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(54) Benævnelse: **BAGKANTREM PÅ ET ROTORBLAD PÅ ET VINDKRAFTANLÆG, ROTORBLAD OG FREMGANGSMÅDE TIL AT FREMSTILLE EN BAGKANTREM**

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EP-A1- 2 543 499
DE-B3-102010 055 874
US-A- 5 392 514
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Description

[1] The invention relates to a trailing edge spar cap of a rotor blade of a wind turbine, to a rotor blade of a wind turbine and to a method for manufacturing a trailing edge spar cap of a rotor blade of a wind turbine.

[2] The manufacture of rotor blades for wind turbines takes place in a time-consuming and labor-intensive process in which numerous work steps are carried out manually. In many cases, the rotor blades are composed of two half-shells, a pressure side shell and a suction side shell. The rotor blade shells consist predominantly of glass and/or carbon fiber materials impregnated with epoxy resin, in which core material, for example foam or balsa wood, is also inserted. To manufacture the rotor blade shells, the fiber material is placed in a mold and combined with core material in a sandwich construction.

[3] In the region of the trailing edge of the rotor blade, i.e., on a trailing edge of the blade shells, spar caps constructed of continuous fibers, so-called trailing edge spar caps, are integrated into the rotor blade shells. The trailing edge spar caps are necessary in order to maintain a predefined strain level of the rotor blade. This results from the changing dead weight moments that occur when using the rotor blade and from the pivoting loads resulting from the torque. A rotor blade constructed of two half-shells and provided with trailing edge spar caps is known from DE 10 2010 055 874 B3, for example, the trailing edge spar cap being formed by inserting resin-soaked rovings in a tool mold and curing the same.

[4] Various demands are placed on a trailing edge spar cap. From a structural point of view, it should be located as far back as possible in the rotor blade, i.e., placed close to the trailing edge of the rotor blade. In addition, the trailing edge spar cap should be easy to adapt to different geometries or blade profiles. It should be as compact as possible in order to avoid dent failure. Furthermore, the spar cap should, if possible, be manufacturable in a simple and reproducible manner, for example, as a prefabricated component (often also referred to as “prefab”). As little rework as possible should be required on the manufactured rotor blade or on the manufactured rotor blade shell. The trailing edge spar cap should also be easy to integrate into the rotor blade shell.

[5] Block trailing edge spar caps are known in which the reinforcement layers are stacked one on top of the other. In the case of block spar caps, the individual fiber layers are not offset from one another. The fiber layers are not considered to be offset from one another if their maximum offset is on the order of one layer thickness.

[6] In addition, fanned-out trailing edge spar caps are known, in which the individual fiber layers are offset from one another. In the case of a fanned out spar cap, the offset of the individual successive layers, i.e., situated directly on top of one another, is greater than the dimension of a single layer, i.e., of the layer thickness. Fanned out trailing edge spar caps taper significantly toward the trailing edge, so that they may also be placed in tapering blade profiles near the rotor blade trailing edge.

[7] Pure block spar caps are not suitable or only poorly suitable for this purpose due to their geometry. They cannot be placed near the trailing edge in tapering profiles. Accordingly, such a block spar cap is not optimally placed for the load in the pivoting direction. Fanned-out spar caps extend far in the direction of the trailing edge of the rotor blade, but they usually also taper significantly in the direction of the leading edge of the rotor blade. This may cause the spar cap to buckle during operation. In addition, some of the layers of such spar caps are far removed from the trailing edge and are therefore not in an optimal position to absorb loads in the pivoting direction.

[8] US Pat. No. 5 392 514 A relates to a method for manufacturing a shell of a lightweight composite propulsor blade having a spar and shell construction with a leading edge section that is twice as thick as the rest of the shell.

[9] EP 2 543 499 A1 relates to a wind turbine blade, which has a shell structure made of a fiber-reinforced polymer material with a polymer matrix and a reinforcement material with several carbon fiber layers embedded in the polymer matrix, at least part of the shell structure being formed from a laminate that comprises at least one metal filament layer, which has metal filaments and is arranged between two carbon fiber layers that include only carbon fibers, the carbon fiber layers being arranged contiguously with the metal filament layer.

[10] It is an object of the invention to specify an improved trailing edge spar cap, an improved rotor blade having such a trailing edge spar cap and an improved method for manufacturing a trailing edge spar cap of a rotor blade of a wind turbine.

[11] The object is achieved by a trailing edge spar cap of a rotor blade of a wind turbine, which is further developed in that a first fiber layer, a second fiber layer, a block fiber layer and a block-shaped core layer are formed from core material, the block fiber layer and the core layer being arranged on the first fanned out fiber layer provided with at least one bevel, and the block fiber layer and the core layer being arranged with one each of their end faces opposite one another, and the fanned-out second fiber layer provided with at least one bevel being arranged on the block fiber layer and the core layer, the fiber layers and the core layer being infused with resin and the resin being cured.

[12] In the context of the present description, the first fiber layer, the second fiber layer and the block fiber layer are each understood to mean a sequence of fiber layers and not a single layer. If reference is to be made to an individual fiber layer, then this is referred to as a single layer.

[13] The trailing edge spar cap according to the invention is a trailing edge spar cap that includes an integrated core material. The core layer is made of foam or balsa wood, for example. The fiber material is, for example, a scrim made of glass or carbon fibers. Various demands are placed on the trailing edge spar cap of a rotor blade that are not optimally met either by pure block spar caps or by fanned out spar caps. It would be possible to combine these two designs with each other in order to find a compromise. However, such a spar cap design is highly asymmetrical in the thickness direction and is therefore prone to buckling. In addition, such a spar cap is complex to construct and produces an inner contour disadvantageous for composite construction and which has steps. In addition, a combination of a fanned-out spar cap and a block spar cap would result in an accumulation of glue on the trailing edge during the sheet bonding, which may lead to deviations in quality.

