Internal distribution code:
(A) [-] Publication in OJ
(B) [-] To Chairmen and Members
(C) [-] To Chairmen
(D) [X] No distribution

Datasheet for the decision of 20 April 2015

Case Number: T 0588/12 - 3.2.05

Application Number: 06733040.7

Publication Number: 1877240

IPC: B29C70/48, B29C70/08

Language of the proceedings: EN

Title of invention:
Method for the manufacturing of a hollow fiber reinforced structural member

Applicant:
Fokker Landing Gear B.V.

Headword:

Relevant legal provisions:
EPC 1973 Art. 56, 111(1)
EPC Art. 123(2)
RPBA Art. 13(3)

Keyword:
Amendments - added subject-matter (no)
Inventive step - (no)
Late-filed request - admitted (yes)
Remittal to the department of first instance - (yes)

Decisions cited:

Catchword:

Europäisches Patentamt
European Patent Office
Office européen des brevets

Beschwerdekammern
Boards of Appeal
Chambres de recours

European Patent Office
D-80298 MUNICH
GERMANY
Tel. +49 (0) 89 2399-0
Fax +49 (0) 89 2399-4465

Case Number: T 0588/12 - 3.2.05

D E C I S I O N
of Technical Board of Appeal 3.2.05
of 20 April 2015

Appellant: (Applicant)	Fokker Landing Gear B.V. Grasbeemd 28 5705 Helmond (NL)
Representative:	Johannes H. Nelissen Algemeen Octrooi- en Merkenbureau B.V. P.O. Box 645 5600 AP Eindhoven (NL)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 6 October 2011 refusing European patent application No. 06733040.7 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	M. Poock
Members:	P. Lanz
	M. J. Vogel

Summary of Facts and Submissions

I. The patent applicant's appeal is against the decision of the examining division, posted on 6 October 2011, to refuse European patent application No. 06733040.7.

II. The appellant requests that the decision under appeal be set aside and that a patent be granted on the basis of the main request or the first, second, third or fourth auxiliary request, all filed with letter of 20 March 2015, or the fifth auxiliary request, filed by telefax of 16 April 2015.

III. By communication of 3 February 2015 the board summoned the appellant to attend oral proceedings on 20 April 2015. As an annex to the communication, the board issued its (negative) preliminary opinion on the allowability of the claims according to the main request and the first auxiliary request.

IV. With letter of 20 March 2015, the appellant re-submitted the main request and the first auxiliary request together with further arguments. Additionally, amended claims according to the second, third and fourth auxiliary requests were filed. The appellant asked for notice of whether the board's objections were overcome.

V. After being informed that the board intended to maintain its view on the main request and the first auxiliary request, and that the case would possibly be remitted to the department of first instance for further prosecution, the appellant announced that it would not attend the oral proceedings.

VI. On 20 April 2015 oral proceedings were held in the appellant's absence.

VII. During the appeal proceedings, reference is made to the following documents:

D4: US-A-2005/0042109
D5: US-A-2002/0008177

VIII. Independent claim 1 of the main request reads as follows:

"Method of manufacturing a hollow fiber-reinforced structural member, in particular for air vehicles, comprising the steps of
- providing a mandrel (1),
- providing a first circumferential braiding layer (2), formed by braiding fiber (8), around the mandrel,
- positioning a flat strengthening body (10) comprising at least one fabric layer having warp fibers and woof fibers at a location on the mandrel against only a part of the surface of the first braiding layer, providing a second braiding layer (3) around the first braiding layer and the strengthening body,
- positioning the entirety including the mandrel and the combination of the first braiding layer, the strengthening body and the second braiding layer in a mould which surrounds the entirety completely,
- impregnating the combination with resin, by injecting the flat strengthening body and the first braiding layer and the second braiding layer in the mould at elevated pressure and elevated temperature with a resin,
- removing the combination as impregnated with a resin from the mould."

Additionally, the main request comprises an independent claim 5 directed to a hollow fiber-reinforced structural member manufactured by a method according to one of claims 1-4.

