



(51) International Patent Classification:
F03D 11/04 (2006.01) *F03D 3/00* (2006.01)
E04H 12/04 (2006.01)

(21) International Application Number:
PCT/SE2009/051341

(22) International Filing Date:
26 November 2009 (26.11.2009)

(25) Filing Language: Swedish

(26) Publication Language: English

(30) Priority Data:
0950281-6 27 April 2009 (27.04.2009) SE

(71) Applicants (for all designated States except US): **VERTICAL WIND AB** [SE/SE]; Sylveniusgatan 5 D, S-754 50 Uppsala (SE). **TÖRNBLOM, Stefan** [SE/SE]; Trädgårdsvägen 46, S-181 65 Lidingö (SE).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **BERNHOFF, Hans** [SE/SE]; Tryffelvägen 61, S-756 46 Uppsala (SE).

(74) Agent: **GROTH & CO. KB**; Box 6107, S-102 32 Stockholm (SE).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: A SECTION OF A CARRYING COLUMN OF A WIND TURBINE WITH VERTICAL SHAFT AND A METHOD FOR THE MANUFACTURE OF SUCH A CARRYING COLUMN.

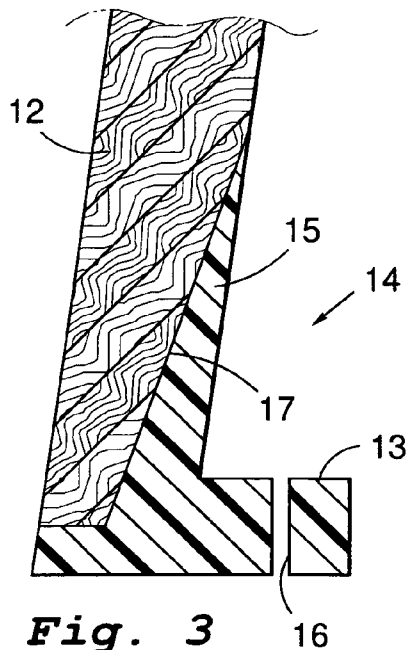


Fig. 3

(57) Abstract: The invention concerns a section of a carrying column of a wind turbine with vertical shaft. The section is hollow and elongate and comprises a wooden frame essentially of wood. According to the invention, the section has a joint part at each end. Each joint part comprises an end portion of the wooden frame and at least one joint component of polymer. The joint component (14) has a flange (13) directed transversely to the longitudinal direction of the section and an anchoring part (15) that is directed along the end portion and extends along the outside and/or inside of the end portion. The invention also concerns a method for the manufacture of a carrying column of a wind turbine with vertical shaft, in which the carrying column is joined together by means of such sections.



Published:

— *with international search report (Art. 21(3))*

A section of a carrying column of a wind turbine with vertical shaft and a method for the manufacture of such a carrying column.

5 Field of the Invention

The present invention relates, in a first aspect, to a section of a carrying column of a wind turbine with vertical shaft.

In a second aspect, the invention relates to a method for the manufacture of a carrying column for a wind turbine with vertical shaft, comprising that a
10 plurality of hollow elongate sections are joined axially, each of which sections comprises a wooden frame essentially of wood.

Background of the Invention

Recovery of wind energy has been known for thousands of years. To
15 utilize wind power for the generation of electric current is also known since long, in principle ever since the electrical generator saw the light of day.

However, the wind power has had difficulties to successfully compete economically with other energy sources for energy production. The utilization of the wind power for this has for long been limited to local energy supply and test
20 plants. Even if commercial production of wind power-based electrical energy to the mains has developed considerably during the last decades, its share of the total electrical energy production is very marginal.

In view of the great amount of energy that potentially is available in the wind power and in view of different disadvantages associated with electrical
25 energy production from other types of energy sources, it is important to provide opportunities for an increased amount of commercially competitive production of electrical energy based on wind power.

The predominant technique in the generation of electrical energy from wind-power units has been based on units where the wind turbine has a horizontal
30 shaft. Different types of wind turbines having a vertical shaft have also been proposed. Among these, the so-called H-rotor may be mentioned. Refer to, e.g., US 6 320 273 and WO 03/058059.

In order to achieve that a wind-power unit should be able to generate electrical energy at competitive prices, it is important to optimize each component in such a one from a technical and economic point of view.

By WO 2008/153 489, it is previously known, from this point of view, to
5 optimize the carrying column that carries the turbine of a wind-power unit with vertical shaft by forming it essentially of wood.

