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Datasheet for the decision of 10 July 2020

Case Number: T 0130/18 - 3.2.04

Application Number: 10839557.5

Publication Number: 2532891

IPC: F03D11/00, F03D1/06

Language of the proceedings: EN

Title of invention:
ROTARY BLADE OF WINDMILL AND METHOD OF MANUFACTURING ROTARY BLADE OF WINDMILL

Patent Proprietor:
Mitsubishi Heavy Industries, Ltd.

Opponent:
GE Wind Energy GmbH

Headword:

Relevant legal provisions:
EPC Art. 56
RPBA Art. 12(4)
RPBA 2020 Art. 13(1)

Keyword:

Inventive step - (no)
Late-filed evidence - admitted (yes)

Decisions cited:

Catchword:

Beschwerdekammern

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Chambres de recours

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Case Number: T 0130/18 - 3.2.04

D E C I S I O N
of Technical Board of Appeal 3.2.04
of 10 July 2020

Appellant: (Opponent)	GE Wind Energy GmbH Holsterfeld 16 48499 Salzbergen (DE)
Representative:	Zimmermann & Partner Patentanwälte mbB Josephspitalstr. 15 80331 München (DE)
Respondent: (Patent Proprietor)	Mitsubishi Heavy Industries, Ltd. 16-5, Konan 2-chome Minato-ku Tokyo 108-8215 (JP)
Representative:	Cabinet Beau de Loménie 158, rue de l'Université 75340 Paris Cedex 07 (FR)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 14 November 2017 concerning maintenance of the European Patent No. 2532891 in amended form.**

Composition of the Board:

Chairman	A. de Vries
Members:	S. Oechsner de Coninck
	W. Van der Eijk

Summary of Facts and Submissions

I. The opponent appeals against the interlocutory decision of the Opposition Division of the European Patent Office posted on 14 November 2017 concerning maintenance of the European Patent No. 2532891 in amended form. The notice of appeal was filed on 12 January 2018, the appeal fee payed on the same day, and the statement of grounds was filed on 22 March 2018.

II. The opposition was based on the grounds of Article 100(b),(c) and (a) EPC in combination with lack of novelty and inventive step. In its written decision the Opposition Division held that the patent as amended according to a main request complied with the requirements of the EPC, having regard in particular to the following documents:

ZP7: DE 10 2008 007 304 A1
ZP8: DE 203 20 714 U1

The further following documents were cited in appeal:

ZP12: SAND REPORT SAND2003-1428: "Cost Study for Large Wind Turbine Blades"; Sandia National Laboratories, New Mexico, May 2003
ZP18: J. Twele: "Marktübersicht Windenergie 2002", BWE Windenergie 2002, pages 34-37

III. The Board issued a communication in preparation for oral proceedings and setting out its provisional view on the relevant issues.

IV. Oral proceedings were held on 10 July 2020.

V. The appellant (opponent) requested that the decision under appeal be set aside and that the European patent No. 2532891 be revoked.

VI. The respondent (patent proprietor) requested that the appeal be dismissed and the patent thus be maintained as upheld by the opposition division (main request) or alternatively maintained on the basis of one of auxiliary requests 0A,1,1A,2,2A,3,3A,4,4A, all requests filed with reply to the grounds of appeal of 6 August 2018, or on the basis of requests 0B or 0C filed on 18 November 2019, and to be considered after 0A.