[14] The trailing edge spar cap according to aspects of the invention has an almost symmetrical structure made up of one fanned out outer and inner layer each and a block and core layer embedded between these. The block layer and the core layer are butted. The opposite end faces are, in particular, arranged directly adjacent to one another. The fanned out inner and outer layers need not have exactly the same number of layers. The exact position between the inner and outer layers may also vary slightly.

[15] Such a structure has the following advantages, among others. The structure has a symmetrical cross-section in the terms of the fiber composite design. High core material thicknesses may be directed far into the trailing edge of the rotor blade. The trailing edge spar cap has a geometrically simple structure and no steps on the surface. It can therefore be manufactured efficiently and integrated into the rotor blade shell without great effort. An increased component thickness may be achieved in the trailing edge of the rotor blade. In addition, the trailing edge spar cap is manufacturable in an easy and reproducible manner. The installation space in the trailing edge of the rotor blade is filled with further reinforcement layers. A harmonious adhesive gap thickness is created. In addition, there are no hard transitions in the spar cap. For example, the block layers abut the core material so that a smooth transition is possible. The core material is simple and inexpensive to manufacture because, contrary to what was previously common, it does not need to taper toward the trailing edge. The trailing edge spar cap is also easy to manufacture, since there are clear delimitations and transitions between its individual functional components.

[16] According to one advantageous embodiment, it is provided that the first fiber layer has two bevels and/or the second fiber layer has two bevels. It is provided, in particular, that the first fiber layer and/or the second fiber layer are/is trapezoidal in a cross section oriented at least approximately perpendicular to a longitudinal extension direction of the trailing edge spar cap.

[17] In the fanned-out fiber layers there are, in particular, two fifths or less of the fiber layers used to manufacture the trailing edge spar cap. By arranging the block fiber layer on one of the two bevels of the fanned-out fiber layer, a large amount of fiber material may be arranged in the end region, i.e., on the trailing edge of the rotor blade, which has a positive effect on the stability of the rotor blade.

[18] It is provided, in particular, that the bevels occupy the full material thickness of the fiber layer, in particular, the first fiber layer and/or the second fiber layer being triangular in a cross-section oriented at least approximately perpendicular to a longitudinal direction of the trailing edge spar cap. The width of the bevel, i.e., its dimension in the transverse direction of the rotor blade, corresponds approximately to the width of the block fiber layer. The fiber layers having a triangular cross-section are often referred to as completely fanned-out fiber layers.

[19] With such a construction, it is possible that, according to a further exemplary embodiment, the trailing edge spar cap tapers in the direction of a trailing edge. The edge closest to the trailing edge of the rotor blade in the assembled state is therefore thinner than a region of the trailing edge spar cap situated further forward.

[20] Furthermore, it is provided, in particular, that the block fiber layer and the core layer have the same material thickness on their opposite end faces, so that advantageously no step is created. The core material abuts the block fiber layer, the end faces of the block fiber layer and the core layer, in particular, being arranged directly adjacent to one another. Thus, the core material on this side has the same height (or material thickness) as the block layer and, with a variable height on the other side, creates a potentially required height compensation to the adjacent core material or to another component. The core material may also be slotted to enable it to follow the contour of the trailing edge spar cap.

[21] According to a further advantageous embodiment, it is provided that the bevel of the fanned out first fiber layer points in the direction of the block fiber layer or in the direction of the core layer and, in particular, a flat side of the first fiber layer opposite the bevel is situated in an outer side of the trailing edge spar cap. By placing the block layer between two fanned-out fiber layers, the block layer having approximately the width of a respective bevel of the fanned-out fiber layers, it is possible to specify a spar cap having a high stability that tapers narrowly toward the end edge.

[22] This is further improved by providing, according to a further embodiment, that a flat side of the second fiber layer opposite the bevel points in the direction of the block fiber layer and/or in the direction of the core layer and, in particular, the bevel of the fanned out second fiber layer is situated in an inner side of the trailing edge spar cap.

[23] It has been found to be particularly advantageous if the block fiber layers and the fanned-out fiber layers are in a specific relationship to one another. Therefore, according to a further embodiment, it is provided that the block fiber layer occupies a proportion of a third or more, based on all fiber layers present in the trailing edge spar cap. The proportion of the block fiber layer is determined, for example, in a cross section of the trailing edge spar cap. One third of the area occupied by fiber layers in this cross section is therefore occupied by the block fiber layer, the cross section at least approximately perpendicular to a longitudinal direction of the trailing edge spar cap. It is also possible that the proportion relates to the volume which the block fiber layer, based on the total volume of all fiber layers, occupies in the trailing edge spar cap.

[24] The trailing edge spar cap according to various embodiments is particularly suitable for rotor blades, whose trailing edge reinforcement is intended to merge directly into the core material—both geometrically and structurally. Furthermore, the trailing edge spar cap is particularly suitable for a combination with cavity shapes. A prefabricated trailing edge spar cap is provided, which requires only minor trimming work.

[25] The object is also achieved by a rotor blade having a trailing edge spar cap according to one or more of the aforementioned embodiments. The same or similar advantages apply to the rotor blade as were previously mentioned with respect to the trailing edge spar cap itself.

