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TRAILING-EDGE GIRDER WITH RECTANGULAR CROSS SECTION

The invention relates to a rotor blade according to claim 1 and to a method for producing a rotor blade according to claim 10.

Rotor blades for wind turbines have of course long been known in the prior art. DE 10 2012 107 932 B4 discloses a rotor blade which consists of a fiber composite system. In this case, rotor blade half-shells are first of all manufactured and adhered to one another. To stabilize the rotor blade half-shell in the impact direction, that is to say perpendicularly to the pivoting direction, or rotor plane, in which the rotor blade rotates, webs are provided between the rotor blade half-shells and are bonded via chords to the rotor blade half-shells. Chords and webs form a double-T beam in cross section. In rotor blades, a main chord is provided on each of the rotor blade half-shells and extends substantially along the line of the largest profile heights. The opposite main chords are interconnected via a web.

US 2014/0301859 A1 describes a rotor blade with main chords integrated into the rotor blade half-shells.

A rotor blade with main chords is known from CA 2 738 123 and has reinforcement portions running along the trailing edge.

US 2009/0169392 A1 again describes main chords integrated into the rotor blade half-shells, said main chords being interconnected via main webs.

DE 10 2014 221 966 A1 relates to rotor blades with main and trailing edge chords integrated in the rotor blade half-shell.

US 2012/0141282 A1 describes a rotor blade with main chords integrated in the rotor blade half-shells, said main chords being interconnected via main webs.

US 2011/008175 A1 discloses a rotor blade with two webs running parallel to one another, which are arranged approximately centrally in the rotor blade shell.

DE 10 2012 019 351 A1 discloses a method for joining a wind turbine rotor blade formed from a blade root-side segment and a blade tip-side segment, wherein a double web runs centrally and a web runs along the rotor blade trailing edge.

US 2011/0206529 A1 discloses a rotor blade with a double web formed in one piece in the rotor blade interior, as well as an angled web arranged between the double web and the rotor blade trailing edge.

Furthermore, in rotor blades for wind turbines, providing chords formed from fibers, which run substantially in the direction of the longitudinal direction of the rotor blade and which are placed directly along the trailing edge of the rotor blade, corresponds to the prior art. In this case, both half-shells, which are component parts of the rotor blade, each have a trailing edge chord, which in accordance with the prior art are then bonded directly to one another along the trailing edge.

A disadvantage of the known rotor blades is the fact that more material needs to be used for forming the trailing edge chord than would be necessary for meeting the rigidity requirements since this configuration corresponding to the prior art has a very strong tendency towards buckling instability if the trailing edge of the rotor blade is subjected to pressure. Therefore, additional layers of fiber semi-finished products must be introduced in order to achieve the required safety against buckling. However, since the distance between the surface of the aerodynamic pressure side of the rotor blade and its aerodynamic suction side is small, the Steiner proportion, which each additional layer of fiber semi-finished product creates, is also low. Therefore, the effectiveness of additional layers of fiber semi-finished products in the trailing edge to increase safety against buckling instabilities is very low and a very large additional number of layers of fiber semi-finished products is required, which makes the rotor blade unnecessarily expensive.

It is therefore the object of the present invention to improve a rotor blade of the type mentioned at the outset in such a way that less material is consumed with the same safety against buckling instability and with the same external dimensions of the rotor blade.

It is furthermore an object of the present invention to provide a method by means of which a rotor blade according to the invention can be manufactured.

With regard to the rotor blade, the object is achieved by a rotor blade mentioned at the outset having the features of claim 1.

The rotor blade according to the invention has two rotor blade half-shells which are each produced in a laminating process and which each have a periphery which almost completely encompasses the rotor blade half-shells and along which the two rotor blade half-shells are bonded to one another. An opening, via which the rotor blade can be fastened by a connection to a rotor hub, only remains on a root of the rotor blade. Arranged in each of the two half-shells is in each case at least one trailing edge chord, preferably in each case exactly one trailing edge chord. According to the invention, the trailing edge chords run along the respective trailing edge periphery of the rotor blade half-shell in a longitudinal direction, and they have, at least along a section in the longitudinal direction, a rectangular cross section transversely, preferably perpendicularly to, their longitudinal direction. Rectangular is also understood here to mean a substantially rectangular cross-sectional shape. The corners can be slightly rounded. Preferably, the cross section is rectangular, preferably exactly rectangular, in some sections. A square cross section can also be provided. The rectangular cross section is preferably such that the trailing edge chord at least along the predominant extent along its width has a straight inner surface pointing into the rotor blade interior, and a height of the rotor blade trailing edge chord along this width is constant. However, at the longitudinal edges the rotor blade trailing edge chord can be beveled, rounded or flattened on the rotor blade inner wall, so that no sharp or sensitive edges are exposed. The aforementioned smooth cross sections are also referred to here as rectangular, at least as long as the straight inner surface constitutes at least half the width.

Two trailing edge chords preferably lie opposite one another, and each of the two oppositely disposed trailing edge chords has a rectangular cross section transversely, preferably perpendicularly, to the longitudinal direction, along a section extending in the longitudinal direction. The longitudinal direction is to be understood here as a longitudinal direction of the trailing edge chord along the particular section which can be variable along the trailing edge chord and can also deviate slightly from the longitudinal direction of the rotor blade.

The two trailing edge chords lie opposite one another if they lie opposite one another with their wide inner sides.