VII. The wording of claim 1 of the different requests reads as follows:

Main request

"A wind turbine rotor blade (5, 30, 40) comprising an outer skin material (11) formed of fiber-reinforced plastic, main strength materials (13) disposed on inner surfaces of a back side and a front side of the outer skin material (11), and cross-beam materials (15, 31, 41) disposed between the main strength materials (13), wherein the main strength material (13) is formed by reinforced fiber sheets (21, 22, 23, 24) stacked one on top of another, the reinforced fiber sheets (21, 22, 23, 24) having constant widths in a longitudinal direction, and all reinforced fiber sheets (21, 22, 23, 24) having the same width,
wherein the stacked reinforced fiber sheets (21, 22, 23, 24) have all the same thickness,

wherein the number of stacked reinforced fiber sheets (21, 22, 23, 24) constituting the main strength material (13) is selected in accordance with a strength required at a position in a longitudinal direction of the wind turbine rotor blade (5, 30, 40),
the wind turbine rotor blade (5, 30, 40) being characterized in that
the reinforced fiber sheets (21, 22, 23, 24) have different lengths in the longitudinal direction, and the number of stacked reinforced fiber sheets (21,22, 23,24) constituting the main strength material (13) is gradually reduced from a position where the number of the stacked reinforced fiber sheets is maximum toward a root side of the wind turbine rotor blade, and from the said position where the number of the stacked reinforced fiber sheets is maximum toward a tip end side of the wind turbine rotor blade."

Auxiliary request 0B
Claim 1 reads as claim 1 of the main request but replaces the term "toward" in the characterising part as follows "the stacked reinforced fiber sheets is maximum ~~toward~~ *until* a root side of the wind turbine rotor blade"

Auxiliary request 1

1. A wind turbine rotor blade (5, 30, 40) comprising an outer skin material (11) formed of fiber-reinforced plastic, main strength materials (13) disposed on inner surfaces of a back side and a front side of the outer skin material (11), and crossbeam materials (15, 31, 41) disposed between the main strength materials (13), wherein the main strength material (13) is formed by reinforced fiber sheets (21, 22, 23, 24) laminated one on top of another, the reinforced fiber sheets (21, 22, 23, 24) having constant widths in a longitudinal direction, and all reinforced fiber sheets (21, 22, 23, 24) having the same width,

wherein the laminated reinforced fiber sheets (21, 22, 23, 24) have all the same thickness,

wherein the number of laminated reinforced fiber sheets (21, 22, 23, 24) constituting the main strength material (13) is selected in accordance with a strength required at a position in a longitudinal direction of the wind turbine rotor blade (5, 30, 40),

the wind turbine rotor blade (5, 30, 40) being characterized in that

the reinforced fiber sheets (21, 22, 23, 24) have different lengths in the longitudinal direction,

the number of laminated reinforced fiber sheets (21,22, 23, 24) constituting the main strength material (13) is gradually reduced from a position where the number of the laminated reinforced fiber sheets is maximum toward a root side of the wind turbine rotor blade, and from the said position where the number of the laminated reinforced fiber sheets is maximum toward a tip end side of the wind turbine rotor blade.

Auxiliary request 2

1. A wind turbine rotor blade (5, 30, 40) comprising an outer skin material (11) formed of fiber-reinforced plastic, main strength materials (13) disposed on inner surfaces of a back side and a front side of the outer skin material (11), and crossbeam materials (15, 31, 41) disposed between the main strength materials (13), wherein the main strength material (13) is formed by reinforced fiber sheets (21, 22, 23, 24) laminated one on top of another, the reinforced fiber sheets (21, 22, 23, 24) having constant widths in a longitudinal direction, and all reinforced fiber sheets (21, 22, 23, 24) having the same width,

wherein the laminated reinforced fiber sheets (21, 22, 23, 24) have all the same thickness,

wherein the number of laminated reinforced fiber sheets (21, 22, 23, 24) constituting the main strength material (13) is selected in accordance with a strength required at a position in a longitudinal direction of the wind turbine rotor blade (5, 30, 40),

the wind turbine rotor blade (5, 30, 40) being characterized in that

the wind turbine rotor blade (5, 30, 40) is twisted in accordance with a predetermined twist up which is set from the root of the wind turbine rotor blade to the end of the wind turbine rotor blade,

the reinforced fiber sheets (21, 22, 23, 24) have different lengths in the longitudinal direction,

the number of laminated reinforced fiber sheets (21,22, 23, 24) constituting the main strength material (13) is gradually reduced from a position where the number of the laminated reinforced fiber sheets is maximum toward a root side of the wind turbine rotor blade, and from the said position where the number of the laminated reinforced fiber sheets is maximum toward a tip end side of the wind turbine rotor blade.