[26] The rotor blade is advantageously developed by a trailing edge spar cap, which is constructed from at least one block fiber layer in a rotor blade root region, and which is formed in a rotor blade tip region according to one or more of the aforementioned embodiments. The trailing edge spar cap according to aspects of the invention is therefore particularly well suited for rotor blades, whose trailing edge reinforcement is built up from a block in the root region and is intended to merge into a trailing edge spar cap from a certain distance from the rotor blade root (in the direction of the rotor blade tip), as is described above according to various embodiments.

[27] It is provided, for example, that in a first third of the rotor blade (viewed from the rotor blade root) the trailing edge spar cap is constructed from a block of fiber layers. In a subsequent second third of the rotor blade, the trailing edge spar cap is designed according to one or more of the aforementioned embodiments. In an outer third of the rotor blade, which comprises the rotor blade tip, the trailing edge spar cap is constructed of fanned-out fiber layers, i.e., a plurality of individual layers arranged in a fanned-out manner, between which core material is also arranged. The structure of the trailing edge spar cap in the outer third is known, for example, from DE 10 2010 055 874 B3.

[28] As a further improvement, in a transition area from a block spar cap to a mixed spar, i.e., to a trailing edge spar cap which contains core material, the strongly decreasing thickness in the trailing edge may be filled with core material or with another filler, such as adhesive or laminate, in order to avoid an inhomogeneous adhesive gap thickness.

[29] The object is further achieved by a method for manufacturing a trailing edge spar cap of a rotor blade of a wind turbine, the method being developed in that the trailing edge spar cap comprises a first fiber layer, a second fiber layer, a block fiber layer and a block-shaped core layer made of core material, the block fiber layer and the core layer being arranged on the fanned out first fiber layer provided with at least one bevel, and the block fiber layer and the core layer being arranged with one of their end faces opposite each other, and the fanned second fiber layer provided with at least one bevel being arranged on the block fiber layer and the core layer, and the fiber layers and the core layer subsequently being infused with resin and the resin subsequently hardening.

[30] The method according to the invention may be carried out in a simple, efficient and reproducible manner, so that a highly stable trailing edge spar cap may be manufactured economically with consistently high quality.

[31] The method is advantageously developed in that the fiber layers and the core layer are arranged in such a way that the bevel of the fanned out first fiber layer points in the direction of the block fiber layer or in the direction of the core layer when the block fiber layer or the core layer is arranged on the first fiber layer, in particular, a flat side of the first fiber layer opposite the bevel being situated in an outer side of the manufactured trailing edge spar cap.

[32] Furthermore, it is provided, in particular, that the fiber layers and the core layer are arranged in such a way that a further flat side of the second fiber layer opposite the bevel points in the direction of the block fiber layer or in the direction of the core layer when the second fiber layer is arranged on the block fiber layer or on the core layer, the bevel of the fanned out second fiber layer, in particular, being situated in an inner side of the manufactured trailing edge spar cap.

[33] The same or similar advantages apply to the method as previously mentioned with respect to the trailing edge spar cap.

[34] Further features of the invention are apparent from the description of embodiments according to the invention together with the claims and the accompanying drawings. The invention is defined by the appended claims.

[35] The invention is described below based on exemplary embodiments with reference to the drawings, express reference being made to the drawings with regard to all details according to the invention not explained in greater detail in the text. In the drawings:

Fig. 1 shows a rotor blade in a schematically simplified top view,

Fig. 2 shows a trailing edge spar cap in a schematically simplified cross-sectional view, along the section line designated by B-B in Fig. 1,

Fig. 3 shows a further schematically simplified cross-sectional view of a trailing edge spar cap in a transition region, along the section line designated by A-A in Fig. 1,

Figs. 4 to 7 show individual steps of a method for manufacturing a trailing edge spar cap of a rotor blade.

[36] In the drawings, the same or similar elements and/or parts are provided with the same reference signs, and are therefore not re-introduced each time.

[37] Fig. 1 shows a rotor blade 2 of a wind turbine in a schematically simplified plan view. The rotor blade 2 extends between a rotor blade root 4 and a rotor blade tip 6 in a longitudinal direction L. The rotor blade 2 is constructed from a suction side shell 12 and a pressure side shell facing away in Fig. 1. The suction side shell 12 and the pressure side shell each have a main spar cap 8 and a trailing edge spar cap 10. The main spar cap 8 of the suction side shell 12 is indicated by dotted lines in Fig. 1. The rotor blade shells are joined together, for example glued, on a rotor blade leading edge 14 facing the wind during operation and on an opposite rotor blade trailing edge 16. The trailing edge spar cap 10, like the rotor blade 2, extends in the longitudinal direction L starting from a position close to the rotor blade root 4 in the direction of the rotor blade tip 6 over approximately 4/5 of the total length of the rotor blade 2.

[38] Fig. 2 shows the trailing edge spar cap 10 in a schematically simplified cross-sectional view in a plane that is oriented at least approximately perpendicular to the longitudinal direction L. A cross section is shown through the trailing edge spar cap 10 along the section line designated B-B in Fig. 1.

[39] The trailing edge spar cap 10 comprises a first fiber layer 20, a second fiber layer 22, a block fiber layer 24 and a block-shaped core layer 26 made of core material. The fibers used to manufacture the fiber layers 20, 22, 24 are, for example, glass fibers or carbon fibers. The core material is, for example, a foam or balsa wood. The fiber layers 20, 22, 24 and the core layer 26 are infused with resin, in particular, synthetic resin. The resin is then cured. The trailing

edge spar cap 10 is preferably a prefabricated component. These are also often referred to as prefab.
The first and second fiber layers 20, 22 are fanned out fiber layers. Their successive layers of, for example, glass or carbon fiber are therefore offset from one another by a value that is greater than the thickness of a single fiber layer. The first and second fiber layers 20, 22 also each include a first bevel 20a, 22a and a second bevel 20b, 22b. The block fiber layer 24 and the core layer 26 are arranged on the fanned out first fiber layer 20, which is provided with at least one bevel 20a, 20b.

