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(54) **DRINKING STRAW OF FIBRE-BASED MATERIAL, COMPUTER- IMPLEMENTED OR ELECTRONIC METHOD FOR PRODUCING THE DRINKING STRAW, AND COMPUTER-READABLE STORAGE MEDIUM**

(57) A drinking straw (11, 22, 25, 29) of fibre-based material comprises a fibre-based material web (1), the drinking straw being open at both ends and comprising a hollow drinking straw body (13, 23, 26, 30) with a passage extending along a length (l, lb1, lb2) of the drinking straw body. The drinking straw body comprises at least three side walls (6, 7, 32) forming the passage, wherein one (32) of the at least three side walls comprises two

wall areas (5, 8) being fixedly arranged at least partly overlapping in an overlap region (14, 24, 27, 31) along the length of the drinking straw body such as to build the one of the at least three side walls. The invention comprises a computer-implemented or electronic method for producing the drinking straw and a computer-readable storage medium.

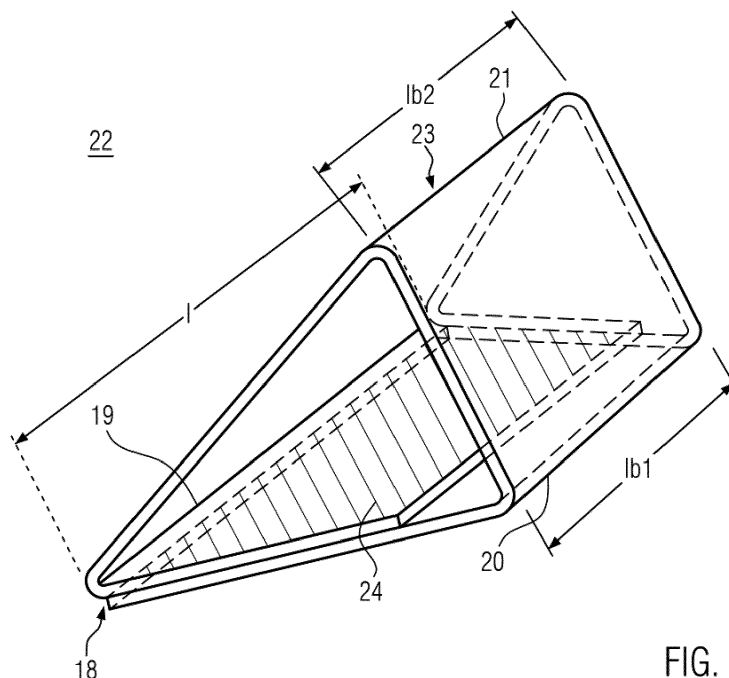


FIG. 3a

Description

[0001] The invention refers to a drinking straw according to claim 1, a computer-implemented or electronic method for producing the drinking straw according to claim 11 and a computer-readable storage medium according to claim 15.

Prior art

[0002] CA 157662 A discloses a paper straw formed of two plies. In a first option, the inner strip of paper is spirally wound on a mandrel with its edges abutting to form a tube, and a strip of paper forming the outer ply of the finished straw is wound over the tube formed from the inner strip so as to cover the joints thereof. In a second option, a single strip of paper may be longitudinally coiled to form two plies.

[0003] A foldable paper straw has been designed by Cheng Wang-Dong. Both the straw and the packaging are made of paper that are provided as a flat paper package. After opening, with a gentle push, the straw can assume a rectangular cylinder shape and can be readily used. After being used, the straw can be flattened and put back in the packaging for recycling.

Problem

[0004] The problem to be solved by the invention is providing a drinking straw that can be produced with a high production rate and that is stable in shape, and a respective computer-implemented or electronic method for producing such a drinking straw.

Solution

[0005] This problem is solved by the drinking straw of claim 1, the computer-implemented or electronic method of claim 11 and the computer-readable storage medium of claim 15. Preferred embodiments are disclosed in the dependent claims.

[0006] The drinking straw of fibre-based material comprises a fibre-based material web, the drinking straw being open at both ends and comprising a hollow drinking straw body with a passage extending along a length of the drinking straw body. The drinking straw body comprises at least three side walls forming the passage, wherein one of the at least three side walls comprises two wall areas being fixedly arranged at least partly overlapping in an overlap region along the length of the drinking straw body such as to build the one of the at least three side walls.

[0007] The fibre-based material web may have n linear grooves ($n \geq 3$) that separate an upper rectangular surface side of the fibre-based material web in $n+1$ rectangular surface areas. The $n+1$ rectangular surface areas may comprise a first wall area, $n-1$ side walls, and a second wall area. The n^{th} side wall may be built by the first

and second wall area being fixedly arranged at least partly overlapping in the overlap region along the length of the drinking straw body. The n side walls may define a hollow drinking straw body of the drinking straw with the passage extending along the length of the drinking straw body. The $n-1$ side walls are delimited by two grooves, respectively, and the first and second wall areas are each delimited by one groove. The width of the overlap region be equal or less than the width of the n^{th} side wall, where the width of the overlap region may depend on the widths of the first and second wall areas and the desired width of the n^{th} side wall.

[0008] The fibre-based material web may be folded at the grooves, and the first and second wall areas overlap in the overlap region. In order to attach the first and second wall areas to each other in the overlap region, e.g., an adhesive may be used.

[0009] The fibre-based material web may be provided as a sheet of fibre-based material. Alternatively, a roll of fibre-based material may be provided from which the fibre-based material may be unwound and the fibre-based material web may be cut off before or after folding. The roll of fibre-based material may comprise the grooves either extending parallel or perpendicular to a direction in which the fibre-based material is unwound from the roll, or the grooves may be provided when the fibre-based material is unwound or while the fibre-based material web is cut off or after the fibre-based material has been cut off.

[0010] A size of the overlap region can correspond to 25% to 100% of a size of the one of the at least three side walls. The size may be defined by the width of the overlap region and the length of the fibre-based material web. E.g., the width of the overlap region may be 25% of the width of the one of the at least three side walls, i.e., the n^{th} side wall.