According to the invention, the trailing edge chord in the section in which the at least one trailing edge chord is rectangular in cross section is further away from the associated trailing edge periphery than in other sections.

Advantageously, a trailing edge of the rotor blade in the section has at most a first thickness and, along the section the trailing edge chord is overall further apart from the trailing edge periphery than in another section in which the rotor blade has a greater thickness than the first thickness. The thickness is understood here to mean the distance between two points of the rotor blade outer skin perpendicular to the rotor blade chord or to the mean camber line. The section is to be understood here as the region in which the trailing edge chord is provided. The trailing edge chord is thus at a greater distance from the trailing edge periphery associated with it where the rotor blade has a first thickness, which is, however, small, at least smaller than in other sections in which the trailing edge chord extends more closely to the trailing edge.

Preferably, each of the trailing edge chords is at such a distance from the trailing edge peripheries associated with them that a minimum distance between the two rotor blade half-shells in the region in which the trailing edge chords are located is at least 3 mm. The distance is understood here to mean the clear distance between two points of the rotor blade inner skin perpendicular to the rotor blade chord or to the mean camber line.

According to the invention, the trailing edge chord is thus displaced, at least in some sections, from the trailing edge in the direction of the profile nose in order to thus realize a higher area moment of inertia of the trailing edge chords with respect to the profile chord if the cross-sectional area of the trailing edge chord remains unchanged in relation to an embodiment according to the prior art. At the same time, in the case of an arrangement according to the invention of the trailing edge chords in the rotor blade, it proves to be advantageous to the manufacturing process to make the cross section of the chord substantially rectangular.

The trailing edge chord advantageously runs along the trailing edge. It can thus have different distances from the trailing edge along the longitudinal direction. Advantageously, the trailing edge chord is rectangular in cross section where the trailing edge has a small thickness. In these sections it can be at a greater distance from the trailing edge than in other sections.

In addition, according to the invention, a connection between the oppositely disposed trailing edge chords is provided by a web or stringer. This results in an arrangement which has a significantly improved ratio of applied mass to achieved safety against buckling.

According to the invention, the trailing edge chord has a significantly smaller cross section than the main chord at the same distance from the blade root.

It has been found that chords with a rectangular cross section are easier to manufacture than other cross-sectional shapes. Therefore, the trailing edge chords are rectangular in cross section along a section in their longitudinal direction, but the cross-sectional area, in particular the height of the rectangle, can vary.

According to the invention, however, the trailing edge chords which are rectangular in cross-section are no longer laid directly along the rotor blade trailing edge overall, as is known in the prior art, but rather they have a varying distance, and in certain sections preferably greater distance, from the rotor blade trailing edge. In particular, in regions of the trailing edge that are narrow in cross section, the rotor blade trailing edge chords are at a greater distance from the rotor blade trailing edge periphery than, for example, in the more spacious root region of the rotor blade. The fixing of the distance between the trailing edge chord and the trailing edge of the rotor blade is an optimization task in which the cross-sectional area of the trailing edge chord and its distance to the trailing edge of the rotor blade, which fixes the distance of the trailing edge chords from one another over the profile shape, must be selected in such a way that a minimum of the ratio of the applied mass to achieved safety against buckling ensues.

In the aerodynamic section of the rotor blade that is provided with a smaller height of the rotor blade interior, this greater distance from the trailing edge of the rotor blade should be made available so that the trailing edge chords do not come into contact during the folding of the rotor blade half-shells during manufacture and an adhesive connection between the two rotor blade half-shell edges is still possible. The two trailing edge chords must not abut one another in front of the rotor blade half-shell edges and prevent a complete folding of the rotor blade half-shells. Advantageously, the two trailing edge chords are at such a distance from their trailing edge peripheries that there is a minimum distance of approximately 3.0 mm and a maximum distance of approximately 20 mm - 50 mm between the mutually facing inner sides of the two trailing edge chords in the profile thickness direction of the rotor blade, therefore, during the manufacturing process, the two trailing edge chords do not come into contact when the rotor blades are being folded and even have a clear distance from one another, which is bridged via a web, preferably via a stringer.

Due to the greatest distance between the two trailing edge chords of between preferably 2 cm to 5 cm, it is expedient to connect the trailing edge chord of the suction-side rotor blade half-shell to the trailing edge chord of the pressure-side rotor blade half-shell by means of a stringer instead of a web.

In the case of a stringer, it is preferably likewise a fiber composite component which in cross section, however, is not rectangular like a web, with a height which is greater by a multiple than a width, but rather in which the height of the component is smaller than the width of the component. Therefore, the height of the stringer is, for example, 2 cm to 5 cm, whereas the width of the stringer is approximately 20 cm to 30 cm. Overall height and width vary, however, along the longitudinal extent of the rotor blade.

In a particularly advantageous embodiment of the invention, the stringer has a trapezoidal cross section, as a result of which it can be integrated easily during the production of the corresponding blade shell, for example during the infusion.

The two trailing edge chords of the two rotor blade half-shells preferably have a width of 20 cm to 30 cm. The width of the trailing edge chords is substantially constant, preferably exactly constant, over the entire longitudinal extent of the trailing edge chord. As a result, a simple production of the trailing edge chord is possible.

The trailing edge chord is expediently formed from a plurality of layers of a fiber semi-finished product laid one on top of the other and/or next to one another. The semi-finished fiber product can be a structure formed from natural fibers, plastic fibers, glass fibers or carbon fibers or the like, which is impregnated with a resin and then cures. However, the design according to the invention of the rotor blade is also intended to comprise other forms of fiber semi-finished products, such as prepregs and pultrudates.