[40] In the exemplary embodiment shown in Fig. 2, the first fiber layer 20 has two bevels, namely the first bevel 20a and the second bevel 20b. The second fiber layer 22 also has two bevels, namely the first bevel 22a and the second bevel 22b. The bevels 20a, 20b, 22a, 22b extend, for example, over the entire material thickness of the respective fiber layer 20, 22. Both the first fiber layer 20 and the second fiber layer 22 are therefore triangular in cross section. According to further exemplary embodiments, it is provided that the bevels 20a, 20b, 22a, 22b do not extend over the entire material thickness of the fiber layers 20, 22. In this case, the fiber layers 20, 22 are trapezoidal in cross section.

[41] The block fiber layer 24 has, for example, a width B which corresponds at least approximately to a width B of the second bevel 20b of the first fiber layer 20. The width B is measured in a direction which is oriented at least approximately perpendicular to the longitudinal direction L. In other words, the block fiber layer 24 is arranged completely on the second bevel 20b of the first fiber layer 20. The second bevel 22b of the second fiber layer 22 also has an extent which corresponds approximately to the width B. Since both the first fiber layer 20 and the second fiber layer 22 are each provided with a second bevel 20b, 22b, the trailing edge spar cap 10 tapers in the direction of its trailing edge 28. The trailing edge 28 of the trailing edge spar cap 10 is situated close to the rotor blade trailing edge 16 in the assembled state (see Fig. 1).

[42] The core layer 26 comes to lie partially on the first bevel 20a of the first fiber layer 20. The core layer 26 is arranged opposite the block fiber layer 24. In other words, an end face 30 of the block fiber layer 24 is arranged directly opposite a further end face 32 of the block fiber layer 24. At these opposite end faces 30, 32, the core layer 26 and the block fiber layer 24 have the same material thickness. The end faces 30, 32 are, in particular, arranged directly adjacent to one another.

[43] The fanned out second fiber layer 22 provided with at least one bevel 22a, 22b is arranged on the core layer 26 and on the block fiber layer 24. The first fiber layer 20 has a flat side 34 opposite the two bevels 20a, 20b, which is situated on an outer side of the trailing edge spar cap 10. The first bevel 20a points in the direction of the core layer 26, the second bevel 20b points in the direction of the block fiber layer 24. In the case of the second fiber layer 22, the first and the second bevel 22a, 22b point away from the core layer 26 and the block fiber layer 24 and are situated in an inner side of the trailing edge spar cap 10. Located opposite the first and second bevels 22a, 22b of the second fiber layer 22 is a further flat side 36, which points in the direction of the core layer 26 and of the block fiber layer 24.

[44] It has been found to be advantageous if the block fiber layer 24 occupies a proportion of a third or more, based on all fiber layers 20, 22, 24 present in the trailing edge spar cap 10. For example, the block fiber layer 24 in the cross section shown in Fig. 2 occupies at least one third or more of the cross-sectional area of all fiber layers 20, 22, 24.

[45] The rotor blade 2 shown in Fig. 1 has a trailing edge spar cap 10 constructed of block fiber layers 24 in a rotor blade root region 40, which extends, for example, starting from the rotor blade root 4 in the direction of the rotor blade tip 6 over a third of the total length of the rotor blade 2. The transition from a trailing edge spar cap 10 constructed of block fiber layers 24 to a trailing edge spar cap 10, as it is designed according to the embodiment described in Fig. 2 takes place in a transition region 42. This trailing edge spar cap 10 constructed from core material and fiber material extends in a rotor blade tip region 44.

[46] Fig. 3 shows the trailing edge spar cap 10 in the transition region 42 along the section line designated by A-A in Fig. 1. The schematic and simplified cross section shown in Fig. 3 is also oriented at least approximately perpendicular to the longitudinal direction L.

[47] The trailing edge spar cap 10 comprises a block fiber layer 24, a first fiber layer 20, whose flat side 34 is oriented toward an outer side of the trailing edge spar cap 10, and a second fiber layer 22. A core layer 26 is also included. The second fiber layer 22 has a very large first bevel 22a and, in comparison therewith, a very small second bevel 22b. Its opposite further flat side 36 is bent twice. In the region of the trailing edge 28, it follows the course of the second bevel 20b of the first fiber layer 20. In the region in which the second fiber layer 22 adjoins the core layer 26, the further flat side 36 extends in mirror image to the first bevel 20a of the first fiber layer 20.

[48] Individual steps of a method for manufacturing a trailing edge spar cap 10 of a rotor blade 2 are illustrated in the Figs. 4 through 7.

[49] The method for manufacturing the trailing edge spar cap 10 begins in Fig. 4 with the provision of the first fanned-out fiber layer 20, which has a first bevel 20a and a second bevel 20b. As shown in Fig. 5, the block fiber layer 24 is placed on the second bevel 20b. The core layer 26 is subsequently placed on the first bevel 20a of the first fanned-out fiber layer 20, as shown in Fig. 6. Care is taken to ensure that a height or material thickness of the end face 30 of the core layer 26 corresponds at least approximately to the height or material thickness of the block fiber layer 24 on its end face 30. An opposite end face 46 of the core layer 26 is adapted, for example, to the material thickness of further core material 48. It is also possible for the height of the core layer 26 on the opposite end face 46 to be adapted to the material thickness of a further component. To better enable the core layer 26 to follow the shape of the trailing edge spar cap 10, the latter may be slotted. Finally, the second fanned-out fiber layer 22 is placed on the core layer 26 and on the block fiber layer 24. The fiber material of the fiber layers 20, 22, 24 and the core material of the core layer 26 are subsequently infused with resin, for example, in a vacuum infusion process. Once the resin, for example synthetic resin, has cured, the trailing edge spar cap 10 is available as a prefabricated component.