By thereby abandoning the conventional material, i.e., steel for such a supporting column, a much higher carrying capacity is attained at the same cost, alternatively the same carrying capacity at a much lower cost in comparison with
10 conventional design. The more inexpensive construction material makes it furthermore possible to form the supporting column with a design more suitable for the purpose than otherwise. Moreover, the use of wood as construction material in this context provides advantages from an environmental point of view. With essentially vertically directed wooden beams, the strength properties of the wood
15 are utilized in the best way, and a stable construction is easy to provide. In that connection, laminated beams are preferable since these are more stable in shape and are generally more suitable for building constructions.

In WO 2008/153 489 mentioned above, it is disclosed that the carrying column suitably may be composed of a plurality of vertically distributed sections. In
20 that connection, high requirements from a strength point of view are imposed on the connections that connect the sections. The object of the present invention is to provide sections for a wind turbine with vertical shaft, which comply with these demands, and to provide a method that meets these demands.

25 **Description of the Invention**

In the first aspect of the invention, this object has been attained by the fact that a section of the kind mentioned by way of introduction comprises the special features that the section at at least one end thereof has a joint part, each joint part comprising an end portion of the wooden frame and at least one joint component
30 of polymer, which joint component comprises a flange situated at the end and directed transversely to the longitudinal direction of the section, and an anchoring part that is directed along the end portion and extends along the outside and/or inside of the end portion.

Thanks to the joint part reinforced by the joint component, it is possible to provide a connection of the sections that in terms of strength is much safer than if the connection would be effected directly via the wooden frame of the sections. The cross-directed flange enables stable attachment for fastening means, e.g., in the form of bolts, and thanks to the anchoring part, the transfer of force to the wooden frame can be distributed over a large surface. Thereby, considerable dynamic point loads directly on the wood material are avoided, which otherwise would entail risk of fracture or similar damage, particularly when the wood has been aged in the vulnerable environment.

10 It should be understood that by the expression "situated at the end", it is meant right out at the end as well as somewhat inward from the end.

Thanks to the material of the joint component at the joint part being a polymer, it is possible to form the anchoring part thereof relatively extended for increased distribution of the forces, something that weight-wise would become problematic if, e.g., steel had been used instead.

The wooden frame is suitably built up of wooden beams, preferably laminated wooden beams.

The most favourable anchorage of the joint component to the wooden frame is achieved if the anchoring part thereof extends on the outside as well as the inside of the wooden frame. It is also advantageous to form the anchoring part running continuously around the entire end portion of the wooden frame. In both cases, it contributes to an increased distribution of the load take-up.

According to a preferred embodiment, the joint part comprises a single joint component, which extends continuously around the entire section.

25 Such a design is simple from a manufacturing point of view. Furthermore, in this way, it is advantageous from a strength point of view to allow maximum distribution of the forces around the entire circumference. In addition, the continuous flange means inherently a stiffening effect of the connection. It is however not impossible that it, under certain conditions, can be an alternative instead to have a plurality of joint components that individually have a short extension in the circumferential direction, and that are evenly distributed in the circumferential direction. For instance, a joint component may be attached to each laminated wooden beam or every second.

According to an additional preferred embodiment, the polymer is fibre reinforced.

Thanks to the good tensile strength property, the component can thereby be made thinner and with a less extension than otherwise. The reinforcement is
5 suitably of glass, carbon, aramid or natural fibre.

According to an additional preferred embodiment, the flange is situated right out at the end.

This allows an uncomplicated joining of the sections and facilitates the fastening of the joint component to the wooden frame.

10 According to an additional preferred embodiment, the flange is situated a short distance inward from the end.

In certain cases, this entails a safer joining of the sections thanks to the fact that the same can be inserted a corresponding distance into each other. Thereby, the joint gets higher shearing strength.

15 By "a short distance from the end", it is meant on the order of up to 1 m. A suitable interval is 15–50 cm, particularly 25–35 cm.

According to an additional preferred embodiment, the end part of the wooden frame has a smaller thickness than the rest of the wooden frame of the sections.

20 Thereby, the increase of the total wall thickness of the section is reduced or eliminated at the joint part due to the anchoring part of the polymer component. Accordingly, the inner and/or outer surfaces of the carrying column become more even.

According to an additional preferred embodiment, the thickness of the end
25 portion decreases out toward the end of the end portion and the total thickness of the anchoring part decreases from the end of the end portion.

The attachment of the anchoring part to the end portion of the wooden frame thereby becomes particularly advantageous from a strength point of view.

According to an additional preferred embodiment, the thickness reduction
30 of the end portion is formed of a chamfer on the inside of the end portion.

According to an additional preferred embodiment, the joint part has essentially the same thickness as the adjacent part of the rest of the section.

This entails that the section gets an even smooth surface on the outside as well as the inside, which reduces the risk of indications of fracture at the

transition of the section to the joint part and facilitates possible surface cover of the walls of the section.

According to an additional preferred embodiment, the anchoring part takes up the greater part of the thickness of the joint part closest to the flange.

