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Datasheet for the decision of 10 July 2019

Case Number: T 1168/16 - 3.2.04

Application Number: 09777267.7

Publication Number: 2318703

IPC: F03D1/06

Language of the proceedings: EN

Title of invention:
WIND TURBINE BLADE

Patent Proprietor:
Vestas Wind Systems A/S

Opponents:
Nordex Energy GmbH
Siemens Aktiengesellschaft

Headword:

Relevant legal provisions:
EPC Art. 56

Keyword:
Inventive step - (no)

Decisions cited:

Catchword:

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Beschwerdekammern

Boards of Appeal

Chambres de recours

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Case Number: T 1168/16 - 3.2.04

D E C I S I O N
of Technical Board of Appeal 3.2.04
of 10 July 2019

Appellant: (Opponent 2)	Siemens Aktiengesellschaft Werner-von-Siemens-Straße 1 80333 München (DE)
Respondent: (Patent Proprietor)	Vestas Wind Systems A/S Hedeager 42 8200 Aarhus N (DK)
Representative:	Taylor, Gillian Claire Reddie & Grose LLP The White Chapel Building 10 Whitechapel High Street London E1 8QS (GB)
Appellant: (Opponent 1)	Nordex Energy GmbH Langenhorner Chaussee 600 22419 Hamburg (DE)
Representative:	Hauck Patentanwaltspartnerschaft mbB Postfach 11 31 53 20431 Hamburg (DE)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 15 March 2016 rejecting the opposition filed against European patent No. 2318703 pursuant to Article 101(2) EPC.**

Composition of the Board:

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

Summary of Facts and Submissions

I. The opponents 1 and 2 both appeal against the opposition division's decision dated 15 March 2016 to reject the opposition against the patent EP 2 318 703. The opponent 2 filed a notice of appeal on the 13 May 2016, paid the appeal fee on the same day, and filed the statement of grounds on 7 July 2016. The opponent 1 filed a notice of appeal on 12 May 2016, paid the appeal fee the same day, and filed the statement of grounds on 25 July 2016.

II. Opposition was filed against the patent as a whole and based on Article 100(a) together with Articles 52(1), and 56 EPC. The opposition division held that the grounds for opposition mentioned in Article 100 (a) EPC did not prejudice the maintenance of the patent as granted having regard to the following documents in particular:

D2: H.Schürmann "Konstruieren mit Faser-Kunstoff-Verbunden", 2.Auflage, 2007, Springer Verlag Berlin Heidelberg,.

D4: WO 03/078832 A1

III. The appellants (opponents 1 and 2) requested that the decision under appeal be set aside and that the European patent No. 2318703 be revoked.

The respondent (patent proprietor) requested that the appeals be dismissed and the patent thus be maintained as granted (main request) or, that the decision under appeal be set aside and the patent be maintained in amended form on the basis of one of auxiliary requests 1-6, filed with letter of 20 December 2016, or auxiliary request 7, filed with letter of 10 May 2019.

IV. Oral proceedings were held on 10 July 2019.

V. The independent claim 1 of the relevant requests read as follows:

Main request (as granted)

" A wind turbine blade (10)(30) having a tip end and a root end and comprising at least one component (16,18,20)(32,34) formed of fibrous composite material including two or more different types of carbon fibres having a different elastic modulus to each other, wherein the proportions of the different types of carbon fibres in the at least one component (16,18,20) vary in the longitudinal direction of the blade (10)(30), such that the elastic modulus of the fibrous composite material increases towards the tip end of the blade."

Auxiliary request 1 (amendments with respect to granted claim 1 highlighted)

1. A wind turbine blade (10)(30) having a tip end and a root end and comprising at least one component ~~(16,18,20)~~(32,34) formed of fibrous composite material including two or more different types of carbon fibres having a different elastic modulus to each other, wherein the proportions of the different types of carbon fibres in the at least one component ~~(16,18,20)~~(32,34) vary in the longitudinal direction of the blade (10)(30), such that the elastic modulus of the fibrous composite material increases towards the tip end of the blade, wherein the at least one component comprises two or more outer shell portions (32,34) and wherein each of the outer shell portions is formed of fibrous composite material comprising two or more different types of carbon fibres having a different elastic modulus to each other. .