Auxiliary request 3

1. A wind turbine rotor blade (5, 30, 40) comprising an outer skin material (11) formed of fiber-reinforced plastic, main strength materials (13) disposed on inner surfaces of a back side and a front side of the outer skin material (11), and crossbeam materials (15, 31, 41) disposed between the main strength materials (13), wherein the main strength material (13) is formed by reinforced fiber sheets (21, 22, 23, 24) laminated one on top of another, the reinforced fiber sheets (21, 22, 23, 24) having constant widths in a longitudinal direction, and all reinforced fiber sheets (21, 22, 23, 24) having the same width,

wherein the laminated reinforced fiber sheets (21, 22, 23, 24) have all the same thickness,

wherein the number of laminated reinforced fiber sheets (21, 22, 23, 24) constituting the main strength material (13) is selected in accordance with a strength required at a position in a longitudinal direction of the wind turbine rotor blade (5, 30, 40),

wherein the crossbeam material (31, 41) is disposed without being twisted from the blade root to the blade end,

the wind turbine rotor blade (5, 30, 40) being characterized in that

the wind turbine rotor blade (5, 30, 40) is twisted in accordance with a predetermined twist up which is set from the root of the wind turbine rotor blade to the end of the wind turbine rotor blade,

the reinforced fiber sheets (21, 22, 23, 24) have different lengths in the longitudinal direction,

the number of laminated reinforced fiber sheets (21,22, 23, 24) constituting the main strength material (13) is gradually reduced from a position where the number of the laminated reinforced fiber sheets is maximum toward a root side of the wind turbine rotor blade, and from the said position where the number of the laminated reinforced fiber sheets is maximum toward a tip end side of the wind turbine rotor blade.

Auxiliary request 4

1. A wind turbine rotor blade (5, 30, 40) comprising an outer skin material (11) formed of fiber-reinforced plastic, main strength materials (13) disposed on inner surfaces of a back side and a front side of the outer skin material (11), and crossbeam materials (15, 31, 41) disposed between the main strength materials (13), wherein the main strength material (13) is formed by reinforced fiber sheets (21, 22, 23, 24) laminated one on top of another, the reinforced fiber sheets (21, 22, 23, 24) having constant widths in a longitudinal direction, and all reinforced fiber sheets (21, 22, 23, 24) having the same width,

wherein the laminated reinforced fiber sheets (21, 22, 23, 24) have all the same thickness,

wherein the number of laminated reinforced fiber sheets (21, 22, 23, 24) constituting the main strength material (13) is selected in accordance with a strength required at a position in a longitudinal direction of the wind turbine rotor blade (5, 30, 40),

wherein the crossbeam material (31, 41) is disposed without being twisted from the blade root to the blade end,

wherein the crossbeam materials (41) are disposed such that a distance between the crossbeam material (41) disposed on a leading edge side and the crossbeam material (41) disposed on a trailing edge side that constitute the crossbeam materials is gradually narrowed linearly from a blade root to a blade end,

the wind turbine rotor blade (5, 30, 40) being characterized in that

the wind turbine rotor blade (5, 30, 40) is twisted in accordance with a predetermined twist up which is set from the root of the wind turbine rotor blade to the end of the wind turbine rotor blade,

the reinforced fiber sheets (21, 22, 23, 24) have different lengths in the longitudinal direction,

the number of laminated reinforced fiber sheets (21,22, 23, 24) constituting the main strength material (13) is gradually reduced from a position where the number of the laminated reinforced fiber sheets is maximum toward a root side of the wind turbine rotor blade, and from the said position where the number of the laminated reinforced fiber sheets is maximum toward a tip end side of the wind turbine rotor blade.

