are arranged to form a hexagon between the base parts 12 of the brush rings 10, 10', i.e. precisely the aforesaid honeycomb structure.

[0021] The brush ring's 10, 10' base part 12 with a constant continuous cross-section, to which the bristle part 11 is centrally attached, is arranged of many points laterally from its base level, as a constant extension with a continuous corrugated shape. The base part 12 can also be said to be arranged from its base level to extend laterally on only one side, particularly if the characteristic plane defined by the contact surfaces 18 arranged for either one side of the brush ring 10, 10' is chosen as the base level.

[0022] More particularly, in the embodiment shown the brush ring's 10, 10' base part 12 is formed to create a structure bent regularly linearly in its lateral direction. Its base part 12 is then arranged at an acute, for example, 45° angle to extend laterally from its base level. Thanks to the aforementioned arrangement, it is, first of all, possible to assemble a brush formed of brush rings 10, 10' by stacking the consecutive brush rings 10, 10' alternately right-way round and wrong-way round on the brush body 17 of the brushing machine. A honeycomb structure formed of consecutive base parts 12, for example according to Figure 3 is then created. In addition, such an arrangement also permits, in an as such known manner, the brush rings 10, 10' to be bundled as an extremely tight package, for example for transportation. In it, all the brush rings are stacked the same way round on top of each other. They then lie against each other on all surfaces. Thanks to this, the space needed for the brush rings 10, 10' diminished significantly compared to an assembled brush.

[0023] The as such known advantages of the brush ring 10, 10' deformed axially A and described above are the simplicity of its construction and operating reliability

and also its cheap manufacturing costs.

[0024] Figures 4 - 6 show in greater detail one example of the base part 12 of the brush ring 10, 10' according to the invention, which can be seen in the example of the brush ring shown already in Figures 1 - 3. The base part 12 also includes a locking-element pair 19 arranged to form axial locking between the brush rings 10, 10', arranged in at least some, in this case however all of the said contact surfaces 18. The inset formed from Figure 5a (Figure 5b) shows this locking-element pair 19 in greater detail. The locking-element pair 19 includes a protrusion 21 and recess 23 arranged compatibly with the locking-element pair 19' formed on a similar implementation principle in the adjacent brush ring 10' (Figures 2 and 7), but stacked the wrong way round. Thus the locking-element pair 19 can also be said to implement the male-female principle with the corresponding locking-element pairs 19' arranged on the contact surfaces 18 of the adjacent brush ring 10' stacked the wrong way round. We will return to this in greater detail later in the description, for example, in connection with Figures 7 and 8.

[0025] One intention of the locking-element pair 19 is to prevent the free rotation of the brush ring 10, in the event that the brush ring's 10 retention element 14 breaks. A heavy load acts of the retention elements 14 in the tightly-formed ring bundle 32 formed of brush rings 10, 10', which can cause them to break. The position of the brush ring 10 relative to the adjacent brush rings 10' is then retained, thanks to the locking-element pair 19, in the circumferential direction of the brush rings 10, 10'. In other words, despite the possible breaking of the retention element 14, the adjacent brush rings 10, 10' keep, at least on one side of the broken brush ring 10, their contact surfaces 18 against each other, and do not lose their alignment relative to each other with the contact surfaces 18 intended for them. Thus the brush-ring bundle 32 remains assembled as intended on the shaft forming the brush body 17, and also in a tight configuration and cannot, due to the axial locking-element pair 19, loosen as a consequence of the possible free rotation of the brush ring 10, the retention element 14 of which has broken.

[0026] There is a bevel 20 between the protrusion 21 and the recess 23 of the locking-element pair 19 arranged to form axial locking. The bevel 20 is arranged to form a wedge effect in connection with the contact surface 18 and the axial locking-element pair 19 with the corresponding locking-element pair 19' formed in the adjacent brush ring 10' which is to be arranged with the brush ring 10 against its contact surface 18. The use of the bevel 20 achieves several significant advantages. First of all, the protrusion 21 and recess 23 are easy to implement as a bevel in terms of manufacturing technique. They then create a low, but nevertheless gripping formation in the base part 12, nor do they thus affect the durability of the base part 12. In addition, the base part 12 need not be specially reinforced for the formations and for their

intended arrangement.

[0027] More particularly, the bevel 20 is arranged in connection with the contact surface 18 as a part of the protrusion 21. The protrusion 21 is arranged to act as a locking pin 22 on the side surface of the brush ring's 10 base part 12. In addition, the bevel 20 is arranged as part of the recess 23 in connection with the contact surface 18. The recess 23 is, in turn, arranged to act as a locking hole 24 for the protrusion 21 arranged to act as a locking pin 22 in the adjacent brush ring 10'. Similarly, the recess 23 arranged in the adjacent brush ring 10' is arranged to act as a locking hole 24 for the protrusion 21 arranged to act as a locking pin 22 of the brush ring 10. Thus the contact surfaces 18 set against each other have both a locking pin 22 and also a locking hole 24, i.e. a male-female function, or a wedge-hole pair for both brush rings 10, 10'.

[0028] The bevel 20 comprising locking-element pairs 19, 19' is on at least some of the brush rings' 10, 10' contact surfaces 18, or even on all of the brush rings' 10, 10' contact surfaces 18, as shown in the example. In addition, there are locking-element pairs 19, 19' on both sides of the brush rings 10, 10'. The locking-element pairs 19 can then be on one side, i.e. on the side when seen in the same direction peripherally and thus in the rotation direction of the brush ring 10 in such an order that first is a protrusion 21 and then a following recess 23. Correspondingly, on the other side of the brush ring 10, i.e. on the side when seen peripherally, the locking-element pair's 19 order is the opposite. Then thus first comes a recess 23, followed by a protrusion 21. Thus, the locking-element pairs 19, 19' are on opposite sides of the brush ring 10, 10' in an opposite peripheral order.

[0029] The aforementioned arrangement permits, for its part, the invention to be implemented using one kind of brush rings 10, 10'. In addition, this permits the brush rings 10, 10' to be stacked right-way round and wrong-way round on the brush body 17. Further in addition, by means of this contrary peripheral order of the locking-element pair 19, 19' arranged on the opposite sides, i.e. side surfaces of the brush ring 10, 10', the implementation of axial locking is permitted in both directions of rotation of the brush ring 10, 10'. So that it also does not restrict their assembly order on the brush body 17.

[0030] Owing to the invention, the assembly of the brush rings 10, 10' on the brush body also takes place easily and rapidly. The single locking pin 22 and single locking hole 24 integrated with the single bevel 20 arranged on the contact surface 18 align automatically with the corresponding formations of the adjacent brush ring 10' stacked wrong-way round, without the creation of the brush from brush rings 10, 10' on the brush body 17 requiring particular placing or the use of force. This is a clear advantage compared, for example, to the locking implemented by toothing, known from the prior art. Thus, the ring bundle 32 tightly assembled on the brush body 17 has no possibility to loosen in operation, because the alignment of the brush rings 10, 10' with each other is

certain. The bevel 20 even permits there to be clearance between the locking-element pairs 19 of the adjacent brush rings 10, 10'. Owing to it, the brush rings 10, 10' can be set as tightly as possible against each other on the brush body 17.