[0011] One of the ends of the drinking straw body may comprise a slant. The drinking straw body can be cut such as to provide the slant. A plane being defined by the cutting edges may define an angle between 20° to 45° with a longitudinal axis of the drinking straw body. Alternatively, the shape of the fibre-based material web may be configured such that the slant forms automatically when the fibre-based material web is folded at the grooves.

[0012] The slant can be reinforced, optionally by means of food safe wax, varnish, and/or water-glass (e.g., sodium silicate, potassium silicate). This may help in case the slant is used to penetrate a (foil) closed opening of a container.

[0013] In one embodiment, the drinking straw body can comprise three side walls, and a cross section of the passage can be an isosceles triangle, or an equilateral triangle, or a triangle with three different sides. Having an isosceles triangular cross section, a slant may optionally be provided by cutting one of the ends of the drinking straw body such that the tip of the slant is formed by the two sides having equal lengths. Optionally, the one side wall comprising the overlap region, in that the fibre-based

material web is arranged fixedly overlapping along the length of the drinking straw body (i.e., the n^{th} side wall comprising the first and second wall areas), is arranged next to the slant; this may reinforce the slant as the two overlapping wall areas are thicker than one side wall.

[0014] The drinking straw body can comprise an uneven number of side walls, wherein the uneven number is three or more. "More" in this case means an uneven value bigger than three.

[0015] In another embodiment, the drinking straw body can comprise four, five, six, or more side walls, and a cross section of the passage can be 4-sided, i.e., quadrangular, 5-sided, i.e., pentagonal, six-sided, i.e., hexagonal, or more-sided. "More" means $n > 6$ side walls such that the cross section is n -sided.

[0016] The drinking straw body can be non-foldable, wherein optionally the drinking straw body can be stable in shape. In order to be able to suck liquid through the passage of the drinking straw, the drinking straw should keep its shape during sucking, especially a reduction of the volume and/or the cross section of the passage, or a collapse of the passage, i.e., no or almost no passing of liquid possible, has to be prevented. For example, a triangular cross section when the drinking straw comprises three side walls provides a non-foldable drinking straw.

[0017] The fibre-based material web can comprise one or more layers of fibre-based material. Two or more of these layers may be attached to each other by means of adhesive or by applying a high pressure to connect the layers. Depending on the number of layers, the thickness of side walls of the drinking straw body may vary accordingly. Optionally, the fibre-based material web comprises coated fibre-based material.

[0018] The fibre-based material may comprise at least one of: wood fibres, bamboo fibres, bagasse fibres, seaweed fibres, fibres of banana plant, fibres of Abaca plant, synthetic fibres, polymer-based fibres, plastic fibres.

[0019] The fibre-based material web may be a paper web.

[0020] Optionally, the fibre-based material, and more optionally the drinking straw, may be biodegradable. Optionally, biodegradable may mean that the fibre-based material and/or the drinking straw of fibre-based material are degradable in a conventional compost heap, i.e., are suitable for home composting, and no industrial plant is required in order to decompose the fibre-based material and/or the drinking straw. Optionally, biodegradable may mean that the fibre-based material and/or the drinking straw of fibre-based material are degradable by using an industrial plant in order to decompose the fibre-based material and/or the drinking straw.

[0021] A computer-implemented or electronic method for producing the drinking straw as described above or below can comprise the steps as mentioned below.

[0022] The drinking straw to be produced comprises a fibre-based material web, the drinking straw being open at both ends and comprising a hollow drinking straw body

with a passage extending along a length of the drinking straw body. The drinking straw body comprises at least three surface areas, wherein one of the at least three surface layers comprises a region in that the fibre-based material web is arranged fixedly overlapping along the length of the drinking straw body.

[0023] The method comprises the steps of:

- providing fibre-based material with at least three grooves, or providing fibre-based material without grooves and then producing at least three grooves,
- applying an adhesive to the overlap region,
- folding the fibre-based material at the at least three grooves,
- arranging the fibre-based material fixedly overlapping in the overlap region,
- when providing the fibre-based material comprises providing the fibre-based material from a roll of fibre-based material, cutting the fibre-based material to form the fibre-based material web.

[0024] The order of these steps as given above is not limiting and does not represent an order that has to be followed. For example, the fibre-based material may be folded first and then adhesive may be applied to the overlap region.

[0025] The fibre-based material being provided may be:

- a fibre-based material web with grooves or a fibre-based material web without grooves. When the fibre-based material web is provided without grooves, at a later step grooves will have to be produced.
- fibre-based material that is unwound from a roll of fibre-based material. When the roll of fibre-based material is provided without grooves, at a later step grooves will have to be produced; the grooves may be produced parallel or perpendicular to a direction in that the fibre-based material is unwound from the roll of fibre-based material.

[0026] Optionally, the at least three grooves have a length corresponding to the length of the drinking straw body of the drinking straw to be produced.

[0027] The method can further comprise the step of cutting one of the ends of the drinking straw such as to provide a slant.

[0028] Alternatively, the fibre-based material may be cut before being folded at the grooves and/or before adhesive is applied to the overlap region and/or before the fibre-based material is arranged fixedly overlapping in the overlap region along the length of the drinking straw body to be produced.

[0029] Additionally, the method can comprise the step of reinforcing the slant.

[0030] The step of providing the fibre-based material web can comprise providing the fibre-based material (or a fibre-based material web) with three grooves, wherein optionally the length is 100 mm to 145 mm, wherein optionally a distance of neighbouring grooves is 4 mm to 8 mm.

[0031] The computer-implemented or electronic method may be performed by a system comprising at least one processor that may be configured to perform the method by executing respective instructions that may be stored on a computer-readable medium.

[0032] A computer-readable storage medium comprises instructions stored thereon that when executed by a processor of a system, cause the system to perform the method as described above or below.