5 This entails a robust design of the polymer component by it having a great thickness where the bending loads are greatest.

According to an additional preferred embodiment, the flange is directed inward.

10 Thereby, the flange does not cause any increase of the outer diameter of the section. It is also an advantage to, in this way, avoid projections on the outside of the carrying column. In addition, the flange joint becomes protected from wind and weather.

According to an additional preferred embodiment, the flange is turned outward.

15 Out-turned flanges may for reasons of accessibility facilitate mounting and dismounting of the sections to each other, particularly in small wind-power units.

Naturally, it is also within the scope of the invention to arrange flanges on both the outside and the inside.

20 According to an additional preferred embodiment, the outside of the section forms in cross-section a polygon of 8–20 sides.

The polygonal shape allows a simple and practical manufacturing procedure of the section. The optimal number of sides of the polygon varies depending on the size of the wind-power unit. In most cases, 10–16 sides should be appropriate, and particularly 12 sides. Preferably, the polygon is equilateral.

25 According to an additional preferred embodiment, the section has an outer cross-section contour that decreases continuously from one joint part of the section to the other joint part thereof.

It is often advantageous to form the carrying column with upwardly more slender dimensions, which is facilitated if each section inherently in this way is 30 tapering. Thereby, a section gets the shape of a truncated pyramid having a small top angle and having a base shape that depends on the number of sides of the polygon.

According to an additional preferred embodiment, each side of the polygon comprises a wooden beam having a trapezoidal cross-section.

In these circumstances, the wooden beam constitutes a suitable construction material and is suitably of the laminated wooden beam type. With a trapezoidal cross-section, the joining of the wooden beams to a section is facilitated. Suitably, the cross-sections of the wooden beams are mutually uniform and equally large. Suitably, each trapezoid is isosceles.

The invention also concerns a carrying column that comprises a plurality of sections according to the invention, which sections are attached to each other by means of the flanges.

Furthermore, the invention concerns a wind-power unit having a vertical turbine shaft and provided with a carrying column according to the invention.

The above-mentioned preferred embodiments are defined in the claims depending on claim 1. It should be appreciated that additional preferred embodiments naturally may consist of all feasible combinations of the above-mentioned preferred embodiments.

When a section is provided with a joint part at its upper as well as at its lower end, the two joint parts do not have to be of identical type. For instance, the joint part at the lower end of the section may have the flange thereof at a distance inward from the end, while the joint part at the upper end of the section has the flange thereof right out at the end.

In the second aspect of the invention, the object set forth has been attained by a method of the kind mentioned by way of introduction comprising the special measures that a joint component of polymer is applied to each end of the respective section in order to, together with an end portion of the wooden frame of the section, form a joint part, which component comprises a flange transverse to the longitudinal direction of the section and is applied on said end portion by an anchoring part that extends along the outside and/or inside of the end portion.

According to preferred embodiments of the invented method, it is exercised while using sections according to the present invention, particularly according to anyone of the preferred embodiments of the same.

The invented carrying column, the invented wind-power unit, and the invented method entail advantages of the corresponding type as the ones of the invented section and the preferred embodiments of the same, and that have been accounted for above.

The invention is explained in more detail by the subsequent detailed description of embodiment examples of the same and with reference to the appended drawing figures.

5 **Brief Description of the Figures**

Fig. 1 is a side view of a wind-power unit according to the invention.

Fig. 2 is a cross-section through a section of the carrying column in the wind-power unit according to Fig. 1.

Fig. 3 is a cross-section through a detail in Fig. 2.

10 Figs. 4–8 are cross-sections corresponding to the one in Fig. 3, but show alternative embodiment examples.

Fig. 9 is a cross-section along the line IX–IX in Fig. 2.

Fig. 10 is a cross-section corresponding to the one in Fig. 9, but shows an alternative embodiment example.

15 Fig. 11 is a side view of a detail in Fig. 9.

Fig. 12 is a cross-section corresponding to the one in Fig. 3, but shows an additional alternative embodiment example.

Description of Embodiment Examples

20 Fig. 1 illustrates in a schematic side view a wind-power unit according to the invention. The wind turbine 2 is of the so-called H-rotor type having a vertical turbine shaft 3 connected with vertical turbine blades 6 via stays 5. The turbine shaft 3 is rotationally fixedly connected with the unit shaft 4 that drives the generator 8 arranged on a foundation 7 arranged on the ground. Via an electric
25 cable 9, the generator 8 delivers current to a mains.