[0031] The protrusion 21 arranged to form the locking pin 22 and the recess 23 arranged to form the locking hole 24 are arranged consecutively in connection with the contact surface 18 in the circumferential direction of the base part 12 and, even more particularly, in the longitudinal direction of the contact surface 18. They then form a continuous bevel 20 between the protrusion 21 and the recess 23. One significant advantage of this is also that the protrusion 21 and the recess 23 are then integrated to a single formation joined by the bevel 20, in which case they are easy to implement in terms of manufacturing. Now the term bevel 20 refers, for example, to a sloping, i.e. deviating surface relative to the contact surface 18 formed by a straight planar surface. The bevel 20 can then be said to extend axially A from the straight planar surface forming the contact surface 18 on both of its sides. Thus, it is extending from the contact surface 18 and also receding relative to the contact surface 18 i.e. protruding inside the base part 12, i.e., on the opposite side of the contact surface 18 relative to the protrusion 21.

[0032] The protrusion 21 and also the recess 23 are arranged on the contact surface 18 in such a way that they are arranged to be between the outer and inner circumference 15, 16 of the base part 12, without, however extending to them, in order to prevent, among other things, the radial R expansion of the brush ring 10. In other words, the protrusion 21 and the recess 23 are then only in the area of the contact surface 18, or even more particularly inside it. The protrusion 21 is a bulge protruding from the contact surface 18. The recess 23 is, in turn, an inward dip in the base part 12 relative to the plane of the contact surface 18. Thus, the protrusion 21 and the recess 23 can also be said to be between the base part's 12 outer and inner circumferences 15, 16. The axial locking between the brush rings 10, 10' also then cannot be lost in the radial direction R due to, for example, possible deformations of the base part 12 caused by stresses, more particularly, radial swelling, because the locking pin 22 is always in the locking hole 24 arranged for it in the opposite brush ring 10', and also vice versa, nor can it escape in any situation in the radial direction R of the base part 12. Thus the locking-element pair 19, 19' according to the invention also holds the brush rings 10, 10' to each other radially, thus preventing their base parts 12 from slipping off the brush body 17 and thus also the brush ring 10, 10' from expanding radially R. Thus in addition to axial locking, radial locking of the brush rings 10, 10' is also achieved by the same locking-element pair 19, 19'.

[0033] By means of the aforesaid arrangement of the protrusion 21 and recess 23 between the outer and inner circumferences 15, 16 of the base part 12 on the contact

surface 18, without however extending to the outer and inner circumference 15, 16, an advantage is also achieved when assembling the brush-ring bundle 32, particularly in the case of corrugated brush rings. Due to the compression taking place when assembling a tight brush-ring bundle 32 of corrugated brush rings 10, 10', they expand radially R, even without particular rotation stress. If the brush rings are equipped on their contact surfaces with the toothing known from the prior art, they do not then remain aligned by the toothing, but instead the base parts slide radially relative to each other. This results in a loosened brush-ring bundle 32. Thus the wedge-hole locking-element pair 19, 19' according to the invention prevents this expansion of the base parts 12, equally also in connection with the assembly of the brush-ring bundle 32.

[0034] Especially a recess 23 like that shown, for example, in Figure 5b can include a flat area 28 arranged as a continuation to the bevel 20. In addition, the recess 23 includes an end 25.1 arranged on the end of the protrusion 21 for the counter-surface 25.2 of the adjacent brush ring 10'. Thus the flat area 28 is between the bevel 20 and the end 25.1 of the recess 23. The angle of slope of the bevel 20 can be, for example, 5 - 30 degrees, more particularly 5 - 20 degrees, and even more particularly 5 - 15 degrees. Here the term angle of slope refers to the angle of the bevel relative to the contact surface 18. The length of the bevel 20 can, in turn, be, in the case of the recess 23, for example, 15 - 25 mm and also taking the outer claw into account, for example, 35 mm. It is, however, typical for the bevel 20 that it is not too steep, thus realizing a wedge-like effect and locking. In addition, it must be sufficiently long in the circumferential direction to form locking and to achieve tightening by the wedge principle. The locking-element pair 19, i.e. the protrusion 21 and the recess 23 can be, for example, 50 - 90 % of the longitudinal direction L of the contact surface 18. The greatest height of the protrusion 21 from the contact surface can be, for example, 2 - 5 mm. The depth of the recess 23 can, for its part, also be 2 - 5 mm. The flat area 28 arranged in the recess 23 can be, for example, more than 7.5-mm long in the circumferential direction.

[0035] The protrusion 21 too can include a flat area 31 (Figures 5b and 8). In the circumferential direction the length of the flat area 31 arranged in the protrusion 21 can be, for example, 5 mm. Thus it is less than the length of the flat area 28 of the recess. The flat area 31 of the protrusion 21 is bounded by the point of the protrusion 21, i.e. in other words between the bevel 20 and the counter-surface 25.2 formed by the end of the protrusion 21. The flat area 31 arranged to the protrusion 21 to form a continuation of the bevel 20 reinforces the protrusion 21.

[0036] In cross-section, the protrusion 21 can have a triangular profile, a right-angled triangle. The term the cross-sectional profile of the protrusion 21 refers to the radial R profile of the protrusion perpendicular to the contact surface 18. The cross-section of recess 23 in the axial A direction of the brush ring 10, 10' can, in turn,

have a rectangular shape. The bottom of the rectangle then is the recess's 23 portion of the bevel 20 and the planar surface 28 following it.

[0037] Figures 7 - 10 show the operation of the locking-element pairs 19, 19' relative to each other, sectioned on the cross-section line B-B (Figures 7 - 8) and C-C (Figure 10) of the base part 12 shown in Figure 6. It can be seen in Figure 6 that the locking-element pair located on the section line B-B and C-C in the base part 12 does not appear in Figure 6, because it is on the contact surface 18 on the opposite side of the base part 12. Thus there are locking-element pairs 19 and also contact surfaces 18 on both sides of the base part 12. Thus the locking-element pairs 19, 19' can also be said to be located on the convex side of the base part 12 i.e. in other words on their ridges. The dells considered as the concave side of the base part 12 are then without locking-element pairs.

[0038] In Figures 7 and 8, the brush formed of brush rings 10, 10' is operating normally. The contact surfaces 18 of the brush rings 10, 10' are then against each other, i.e. the protrusions 21 are in the recesses 23 arranged for them in the opposite brush ring. Thus the bevels 20 do not then substantially cause a wedge effect between the brush rings 10, 10'. The retention element 14 is arranged on the inner circumference 16 of the base part 12 in such a way that the counter-surface 25.2 arranged in the end of the locking pin 22 is at the border point between the bevel 20 arranged in the recess 23 of adjacent brush ring 10' and the planar surface 28 or in the area of the planar surface 28.

[0039] If, for example, the brush ring's 10 retention element 14 breaks, then the peripheral mutual position of the brush rings 10, 10' changes slightly relative to each other, relative to the brush rings on either side of the broken brush ring 10. This situation is shown in Figure 10. The brush ring 10 with the broken retention element 14 tends to rotate freely on the brush body 17, because it is no longer locked to the brush body 17 by the retention element 14.