[0033] The instructions may be used to operate one or more machines that are configured to unwind fibre-based material from a roll of fibre-based material (being provided with fibre-based material with or without grooves), to cut a fibre-based material web from the fibre-based material of the roll of fibre-based material, to provide a fibre-based material web (with or without grooves), to provide the fibre-based material unwound from the roll of fibre-based material or the fibre-based material web with grooves, to provide adhesive to the overlap region (of the first wall area and/or second wall area), to fold the fibre-based material unwound from the roll of fibre-based material or fold the fibre-based material web at the grooves, to arrange the folded fibre-based material unwound from the roll of fibre-based material or the folded fibre-based material web after being provided with adhesive to fixedly overlapping in the overlap region along the length of the drinking straw body to be produced, to cut one of the ends of the drinking straw body such as to provide a slant, and/or to reinforce the slant.

[0034] Preferred embodiments of the invention will be illustrated with reference to the enclosed figures. In the figures:

Figure 1 shows a perspective view of a fibre-based material web for producing a drinking straw with a triangular cross section;

Figure 2a shows a perspective view of a drinking straw with triangular cross section with a first overlap region;

Figure 2b shows a perspective view of a drinking straw with triangular cross section with a second overlap region;

Figure 2c shows a lateral view of the drinking straw of Figure 2a/2b;

Figure 3a shows the drinking straw of Figure 2a provided with a slant;

Figure 3b shows a lateral view of the drinking straw of Figure 3a;

Figure 3c shows the drinking straw of Figure 2b provided with a slant;

Figure 3d shows a lateral view of the drinking straw of Figure 3c; and

Figure 4 shows a flow diagram of one embodiment of a method for producing a drinking straw.

[0035] Figure 1 shows a perspective view of a fibre-based material web 1 for producing a drinking straw with a triangular cross section. The shown fibre-based material web 1 of length l , width w and thickness t comprises three linear, parallel grooves 2, 3, 4, that separate the depicted upper rectangular surface side of the fibre-based material web 1 in a first wall area 5 with a width w_0 , two side walls 6, 7 with widths w_1 , w_2 , respectively, and a second wall area 8 with a width w_3 . For producing the drinking straw, the fibre-based material web 1 will be folded at the grooves 2, 3, 4 in order to produce a hollow cylindrical drinking straw body (see, e.g., Figure 2: drawing straw body 13) with a triangular cross section. The sum of the individual widths w_0 , w_1 , w_2 , w_3 is equal to the width w of the fibre-based material web 1.

[0036] Next to a first edge 9 along the length l of the fibre-based material web 1, the first wall area 5 extends; next to the first wall area 5, the first side wall 6 extends; next to the first side wall 6, the second side wall 7 extends; next to the second side wall 7, the second wall area 8 extends, where the second wall area 8 comprises a second edge 10 along the length l of the fibre-based material web 1.

[0037] Figure 2a shows a perspective view of a drinking straw 11 with triangular cross section 12 and a drinking straw body 13 that may be produced by using the fibre-based material web 1 of Figure 1. The fibre-based material web 1 has been folded at the grooves 2, 3, 4. The first wall area 5 overlaps the second wall area 8 in an overlap region 14 and form the third side wall 32. In order to attach the first wall area 5 in the overlap region 14 with the second wall area 8, e.g., an adhesive 15 may be used. In the shown embodiment, the adhesive 15 is provided between the second wall area 8 and the rear side of the first wall area 5. In general, the drinking straw 11 will have rounded straw edges 16 where the fibre-based material web 1 has been folded at the grooves 3, 4 that are located between the first and second side wall 6, 7 and the second side wall 7 and the second wall area 8, respectively. The edge 17 that is located where the fibre-based material web 1 has been folded at the groove 2 between the first wall area 5 and the first side wall 6 is also rounded but next to it lies the second edge 10. The first edge 9 lies inside the hollow part of the drinking straw 11.

[0038] The third side wall of the drinking straw body

has a width w_4 that is defined by the width w_0 of the first wall area 5 and the width w_3 of the second wall area 8 and a width d of an overlap region (Figure 2: overlap region 14):

$$w_4 = w_0 + w_3 - d, \text{ where } 2\text{mm} \leq d \leq w_4.$$

[0039] The minimal value of the width of the overlap region may be more or less than 2mm.

[0040] The embodiment shown in Figure 2a shows a drinking straw 11 of the length l with the described triangular cross section 12, where the drinking straw 11 is not provided with a slant.

[0041] Figure 2b shows a perspective view of a drinking straw 25 with triangular cross section 12 with a second overlap region 27. In order to attach the first wall area 5 in the overlap region 27 with the second wall area 8, e.g., an adhesive 28 may be used. In the shown embodiment, the adhesive 28 is also provided between the second wall area 8 and the rear side of the first wall area 5. The first wall area 5 and the second wall area 8 overlap in the overlap region 27 and form the third side wall 33.

[0042] Figure 2c shows a lateral view of the drinking straw of Figure 2a/2b.

[0043] Figure 3a shows the drinking straw of Figure 2a that is provided with a slant 18. In the shown embodiment, the slant 18 is provided such that the overlap region 24 is part of the slant 18.

[0044] Now, one edge 19 of the drinking straw body 23 still has the length l , while the other two edges 20, 21 have shorter lengths l_{b1} , l_{b2} . The other two lengths l_{b1} , l_{b2} may have the same value, or may have different values.

[0045] Figure 3b shows a lateral view of the drinking straw 22 of Figure 3a.

[0046] Figure 3c shows the drinking straw 29 of Figure 2b that is provided with a slant 18. The overlap region 31 is not located next to the slant 18.

[0047] Figure 3d shows a lateral view of the drinking straw 29 of Figure 3a.

[0048] Figure 4 shows a flow diagram of one embodiment of a method for producing a drinking straw.

[0049] The drinking straw may be a drinking straw as described above or below.

[0050] In step 100, a fibre-based material with at least three grooves may be provided. The fibre-based material may be the fibre-based material web or may be fibre-based material unwound from a roll of fibre-based material.

[0051] Alternatively, in step 101, fibre-based material without grooves may be provided. Then, in step 102, at least three grooves are produced; this step does not have to follow immediately after step 101.

[0052] In step 103, an adhesive is applied to the overlap region,

[0053] In step 104, the fibre-based material is folded

at the at least three grooves. Step 103 may alternatively follow after step 104.

[0054] In step 105, the (folded) fibre-based material is arranged fixedly overlapping in the overlap region. In this step, the overlap region has already to be provided with adhesive.