The number of layers of the trailing edge chord, which are laid one on top of the other, is adapted to the requirement for strength and safety against buckling in the particular rotor blade section.

Preferably, the trailing edge chords have a height of less than 1 cm at the root-side or tip-side ends and up to 7 - 10 cm at their thickest point.

With regard to the method, the object is achieved by a method having the features of claim 10. The method is in particular suitable for manufacturing one of the above-mentioned rotor blades.

Rotor blades are preferably assembled from separately manufactured components, such as rotor blade half-shells, webs, stringers and chords. In this case, the separate components are manufactured in production molds individually determined for them. In the production molds, a plurality of layers, for example fiber-containing layers formed from glass fibers and/or carbon fibers and/or plastics and/or even natural materials and foams and balsa, etc., are first of all laid one on top of the other and next to one another. The layers arranged in this way form a preferably dry semi-finished product. The semi-finished product is impregnated with a resin system in methods such as the resin injection molding (RIM method) or the resin transfer molding (RTM method). Once the resin system has cured, the components are adhered together and the rotor blade is finished.

However, production methods, such as the use of prepregs and pultrudates, are also included in the production according to the invention of the rotor blade.

In particular with regard to the production of the chords, it is not provided for the invention that the chords are already an integral component of the rotor blade half-shells, that is to say are integrally co-manufactured during the production process of the rotor blade half-shells. They can, however, also be adhesively fastened to the inner sides of the rotor blade half-shells retrospectively or, not as part of the invention, can be introduced as prefabricated components during the production of the rotor blade half-shells.

In particular, the trailing edge chords expediently run as close as possible to the rotor blade trailing edge in order to increase the rigidity to a particularly high degree in the pivoting direction. In this case, however, the problem arises that, in particular in the aerodynamic region of the rotor blade along the rotor blade trailing edge, only very little free, in particular not very high, interior space is made available in the rotor blade. In particular, this leads to the fact that the rotor blade trailing edge chords according to the prior art are flattened or rounded towards the trailing edge at least along their longitudinal side pointing to the rotor blade trailing edge so that during the folding and adhering together of the two rotor blade half-shells they do not abut one another and prevent a complete bonding of the rotor blade half-shells. In the prior art, this results in a very low, often too low, safety against buckling, so that additional material must be provided in the trailing edge chords, which increases the cost of the rotor blade.

Usually, and also according to the invention, the rotor blade half-shells are manufactured in separate mold half-shells, which are arranged next to one another and can be pivoted on top of one another via an articulated connection. This pivoting mechanism makes it possible to position the almost completely encompassing peripheries of the two rotor blade half-shells on top of one another in an accurately positioned manner and to bond them to one another after application of an adhesive layer along the two or at least one of the two peripheries.

Before the two mold half-shells are folded, the webs, stringers and chords are expediently also adhered into the rotor blade half-shells.

The method according to the invention makes use of the idea of producing the trailing edge chords by means of preferably precise arrangement, one on top of the other, of layers, i.e. fiber layers formed from a wide variety of materials, wherein the semi-finished product formed from the layers arranged one on top of the other is infused, for example with a resin system which subsequently cures. Other production methods, such as the use of prepregs or pultrudates, are also conceivable. A rectangular cross section of the trailing edge chord is created, wherein the trailing edge chord of course has to be adapted to the aerodynamic shape of the rotor blade inner wall along the longitudinal extent, that is to say, in particular, does not run exactly in a straight line in the longitudinal direction but follows the trailing edge and the surface of the rotor blade in an arc shape, so that it can be integrated overall into the blade shell structure.

However, the trailing edge chords have a distance from the trailing edge periphery, at least in the aerodynamic section. A distance is understood here to mean a distance from the trailing edge periphery of a longitudinal edge of the trailing edge chord adjacent to the trailing edge periphery, which is not zero but preferably a few centimeters. Layers are placed one on top of the other in such a number that the trailing edge chord has a thickness of 1 cm to 10 cm, preferably up to 7 - 8 cm, after the resin infusion.

The rotor blade trailing edge chord can be formed in one piece or in multiple pieces, wherein the individual pieces are then together adhered into the rotor blade half-shells and interconnected.

The individual fiber layers of the rotor blade trailing edge chord preferably have a constant width so that the longitudinal edges of the fabric layers are positioned exactly one on top of the other, wherein demolding bevels can be provided.

It has been shown that, with a constant cross-sectional area of the rotor blade trailing edge chord, this rectangular shape has a higher degree of safety against buckling even with a greater distance from the rotor blade trailing edge than conventional chords, extending exactly along the rotor blade trailing edge, with beveled or rounded longitudinal edges.

Particularly preferably, the inner sides of the trailing edge chords, which lie opposite in the rotor blade interior, are connected by stringers. Due to their greater width compared to webs and the preferably trapezoidal cross section, stringers are simpler to realize than webs in the construction of the blade shell.

The invention is described with reference to an exemplary embodiment in six figures, in which:

Fig. 1 shows an interior view of a conventional rotor blade with a main chord and a trailing edge chord,

Fig. 2 shows a sectional view of a conventional rotor blade along the line II - II of Fig. 1,

Fig. 3 shows a sectional view of a structure of a trailing edge chord according to the prior art;

Fig. 4 shows an interior view of a rotor blade half-shell according to the invention with a main chord and a trailing edge chord according to the invention,

Fig. 5 shows a sectional view of a rotor blade according to the invention along a line V - V in Fig. 4,

Fig. 6 shows a sectional view of the structure of a trailing edge chord according to the invention.