[50] It is also provided that the trailing edge spar cap 10 is manufactured together with the rotor blade shells, for example, of the suction side shell 12, during manufacture. Consequently, the trailing edge spar cap 10 is also infused together with the fiber material of the rotor blade shells. In such a method, the trailing edge spar cap 10 is not manufactured as a prefabricated component.

List of reference signs

[51]

2	Rotor blade
4	Rotor blade root
6	Rotor blade tip
8	Main spar cap
10	Trailing edge spar cap
12	Suction side shell
14	Rotor blade leading edge
16	Rotor blade trailing edge
20	First fiber layer
22	Second fiber layer
20a, 22a	First bevel
20b, 22b	Second bevel
24	Block type fiber layer
26	Core layer
28	Trailing edge
30	End face
32	Further end face
34	Flat side
36	Further flat side
40	Rotor blade root region
42	Transition region

44	Rotor blade tip region
46	Opposite end face
48	Further core material
L	Longitudinal direction
B	Width

Patentkrav

1. Bagkantrem (10) på et rotorblad (2) på et vindkraftanlæg med et blok-fiberlag (24), **kendetegnet ved** et første fiberlag (20), et andet fiberlag (22) og et blokformet kernelag (26) af kernemateriale, hvor blok-fiberlaget (24) og kernelaget (26) er anbragt på det første fiberlag (20), som er opdelt og forsynet med mindst en fas (20a, 20b, 22a, 22b), og hvor blok-fiberlaget (24) og kernelaget (26) er anbragt med hver en af deres endesider (30, 32) over for hinanden, og hvor det andet fiberlag (22), som er opdelt og forsynet med mindst en fas (22a, 22b), er anbragt på blok-fiberlaget (24) og kernelaget (26), hvor fiberlagene (20, 22, 24) og kernelaget (26) er infusioneret med harpiks, og harpiksen er hærdet.

2. Bagkantrem (10) ifølge krav 1, **kendetegnet ved, at** det første fiberlag (20) har to fase (20a, 20b), og/eller det andet fiberlag (22) har to fase (22a, 22b).

3. Bagkantrem (10) ifølge krav 2, **kendetegnet ved, at** det første fiberlag (20) og/eller det andet fiberlag (22) er trapezformet/trapezformede i et tværsnit af bagkantremmen (10) orienteret i det mindste tilnærmelsesvist vinkelret på en længdeudstrækningsretning (L)

4. Bagkantrem (10) ifølge krav 2 eller 3, **kendetegnet ved, at** fasene (20a, 20b, 22a, 22b) indtager hele materialetykkelsen af fiberlaget (20, 22), hvor særligt det første fiberlag (20) og/eller det andet fiberlag (22) er trekantet/trekantede i et tværsnit af bagkantremmen (10) orienteret i det mindste tilnærmelsesvist vinkelret på en længdeudstrækningsretning (L).

5. Bagkantrem (10) ifølge et af kravene 1 til 4, **kendetegnet ved, at** bagkantremmen (10) bliver smallere i retning mod en bagkant (28).

6. Bagkantrem (10) ifølge et af kravene 1 til 5, **kendetegnet ved, at** blok-fiberlaget (24) og kernelaget (26) har den samme materialetykkelse på endesiderne (30, 32), der ligger over for hinanden.

7. Bagkantrem (10) ifølge et af kravene 1 til 6, **kendetegnet ved, at** fasen (20a, 20b) på det opdelte første fiberlag (20) peger i retning mod blok-fiberlaget (24) eller i retning mod kernelaget (26), og særligt en flad side (34) af det første fiberlag (20), som ligger over for fasen (20a, 20b), ligger i en yderside af bagkantremmen (10).

8. Bagkantrem (10) ifølge et af kravene 1 til 7, **kendetegnet ved, at** en flad side (36) af det andet fiberlag (22), som ligger over for fasen (22a, 2b), peger i retning mod blok-fiberlaget (24) og/eller i retning mod kernelaget (26), og særligt fasen (22a, 22b) på det opdelte andet fiberlag (22) ligger i en inderside af bagkantremmen (10).

9. Bagkantrem (10) ifølge et af kravene 1 til 8, **kendetegnet ved, at** blok-fiberlaget (24) indtager en andel på en tredjedel eller mere i forhold til alle de fiberlag (20, 22, 24), som findes i bagkantremmen (10).

10. Rotorblad (2) med en bagkantrem (10) ifølge et af kravene 1 til 9.

11. Rotorblad (2) ifølge krav 10, **kendetegnet ved** en bagkantrem (10), som i et rotorbladsrodområde (40) er opbygget af mindst et blok-fiberlag (24), og som i et rotorbladsspidsområde (44) er udformet ifølge et af kravene 1 til 9.