[0055] When providing the fibre-based material comprises providing the fibre-based material from a roll of fibre-based material, in step 106, the fibre-based material is cut to form the fibre-based material web to form the fibre-based material web.

[0056] In step 107, one of the ends of the drinking straw body may be cut such as to provide a slant.

[0057] In step 108, the slant may be reinforced, optionally by means of food safe wax, varnish, and/or water-glass.

Claims

1. Drinking straw (11, 22, 25, 29) of fibre-based material comprising a fibre-based material web (1), the drinking straw (11, 22, 25, 29) being open at both ends and comprising a hollow drinking straw body (13, 23, 26, 30) with a passage extending along a length (l , l_{b1} , l_{b2}) of the drinking straw body (13, 23, 26, 30), **characterised in that** the drinking straw body (13, 23, 26, 30) comprises at least three side walls (6, 7, 32) forming the passage, wherein one (32) of the at least three side walls (6, 7, 32) comprises two wall areas (5, 8) being fixedly arranged at least partly overlapping in an overlap region (14, 24, 27, 31) along the length (l) of the drinking straw body (13, 23, 26, 30) such as to build the one of the at least three side walls (32).
2. The drinking straw (11, 22, 25, 29) of claim 1, wherein a size of the overlap region (14, 24, 27, 31) corresponds to 25% to 100% of a size of the one (32) of the at least three side walls (6, 7, 32).
3. The drinking straw (22, 29) of claim 1 or 2, wherein one of the ends of the drinking straw body (23, 30) comprises a slant (18).
4. The drinking straw (22, 29) of claim 4, wherein the slant (18) is reinforced, optionally by means of food safe wax, varnish, and/or water glass.
5. The drinking straw (11, 22, 25, 29) of one of claims 1 to 4, wherein the drinking straw body (13, 23, 26, 30) comprises three side walls (6, 7, 32), and wherein a cross section of the passage is an isosceles triangle, or an equilateral triangle, or a triangle with three different sides.
6. The drinking straw (11, 22, 25, 29) of one of claims 1 to 4, wherein the drinking straw body (13, 23, 26,

- 30) comprises an uneven number of side walls (6, 7, 32), wherein the uneven number is three or more.
7. The drinking straw of one of claims 1 to 4, wherein the drinking straw body comprises four, five, six, or more side walls, and wherein a cross section of the passage is 4-sided, i.e., quadrangular, 5-sided, i.e., pentagonal, six-sided, i.e., hexagonal, or more-sided. 5
8. The drinking straw (11, 22, 25, 29) of one of claims 1 to 7, wherein the drinking straw body (13, 23, 26, 30) is non-foldable, wherein optionally the drinking straw body (13, 23, 26, 30) is stable in shape. 10
9. The drinking straw (11, 22, 25, 29) of one of claims 1 to 8, wherein the fibre-based material web (1) comprises one or more layers, wherein optionally the fibre-based material web (1) comprises coated fibre-based material. 15
10. The drinking straw (11, 22, 25, 29) of one of claims 1 to 9, wherein the fibre-based material comprises at least one of: wood fibres, bamboo fibres, bagasse fibres, seaweed fibres, fibres of banana plant, fibres of Abaca plant, synthetic fibres, polymer-based fibres, plastic fibres, optionally the fibre-based material is paper. 20
11. Computer-implemented or electronic method for producing a drinking straw (11, 22, 25, 29) according to one of claims 1 to 10, wherein the method comprises the steps of: 30
- providing (100) fibre-based material with at least three grooves, or providing (101) fibre-based material without grooves and then producing (102) at least three grooves, 35
 - applying (103) an adhesive to the overlap region, 40
 - folding (104) the fibre-based material at the at least three grooves,
 - arranging (105) the fibre-based material fixedly overlapping in the overlap region,
 - when providing the fibre-based material comprises providing the fibre-based material from a roll of fibre-based material, cutting (106) the fibre-based material to form the fibre-based material web. 45
12. The method of claim 11, further comprising the step of cutting (107) one of the ends of the drinking straw body such as to provide a slant. 50
13. The method of claim 12, further comprising the step of reinforcing (108) the slant. 55
14. The method of one of claims 11 to 13, wherein the
- step of providing the fibre-based material comprises providing a fibre-based material web with three grooves, wherein optionally the length of the fibre-based material web is 100 mm to 145 mm, wherein optionally a distance of neighbouring grooves is 4 mm to 8 mm.
15. A computer-readable storage medium with instructions stored thereon that when executed by a processor of a system cause the system to perform the method of one of claims 11 to 14.