Auxiliary request 2 (amendments with respect to granted claim 1 highlighted)

1. A wind turbine blade (10)(30) having a tip end and a root end and comprising at least one component ~~(16,18,20)~~(32,34) formed of fibrous composite material including two or more different types of carbon fibres having a different elastic modulus to each other, as well as non-carbon fibres, wherein the proportions of the different types of carbon fibres in the at least one component ~~(16,18,20)~~ vary in the longitudinal direction of the blade (10)(30), such that the elastic modulus of the fibrous composite material increases towards the tip end of the blade, wherein the at least one component comprises two or more outer shell portions (32,34) and wherein each of the outer shell portions is formed of fibrous composite material comprising two or more different types of carbon fibres having a different elastic modulus to each other.

Auxiliary request 3 (amendments with respect to granted claim 1 highlighted)

1. A wind turbine blade (10)(30) having a tip end and a root end and comprising at least one component ~~(16,18,20)~~(32,34) formed of fibrous composite material including two or more different types of carbon fibres having a different elastic modulus to each other, as well as non-carbon fibres, wherein the proportions of the different types of carbon fibres in the at least one component ~~(16,18,20)~~ vary in the longitudinal direction of the blade (10)(30), such that the elastic modulus of the fibrous composite material increases towards the tip end of the blade, wherein the at least one component comprises two or more outer shell portions (32,34) and wherein each of the outer shell portions is formed of fibrous composite material comprising two or more different types of carbon fibres having a different elastic modulus to each other, at least one of the different types of carbon fibres having an elastic modulus of greater than 230 GPa, and another of the different types of carbon fibres having an elastic modulus of greater than 280 GPa.

Auxiliary request 4 (amendments with respect to granted claim 1 highlighted)

1. A wind turbine blade (10)(30) having a tip end and a root end and comprising at least one component ~~(16,18,20)~~(32,34) formed of fibrous composite material including two or more different types of carbon fibres having a different elastic modulus to each other, as well as non-carbon fibres, wherein the proportions of the different types of carbon fibres in the at least one component ~~(16,18,20)~~ vary in the longitudinal direction of the blade (10)(30), such that the elastic modulus of the fibrous composite material increases towards the tip end of the blade, and vary to provide at least two regions of the component in which the fibrous composite material has a higher elastic modulus than in the rest of the component, wherein the at least one component comprises two or more outer shell portions (32,34) and wherein each of the outer shell portions is formed of fibrous composite material comprising two or more different types of carbon fibres having a different elastic modulus to each other, at least one of the different types of carbon fibres having an elastic modulus of greater than 230GPa and another of the different types of carbon fibres having an elastic modulus of greater than 280GPa.

Auxiliary request 5 (amendments with respect to granted claim 1 highlighted)

1. A wind turbine blade (10)(30) having a tip end and a root end and comprising at least one component ~~(16,18,20)~~ (32,34) formed of fibrous composite material including two or more different types of carbon fibres having a different elastic modulus to each other, as well as non-carbon fibres, wherein the proportions of the different types of carbon fibres in the at least one component ~~(16, 18, 20)~~ vary in the longitudinal direction of the blade (10)(30), such that the elastic modulus of the fibrous composite material increases towards the tip end of the blade, and vary to provide at least two regions of the component in which the fibrous composite material has a higher elastic modulus than in the rest of the component, wherein the at least one component comprises two or more outer shell portions (32,34) and wherein each of the outer shell portions is formed of fibrous composite material comprising two or more different types of carbon fibres having a different elastic modulus to each other, at least one of the different types of carbon fibres having an elastic modulus of greater than 230GPa and another of the different types of carbon fibres having an elastic modulus of greater than 280GPa, and wherein the fibrous composite material includes strips of fibrous composite material extending along substantially the entire length of the blade.