The turbine is carried by a carrying column 1 in which the unit shaft 4 and the turbine shaft 3 are axially and radially mounted in bearings. The carrying column 1 is composed of a plurality of sections 11a–11d, in the example shown four ones. The number of sections may be more or fewer depending on the size of
30 the unit. The sections are interconnected in a way that is described in more detail below. In the example shown, the carrying column is slightly tapering upward and has accordingly a shape of a pyramid or a cone. It should however be appreciated that the invention is suitable also when the carrying column has a constant width.

Fig. 2 is a cross-section through a section 11 of the carrying column 1 in Fig. 1. The section 11 is composed of vertical laminated wooden beams 12 that are attached to each other so that they form a polygon or a circle. At the top and at the bottom, the section has an inwardly directed flange 13 to be connected with the adjacent section, e.g., by bolt joints.

The top section 11a in Fig. 1 needs for this purpose to have a flange only at its lower end, but there is nothing to prevent that there, *per se*, is a flange also at its upper end. The sections 11b and 11c have flanges in both ends. Also the lowermost section 11d has flanges in both ends, where the lower flange can be utilized for anchorage of the carrying column 1 to the foundation 7. This may, *per se*, be made in another way, wherein its lower flange is not required.

Fig. 3 illustrates in detail how the flange 13 at the lower end of a section is connected with the wooden beams 12 of the section. The flange 13 constitutes a part of a joint component 14 of fibre reinforced polymer and is directed inward. The joint component 14 has an anchoring part 15 that extends a distance up along the inside of the wooden beams 12. In the area of the anchoring part 15, the wooden beams 12 are provided with a chamfer 17 so that space is provided for the anchoring part 15. The wall thickness of the section is thereby the same in the area of the anchoring part as at the rest of the section. The joint component 14 and the part of the section that is situated in the area of the anchoring part constitute together the joint part of the section. In the flange 13, holes 16 are recessed for bolts.

In the example according to Fig. 4, the anchoring part 15 of the joint component 14 is situated on the outside of the wooden beams and the wooden beams 12 have a chamfer 17b at the outside.

Fig. 5 shows an example where the anchoring part of the joint component 14 has an inner 15a as well as an outer 15b part and the wooden beams have chamfers on both the inside 17a and the outside 17b.

Fig. 6 shows an example similar to the one according to Fig. 3, but differs from the same in that the wooden beams 12 do not have any reduction of the thickness at the joint part. The anchoring part of the joint component 14 entails therefore that the wall thickness of the section is greater at the joint part than at the rest of the section and the thickness increases toward the flange.

In the embodiment according to Fig. 7, the flange 13b is situated on the outside of the section and the anchoring part of the joint component 14 is situated on the outside.

Fig. 8 shows a joint part corresponding to the one in Fig. 3, but differs from what is shown in this example by the section along its entire length being covered by a surface layer of polymer, which may be of the same material as the one in the joint component 14 or alternatively of another polymer material. A corresponding cover may be arranged also on the inside, as is the case in the example shown.

The joint components 14 may be applied on the wooden frame by being cast around the respective end, and be held there by its own adhesion and the form locking that is created when the sections are joined. For improved securing between the wooden frame and the joint component, additional fastening means may be applied, e.g., an adhesive layer between the same or screws.

A joint component may be applied on the respective end of each laminated wooden beam 12 before these having been joined into a section. Alternatively, the application of the joint component(s) may be made on the joined section.

The flange at the upper end of the respective section is formed and anchored in a corresponding way as has been described for the flange at its lower end.

Fig. 9 shows an example of the shape of a section in cross-section. In this case, the section is composed of twelve laminated wooden beams 12, each of which have a trapezoidal cross-sectional area, and are glued together with each other along the inclined side surfaces. For one of the laminated wooden beams, it has furthermore been drawn-in how it is glued together from a plurality of wooden beams that have been glued up.

Fig. 10 shows an alternative example where the wooden beam structure has a circular cross-section.

Fig. 11 shows a side view from the outside of one of the laminated wooden beams in Fig. 9 and illustrates an example where the beams are slightly trapezoidal also in the longitudinal direction so as to taper upward in order to adapt to the upwardly tapering of the carrying column.

Fig. 12 shows an alternative embodiment example of the joint part, where the flange 13c is placed at a distance from the end of the section. In this case, the

flange is on the outside, but a corresponding design may alternatively be applied to the inside of the laminated wooden beam.

The anchoring part of the joint component 14 consists in this case of an upwardly directed part 15c and a downwardly directed part 15d. The downwardly
5 directed part connects to an end cover 15e.

The example according to Fig. 12 may alternatively be formed so that a part of the anchoring part continues on the inside and connects to the end cover 15e.

Compare with Fig. 5.