IX. The subject-matter of the independent claims according to the first auxiliary request differs from the subject-matter claimed in the main request in that claim 1 comprises the following additional feature:

"wherein the strengthening body comprises a stack of fabric layers"

X. The wording of independent claims 1 and 4 of the second auxiliary request reads as follows:

"1. Method of manufacturing a hollow fiber-reinforced structural member as part of a landing gear of an air vehicle, comprising the steps of
- providing a mandrel (1),
- providing a first circumferential braiding layer (2), formed by braiding fiber (8), around the mandrel,
- positioning a flat strengthening body (10) comprising at least one fabric layer having warp fibers and woof fibers at a location on the mandrel against only a part of the surface of the first braiding layer, wherein the strengthening body comprises a stack of fabric layers,
- providing a second braiding layer (3) around the first braiding layer and the strengthening body,
- positioning the entirety including the mandrel and the combination of the first braiding layer, the strengthening body and the second braiding layer in a mould which surrounds the entirety completely,
- impregnating the combination with resin, by injecting the flat strengthening body and the first braiding layer and the second braiding layer in the mould at

elevated pressure and elevated temperature with a resin,
- removing the combination as impregnated with a resin from the mould."

"4. Hollow fiber-reinforced structural member as part of a landing gear of an air vehicle, manufactured by a method according to one of the claims 1-3."

XI. The appellant's arguments regarding the main request and the first auxiliary request can be summarised as follows:

Regarding the main request the appellant submitted that in the closest prior art document D4 the strengthening fabric was interwoven within the braiding layer. Thus, document D4 did not disclose the method step of positioning the fabric layer having warp fibres and woof fibres against the surface of the first braiding layer after having braided the first braiding layer. In view of this difference, the subject-matter of claim 1 according to the main request was new.

Regarding the technical effect achieved by the differing feature, the appellant argued that a more efficient manufacturing process was provided, since positioning the strengthening bodies in between two subsequent braiding layers was less laborious than interweaving. Also, strengthening bodies could be positioned more accurately and with more flexibility since the braiding pattern of the braiding layers did not form a constraint in this respect. The objective problem was thus how to provide a more efficient and accurate way of manufacturing a fibre-reinforced structural member having local reinforcement.

Regarding the proposed solution, the appellant put forward that the skilled person, when starting from document D4 and faced with the above technical problem, would not consider positioning the material sheet in between two layers ("interleaving"), since document D4 presented interleaving as being disadvantageous for achieving a homogenous fibre distribution and for providing fibre orientations at 0° (cf. paragraphs [0007], [0008] and [0010] to [0012] as well as claims 1 and 8). Rather, the specific teaching of document D4 was to interweave the strengthening body into the braiding layer in order to overcome these disadvantages and to maintain a high degree of fibre interaction. Also the disclosure of document D5 could not render the claimed subject-matter obvious. There, the manufactured structural member comprised pre-braided layers with bias angle glass fibres, between which layers of graphite material having zero degree fibres were interleaved. The combination of a braided glass fibre layer and a layer of graphite material could be compared to the single braided layer with interwoven zero-degree fibres of document D4. Thus, document D5 did not disclose or hint at the distinguishing feature of positioning a flat strengthening body comprising at least one fabric layer having warp fibres and woof fibres at a location on the mandrel against only a part of the surface of the first braiding layer. The subject-matter of claim 1 according to the main request was based on an inventive step.

As to the first auxiliary request, the appellant essentially argued that document D5 did not disclose the use of local strengthening bodies at all, let alone a strengthening body comprising a stack of layers, which implied a pre-produced component made of interconnected layers. Hence, the subject-matter of

claim 1 of the first auxiliary request was based on an inventive step.

Reasons for the Decision

1. Main request

1.1 Claim amendments

The subject-matter of the present main request is essentially based on original claims 1 and 3 as well as on the originally filed description, page 3, last paragraph and page 5, second paragraph. The requirements of Article 123(2) EPC are fulfilled.

1.2 Inventive step

1.2.1 The board shares the view of both the examining division and the appellant that document D4 represents the closest prior art for the subject-matter of claim 1 of the main request. The method of document D4 is conceived for the same purpose as and has the most relevant technical features in common with the claims of the main request.

1.2.2 Regarding the disclosure of document D4, the appellant emphasised that the strengthening fabric was not interleaved between the braiding layers but interwoven within the braiding layers. In that respect, the board notes that document D4 contains the following references to the strengthening fabric layer within the meaning of the contested claim (emphasis by the board):

*"Additional local reinforcement of the spar 32 is accomplished by **separate composite layers** (illustrated schematically at 33) at desired locations. That is, dry*

composite material sheets may additionally be ***located at desired locations within the fibers during the braiding cycle.***" (paragraph [0031])

"8. The hollow composite article [...], further comprising a ***separate composite sheet interwoven*** *with said multiple of braided bias angled fibers and said multiple of zero degree fibers."* (claims 8 and 14)

"21. A method as recited in claim 16, wherein said step (1) [i.e. braiding a multiple of composite fibers to form a braided sleeve over a mandrel] further comprises locating ***a separate composite sheet within the braided sleeve.***" (claim 21)

Following the interpretation favoured by the appellant, the strengthening layer is interwoven within the braiding layer, thereby establishing a difference to the present claim, according to which the fabric layer is positioned against the surface of the first braiding layer. However, the strengthening layer is also presented as a separate composite sheet, which could imply the claimed method step of positioning the fabric layer against the surface of the braiding layer.