Auxiliary request 6 (amendments with respect to granted claim 1 highlighted)

1. A wind turbine blade (10)(30) having a tip end and a root end and comprising at least one component ~~(16,18,20)~~(32,34) formed of fibrous composite material including two or more different types of carbon fibres having a different elastic modulus to each other, as well as non-carbon fibres, wherein the proportions of the different types of carbon fibres in the at least one component ~~(16,18,20)~~ vary in the longitudinal direction of the blade (10)(30), such that the elastic modulus of the fibrous composite material increases towards the tip end of the blade, vary to provide at least two regions in which the fibrous composite material has a higher elastic modulus than in the rest of the component, and vary along the width of the blade, wherein the at least one component comprises two or more outer shell portions (32,34) and wherein each of the outer shell portions is formed of fibrous composite material comprising two or more different types of carbon fibres having a different elastic modulus to each other, at least one of the different types of carbon fibres having an elastic modulus of greater than 230GPa and another of the different types of carbon fibres having an elastic modulus of greater than 280GPa, and wherein the fibrous composite material includes strips of fibrous composite material extending along substantially the entire length of the blade.

Auxiliary request 7 (amendments with respect to granted claim 1 highlighted)

1. A wind turbine blade (10)(30) having a tip end and a root end and comprising at least one component ~~(16,18,20)~~(32,34) formed of fibrous composite material including two or more different types of carbon fibres having a different elastic modulus to each other, as well as non-carbon fibres, wherein the proportions of the different types of carbon fibres in the at least one component ~~(16,18,20)~~ vary in the longitudinal direction of the blade (10)(30), such that the elastic modulus of the fibrous composite material increases towards the tip end of the blade, vary to provide at least two regions in which the fibrous composite material has a higher elastic modulus than in the rest of the component, and vary along the width of the blade, wherein the at least one component comprises two or more outer shell portions (32,34) and wherein each of the outer shell portions is formed of fibrous composite material comprising two or more different types of carbon fibres having a different elastic modulus to each other, at least one of the different types of carbon fibres having an elastic modulus of greater than 230GPa and another of the different types of carbon fibres having an elastic modulus of greater than 280GPa.

VI. The appellants argue as follows:

- The technical effect related to the two types of carbon fibres concerns the stiffness of the blade, not its aerodynamic characteristics. D2 teaches to provide several types of carbon fibres to achieve a certain stiffness and is therefore directly applicable to modify the glass fibres of D4. Applying this teaching thus represents a straightforward measure for the skilled person.
- Claim 1 according to the auxiliary requests defines further additional features that are disclosed in either D2 or D4 and cannot provide the necessary inventive step.

VII. The respondent argues as follows:

- Starting from D4 the problem should be reformulated to also provide an aerodynamic improvement, as stated in the patent. To solve that problem the skilled person does not find any hint in D2 because its teaching is of general nature, and does not suggest to tailor the elastic modulus in the blade's tip region.
- Turning to the auxiliary requests, they all further specify features that are not disclosed or suggested by D2 or D4.

Reasons for the Decision

1. The appeal is admissible.

2. Background of the invention

The patent relates to a wind turbine blade structure. A construction material for such a wind turbine blade is

sought that optimises the strength and stiffness of the blade, such that the deflection of the tip end of the blade can be reduced (paragraph [006], first sentence). The core of the solution consists in providing at least two types of carbon fibres having a different elastic modulus to each other, and achieving an increased modulus of elasticity towards the tip. This measure allows to vary the proportions of the different types of fibres, providing a suitable loading behaviour while staying cost effective, by keeping more expensive fibres in this outer tip region only (paragraph [018] of the patent).

3. Main request - inventive step

3.1 It is common ground that D4 discloses a similar composite wind turbine blade comprising two types of fibre that are distributed in the polymer matrix, wherein the quantitative ratio of the two types of fibre varies continuously in the longitudinal direction of the blade (page 4, lines 21 to 23; see also claim 1). This is done to optimise areas of the blade in particular as regards strength and stiffness (page 4, lines 17 to 19). It moreover suggests the use of carbon fibre as one of the different types of fibre of the composite. As it relates to composite blades, where the composite may include carbon fibre, and concerns the same purpose of optimising the strength and stiffness of the blade, D4 is considered a promising springboard for assessing inventive step.