12. Fremgangsmåde til fremstilling af en bagkantrem (10) på et rotorblad (2) på et vindkraftanlæg med et blok-fiberlag (24), **kendetegnet ved, at** bagkantremmen (10) omfatter et første fiberlag (20), et andet fiberlag (22) og et blokformet kernelag (26) af kernemateriale, hvor blok-fiberlaget (24) og kernelaget anbringes på det første fiberlag (20), opdelt og forsynet med mindst en fas (20b, 20b), og hvor blok-fiberlaget (24) og kernelaget (26) anbringes med hver en af deres endesider (30, 32) over for hinanden, og hvor det andet fiberlag (22), opdelt og forsynet med mindst en fas (22a, 22b), anbringes på blok-fiberlaget (24) og kernelaget (26), og efterfølgende fiberlagene (20, 22, 24) og kernelaget (26) infusioneres med harpiks, og efterfølgende harpiksen hærdes.

13. Fremgangsmåde ifølge krav 12, **kendetegnet ved, at** fiberlagene (20, 22, 24) og kernelaget (26) er anbragt på en sådan måde, at fasen (20a, 20b) på det opdelte første fiberlag (20) peger i retning mod blok-fiberlaget (24) eller i retning mod kernelaget

(26), når blok-fiberlaget (24) eller kernelaget (26) anbringes på det første fiberlag (20), hvor særligt en flad side (34) af det første fiberlag (20), som ligger over for fasen (20a, 20b), ligger i en yderside af den fremstillede bagkantrem (10).

14. Fremgangsmåde ifølge krav 12 eller 13, **kendetegnet ved, at** fiberlagene (20, 22, 24) og kernelaget (26) anbringes på en sådan måde, at en yderligere flad side (36) af det andet fiberlag (22), som ligger over for fasen (22a, 22b), peger i retning mod blok-fiberlaget (24) eller i retning mod kernelaget (26), når det andet fiberlag (22) anbringes på blok-fiberlaget (24) eller kernelaget (26), hvor særligt fasen (22a, 22b) på det opdelte andet fiberlag (22) ligger i en inderside af den fremstillede bagkantrem (10).