[0040] According to what is shown in Figure 10, the contact surfaces 18 on one side of the brush ring 10 with a broken retention element 14 move slightly apart from each other, due to the wedge effect caused by the rotational direction of the brush rings 10, 10' and the bevels 20. Both protrusions 21 on relevant contact surfaces 18, arranged to act also as locking pins 22 also act as wedging bevels 20. The wedge effect causes the brush ring 10 with the broken retention element 14 to press more tightly against the brush ring on the opposite side of the brush ring 10 and onto the brush ring 10' on one side of it.

[0041] This brush ring, against which the brush ring 10 now presses tightly, would thus be above the brush ring 10 in Figure 10. As one consequence of the pressing together, the brush rings' contact surfaces marked with the reference number 18' remain tightly against each other while the protrusions 21 are in the recesses 23 reserved for them. In addition, as a result of a small peripheral movement of the brush ring 10, the counter-surfaces

25.2 arranged in the ends of the protrusions 21 of the brush rings settle against the ends 25.1 arranged in the recesses 23, on the other side of the brush ring 10, i.e. of the side of the contact surface 18'. In other words, the locking-element pairs marked in Figure 10 with the reference number 19* create the axial locking of the brush ring 10 with the broken retention element 14 to its adjacent brush ring, not shown in Figure 10, above the brush ring 10. As a result, the brush ring 10 with the broken retention element 14 also continues to rotate along with the other brush rings, and their position relative to each other also cannot change. Thus, in addition to the protrusions 21 also acting as bevels 20, they thus also have the task of locking the periphery. Of course, the wedge effect formed using the bevel 20 also acts to tighten the brush-ring bundle on the first side of the brush ring 10, i.e. the brush-ring 10' side. Thanks to the wedge effect, the friction effect between the contact surfaces 18 also increases over the whole length of the brush formed of brush rings, i.e. the axial length of the ring bundle 32.

[0042] The aforesaid situation may also arise as a result of axial forces in the brush. Axial forces on the brush are caused, for example, simply by the rotation of the brush around its rotation axis A and also by the brush being loaded against the surface being swept during sweeping. These axial forces arise in both situations; when the retention elements 14 of all the brush rings are unbroken and, in addition, also when the retention elements 14 of one or more brush rings are broken.

[0043] According to Figure 10, the bevels 20 arranged in the brush rings 10, 10' are dimensioned in their slope to the locking-element pair 19, 19' so as to permit to the adjacent brush rings 10, 10' an opposite torsional movement relative to each other peripherally. The slope of the bevels 20 can be defined so that, in the brush rings' 10, 10' opposite torsional movement, their contact surfaces 18 separate slightly from each other and the brush rings 10, 10' oppose each other mainly only by their bevels 20, when they can also be said to wedge against each other. The slope of the bevels 20 is arranged to tighten the brush-ring bundle 32 on the brush body 17 on both sides of the brush rings 10, 10' and thus also to prevent vibrations from appearing in it. In other words, one definition of the slope of the bevels 20 can be that they are arranged to permit the brush rings 10, 10' peripheral movement relative to each other. For example, a steeply toothed locking form on both sides, known from the prior art, does not permit the tooth rings such a peripheral movement. In addition, the bevels set against each other are in opposite directions. Their mutual interaction, when an opposite peripheral movement acts on the rings relative to each other, results in the creation of the wedging effect according to the invention.

[0044] The bevel 20 causes the brush rings 10, 10' to wedge against each other axially. By being bound together against each other axially the brush ring 10, 10' cannot then, for example, vibrate, because due to the wedge i.e. the bevel 20, a continuous axial loading remains between

the brush rings 10, 10'. Then, for example, in a loose brush-ring bundle 32, the wedges formed on the contact surfaces 18, i.e. on the bevels 20 creates axial tightening of the brush rings 10, 10' and thus also avoids detrimental vibrations.

[0045] In addition to brush rings 10, 10', the invention also concerns a brush assembled from the brush rings 10, 10'. The brush includes brush rings 10, 10' assembled replaceably on a brush body 17 to form a brush-ring bundle 32. The brush body 17 includes a groove 26 or similar for the retention element 14 arranged in the brush rings 10, 10'. At least some of the brush-ring bundle's 32 brush rings 10, 10' are brush rings according to the invention.

[0046] By means of the bevel surfaces 20 set against each other, i.e. by the wedge surfaces between the brush rings 10, 10', a more even distribution of forces is achieved between the brush rings 10, 10', for example when the retention element 14 of one or more brush ring is broken. The broken brush ring stresses the adjacent brush rings on either side. In addition, a situation can arise, in which there are brush rings with broken retention elements 14 on both sides of a brush ring. In the brush-ring bundle 32 there are then two brush rings depending on a single brush ring. The brush-ring bundle 32 then expands in axial direction A due to the bevels and the brush-ring bundle 32 formed of brush rings tightens and power is transmitted through the brush rings to the end flange 30 and through it to the brush body 17. If one ring lags after the others, the bevels cause the ring bundle 32 to tighten. Even simply a stone on the shaft, i.e. the brush body 17, or in its groove 26 can cause a single ring to lag, without the retention element 14 being broken. Thanks to the bevels 20 the end flange 30 then too tightens against the brush rings 10, 10'.

[0047] It should be understood, that the above description and the related figures are only intended to illustrate the present invention. The invention is thus not restricted to only the embodiments presented above or defined in the Claims, but many different variations and adaptations of the invention, which are possible within the scope of the inventive idea defined in the accompanying Claims, will be obvious to one skilled in the art.

Claims

1. A brush ring, which includes

- a bristle part (11), which includes bristles (13),
- an annular base part (12), arranged to be corrugated axially (A) on both sides, formed as a combining structure with bristle part (11), and arranged to connect the radial (R) bristles (13) fitted to its outer circumference (15), which base part (12) includes,

- retention elements (14) on the inner circumference (16) of the base part (12), to

prevent the rotation of the brush ring (10) on the brushing machine's brush body (17),

- contact surfaces (18), by which the brush ring (10) is arranged to settle against the adjacent brush rings (10') when set on the brushing machine's brush body (17),
- on at least some of the said contact surfaces (18), a locking-element pair (19) arranged to form axial locking between the brush rings (10, 10'), which includes a protrusion (21) and recess (23) arranged compatibly with a corresponding locking-element pair (19') of the adjacent brush rings (10'),

characterized in that

- between the protrusion (21) and recess (23) of the locking-element pair (19) arranged to form axial locking there is a bevel (20) arranged to form a wedge effect in connection with the contact surface (18) with the corresponding locking-element pair (19') of the adjacent brush ring (10') which is to be arranged with the brush ring (10) against its contact surface (18),
- the protrusion (21) and recess (23) are arranged on the contact surface (18) in such a way that they are arranged between the outer and inner circumference (15, 16) of the base part (12) without extending to them, in order to arranged radial (R) locking of the brush ring (10, 10').

2. The brush ring according to Claim 1, **characterized in that** the slope of the bevel (20) is dimensioned to the locking-element pair (19, 19') in such a way that it is arranged to permit an opposite peripheral torsional movement of the adjacent brush rings (10, 10') relative to each other.