Claim 1 according to the auxiliary requests 0A,0C,1A, 2A,3A and 4A contains the same features of the wind turbine rotor blade as claim 1 according to the main request, auxiliary requests 0B,1,2,3 and 4 respectively but additionally defines a wind generating wind turbine in the introductory part as follows:
"A wind-generating wind turbine (1) comprising a column(2), a nacelle (3) disposed on an upper end of the column (2), a rotor head (4) provided on the nacelle (3) such that the rotor head (4) can rotate

around a substantially horizontal axis, and a plurality of wind turbine rotor blades (5, 30, 40) radially mounted on the rotor head (4) around its rotation axis,"

VIII. The appellant argues as follows
- ZP12 and ZP18 are relevant to support lack of inventive step and should be admitted into the proceedings.
- The subject-matter of claim 1 according to the main request lacks an inventive step starting from ZP7 when applying the teaching of ZP12.
- The additional features of the further requests are also obvious. In particular a cross-beam as added in claim 1 of the auxiliary requests 3,3A,4,4A is shown in ZP18 and does not contribute to an inventive step.

IX. The respondent argues as follows
- ZP12 and ZP18 are late filed and should not be admitted.
- ZP12 concerns cost issues and the skilled person person would not find the solution defined in claim 1 according to the main request.
- The subject-matter of claim 1 according to auxiliary requests 3,3A,4 and 4A contain added features having a synergy effect with the material thickness of the main strength material. These features are not derivable from ZP18 and thus imply inventive step.

Reasons for the Decision

1. The appeal is admissible.

2. Background

The present patent is concerned with the structure of a wind turbine rotor blade. The type of wind turbine rotor blade concerned includes outer skin materials formed of fiber reinforced plastic and uses structural reinforcements to increase load resistance. These reinforcements provided on the skin of the pressure and suction sides are called in the context of the patent main strength materials or super cap materials and form what is commonly known as a spar cap. The patent seeks to reduce waste of raw material when such a main strength material is produced, thereby also reducing the production cost (paragraph 007).

The claimed solution involves selecting the number of stacked reinforced fiber sheets constituting the main strength material in accordance with the strength required at a position along the span of the rotor blade, i.e. in dependence of a position along the blade. More particularly, the number of stacked reinforced fiber sheets constituting the main strength material is gradually reduced from a position where the number is maximum toward the root side of the wind turbine rotor blade, and (in the opposite direction) toward the tip end side of the blade.

3. Late filed documents ZP12 and ZP18

3.1 ZP12 was filed together with the appellant's grounds of appeal and therefore after expiry of the opposition time limit set forth in Art 99(1) EPC. ZP12 discloses how the thickness of the main load bearing part of the blade (the spar cap) varies along its length for blades of different sizes (Table 2.3). In particular it shows thickness decreasing both towards the root and towards the tip from a maximum value in between. In the Board's view in particular this variation of thickness of the main load bearing part along the blade and not shown in the previously cited prior art prima facie renders this document of special relevance vis-a-vis the earlier citations.

Whether or not the singular values shown in table 2.3 are proof of a gradual variation may require subsequent closer scrutiny. However this does not take away the fact that on first glance, i.e. prima facie, this disclosure appears of relevance.

Therefore in view of its prima facie relevance for inventive step and since it was filed at the earliest stage of the appeal, the Board decided to exercise its discretion afforded by Art 114(2) EPC and Art 12(4) RPBA 2007 to admit ZP12 into the proceedings.

3.2 ZP18 was filed with the appellant's letter of 30 November 2018 in the context of the auxiliary requests 3,3A,4,4A re-filed with the respondent's reply to the statement of grounds.
ZP18, in particular in the figure on page 2/34 (see the rotor blade half on the left hand side), appears to show laminated twisted blades having two untwisted cross-beams or shear webs. It thus appears prima facie of particular relevance, more than what is already on file, for the features of the untwisted cross beam, which were added from the description to claim 1 of these requests. The filing of ZP18 shortly after the

filing of these auxiliary requests can thus seen to be a timely and fair response to the introduction of these features from the description.
In view of its prima facie relevance for these requests, the Board decided to exercise its discretion afforded by Art 12(4) RPBA 2007 and Art 13(1) RPBA 2020 to admit ZP18 into the proceedings.