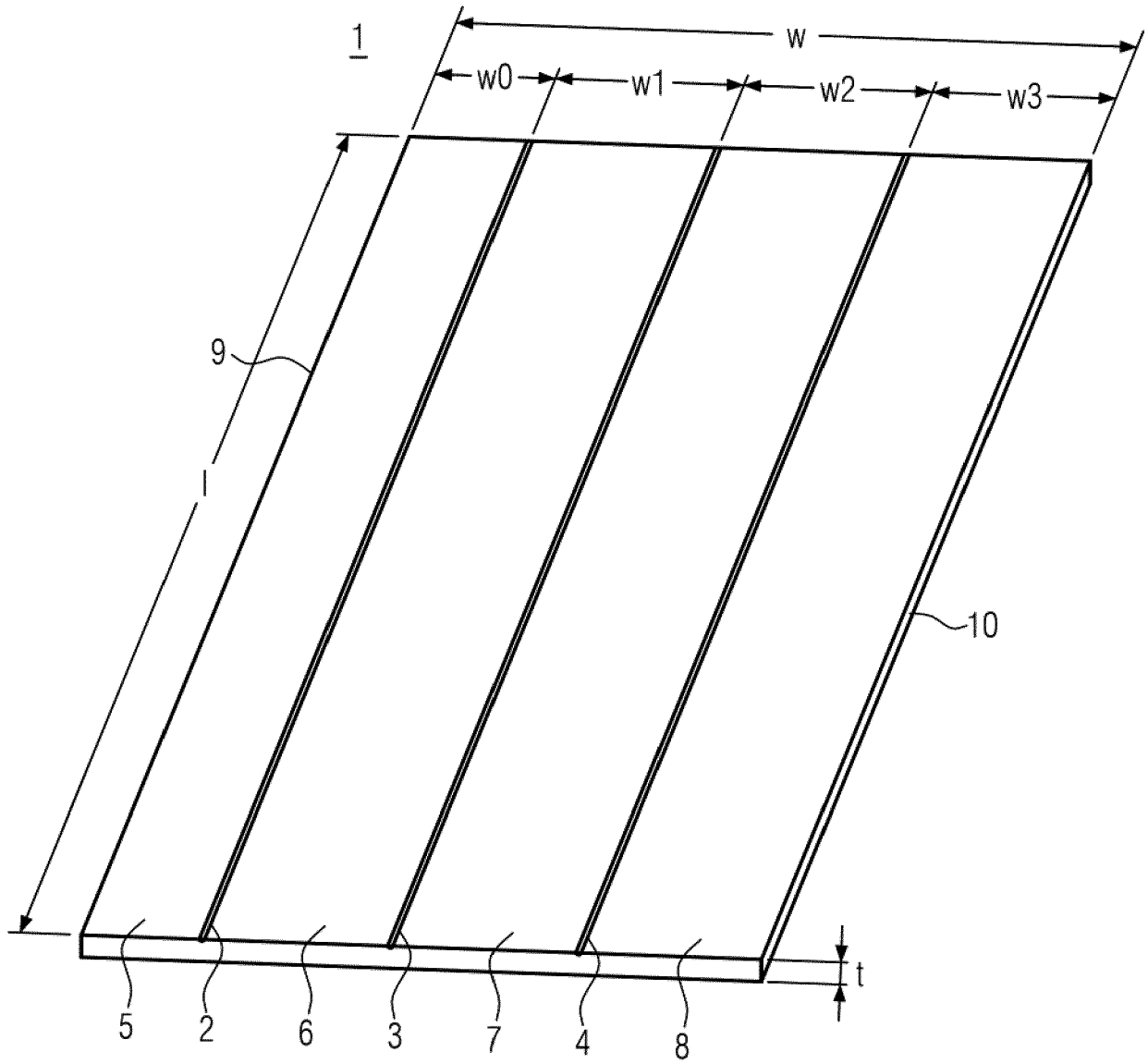
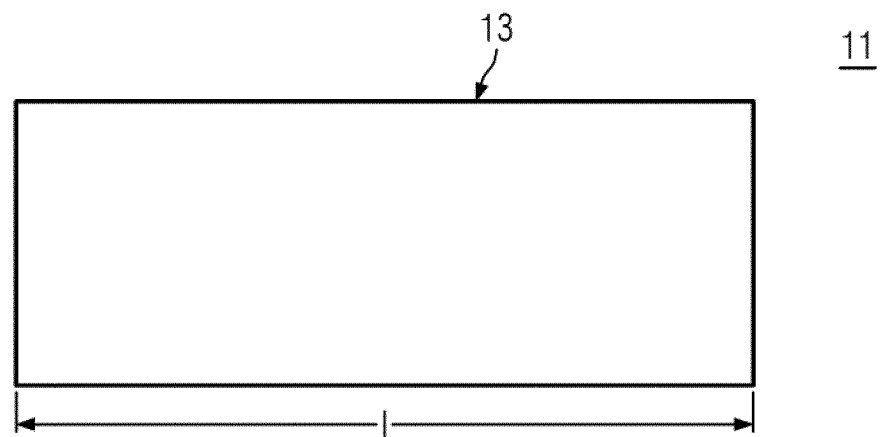
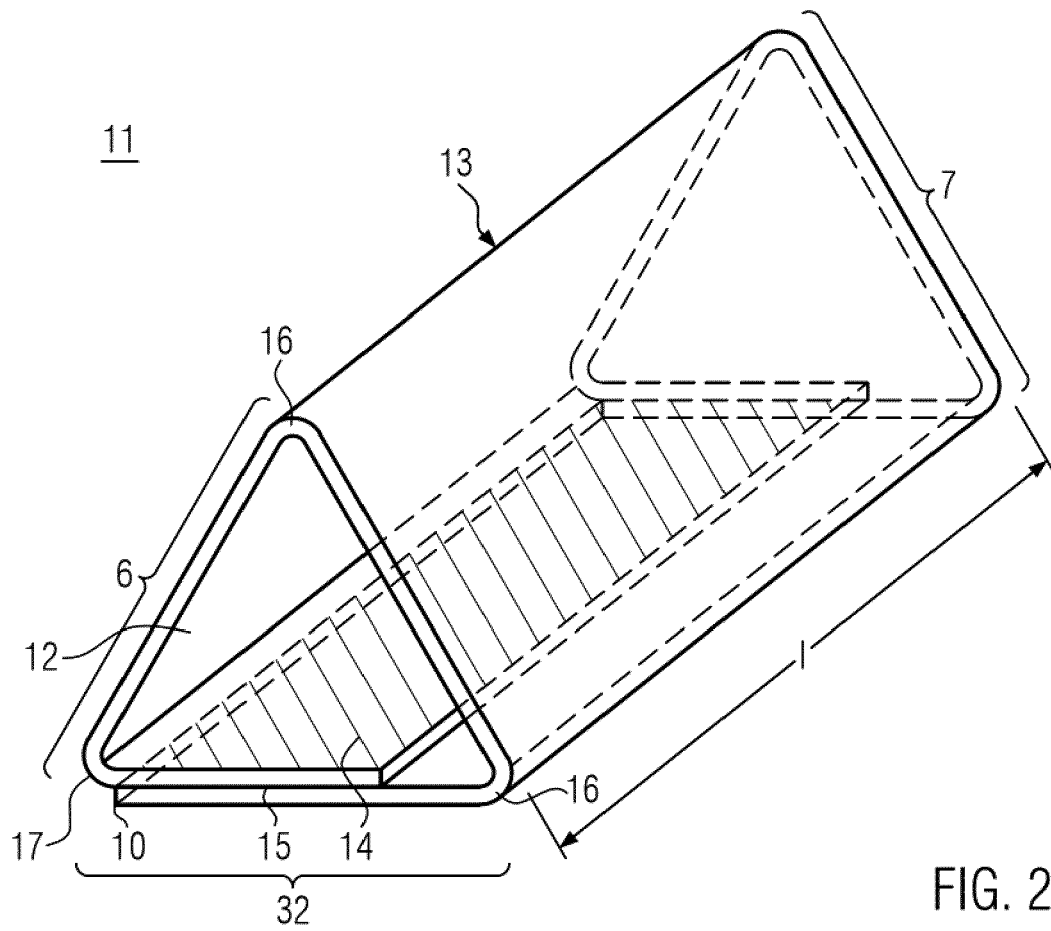