Fig. 1 shows a suction-side rotor blade half-shell 1 of a conventional rotor blade. Fig. 1 shows an interior view of the rotor blade half-shell 1. The figures are not true to scale.

Rotor blades are preferably assembled from separately manufactured components, such as rotor blade half-shells 1, chords, webs or stringers. The separate components are manufactured in production molds individually determined for them. In the production molds, a plurality of layers, for example fiber-containing layers, foams, balsa, etc., are first placed one above the other and/or next to one another. The layers arranged in this way form a preferably dry semi-finished product. The semi-finished product rests on an inner side of a production mold and is adhered to a vacuum film on the side facing away from the production mold. The production mold or the vacuum film has a plurality of inlet openings and outlet openings. The semi-finished product is impregnated with a resin system in methods, such as the RIM method (resin injection molding) or the RTM method (resin transfer molding). To this end, the semi-finished product, under the vacuum film, i.e., between the inner wall of the production mold and the vacuum film, is subjected to a negative pressure by air being sucked out through the outlet openings. Also, as a result of the negative pressure, the liquid or viscous resin system is sucked into the semi-finished product and completely saturates the semi-finished product. The process is carried out until the resin system also escapes from the outlet openings. However, prepregs and/or pultrudates can also be used.

According to the prior art, the rotor blade half-shells 1 are manufactured individually and in one piece in each case. Modern rotor blades have lengths between 40 m and 60 m and up to 75 m and even more. For their manufacture, manufacturing molds with corresponding lengths of up to 70 m, 75 m or even longer manufacturing molds can even be provided.

After the curing of the rotor blade half-shells 1, a main chord 2 and a trailing edge chord 3 are adhered in each case to the inner side of the two rotor blade half-shells. Fig. 1 shows an inner side of one of the two rotor blade half-shells of a rotor blade. Fig. 1 shows the suction-side rotor blade half-shell 1. However, it is also possible, according to a non-claimed embodiment, to place the trailing edge chord 3 as a prefabricated component in the corresponding production mold during the production of the rotor blade half-shells and, if necessary, to connect the trailing edge chord to the other layers and materials by the infusion.

Each of the rotor blade half-shells 1 has a tip-side end 4 and a root-side end 5 as well as a leading edge 6 and a trailing edge 7. The corresponding nomenclature also applies for the rotor blade assembled from two rotor blade shells.

The rotor blade half-shell 1 is provided in an almost completely encompassing manner with a rotor blade half-shell periphery 8 which has a width of preferably 3 to 25 cm. The periphery 8 runs along the rotor blade leading edge 6 around the tip-side end 4 of the rotor blade half-shell 1 and along the entire rotor blade trailing edge 7. The two rotor blade half-shells 1 each have the periphery 8, and the rotor blade shells 1 are bonded together along their two peripheries 8. The width of the periphery 8 can vary in some regions, wherein the transitions are then preferably embodied continuously. For this purpose, the production molds are arranged next to one another, and a foldable mold half-shell is pivotable over a positionally fixed mold half-shell so that, after the two rotor blade half-shells are manufactured in the two mold half-shells and have been cured, and optionally after the adhering of further components, such as chords and webs, the foldable mold half-shell can be folded over the positionally fixed mold.

It is also conceivable that both mold half-shells are foldable at the same time or one after the other and are folded shut towards one another.

An adhesive is applied along the entire rotor blade half-shell periphery 8 to the rotor blade half-shell produced in the positionally fixed mold half-shell. The two rotor blade half-shells 1 are bonded along their two peripheries 8 with the aid of the adhesive. To compress the two mold half-shells, clamping closures can be provided on the mold half-shells, which produce a sufficient pressure between the two rotor blade half-shells 1 and thus on the adhesive mass.

The main chord 2 is laid along the line of the largest profile thickness. The main chord 2 can be manufactured separately or, although this is not claimed, can be integrally formed on the inner side of the rotor blade half-shell 1 during the production process of the rotor blade half-shell 1.

The main chord 2 and the trailing edge chord 3 likewise have fiber layers extending in a longitudinal direction L, wherein the fiber layers of the chords 2, 3, but also of the rotor blade half-shells 1 or the webs, can have glass fibers, carbon fibers, plastic-containing fibers, natural fibers, but also other types of fibers. The individual fiber layers can each be formed in one piece. In the case of long chords 2, 3, however, it can also be expedient to manufacture the chords 2, 3 in a piece-wise manner along the longitudinal direction L and to only assemble them in the rotor blade half-shell 1. The same also applies to the other components.

The chords 2, 3 are also saturated with resin in a vacuum infusion process, cured, and then adhered onto the inner side of the rotor blade half-shell 1 or, although this is not claimed, formed integrally during the manufacturing process of the rotor blade half-shell 1. However, it is also possible in a non-claimed embodiment to prefabricate the chords 2, 3 and then integrate them during the construction of the half-shell in which they are connected, for example, during the infusion with the other materials of the rotor blade half-shell. The main chord 2 serves to increase the flexural strength of the rotor blade in the impact direction.

The previous discussions relate not only to the rotor blades according to the prior art, but also to the rotor blades according to the invention.