4. Main request - inventive step

4.1 It is common ground that ZP7, see figures 1 and 2 and paragraphs 34 to 37, represents a suitable starting point for assessing inventive step.
It discloses a blade for a wind turbine comprising a main strength material ("Gurt" 20,30) made of a stack of reinforced fiber bands. Paragraphs 007 and 014 detail the general objective of ZP7, namely to better match the height or thickness ("Höhe des Gurts") of the main strength material to the applied load ("auftretenden Belastungen") along the length of the rotor blade ("Längstabschnitt des Rotorblatts"). With such a locally adapted height or thickness weight and material can be saved.
Therefore ZP7 discloses a similar wind turbine rotor blade design with the same aim of materials' savings as the patent. It thus represents a promising starting point for assessing inventive step.

To achieve varying thickness, fiber strips or bands that form the main strength material are arranged in stacks of rectangular identical cross-section ("einheitlichen Querschnitt" paragraph 019). Their height ("Abschnitte" 22 bis 28,32,34) is varied by different numbers of bands.

The heights of these stacks vary in at least a section of the length of the blade as required by claim 1. More particularly, as explained in paragraph 036 in relation to the embodiment of figure 2 the main strength material ("Gurt" 20) is made of stacks ("Abschnitte" 22 bis 28,32,34) having a varying height that decreases towards the blade end ("Abstufung ... innerhalb der einzelnen Abschnitte .. führt zu einer stufenweisen Variation der Höhe... Die Höhe nimmt in Richtung zu der Blattspitze hin ab"). Therefore ZP7 discloses the last feature of the characterising portion of claim 1 according to which the reinforced fiber sheets have different lengths in the longitudinal direction, and the number of stacked reinforced fiber sheets constituting the main strength material is gradually reduced from a position where the number of the stacked reinforced fiber sheets is maximum toward a tip end side of the wind turbine rotor blade.

4.2 It is undisputed that the rotor blade defined in claim 1 differs from the one disclosed in ZP7 in that the number of stacked reinforced fiber bands is "gradually reduced from a position where the number of the stacked reinforced fiber bands is maximum toward a root side near the hub of the rotor.

4.3 The advantage sought by this reduction of the number of stacked reinforced fiber bands also towards the root results in a further elimination of waste of raw material and thus in a further reduction of production cost (paragraph 007 of the patent). More specifically, in the last two sentences of paragraph 045 of the patent, the reduction of the number of sheets towards the root side also there allows the band structure to better match the strength required at a radial position of the blade. Therefore gradually reducing the number of stacked fiber bands in a direction toward the root further avoids unnecessary raw material.

4.4 As stated above paragraph 007 of ZP7 already contemplates a bearing structure that is better adapted to loads applied ("an die auftretenden Belastungen besser angepasste Tragstruktur") with associated material and cost savings ("materialsparend","kostengünstig"). Consequently, the objective technical problem must be reformulated, and may be seen as to *further* reduce weight and material costs based on additional adaptation of a spar cap to a specific load distribution.

4.5 The decision held that ZP7 taught away from the solution by consistently disclosing constant thickness of the reinforced bands towards the hub. Thus, as argued by the respondent, the embodiments of ZP7, figures 1 to 3, only ever show a stepwise decrease towards the tip, but a constant height towards the root.

4.6 The Board does not agree. The argument that ZP7 teaches away from a height decrease toward the root rests entirely on the fact that it does not disclose such a decrease. In the Board's view this conflates the issues of novelty and inventive step. For ZP7 to teach away from a non-disclosed variation or application of its core teaching, it must for example be derivable for the skilled person from what is stated regarding the embodiments and associated effects, that those effects are expected only for the embodiments described or that beyond those embodiment disadvantages are expected to outweigh any benefits. Only then would the skilled person not seriously contemplate applying the teaching outside the confines of the embodiments specifically shown.