CLAIMS

1. Section (11) of a carrying column of a wind turbine (2) with vertical shaft, which section (11) is hollow and elongate and comprises a wooden frame
5 essentially of wood, **characterized in** that the section at at least one end thereof has a joint part, each joint part comprising an end portion of the wooden frame and at least one joint component (14) of polymer, which joint component (14) comprises a flange (13, 13b, 13c) situated at the end and directed transversely to the longitudinal direction of the section (11), and an anchoring part (15, 15a, 15b,
10 15c, 15d) that is directed along the end portion and extends along the outside and/or inside of the end portion.
2. Section according to claim 1, **characterized in** that the joint part comprises a single joint component (14) that extends continuously around the
15 entire section (11).
3. Section according to claim 1 or 2, **characterized in** that the polymer is fibre reinforced.
- 20 4. Section according to anyone of claims 1–3, **characterized in** that the flange 13, 13b, 13c) is situated right out at the end.
5. Section according to anyone of claims 1–3, **characterized in** that the flange 13, 13b, 13c) is situated a short distance inward from the end.
25
6. Section according to claim 4 or 5, **characterized in** that said end portion has a smaller thickness than the rest of the wooden frame of the section, at least along a part of the end portion.
- 30 7. Section according to claim 6, **characterized in** that the thickness of the end portion decreases out toward the end of the end portion, and that the total thickness of the anchoring part (15, 15a, 15b) decreases in the direction from the flange (13, 13b).

8. Section according to claim 7, **characterized in** that the thickness reduction of the end portion is formed of at least one chamfer (17, 17a, 17b) on the inside of the end portion.
- 5 9. Section according to any one of claims 4–8, **characterized in** that the joint part has essentially the same thickness as the adjacent part of the rest of the section (11).
- 10 10. Section according to anyone of claims 4–9, **characterized in** that the anchoring part takes up the greater part of the thickness of the joint part closest to the flange (13, 13b, 13c).
11. Section according to anyone of claims 4–10, **characterized in** that the flange (13) is directed inward.
- 15 12. Section according to anyone of claims 4–10, **characterized in** that the flange (13b, 13c) is turned outward.
13. Section according to anyone of claims 11–12, **characterized in** that the outside of the section (11) in cross-section forms a polygon of 8–20 sides.
- 20 14. Section (11) according to anyone of claims 11–13, **characterized in** that the section (11) has an outer contour that decreases continuously from one joint part of the section (11) to the other joint part thereof.
- 25 15. Section according to claim 13 or 14, **characterized in** that each side of the polygon comprises a wooden beam (12) having a trapezoidal cross-section.
16. Carrying column (1) for a wind turbine with vertical shaft, **characterized in** that the carrying column comprises a plurality of sections (11a–11d) according to any one of claims 1–15, which sections (11a–11d) are attached to each other by means of said flanges (13, 13b).
- 30

17. Wind-power unit having a vertical turbine shaft, **characterized in** that the wind-power unit comprises a carrying column (1) according to claim 16.

18. Method for the manufacture of a carrying column for a wind turbine with
5 vertical shaft, comprising that a plurality of hollow elongate sections are joined axially, each of which sections comprises a wooden frame essentially of wood, **characterized in** that a joint component of polymer is applied to each end of the respective section in order to, together with an end portion of the wooden frame of the section, form a joint part, which joint component comprises a flange transverse
10 to the longitudinal direction of the section and is applied on said end portion by an anchoring part that extends along the outside and/or inside of the end portion.

19. Method according to claim 14, **characterized in** that it is exercised while using sections of the type that is defined in any one of claims 1–15.