3. The brush ring according to Claim 1 or 2, **characterized in that** the bevel (20) is arranged in connection with the contact surface (18) as part of

- the said protrusion (21), which is arranged to act as a locking pin (22),
- the said recess (23), which is arranged to act as a locking hole (24) for the said protrusion (21) arranged to act as a locking pin (22).

4. The brush ring according to any of Claims 1 - 3, **characterized in that** the protrusion (21) and recess (23) are arranged consecutively in connection with the contact surface (18) to form a continuous bevel (20) between the protrusion (21) and the recess (23).

5. The brush ring according to any of Claims 1 - 4, **characterized in that** the protrusion (21) includes a flat

area (31) arranged as an extension of the said bevel (20) in order to reinforce the protrusion (21).

6. The brush ring according to any of Claims 1 - 5, **characterized in that** the recess (23) includes a flat area (28) arranged to form an extension of the said bevel (20). 5
7. The brush ring according to any of Claims 1 - 6, **characterized in that** 10
 - the protrusion (21) is triangular in cross-section,
 - the recess's (23) cross-section is rectangular in the axial direction (A) of the brush ring (10, 10'). 15
8. The brush ring according to any of Claims 1 - 7, **characterized in that** the angle of slope of the bevel (20) is 10 - 30 degrees. 20
9. The brush ring according to any of Claims 1 - 8, **characterized in that** the length of the bevel (20) is 15 - 25 mm. 25
10. The brush ring according to any of Claims 1 - 9, **characterized in that** the contact surfaces (18) are straight planar surfaces.
11. The brush ring according to any of Claims 1 - 10, **characterized in that** the locking-element pairs (19, 19') are on opposite sides of the brush ring (10, 10') in an opposite peripheral order. 30
12. The brush ring according to any of Claims 1 - 11, **characterized in that**, if the brush ring's (10, 10') retention element (14) breaks, the bevel (20) is arranged to tighten a brush-ring bundle (32) assembled from brush rings (10, 10') on the brush body (17). 35 40
13. The brush ring according to any of Claims 1 - 12, **characterized in that** the recess (23) includes an end (25.1) arranged for a counter-surface (25.2) arranged for it in the protrusion (21). 45
14. The brush ring according to any of Claims 1 - 13, **characterized in that** axial (A) displacement portions (27) are fitted to the brush ring's (10) base part (12) oriented alternately on opposite sides of the brush ring (10), between which displacement portions (27) there are straight portions (33), from the said contact surfaces (18) arranged in these the brush rings (10, 10') are to be arranged against each other when they form the brush-ring bundle (32), and which displacement portions (27) and straight portions (33) are arranged to form a hexagon between the brush rings' (10, 10') base parts (12). 50 55

15. A brush, which includes brush rings (10, 10') replaceably assembled on a brush body (17) to form a brush-ring bundle (32), which brush body (17) includes a groove (26) or similar for the retention element (14) arranged in the brush rings (10, 10'), **characterized in that** at least some of the brush rings (10, 10') of the brush-ring bundle (32) are brush rings according to one or more of Claims 1 - 14.