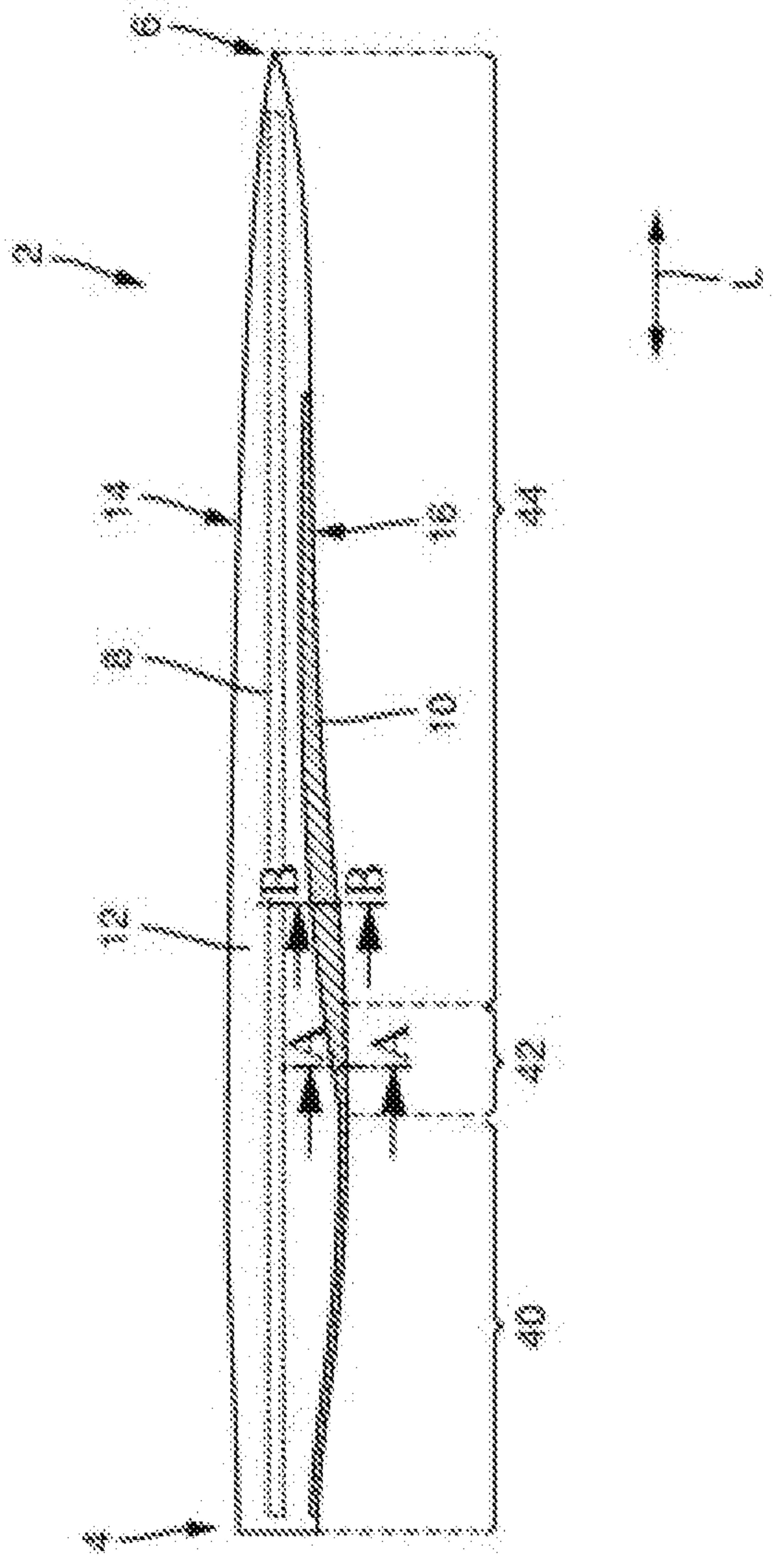

Fig. 1

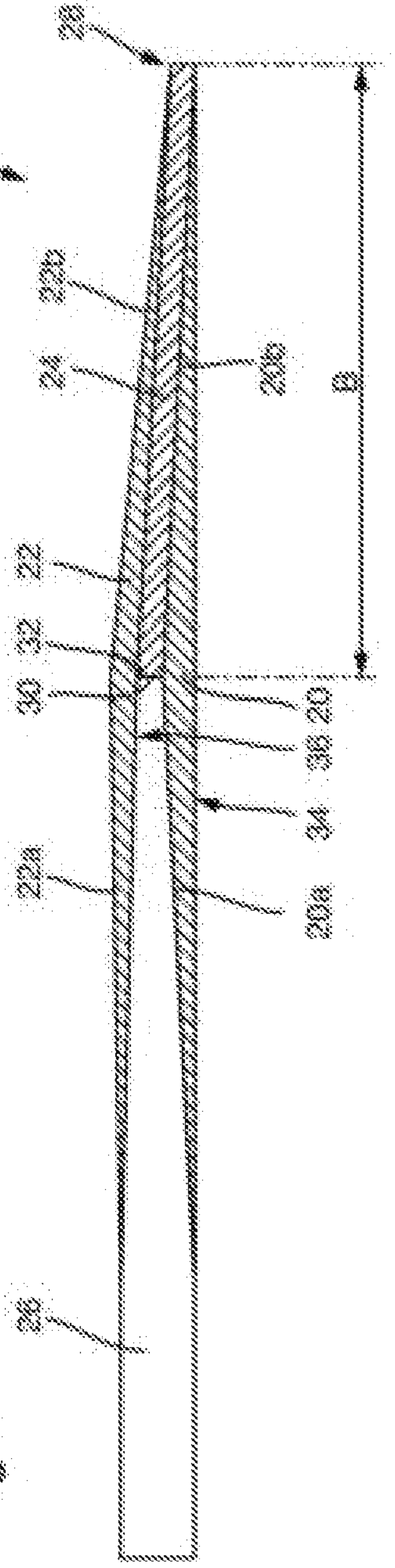

Fig. 2

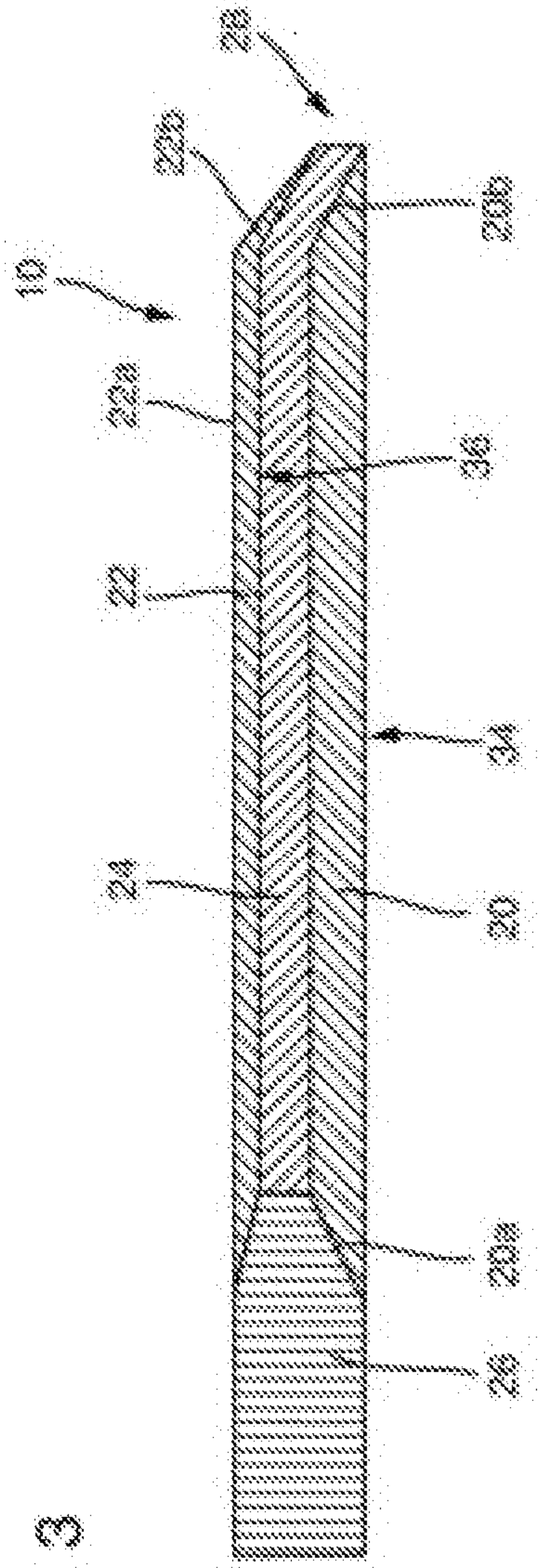

Fig. 3

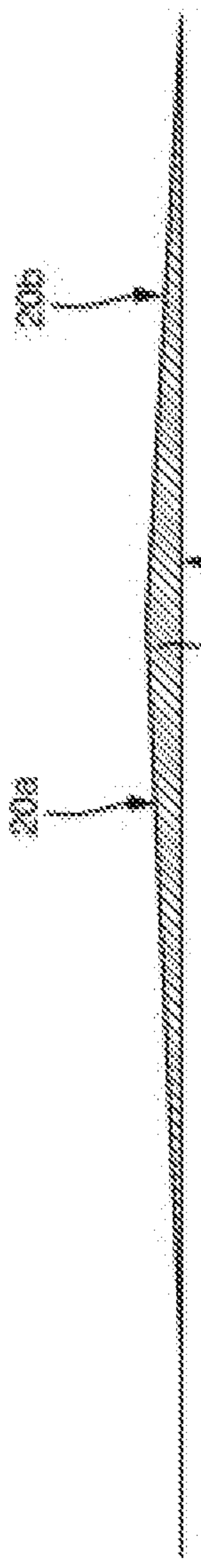