1/4

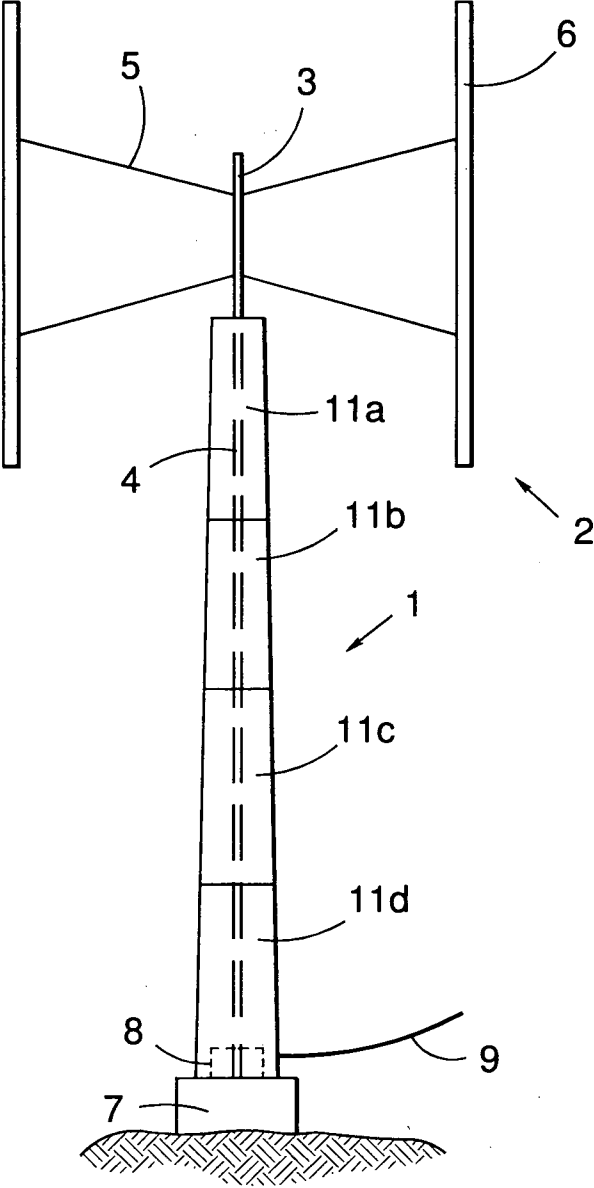


Fig. 1

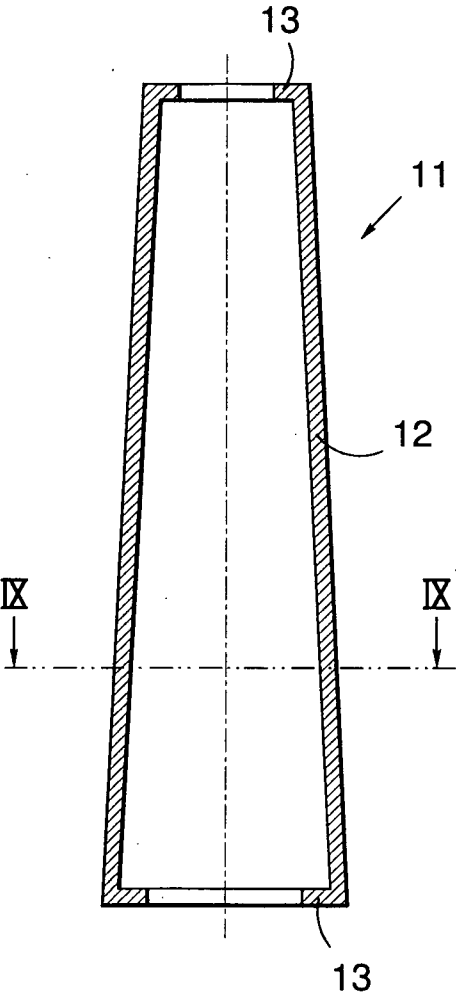
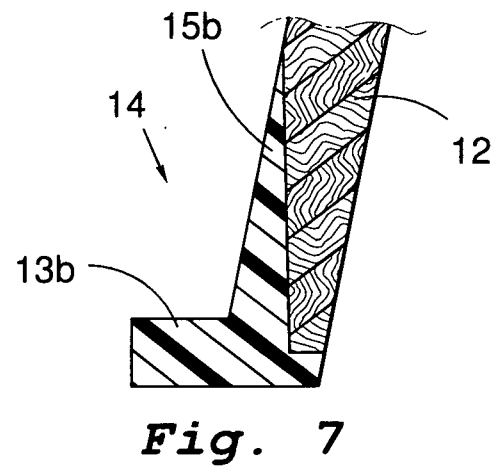
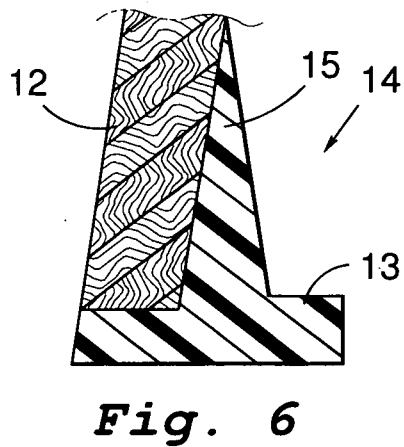
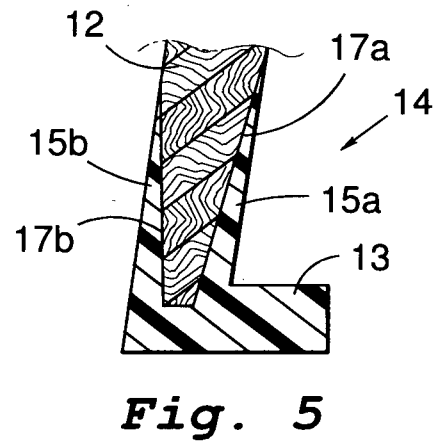
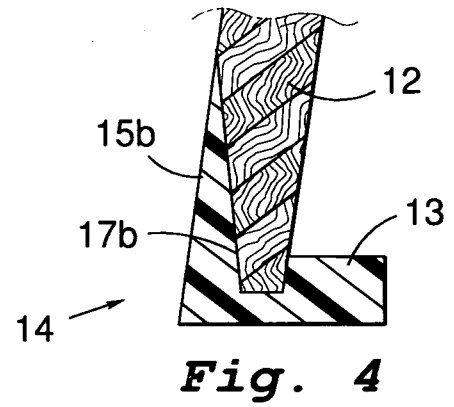
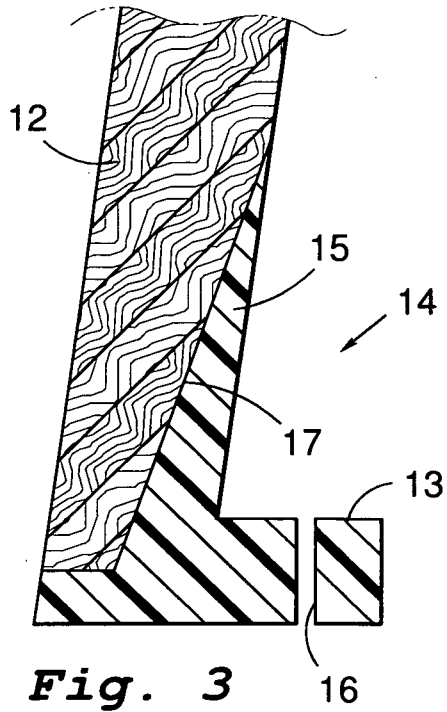