In the Board's view this is not the case here. In particular it is unable to infer any expectation of advantage to be limited to the embodiments of figures 1 to 3, or of disadvantage beyond those limited examples. There is no indication apparent to the Board that ZP7's teaching should be limited to these embodiments, which are cited as examples ("Ausführungsbeispiele", paragraphs 025, 028, 029, 038). Nor can the Board infer from the description of these embodiments that advantages arise only from height reduction towards the blade tip, much less that variation in the opposite direction towards the root would be disadvantageous.

Rather, where ZP7 first discloses height variation in the spanwise direction, this teaching appears to be of much broader applicability. The introductory part of the description, paragraphs 007 to 014 discloses how, in order to save material, height at a given length section of the blade, can be varied chord-wise to precisely match the local load across the chord. Subsequently, in paragraphs 015 and 016, this idea of matching height to local load is expanded to include variations along the length of the blade. By way of example ("Beispielsweise") paragraph 015 suggests to taper height (or width) of the "Gurt" towards the tip; as it is cited only as an example it will be clear to the skilled person that the idea of height variation along the length is not limited thereto. The following paragraph 016 suggests another alteration, in which height changes are stepwise along the length of the blade, but without any indication of direction.

Therefore the Board is unable to see any disincentive to apply the more general teaching of varying height along blade length to match local load, in the fact that ZP7 in its detailed embodiments only reduces height or thickness towards the blade tip. Thus, the skilled person will seriously contemplate applying the broader teaching of varying height according to load also in other ways, depending on the blade structure and configuration, if they expect a different load distribution.

4.7 ZP12 has been cited to illustrate possible load distribution in the root section with associated adaptation of the spar cap thickness to applied loads. In particular table 2.3 shows spar cap (main strength material) thickness values that are progressively reduced vis-a-vis a central maximum (station at 45% of span) towards the blade tip (stations 65%,85%) and blade root (stations 25%,15%).

ZP12 in its abstract explains that it concerns a cost study for large wind turbine blades, and to this end considers three blades of 30, 50 or 70 meter length. Extreme wind design loads were estimated according to international recommendations and structural analyses of these three blade sizes performed at representative spanwise stations. A bill of materials was prepared for each blade type using laminates requirements. The results obtained show that the larger the size of the blade is, the greater the proportion of material costs of the overall cost is(see abstract).

4.8 The Board cannot agree with the respondent's view that ZP12 represents a cost study that the skilled person would not have found relevant for solving a problem related to distribution of loads. Chapter 5.1 on page

30 referred to by the respondent indeed relates to the the different contributions to cost (labor, material, transport...) for each blade. However, cost is clearly not the only concern of ZP12, which examines the relationship between structural requirements and material cost, as already apparent from the abstract, and discussed in greater detail in chapter 2.3 on pages 12-13 under the heading blade structural design. This section clearly considers structural aspects of the blade and relates the type of material used (mat, unidirectional or double bias E-glass fabrics) and its thickness to estimated loads. The material required to match the loads is then used in the blade bill of material in chapter 2.6 on pages 15 to 17 and finally integrated with the other costs in the chapter referred to. Therefore, contrary to the respondent's opinion, the skilled person does find in ZP12 a relevant teaching relating loads to material strength requirements as well as cost. Therefore, this document provides them with useful information for solving the objective technical problem (section 4.4 above), namely adapting the structure of a main strength material in the context of material savings both in terms of weight and cost.