Fig. 4

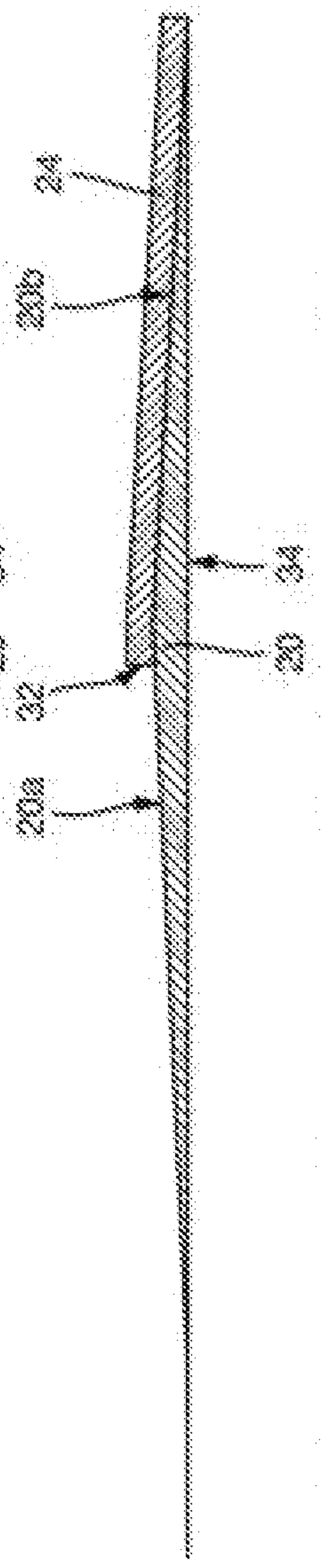

Fig. 5

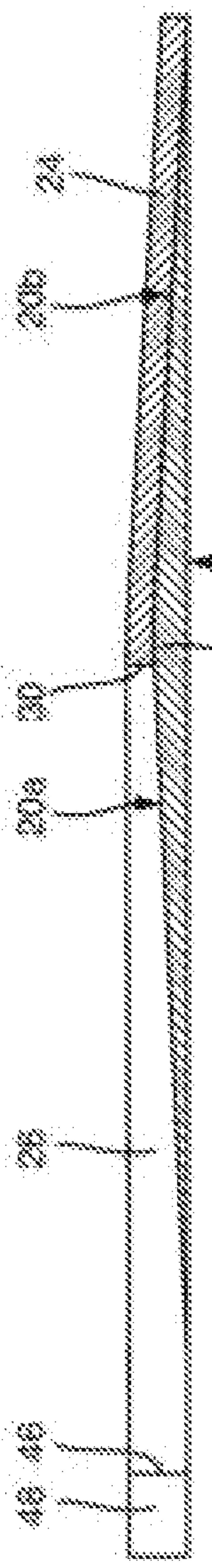

Fig. 6

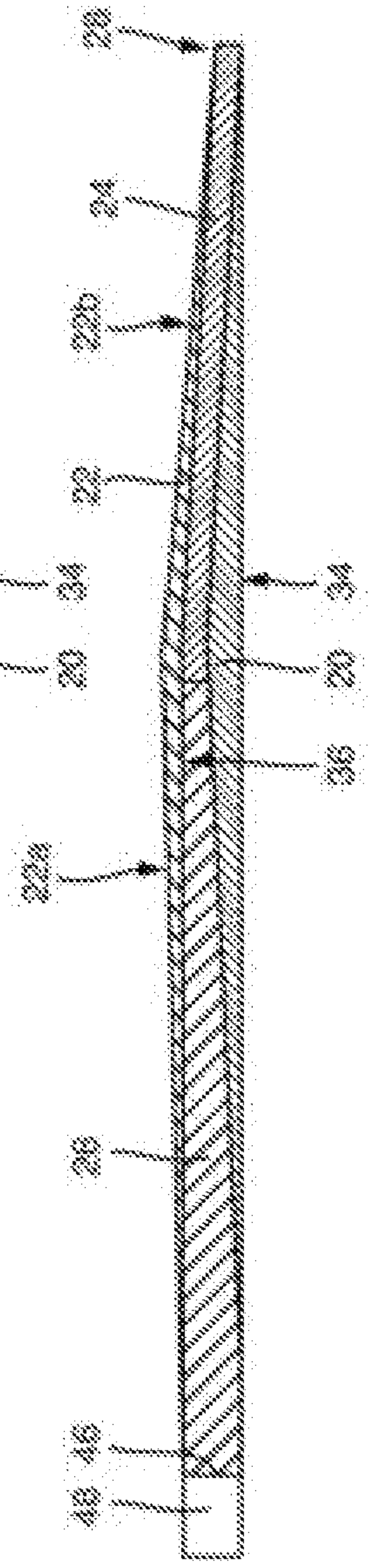

Fig. 7