In addition, according to the prior art, the trailing edge chord 3 is laid along a rotor blade half-shell trailing edge periphery 8a. The trailing edge chord 3 runs directly along the trailing edge 7 at a distance of a few centimeters from the periphery 8, preferably at a distance of at most three to four centimeters. The distance of the trailing edge chord 3 from the rotor blade half-shell trailing edge periphery 8a is substantially constant over the entire longitudinal extent of the trailing edge chord 3 according to the prior art, but in any case is very small and lies in the order of a few centimeters. The trailing edge chord 3 according to the invention runs along a line in the rotor blade half-shell 1 that differs from the known trailing edge chord 3.

Fig. 2 shows a cross section of a rotor blade 20 according to the prior art along a line which has approximately the height of the cross-sectional line II - II shown in Fig. 1. However, only one rotor blade half-shell 1 is shown in Fig. 1, whereas Fig. 2 shows a cross section of the complete rotor blade 20. The two rotor blade half-shells 1, 21 each have an associated rotor blade half-shell periphery 8a, 22a, and they are bonded together along their rotor blade half-shell peripheries 8a, 22a.

In this case, the two main chords 2, 23 lie approximately parallel to one another within the rotor blade 20. The two main chords 2, 23 are bonded to one another by two adhesive connections between web longitudinal sides and chord inner sides via a web 24, which is likewise produced separately in a laminating process. The web 24 has, on its longitudinal sides, adhesive lips which produce a larger contact surface between the main chords 2, 23 and the web 24.

Since the trailing edge chords 3, 25 are arranged very close to their respective trailing edge peripheries 8a, 22a and are also arranged close to the particular rotor blade half-shell trailing edge periphery 8a, 22a in the aerodynamic region of the rotor blade 20, which is in the center in the longitudinal direction L, the two trailing edge chords 3, 25 have to be beveled towards the trailing edge periphery 8a, 22a so that, when the two rotor blade half-shells 1, 21 are folded onto one another, the two trailing edge chords 3, 25 do not come into contact, in particular do not come into contact earlier than the two rotor blade half-shell trailing edge peripheries 8a, 22a, and therefore make bonding impossible or at least hinder it. In Figures 1 and 2, the two trailing edge chords 3, 25 in cross section are of approximately semi-lenticular design or are of a slightly inwardly curved design.

Fig. 3 shows a known structure of the trailing edge chord 3. In this case, fiber layers 31 of approximately constant width, preferably exactly of constant width, are laid not exactly one on top of the other along a width B of the rotor blade 20 or of the rotor blade half-shell 1, 21, but are laid one on top of the other in an offset manner so that more fiber layers are overlaid in a middle region, as seen along the width B, than at longitudinal edges of the trailing edge chords 3, 25, i.e., the further one moves along the width in the direction of the leading edge 6 and the trailing edge 7, the fewer fiber layers 31 are laid one on top of the other in each case, and therefore a semi-lenticular shape in cross section is created. The semi-lenticular shape is created after the infusion with the resin system by the fiber layers being infused with a resin system.

Fig. 4 shows a rotor blade half-shell 1 according to the invention. The statements made in relation to Fig. 1, 2 and 3 can also be applied to the rotor blade 20 according to the invention, except for the arrangement of the trailing edge chord 3. Therefore, the same reference signs are also selected.

The rotor blade half-shells 1, 21 themselves can be manufactured in a conventional manufacturing method, for example in the infusion method. Likewise, the main chords 2, 23 can be manufactured in a known manner. The position of the two trailing edge chords 3, 25 in the two rotor blade half-shells 1, 21 differs from the prior art according to Fig. 1 and Fig. 2.

First, the trailing edge chord 3 according to Fig. 4 is no longer guided along the entire longitudinal direction L of the rotor blade half-shell 1 closely along the trailing edge periphery 8a, but rather it preferably has a different distance from the trailing edge periphery 8a. In the aerodynamic region of the rotor blade, the distance from the trailing edge periphery 7 is greater than in the region of the root-side end 5.

Fig. 5 shows a cross section according to the invention of a rotor blade 20 according to the invention along a line which is arranged approximately at the height V - V in Fig. 4, wherein only one rotor blade half-shell 1 is shown in Fig. 4, whereas Fig. 5 shows a cross section of an entire rotor blade 20. The two trailing edge chords 3, 25 are at a greater distance from the trailing edge peripheries 8a, 22a in comparison to Fig. 2, in particular the two trailing edge chords 3, 25 being at such a distance from the rotor blade trailing edge 7 that they are rectangular, preferably exactly rectangular, in cross section. The distance from the rotor blade half-shell trailing edge periphery 8a, 22a is dimensioned in each case so that, when the two rotor blade half-shells 1, 21 are folded onto one another, the two trailing edge chords 3, 25 do not come into contact despite the rectangular shape of the two trailing edge chords 3, 25 in cross section, whereas the two trailing edge peripheries 8a, 22a, however, are arranged so closely opposite that they can be bonded together. The two trailing edge chords 3, 25 are interconnected via adhesive connections by means of a stringer 50.