Fig. 2

2/4



3/4

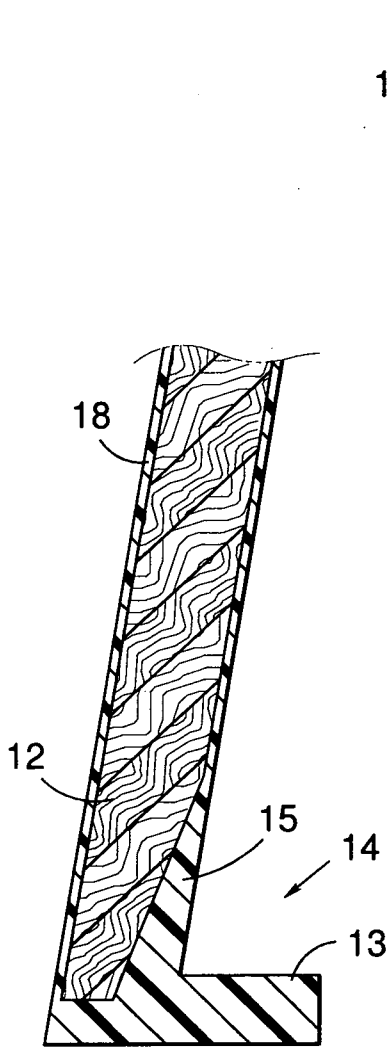


Fig. 8

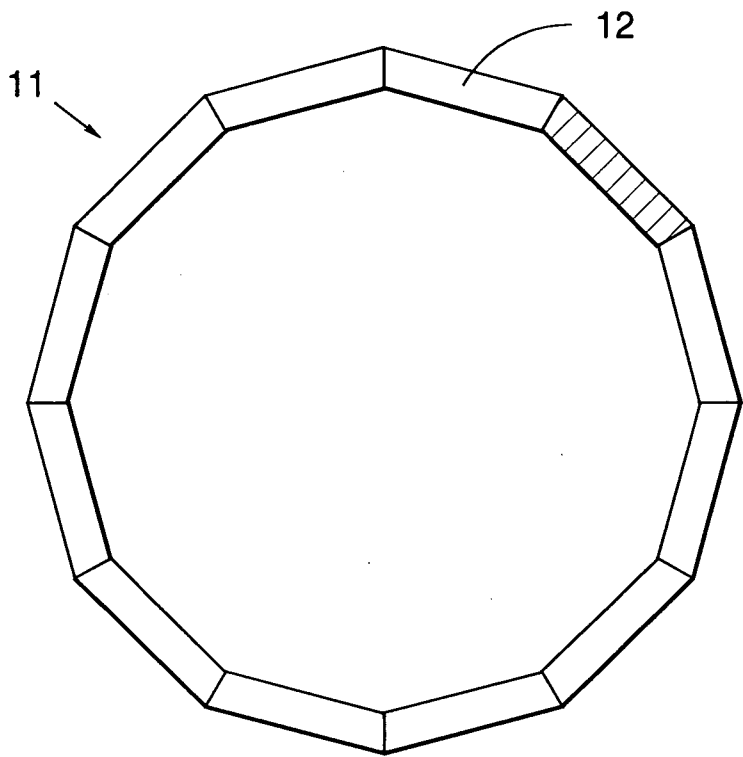


Fig. 9

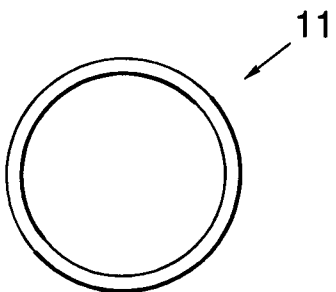


Fig. 10

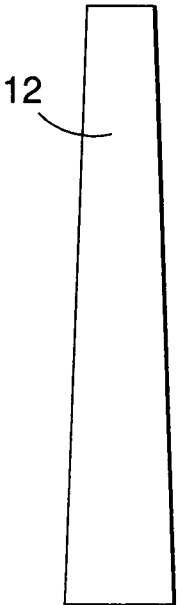


Fig. 11

4 / 4

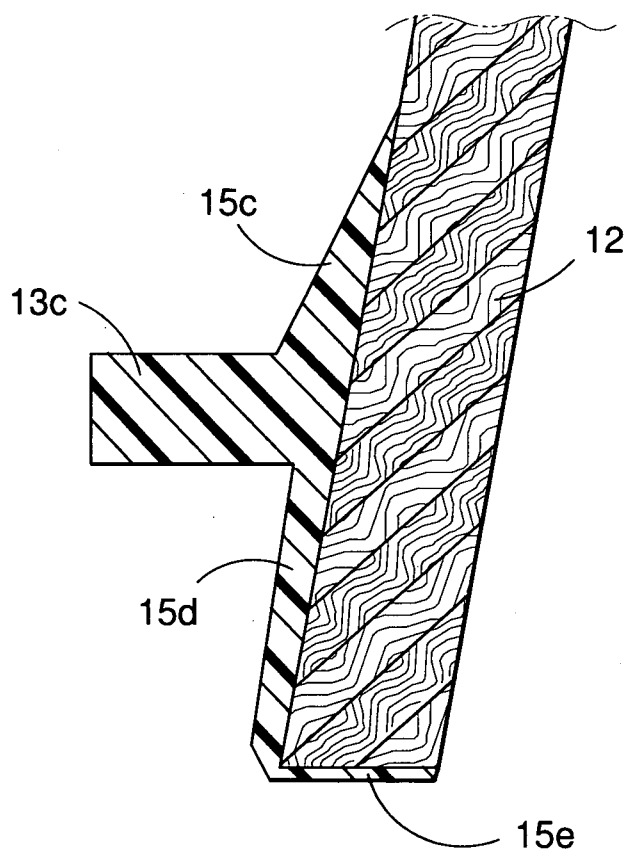


Fig. 12

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE2009/051341

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: E04H, F03D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2008153489 A1 (VERTICAL WIND AB), 18 December 2008 (18.12.2008), figures 2-6, abstract --	1-19
A	DE 202008010515 U1 (FIBER-TECH PRODUCTS GMBH), 15 January 2009 (15.01.2009), figures 4-6, abstract --	1-19
A	US 20060000185 A1 (WOBBEN), 5 January 2006 (05.01.2006), abstract -- -----	1-19



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

1 Sept 2010

Date of mailing of the international search report

01-09-2010

Name and mailing address of the ISA/

Swedish Patent Office

Box 5055, S-102 42 STOCKHOLM

Facsimile No. +46 8 666 02 86

Authorized officer

Krzysztof Kwiatkowski / MRo

Telephone No. +46 8 782 25 00

International patent classification (IPC)**F03D 11/04** (2006.01)**E04H 12/04** (2006.01)**F03D 3/00** (2006.01)**Download your patent documents at www.prv.se**

The cited patent documents can be downloaded:

- From "Cited documents" found under our online services at www.prv.se (English version)
- From "Anförda dokument" found under "e-tjänster" at www.prv.se (Swedish version)

Use the application number as username. The password is

JEMUVCIUDR.

Paper copies can be ordered at a cost of 50 SEK per copy from PRV InterPat (telephone number 08-782 28 85).

Cited literature, if any, will be enclosed in paper form.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/SE2009/051341

WO	2008153489	A1	18/12/2008	CA	2689597 A	18/12/2008
				CN	101688524 A	31/03/2010
				EP	2167816 A	31/03/2010
				KR	20100029831 A	17/03/2010
				MX	2009012918 A	24/02/2010
				SE	532463 C	26/01/2010
				SE	0701404 A,L	12/12/2008
				US	20100170164 A	08/07/2010

DE	202008010515	U1	15/01/2009	NONE
----	--------------	----	------------	------

US	20060000185	A1	05/01/2006	NONE
----	-------------	----	------------	------