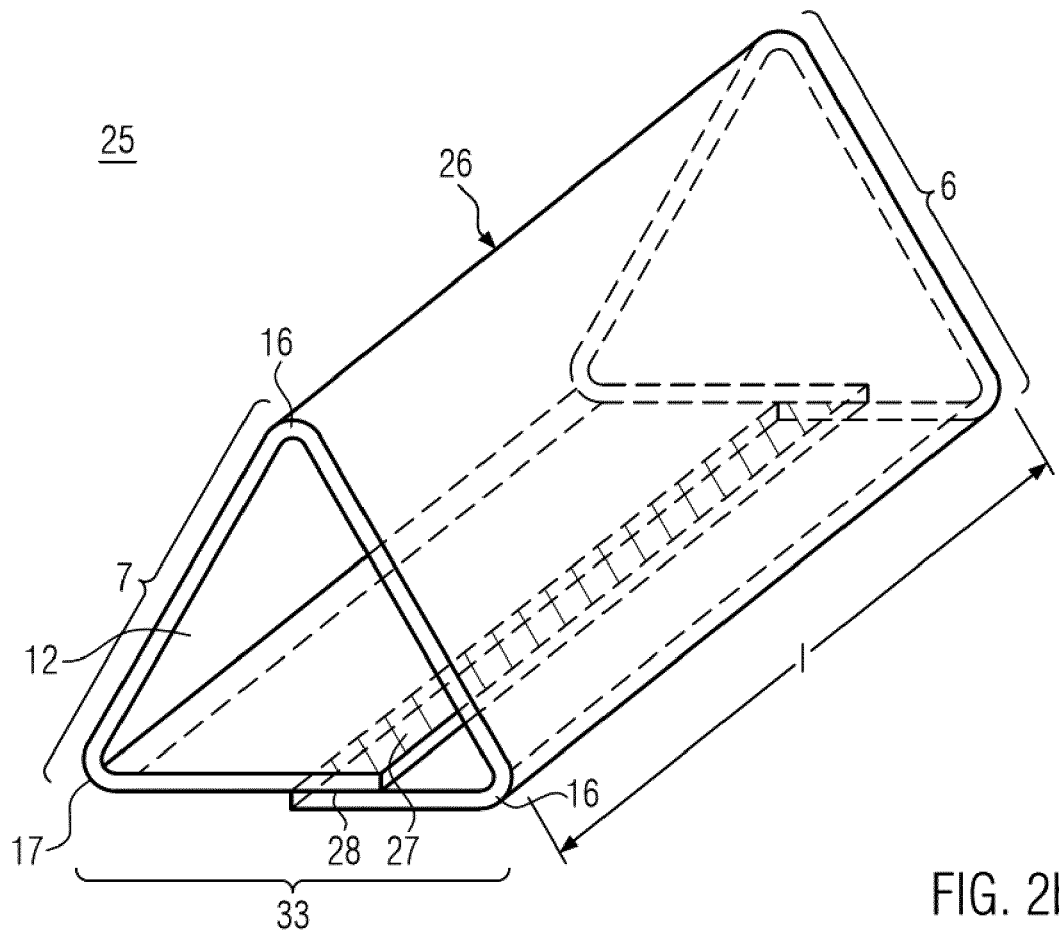
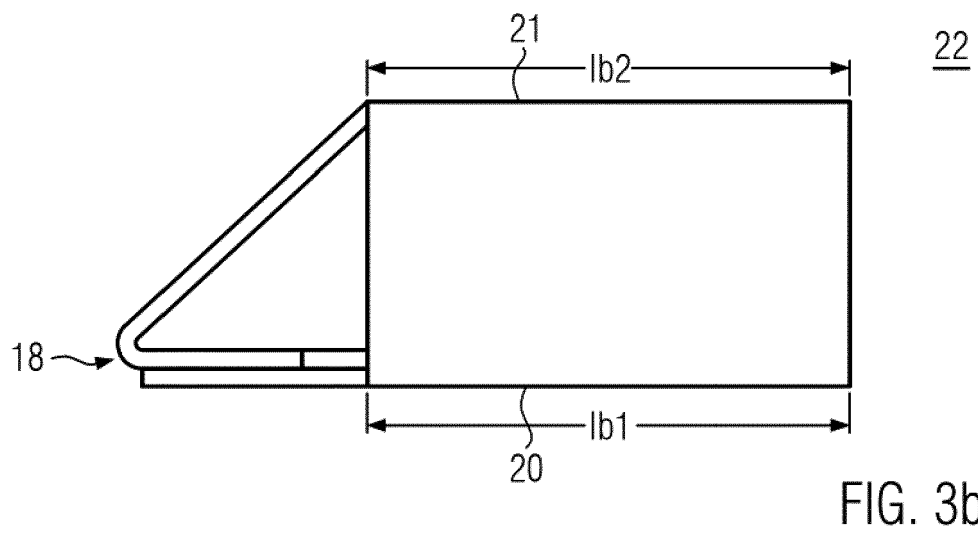