4.9 The teaching derivable from the paragraph directly preceding table 2.3 on page 13 explains that the spar cap thickness is derived from the imposed load, and therefore establishes a clear relationship between the loads to be expected and the required thickness of the spar cap. In this paragraph it is furthermore explained that the spar cap becomes thinner as the airfoil thickness increases because the separation between tension and compression side materials increases. This recognition does not limit the teaching to the sole relationship between the dimension of the airfoil section and spar cap thickness as argued by the respondent, but confirms what is otherwise well-known to the skilled person from their mechanical knowledge. For a given bending moment, the load applied on the spar cap is lower if the airfoil section is larger between its suction and pressure sides, that is when the distance between both spar caps increases. Such distance is usually larger in the root region and decreases towards the tip. In such a situation the load exerted on each spar cap in the root region is relatively lower and the spar cap thickness can be decreased although the bending moment applied at that location is higher. This is reflected in all blade designs considered in ZP12. The thickness distribution of the spar cap shown in the last two columns of table 2.3 as dimensions in mm and relative percentage of the airfoil maximum thickness is located in a mid portion of the span (at station 45% of the span).

4.10 The Board is therefore convinced that the skilled person not only could have used the teaching of ZP12 but would have done so in expectation of success to solve the problem posed (CLBA, 9th edition, 2019 I.D.5 "could-would"). In the process of further adapting the number of stacked fiber bands forming the spar cap of ZP7, to adapt it to a specific load distribution, ZP12 is not only consistent with the principle of matching spar cap thickness to local expected load, but also gives a clear and directly applicable instruction to further save on spar cap material in the root region, by also reducing thickness towards the root. The skilled person, an aerodynamic engineer involved in the design and manufacture of wind turbine rotor blades, also has sufficient knowledge of interpolation to be able to recognize in the two discrete, successively lower values of table 2.3 of ZP12 a gradual decrease (rather than seeing therein only isolated points that are uncorrelated to each other and points in between as the respondent would have it). Applying this understanding of table 2.3 of ZP12 to the teaching of ZP7 the skilled person would realize the blade also with a gradual reduction of the stack height and thus height of cap (or "Gurt") also towards the root, by choosing an appropriate number of bands of the stack corresponding to load. This adaptation of the number of stacked fiber sheets would furthermore be in accordance with the stepwise variation disclosed in ZP7 towards the tip of the blade. In this manner they would arrive at the subject-matter of claim 1 of the main request in an obvious manner.

4.11 In view of the above the Board concludes that the subject-matter of claim 1 of the main request, contrary to the decision's positive assessment, does not involve an inventive step in the light of the prior art cited as required by Articles 52(1) and 56 EPC.

5. Auxiliary requests - Inventive step

5.1 Claim 1 according to auxiliary request 0B replaces the expression "toward a root side" by the expression "until a root side". This minor amendment does not change the basic meaning of decreasing the number of the stacked reinforced fiber sheets from a maximum toward a root side of the wind turbine rotor blade.

5.2 Claim 1 according to auxiliary request 1 further specifies that the stacked reinforced fiber sheets are laminated one on top of the other. This is also how the bands of reinforcement fibers of the stack are produced in ZP7 (paragraph 017); it is in any case standard for reinforced composite fibers.

5.3 Claim 1 according to auxiliary request 2 further requires that the wind turbine rotor blade is twisted in accordance with a predetermined twist from the root of the wind turbine rotor blade to its end. Twisting a blade along its length is a common measure in rotor blades to adapt to the relative wind direction along the rotating blade. It is for example known from ZP, table 2.1.

5.4 Claim 1 of auxiliary requests 0A,0C,1A and 2A contains the same features of the blade as defined in claim 1 of the main and auxiliary request 0B,1 and 2 respectively but link them to a wind-generating wind turbine with a horizontal axis. That this is an obvious application of a wind turbine rotor blade goes without saying.

5.5 Claim 1 according to auxiliary request 3 and corresponding wind turbine of auxiliary request 3A further require the cross-beam material to be disposed without being twisted from the blade root to the blade end. cross-beam or shear webs are indisputably well-known features of the internal support structure of rotor blades that use spar caps. Such a structure is for example shown in ZP12, figure 2.2. However, ZP12 does not disclose how that structure is realized in a twisted blade.