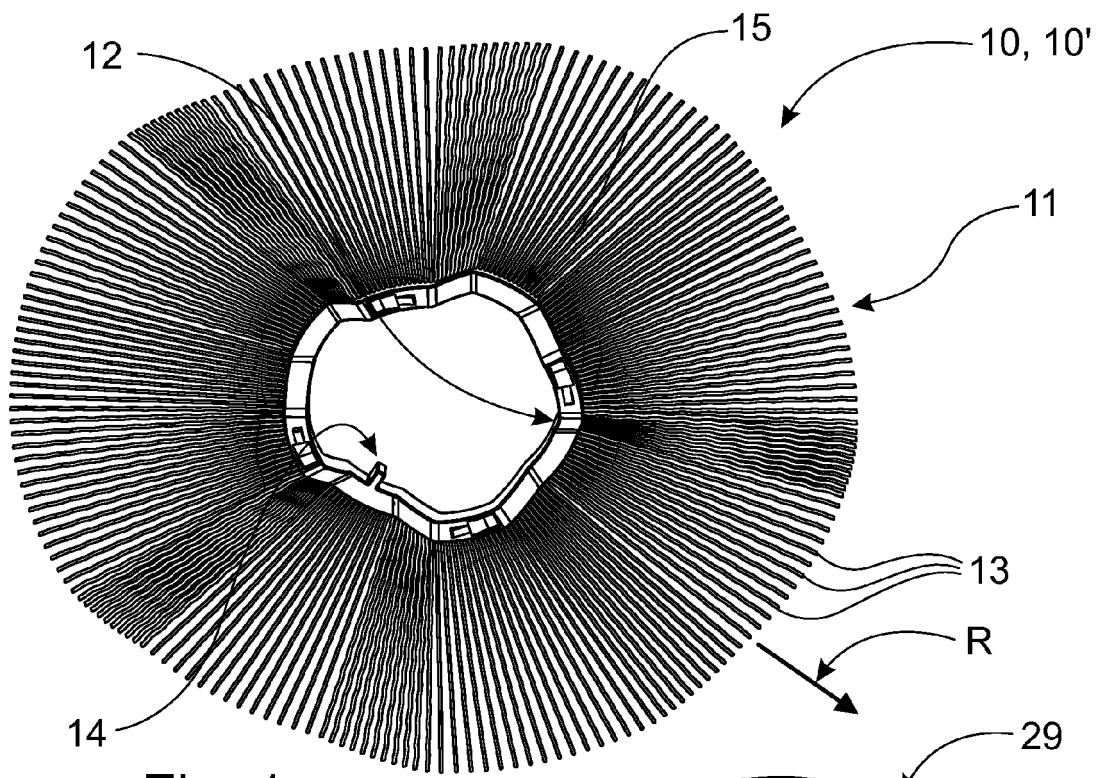


Fig. 1

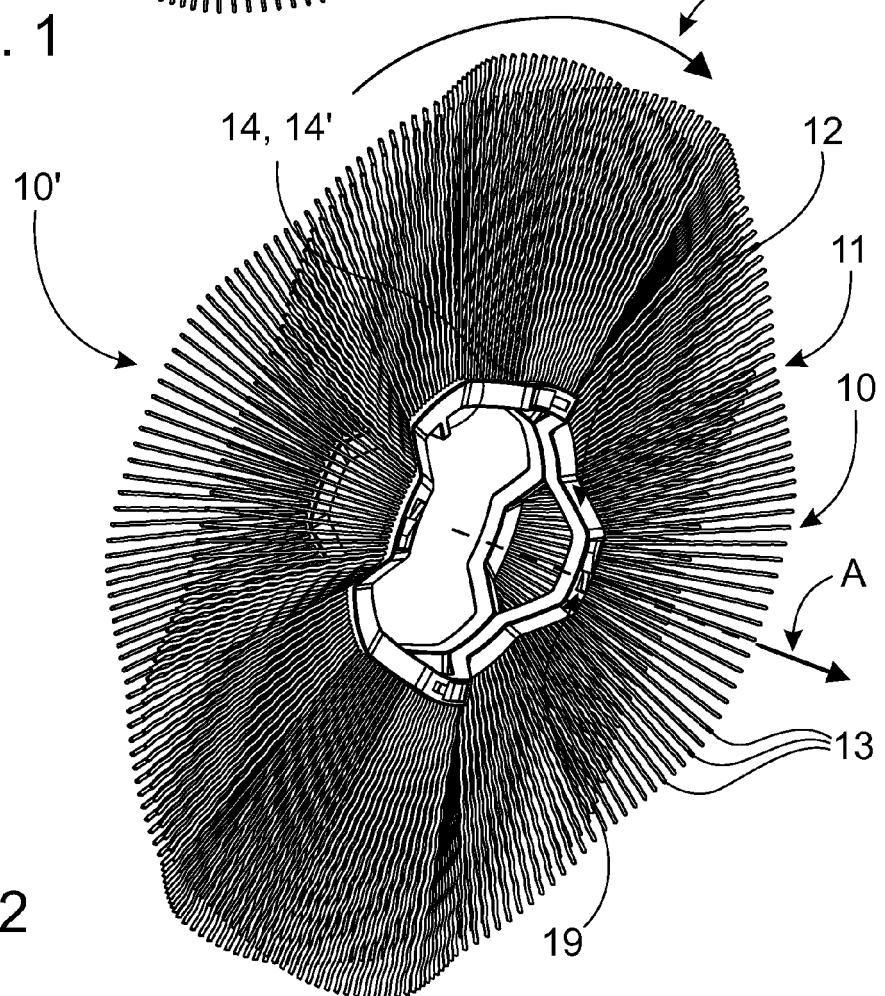


Fig. 2

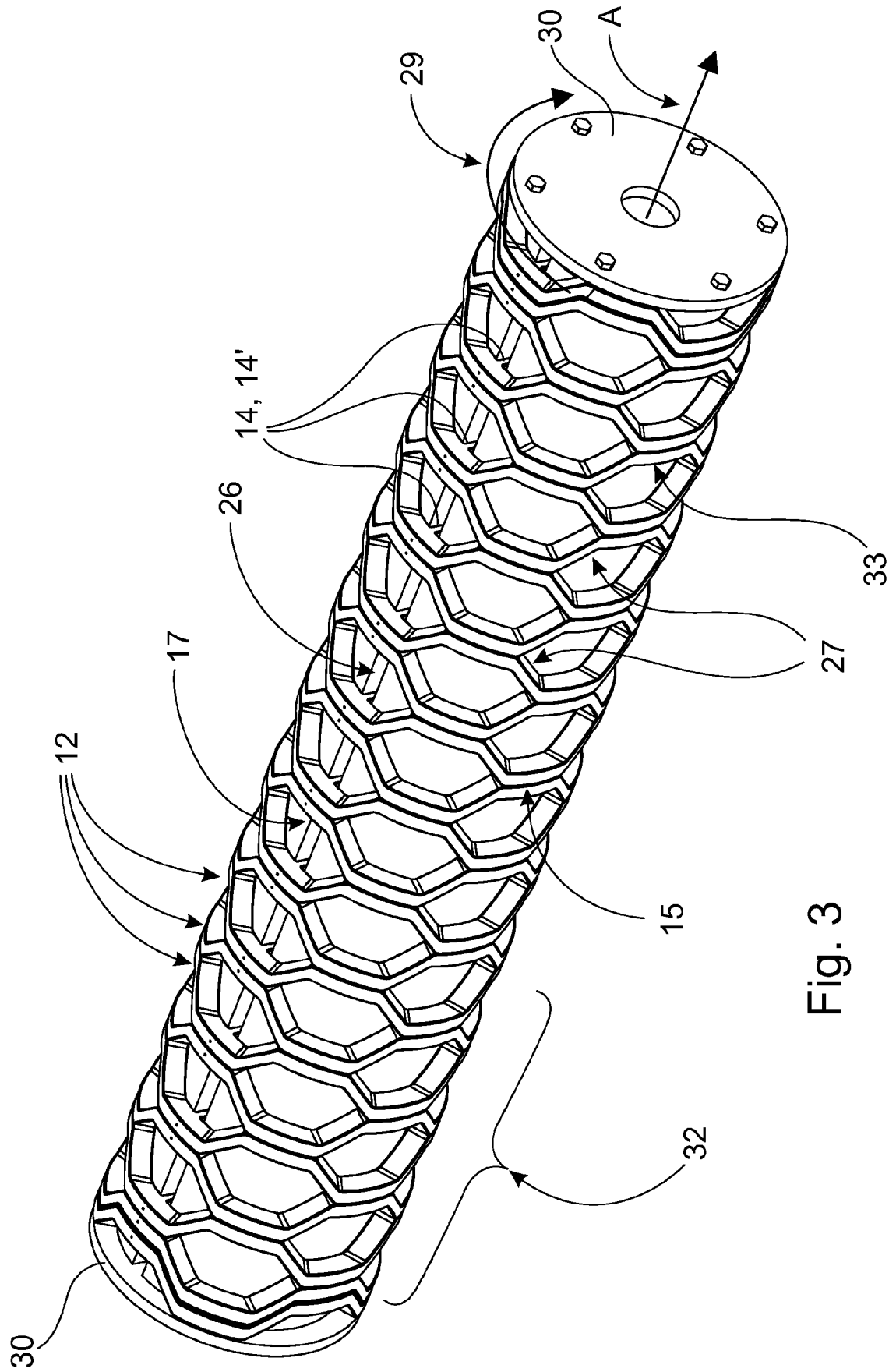