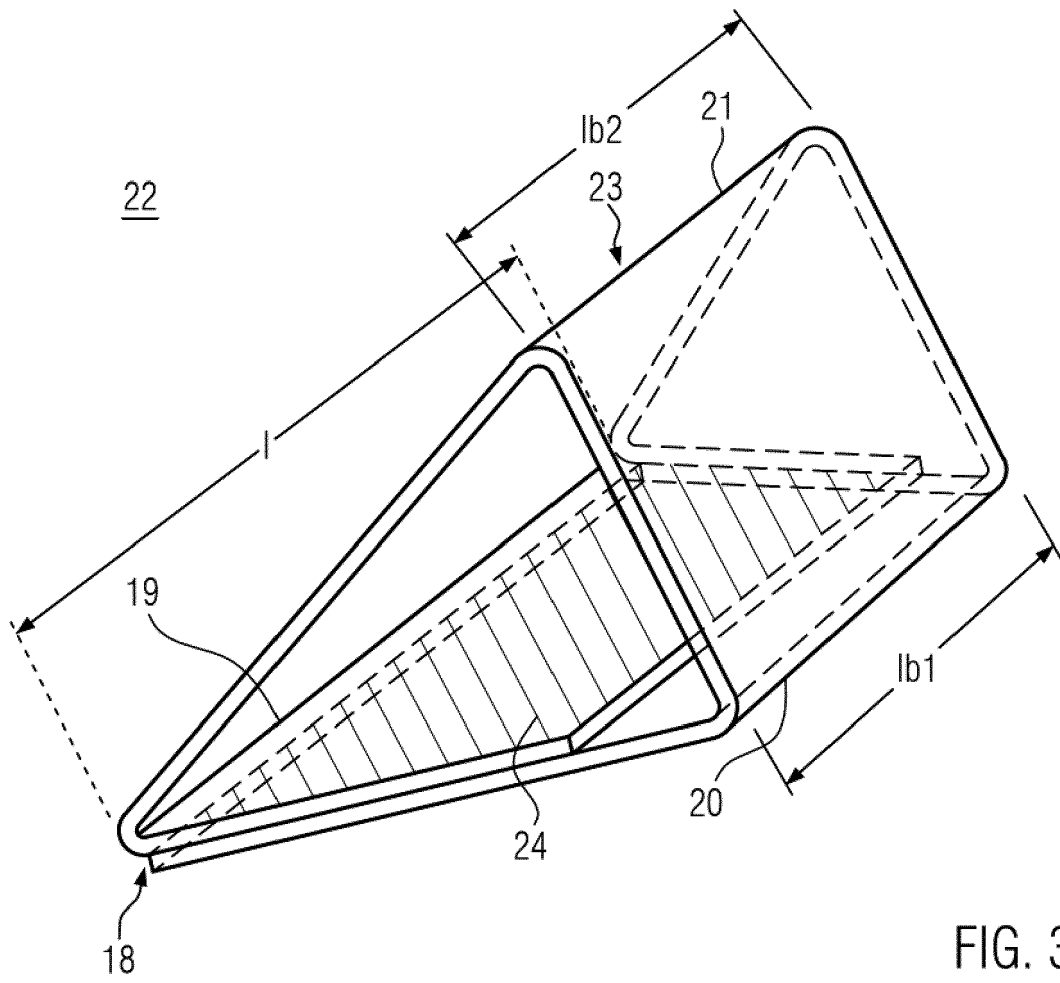
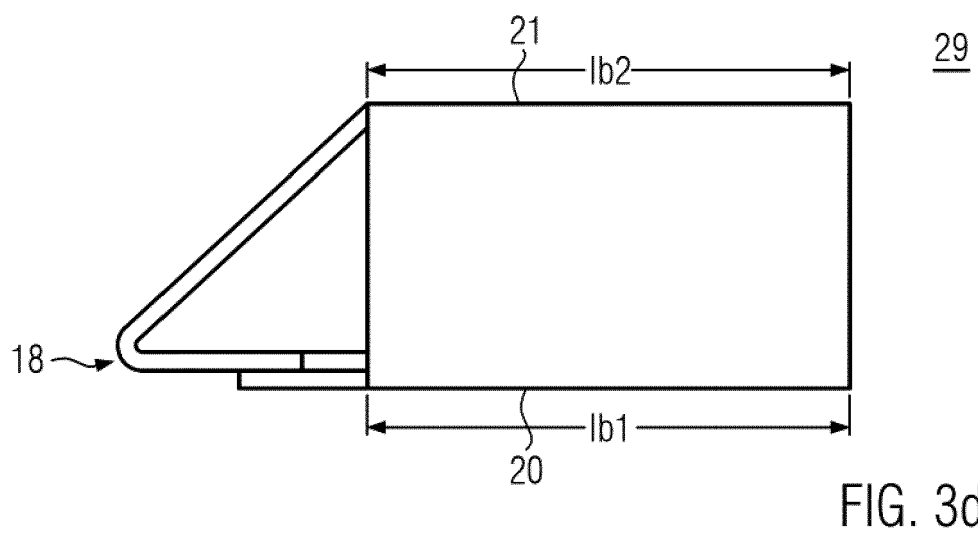
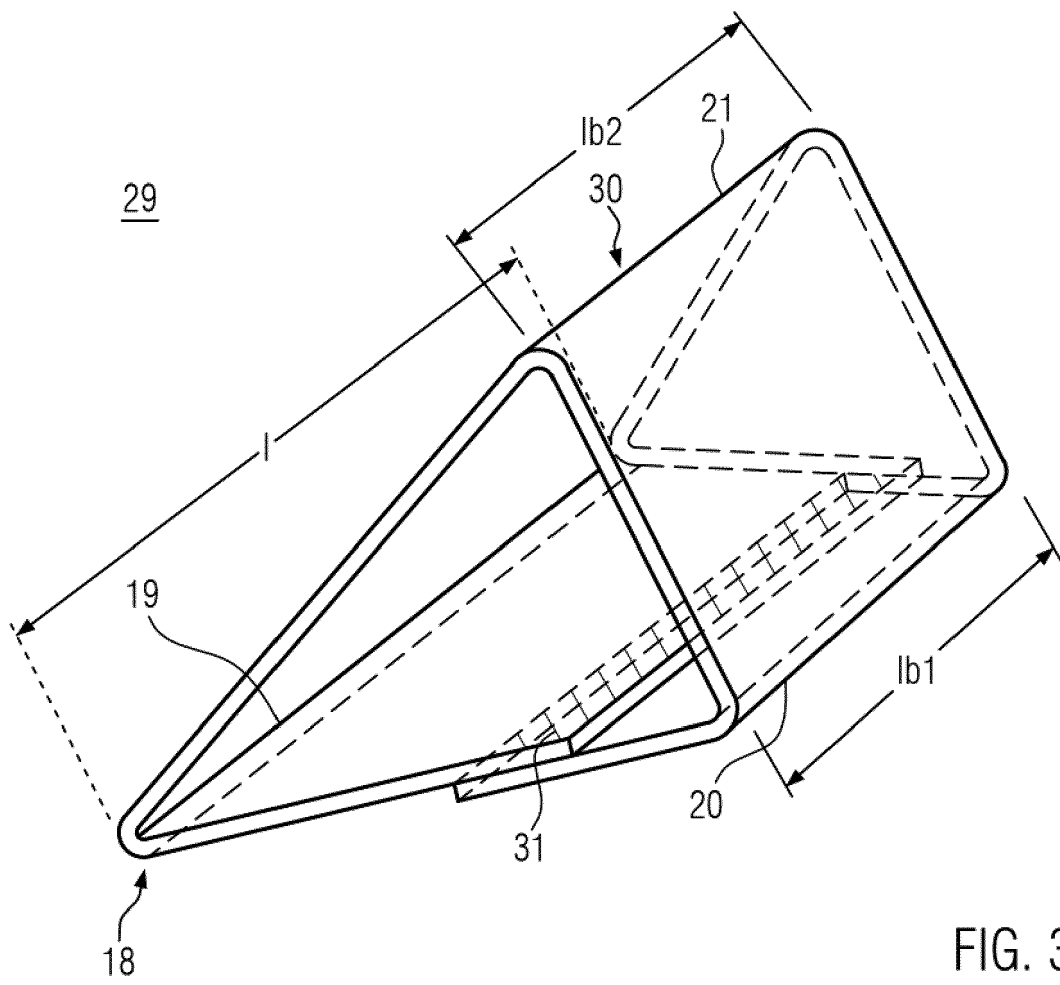