Fig. 6 shows the cross section of one of the trailing edge chords 3, 25 according to the invention. The layered structure can be selected in a known manner, i.e., the substance type of the layers and the number of layers can be selected according to the prior art similarly to the structure in Fig. 3. However, other layer sequences and a different number of layers as compared to the prior art can also be selected. However, it is essential to the invention that the individual layers are no longer offset, but are preferably positioned exactly one above the other, so that their lateral edges are arranged parallel to one another and perpendicular to the inner side of the rotor blade half-shell 1. As a result, in contrast to the prior art, a substantially rectangular shape of the trailing edge chords 3, 25 in cross section is formed. Trailing edge chords 3, 25, which are rectangular in cross section, have a greater safety against buckling with the same cross-sectional area compared to the chords of semi-elliptical cross section. The trailing edge chords 3, 25 are then buckling critical if the tip-side end 4 is bent in the direction of the trailing edge 7 by external forces counter to the direction of rotation of the rotor and the trailing edge 7 is thereby under a pressure load. It has been found that, with the same cross-sectional area, trailing edge chords 3, 25 which are rectangular in cross section have a higher safety against buckling than trailing edge chords 3, 25 which are semi-elliptical in cross section. The invention makes it possible to save material without reducing the safety against buckling of the trailing edge or trailing edge chords of the rotor blade.

List of Reference Signs

1	Rotor blade half-shell
2	Main chord
3	Trailing edge chord
4	Tip-side end
5	Root-side end
6	Rotor blade leading edge
7	Rotor blade trailing edge
8	Rotor blade half-shell periphery
8a	Rotor blade half-shell trailing edge periphery
20	Rotor blade
21	Rotor blade half-shell

22	Rotor blade half-shell periphery
22a	Rotor blade half-shell trailing edge periphery
23	Main chord
24	Web
25	Trailing edge chord
31	Fiber layers
50	Stringer
L	Longitudinal direction
B	Width

PATENTKRAV

1. Rotorblad til en vindmølle med to halve rotorbladsskaller (1, 21), hver med en for- og en bagkantsflange (8a, 22a), hvor de halve rotorbladsskaller er limet sammen langs for- og bagkantsflangerne (8a, 22a) og hver har et bagkantsbånd (3, 25), hvor de to bagkantsbånd (3, 25) i det mindste langs et afsnit i en længderetning (L) har et rektangulært tværsnit på tværs af længderetningen (L), og de to bagkantsbånd (3, 25) er limet på en inderside af de halve rotorbladsskaller (1, 21) og er forbundet med hinanden med en stringer (50) via limsamlinger, og en afstand af det respektive bagkantsbånd (3, 25) i et aerodynamisk område for rotorbladet fra bagkantsflangen (8a, 22a) er større end i et område for en rodsideende (5), hvor det respektive bagkantsbånd (3, 25) i det afsnit, hvor bagkantsbåndet (3, 25) er rektangulært i tværsnit, er længere væk fra den tilhørende bagkantsflange (8a, 22a) end i andre afsnit.

2. Rotorblad ifølge krav 1,

kendetegnet ved, at de to bagkantsbånd (3, 25) ligger over for hinanden.

3. Rotorblad ifølge krav 1 eller 2,

kendetegnet ved, at en bagkant (7) af rotorbladet (20) i afsnittet højst har en første tykkelse, og det respektive bagkantsbånd (3, 25) langs afsnittet overalt har en større afstand fra bagkantsflangerne (8a, 22a) end i et andet afsnit, hvor rotorbladet (20) har en tykkelse, der er større end den første tykkelse.

4. Rotorblad ifølge et hvilket som helst af de foregående krav,

kendetegnet ved, at hvert af bagkantsbåndene (3, 25) har en så stor afstand fra deres tilhørende bagkantsflanger (8a, 22a), at en minimumsafstand mellem de to halve rotorbladsskaller (1, 21) i det område, hvor bagkantsbåndene (3, 25) befinder sig, udgør mindst 3 mm.

5. Rotorblad ifølge et hvilket som helst af de foregående krav,

kendetegnet ved, at en maksimumafstand mellem de to halve rotorbladsskaller 1, 21) i det område, hvor bagkantsbåndene (3, 25) befinder sig, højst udgør 5-6 cm.

6. Rotorblad ifølge et hvilket som helst af de foregående krav,

kendetegnet ved, at stringeren (50) er anbragt, så den løber i det mindste i afsnit langs de to bagkantsbånds (3, 25) udstrækning i længderetningen mellem modstående bagkantsbånd (3, 25).

7. Rotorblad ifølge et hvilket som helst af de foregående krav,

kendetegnet ved, at hvert af de to bagkantsbånd (3, 25) har en bredde (B) på 20 cm til 40 cm, fortrinsvis en bredde (B) på 20 cm til 30 cm.

8. Rotorblad ifølge et hvilket som helst af de foregående krav,

kendetegnet ved, at hvert af de to bagkantsbånd (3, 25) har en højde på 1 mm til 80 mm.

9. Rotorblad ifølge et hvilket som helst af de foregående krav,

kendetegnet ved, at en største afstand af hvert af de to bagkantsbånd (3, 25) fra bagkantsflangen (8a, 22a) højst udgør 20 cm til 60 cm, fortrinsvis højst 30 cm til 45 cm.

10. Fremgangsmåde for fremstilling af et rotorblad, der omfatter at fremstille to halve rotorbladsskaller (1, 21) og at lægge et bagkantsbånd (3, 25) langs hver af de to halve rotorbladsskallers (1, 21) bagkantsflanger (8a, 22a), hvilket bagkantsbånd er fremstillet ved at placere lag (31) af samme bredde oven på hinanden med deres langsgående kanter og derefter infundere et harpikssystem i lagene (31), hvor de to bagkantsbånd (3, 25) efter harpikssystemets hærdning limes på en inderside af de halve rotorbladsskaller (1, 21) og forbindes med hinanden med en stringer (50), og det respektive bagkantsbånd (3, 25) anbringes i et aerodynamisk område for rotorbladet med en større afstand fra bagkantsflangen (8a, 22a) end i et område for en rodsideende (5), og det respektive bagkantsbånd (3, 25) i et afsnit, hvor bagkantsbåndet (3, 25) er

rektangulært i tværsnit, er længere væk fra den tilhørende bagkantsflange (8a, 22a) end i andre afsnit.