The Board is firstly not convinced by the respondent's view that there exists a synergy between the claimed thickness distribution of the spar cap and the cross-beam material that achieves a surprising effect of rendering twist of the cross beam unnecessary. It is not apparent to the Board from cited paragraph 018 of the patent why twist of the cross-beam material would be unnecessary, nor that this is linked to the reduction of thickness towards the root. The paragraph simply explains that twisting the cross-beam is unnecessary, with associated reduction of the manufacturing cost. Paragraph 071 repeats that twisting the shear web is unnecessary, and the last sentence of paragraph 72 further explains how the expected reduction in cost is achieved. None of the above passages establishes any relationship between the varying thickness of the spar cap and the production of the cross-beam in twisted or untwisted state.

Therefore absent any relationship with the varying thickness of the spar cap, the additional separate problem to be solved may merely be seen in realizing a blade as in ZP7 with a suitable shear web or cross beam structure.

Although the photograph on page 34 of ZP18 does not show all steps of the manufacturing process, the cross beam structure shown in one half of a twisted blade appears to be comprised of two relatively flat and straight shear webs, already in position before assembly of the two blade halves and subsequent curing in the mold. That the blade half is twisted is inferred from the apparent angle between the nearer root end and the far tip end, which appear tilted in opposite directions. The respondent also argues that any twist would be effected after assembly of the two halves before curing, resulting in twisting of the shear webs. With such a large structure the Board considers this to be highly unlikely. Therefore this configuration of straight untwisted cross-beam already produced before its attachment to the blade half is intended to stay in the untwisted state after assembly with the other blade half.

In the Board's estimation the skilled person who wishes to realize an appropriate shear web/cross-beam structure for a twisted blade resulting from the obvious combination of the teachings of ZP7 and ZP12 would draw on ZP18 by way of obviousness.

5.6 Claim 1 according to auxiliary request 4 and corresponding wind turbine of auxiliary request 4A further requires that the cross-beam material is disposed such that a distance between the cross-beam material disposed on a leading edge side and the cross-beam material disposed on a trailing edge side that constitute the cross-beam materials is gradually narrowed linearly from a blade root to a blade end.

Paragraph 026 that relates to this embodiment with gradually narrowing distance presents this feature without any particular effect or advantage, as an alternative to keeping the distance between the cross-beam disposed on the leading edge side and trailing edge side constant, as presented in preceding paragraph 025. The advantage of easier manufacture mentioned in paragraph 027 rather relates to this first option of keeping the distance between cross-beams constant along the length.

The corresponding partial problem can be formulated as realizing a rotor blades as in ZP7 with a suitable cross-beam structure.

The Board concurs with the appellant's view that providing such a gradually narrowing distance between two cross-beams merely requires the skilled person to select amongst two basic choices of either narrowing the distance to accommodate the blade taper toward the tip or to keep the distance constant. This appears all the more so as ZP18, which does show the shear web structure, is inconclusive - due to perspective - as to whether the shear webs are parallel or converge towards the tip end of the blade. The skilled person who as a matter of obviousness draws on ZP18 to realize such a structure (see preceding section) would thus consider both possibilities. Given that the blade itself tapers toward the tip it may even be argued that a similar taper in the cross-beam structure is then the more obvious of the two.

5.7 In the light of the above the Board concludes that none of the features added to claim 1 according to the auxiliary requests either alone or in combination contributes to inventive step. Thus the subject-matter of claim 1 of these requests also lacks inventive step contrary to Articles 52(1) and 56 EPC.

6. The Board concludes that neither the amended version of claim 1 upheld nor the amended versions of claim 1 according to the auxiliary requests on file involve an inventive step as required by Articles 52(1) and 56 EPC. Thus, the patent as amended fails to meet the requirements of the EPC. Pursuant to Article 101(3)(b) EPC the patent must then be revoked.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

The Registrar: The Chairman:

G. Magouliotis A. de Vries

Decision electronically authenticated