FIG. 1









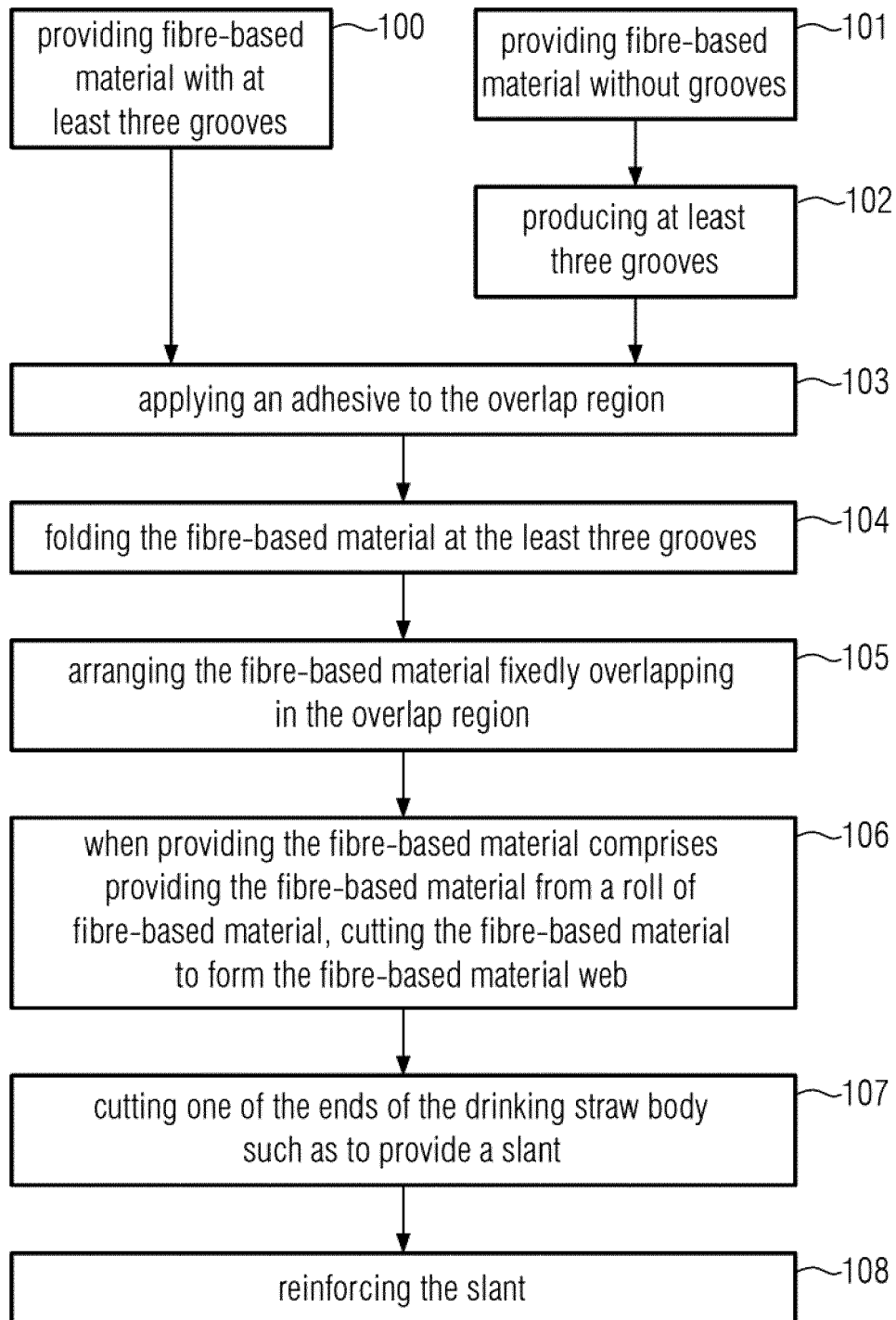


FIG. 4



EUROPEAN SEARCH REPORT

 Application Number
 EP 18 19 6421

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DOCUMENTS CONSIDERED TO BE RELEVANT			
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 12 March 2019	Examiner Vistisen, Lars
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