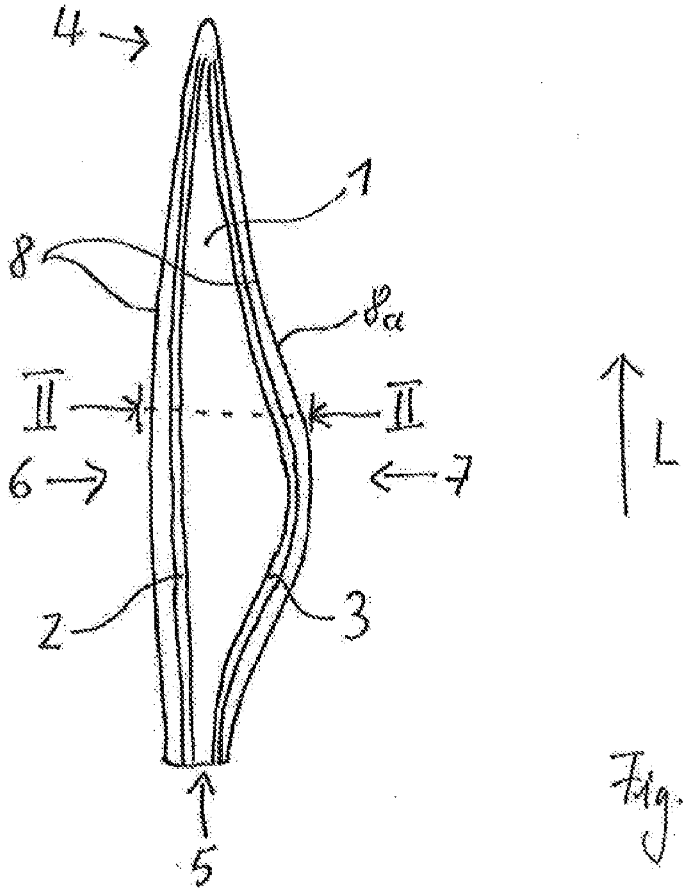


Fig. 1

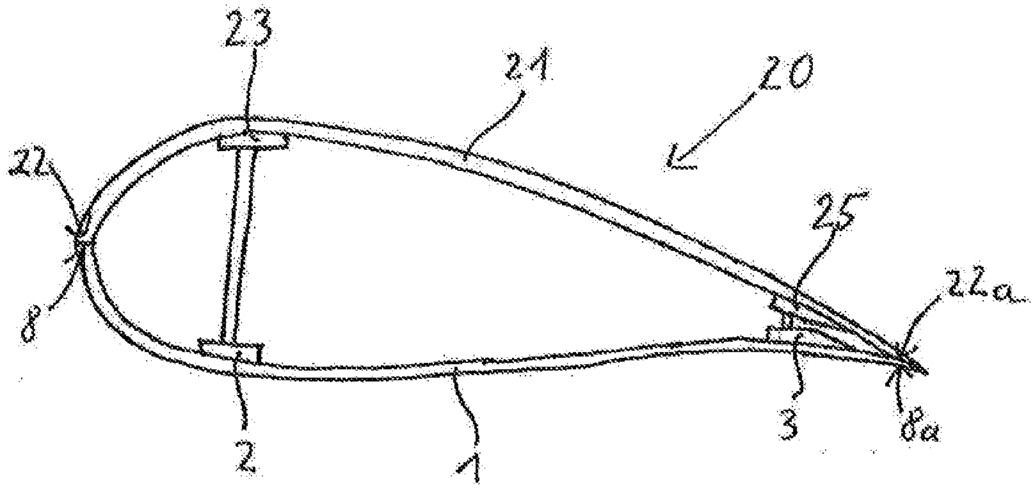


Fig. 2

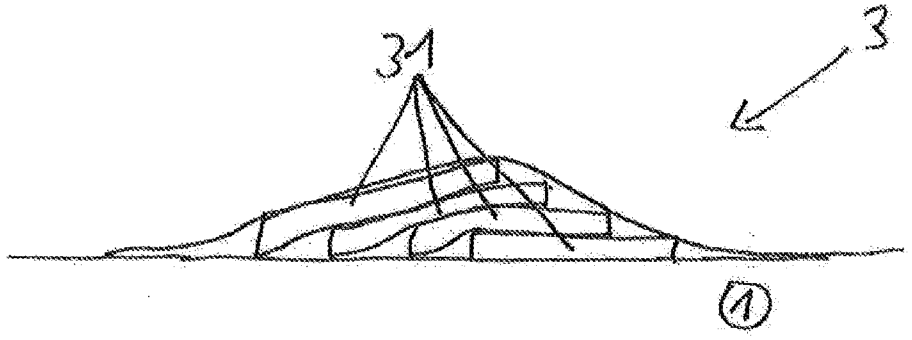
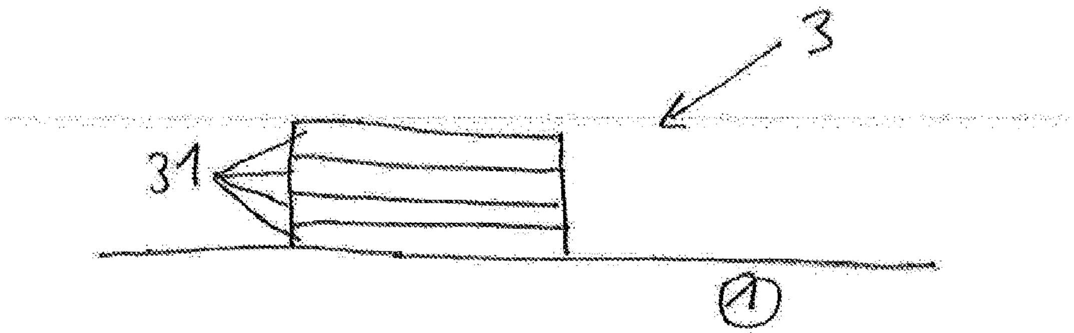