Fig. 3

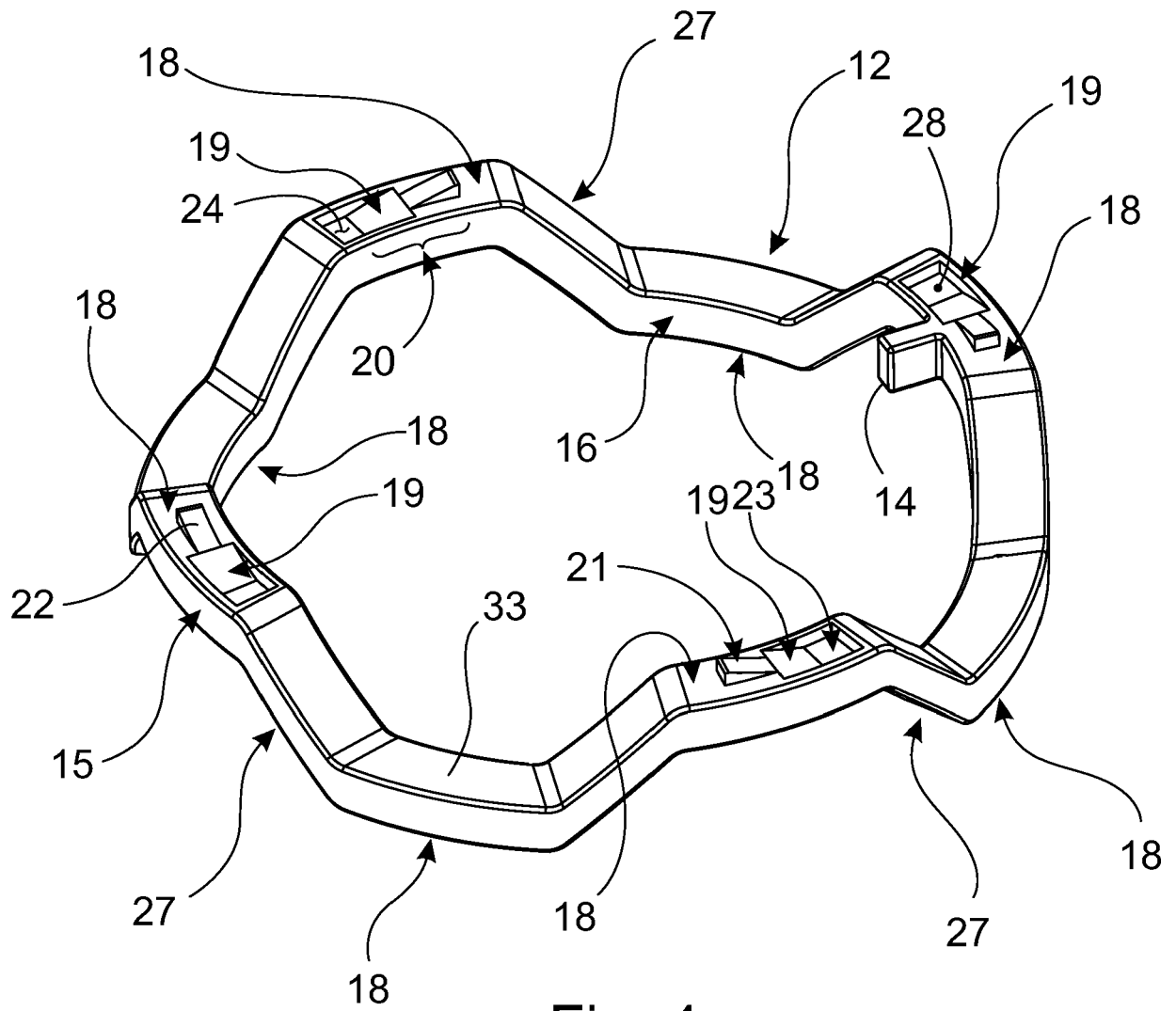


Fig. 4

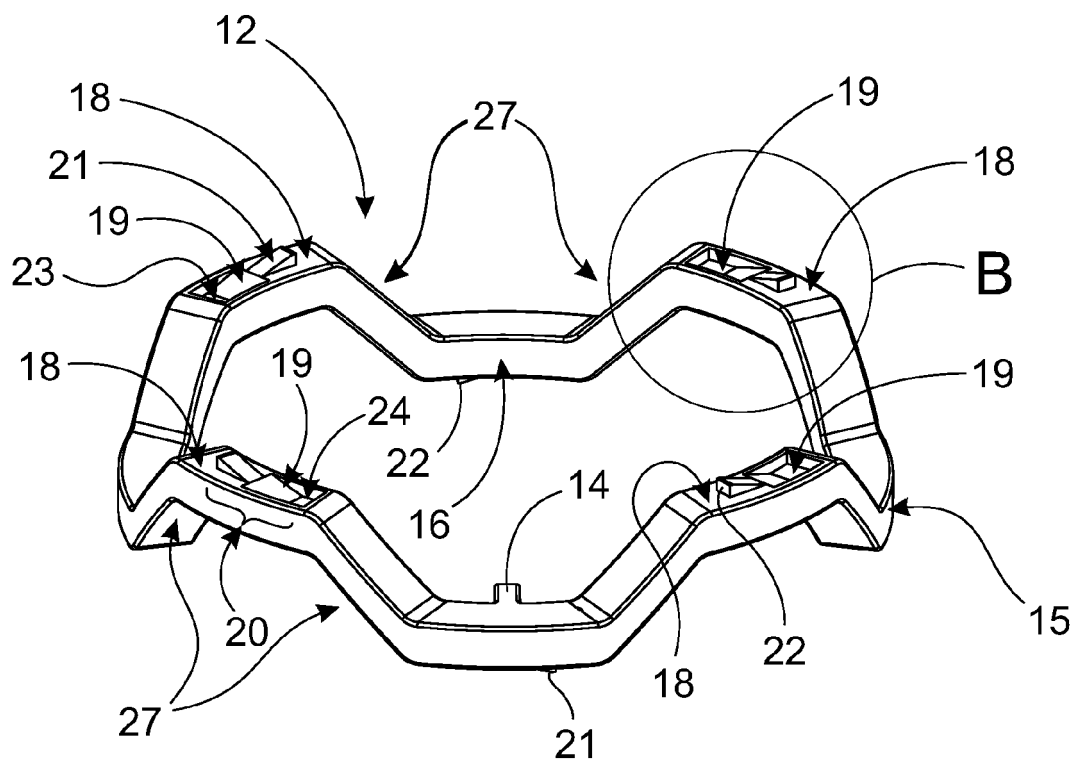


Fig. 5a