3.2 It is furthermore undisputed that the subject-matter of claim 1 differs from D4 in that the two or more types of different fibre are different types of carbon fibres. Though D4 does mention as its main example carbon fibres in combination with glass fibre, there is

no disclosure of different types of carbon fibre making up the composite. The above differentiating feature thus constitutes the contribution of the claimed subject-matter over the prior art, and the effect achieved by this feature needs to be assessed to formulate an objective technical problem.

3.3 Starting from the technical problem identified in the patent, the problem of providing sufficient stiffness in the tip of the blade expressed in [006] is already solved to some extent by the composite used in D4 (page 4, lines 14 to 19). According to established case law a reformulation of the technical problem based on the technical effect achieved is thus necessary, whereby the new problem should be deduced from the application as filed (Case law of the boards of appeal (CLBA), 8th edition, 2016, I.D.4.4.1). As explained in paragraph [014] and [015] of the patent, the technical advantage of carbon fibres is that they have a higher value of elastic modulus than a composite material comprising glass fibres, as well as a much lower weight. Vis-a-vis D4, combining two different types of carbon fibre, rather than carbon fibre with say glass fibre, further improves the stiffness to weight ratio.

Based on the above effect, the Board agrees with the appellants' reformulation of the objective technical problem as providing a blade that is further improved or optimized as regards stiffness and weight.

3.3.1 The respondent furthermore considers the aspect of aerodynamic improvement to form a further aspect of the objective technical problem, because paragraph [022], last sentence of the patent indicates that the

reduction of the thickness to chord ratio at the tip optimises the aerodynamics of the blade.

It is established case law that the technical problem should be based on the technical effect(s) of exactly those features distinguishing the claim from the prior art (e.g. T 1557/07, point 4.4 and T 1192/09 point 3.7 both referring to T 1019/99 (unpublished); Reasons, point 3.3;). In the Board's view this positive influence on aerodynamics will only arise if a different design of the aspect ratio of the blade profile is indeed chosen. In particular, that aerodynamic properties are optimized will not be a direct consequence of the use of carbon fibres of a different type, but rather the result of a blade design with a different cross-sectional shape. Claim 1 however does not specify any detail of the cross-sectional design of the blade, let alone specify any thickness to chord ratio. Therefore any potential aerodynamic improvement cannot be invoked. Therefore there is no support for this aspect to be reflected in the formulation of the technical problem.

3.4 As noted, D4 already itself suggests the use of carbon fibre as one of the different types of fibre of the composite material of the blade. In particular it identifies carbon fibres as advantageous due to their stiffness and low density (page 3, lines 9-10), and suggests its use in the outermost portion because of its reduced weight and increased stiffness (page 3, lines 12 to 19). Use of carbon fibre is also suggested for the innermost portion of the blade as this will reduce the blade's total weight (page 3, lines 23-26).

3.5 From textbook D2, it will be commonly known to the skilled person that there are different types or classes of carbon fibre which are all very light but exhibit different degrees of stiffness, see chapter 3.4.2, in particular table 3.2 and the immediately preceding paragraph. Table 3.2 lists the different values of the modulus of elasticity as well as density of the different types of carbon fibres, namely HT (high tenacity), ST (super tenacity), IM (intermediate modulus), HM (high modulus) and UHM (ultrahigh modulus) type carbon fibres. D2 in chapter 25.1.1 on page 70 further teaches to combine different types of carbon fibres to adjust the modulus of elasticity in the longitudinal extension (first sentence) to a desired value, citing the example of HT with HM carbon fibres. This is also part of the skilled person's textbook knowledge of carbon fibres, their properties and their use.