Fig. 3



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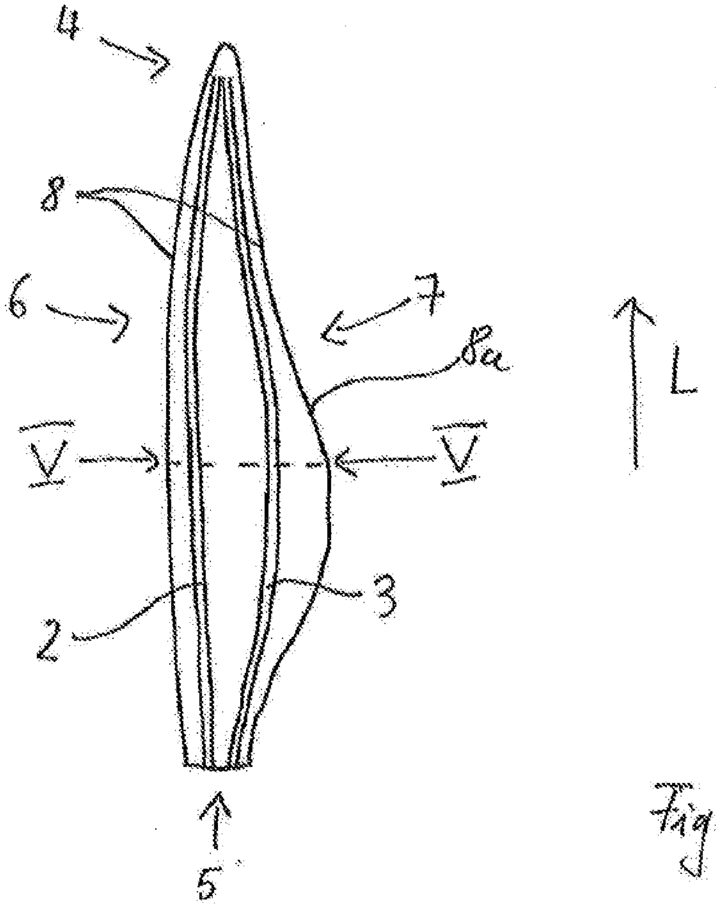

Fig. 4

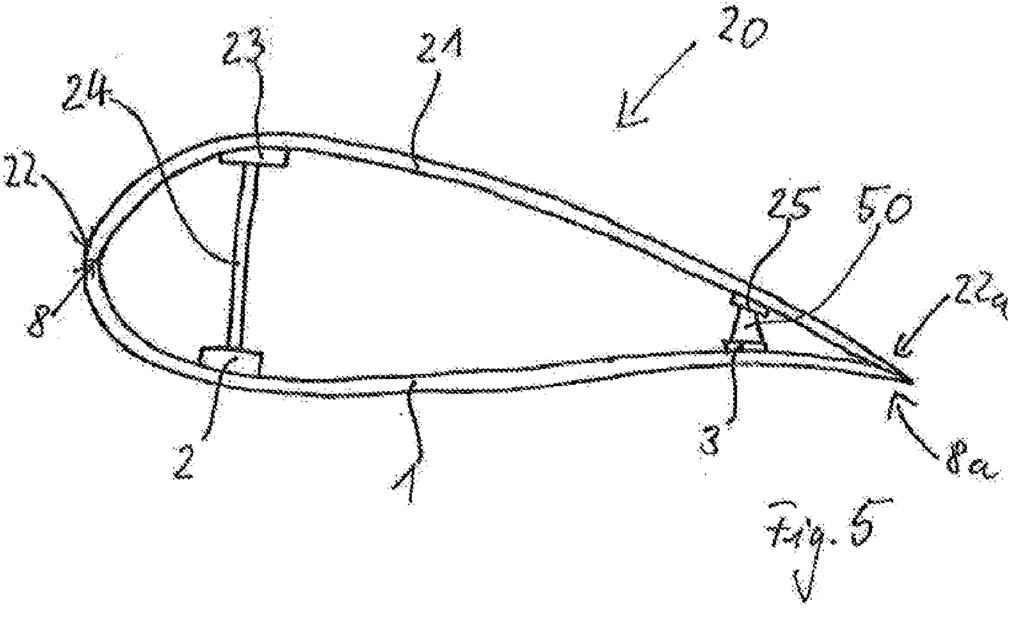

Fig. 5