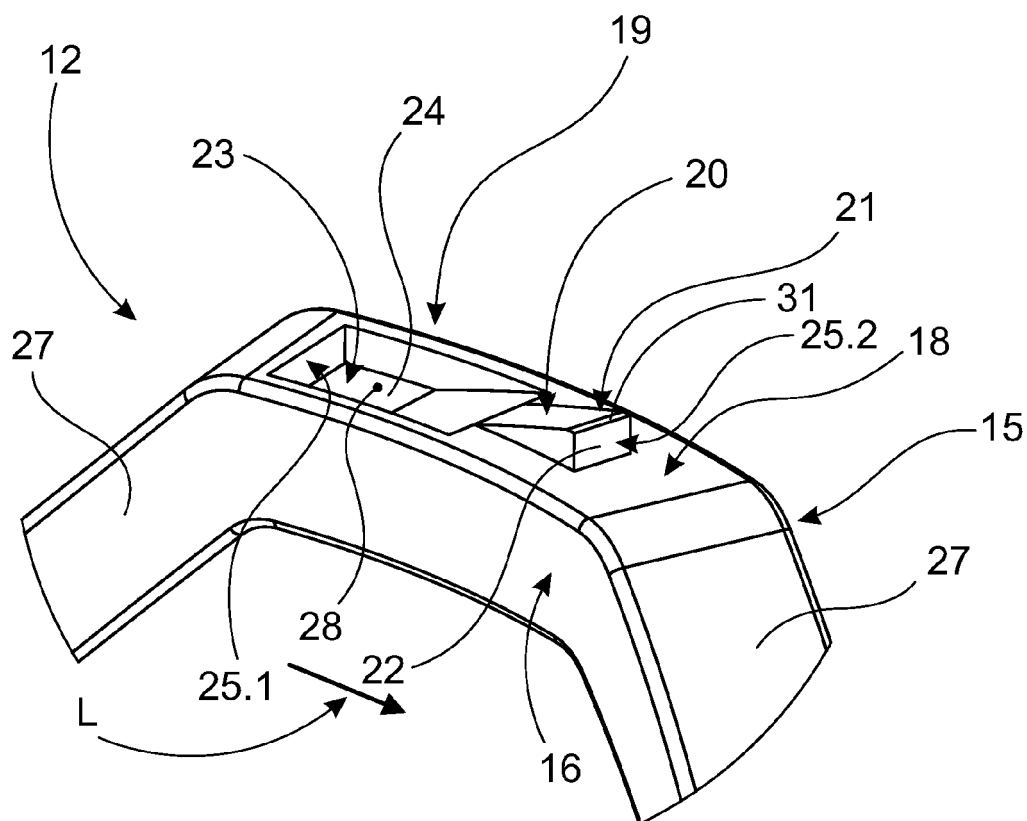


Fig. 5b
DETAIL B

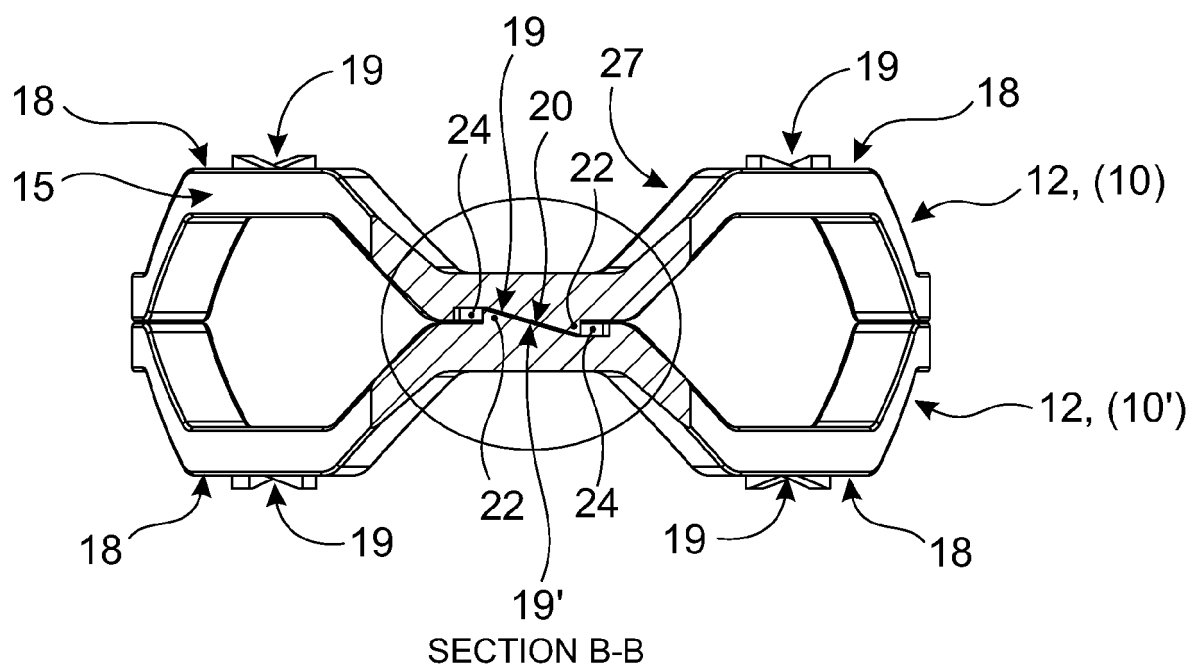
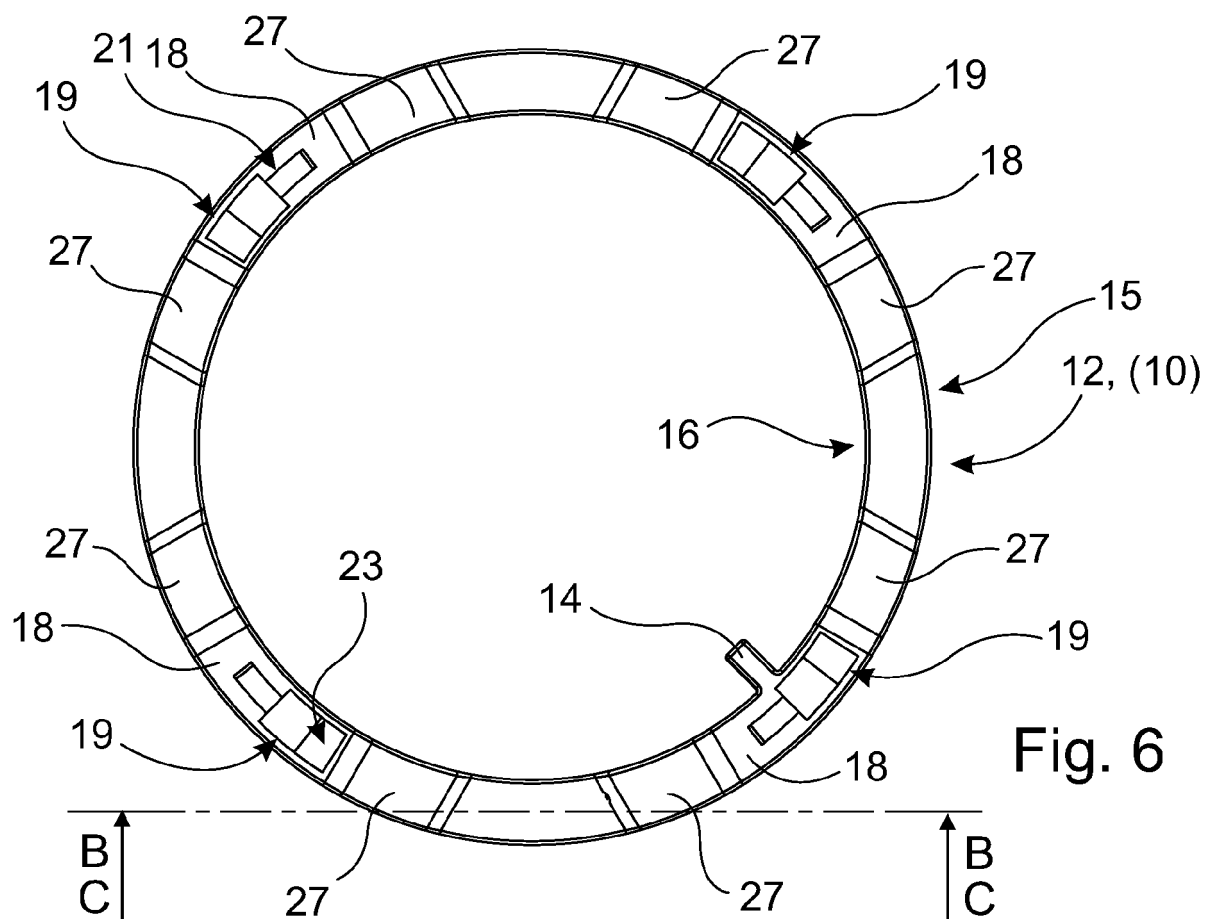