3.6 It is established jurisprudence that the use of a known material on the basis of its known properties and in a known manner to obtain a known effect in a new combination is not inventive (CLBA), 8th edition, 2016, I.D.9.6). The Board considers that in the present case the skilled person, in order to further improve the stiffness and weight properties of a carbon fibre composite blade as in D4, will draw on their textbook knowledge of the different types of carbon fibre and their use in combination as documented in D2, to realize a blade composite that combines two different types of carbon fibre, such as for example HT and HM carbon fibre as suggested in D2. By straightforward application of the textbook knowledge of D2, relating to the combination of two different types of carbon fibres of different elasticity to obtain a desired stiffness, to a carbon fibre composite blade as in D4,

the skilled person arrives without an inventive step at the subject-matter of claim 1.

3.7 The respondent argues that D2 is a teaching of very general nature relating primarily to carbon fibre laminates, but which does not at all suggest the sophisticated application of carbon fibre in wind turbines,let alone wind turbine blades that need to tailor the elastic modulus in the tip region.

In the Board's view the skilled person does not need to find an incentive in D2 to vary the elastic modulus to tailor it to the required local stiffness of a wind turbine blade. Such a design consideration is already present in D4. D4 explains on page 9, lines 17 to 19, that the transition area in which one type of fibre is gradually replaced by the other type of fibre, whereby this transition area according to page 6, lines 11 to 12, can have a length up to 10 meters. In that region the gradual addition of carbon fibres produces a ramped increase of the elastic modulus towards the tip, which is therefore tailored to the load distribution gradient. The Board emphasises that although D4 provides as example only the combination of glass and carbon fibres (see also its claim 2), its teaching is much more general and encompasses cases having a first type of fibre made of any material, that is also in the form of carbon fibres (e.g. claim 1). Nor does the Board find any indication in D4 that where it refers to different types of fibres it only means fibres of essentially different materials.

3.8 The respondent further argues that in D4 the high cost of carbon fibre mentioned would constitute a technical prejudice, and would prevent the skilled person from

replacing the relatively cheap glass fibre mentioned in the examples of D4 by carbon fibre.

It is true that manufacturing costs are a major design consideration that the skilled person must consider in blade design and manufacture. Cost is indeed mentioned in D4, see page 1, lines 29 to 31.

However, in the present case the Board does not consider the concern for higher cost to represent a technical prejudice as this is normally understood by the skilled person. As secondary indicia in the assessment of inventive step, a technical prejudice is defined as a widely held but incorrect opinion of a technical fact, that needs to be overcome (CLBA , 8th edition, 2016, I.D.10.2).

The Board agrees that cost is a genuine concern of the skilled person. However, that it is a concern does not mean it represents a technical prejudice which bars the skilled person from even considering a particular technical solution. At best high cost might make the decision maker decide not to further pursue that solution, the skilled person will nevertheless have considered it. Technical feasibility is the primary concern of the skilled person in the process of designing an object. Once considered technically possible or advantageous to manufacture, the question of its costs is evaluated as a second step, for example to evaluate whether it meets budgetary constraints. In the present case, D4 may mention the drawback of carbon fibre's high cost, it nevertheless makes use of carbon fibre for manufacturing a large portion of the blade from a transition area to its tip. Therefore the question of cost, already at the application date of

D4, was not considered so prohibitive as to exclude consideration for use in turbine blades.

3.9 The respondent also points at the availability of other possible solutions that the skilled person would have selected to modify the blade of D4. These solutions, such as choosing other fibres made of aramid or varying the content of glass fibres, would also address the problem in a satisfactory manner, but would not lead to the claimed solution.

In the Board's view the fact that there are other obvious solutions does on its own not render a given different solution non obvious. Nor is it relevant that those other solutions might be more obvious than that considered. The question is whether the solution is obvious or not, which must be considered in its own right; not whether there might be other obvious solutions or what their relative merit is. Thus, the selection of carbon fibres amongst a number of different possible known solutions, that would be obvious when considered separately, does not render the selected solution inventive, see also CLBA, I.D.9.18.7.

3.10 The Board concludes that the opposition ground under Art. 100(a) in conjunction with Art.52(1) and 56 EPC prejudices maintenance of the patent as granted.