Fig. 7

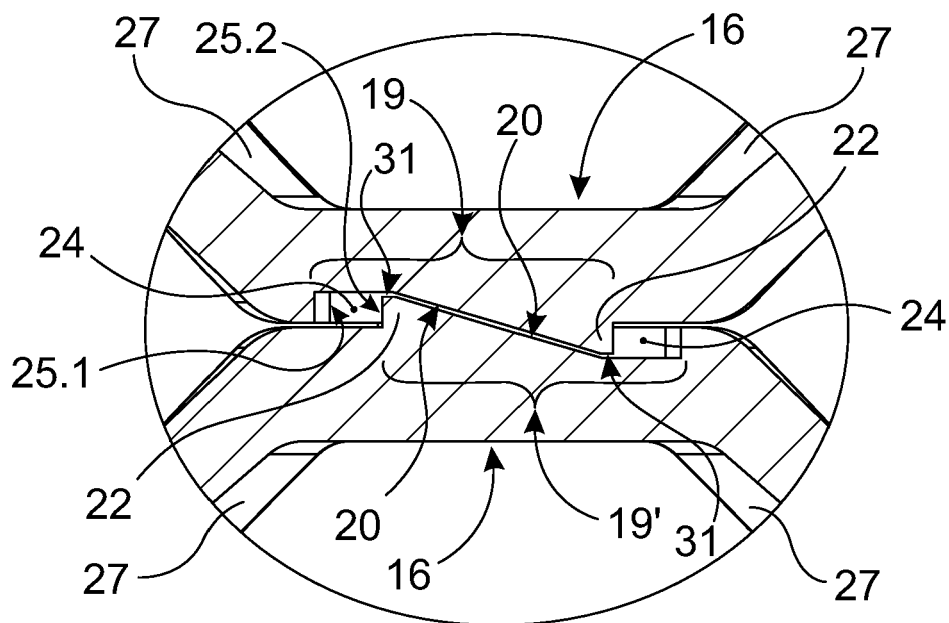


Fig. 8

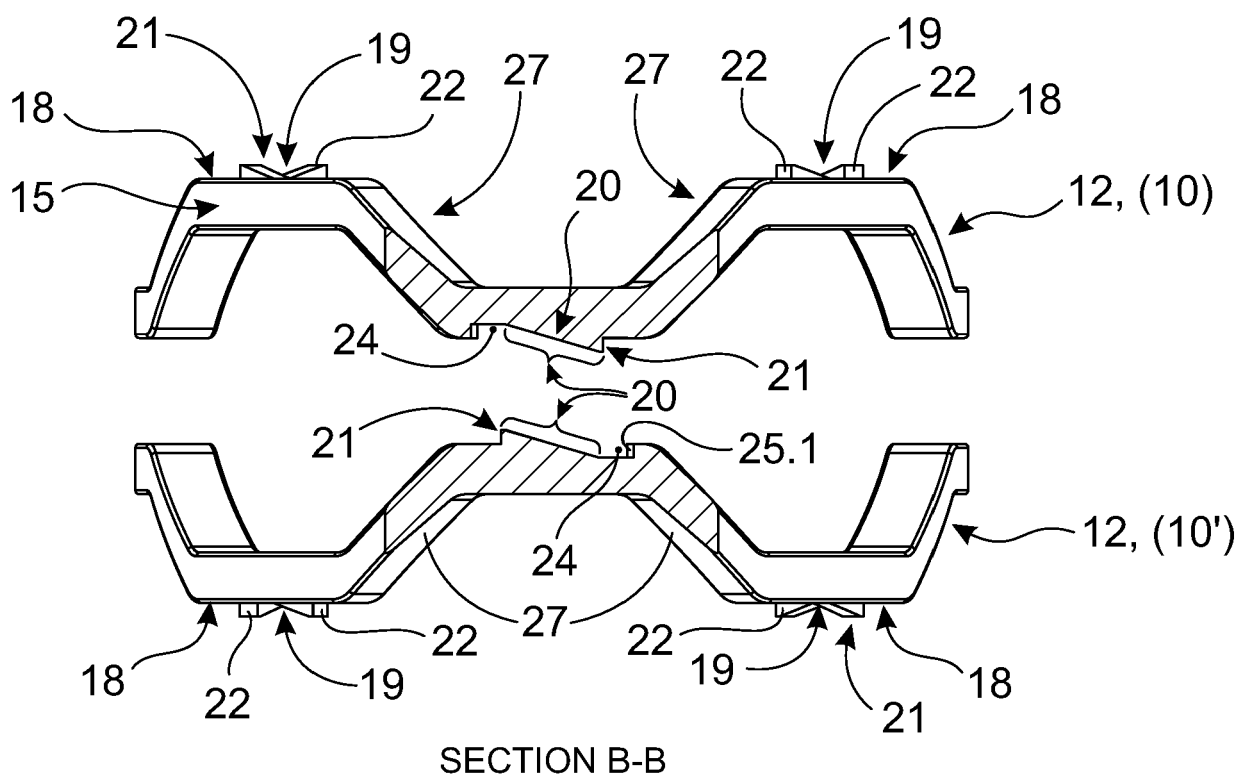
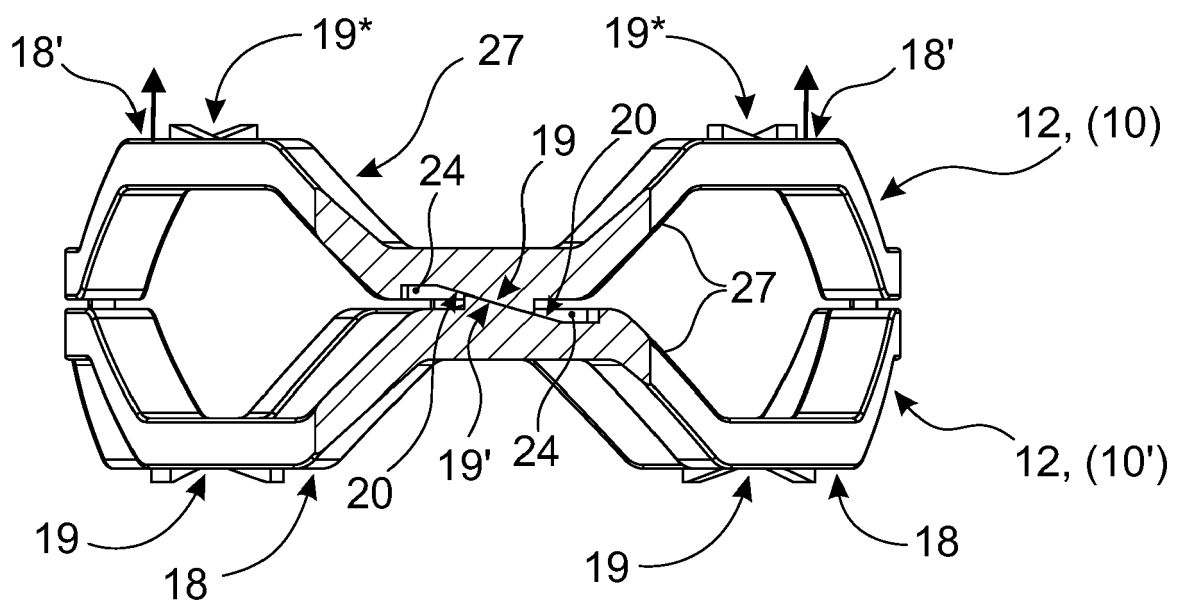


Fig. 9



SECTION C-C

Fig. 10



EUROPEAN SEARCH REPORT

Application Number
EP 20 15 0226

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Place of search The Hague		Date of completion of the search 30 April 2020	Examiner Kun, Karla
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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