4. Auxiliary requests - inventive step

4.1 Claim 1 of the first auxiliary request requires that the at least one component comprises two or more shell portions. The respondent did not contest that D4, figure 3, discloses a sectional view of a wind turbine blade shell in a transition area in which the quantitative ratio of two types of fibres with

different properties changes gradually (page 9, lines 21-23).
Because the amendment does not add any further distinguishing feature, the above conclusion of lack of an inventive step also applies to the subject-matter of claim 1 containing this further limitation.

4.2 Claim 1 of the second auxiliary request further adds to claim 1 according to the first auxiliary request the features of claim 13, that requires the provision of non-carbon fibres. D4 explicitly discloses the possibility to provide three different types of fibres in the first paragraph of page 13. The respondent's observation that this third type of fibres further enhances the possibility to tailor the properties of the outer shell, cannot be followed as no specific application of the non-carbon fibres in any specific part of the blade is claimed. Thus the features added in claim 1 of the second auxiliary request are known from D4 and cannot contribute to provide the necessary inventive step.

4.3 Compared to claim 1 of the second auxiliary request, claim 1 of the third auxiliary request further requires fibres having an elastic modulus above 230 GPa, and another type of fibres above 280GPa. These respective ranges of elastic moduli correspond to all fibre types above HT fibres, respectively IM fibres disclosed in table 3.2 of D2, i.e. cover any combination of IM, HM or UHM fibres with any carbon fibre, including the HT and HM combination specifically mentioned in section 25.1.1 of D2. As the features added to claim 1 according to the third auxiliary request are thus already known from D2 and readily applicable in the modification of D4, they cannot contribute to inventive step.

4.4 Claim 1 of the fourth auxiliary request further adds to claim 1 according to the third auxiliary request some of the features of claim 6, requiring the elastic modulus to vary to provide at least two regions in which the fibrous composite material has a higher elastic modulus than in the rest of the component. According to the respondent the claim now defines three different regions one with non-carbon fibres, and two additional regions of different elastic modulus that D4 fails to disclose.
Figure 6 of D4 however depicts four possible blade profiles each having three different zones. Applying this further option to the modified blade according to claim 1 of the third auxiliary request would be considered as an obvious design option, especially as claim 1 does not further limit the respective longitudinal extension of the different regions.

4.5 Compared to claim 1 of the fourth auxiliary request, claim 1 of the fifth auxiliary request further requires the fibrous composite material to include strips of fibrous composite material extending along the entire length of the blade. D4 however already teaches forming the main laminates as fibre reinforced bands, page 13, lines 15 to 14. This additional feature there cannot contribute to an inventive step.

4.6 Claim 1 of the sixth and seventh auxiliary request further adds to claim 1 according to the fifth auxiliary request the variation of the elastic modulus along the width of the blade. The respondent is of the opinion that the unhomogeneous transition depicted in figures 3 and 4 of D4 cannot be considered as a purposive substantial variation across the width of the blade as explained in paragraph 20 of the patent.

The Board observes that the sole basis - lines 7 to 9 of paragraph 20 - merely mentions this additional possibility within the context of varying the proportions of the two or more carbon fibres along the length of the blade (paragraph 20, lines 3-7 and 9-14). The passage does not specify how exactly the proportion must vary, nor what particular effect might be associated with this width-wise variation. Absent such detail, and given that figures 3 and 4 of D4 show a form of variation, this feature also already appears known from D4. In any case the Board considers the idea of extending D4's teaching to vary composition in one (namely the lengthwise) dimension of a blade, also to a further dimension (along the width or breadth) does not require an inventive insight.

4.7 The Board concludes that the subject-matter of claim 1 of the auxiliary requests also does not involve an inventive step over D4 combined with D2, contrary to Art.52(1) in conjunction with Art. 56 EPC.

5. As maintenance of the patent as granted is prejudiced by at least one opposition ground, and the patent as amended according to any of the auxiliary requests fails to meet the requirements of the EPC, the patent must be revoked pursuant to Art. 101(3)(b) EPC.

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