In the board's judgement, the above disclosure of the fabric as being at same time a separate sheet and interwoven within the braining layer remains ambiguous. Thus, document D4 fails to disclose clearly and unambiguously the step of positioning the fabric layer having wrap fibres and woof fibres against the surface of the first braiding layer and thereby establishes a difference of the subject-matter claimed over the prior art (cf. Case Law of the Boards of Appeal of the European Patent Office, 7th edition, 2013, I.C.3.).

Additionally, document D4 is silent on the temperature at which the resin is injected into the mould. Hence, the claimed injection of the resin at an elevated temperature constitutes a further difference of the subject-matter claimed over the disclosure of document D4.

The board concludes that the subject-matter of claim 1 of the main request differs from the content of document D4 in the distinguishing features of

(1) positioning a flat strengthening body comprising at least one fabric layer having warp fibres and woof fibres at a location on the mandrel against only a part of the surface of the first braiding layer, and

(2) injecting the flat strengthening body and the first braiding layer and the second braiding layer in the mould at elevated temperature with a resin.

1.2.3 Regarding the technical effect achieved by feature (1), the board agrees with the appellant that positioning the strengthening bodies in between two subsequent braiding layers is more flexible and less laborious than interweaving. Hence, the technical effect provided by feature (1) is to simplify the manufacturing process. With respect to feature (2), the technical effect is to improve the impregnation of the reinforcement and curing of the resin. It is noted that these technical effects are achieved independently of each other.

1.2.4 Thus, the objective technical problems to be solved by the subject-matter of claim 1 consist in

(1) simplifying the manufacturing process, and

(2) improving the impregnation of the reinforcement and curing of the resin.

1.2.5 Turning first to the proposed solution to problem (1), the board regards it as a straightforward possibility to position the strengthening fabric layer at a desired location on the mandrel against the surface of the first braiding layer when seeking to provide the first braiding layer locally with a strengthening fabric. The benefits (simplification of the process and equipment needed, increased flexibility regarding the location of the reinforcement) and drawbacks (less fibre interaction) of such an interleaving of layers compared to interweaving of the layers by multi-axial braiding according to document D4 would be evident for a person skilled in composite moulding. It is not apparent or alleged that a technical prejudice is overcome or an unexpected technical effect achieved by the simplified method according to present claim 1. The board judges that the modification of the prior art method of document D4 as proposed with feature (1) of claim 1 of the main request would be within the customary practice of a skilled person and thus does not involve an inventive step.

Regarding differing feature (2), it is observed that the appellant remains silent on its merits. The board therefore follows the examining division's statement in the contested decision (cf. paragraph bridging pages 4 and 5) that heating the resin is common practice in composite moulding to improve impregnation and curing. Such a thermal treatment depends on the type of resin used. While some resins can be cured at room temperature and have a viscosity low enough to perform impregnation, other resins require to be heated in

order to initiate a curing cycle and lower the viscosity enough to perform an injection of the resin. This comes as common practice for the skilled person in composite moulding technology.

1.2.6 As regards the appellant's arguments, the board does not share the view that the introductory portion of document D4 teaches away from the claimed solution of positioning the strengthening body between two braiding layers. In fact, document D4, which is generally directed to the manufacturing of spars for a rotor blade, discusses in paragraphs [0004] to [0008] the drawbacks of the conventional methods of prepreg lay-up and winding, both of which are considered relatively time and labour intensive. Additionally, the prepreg sheets used for prepreg lay-up were expensive and required meticulous storage and handling processes which further increased the manufacturing expense, while filament winding was disadvantageous for achieving a homogenous fibre distribution and for providing fibre orientations at 0°. It is, however, noted that the disputed feature (1) does not concern the use of prepregs or filament winding but the positioning of a (dry) woven strengthening layer on the mandrel against the surface of a (dry) first braiding layer. Furthermore, it is observed that paragraphs [0010] to [0012] of document D4, which the appellant also relies upon, do not refer to a woven fabric layer. In summary, the closest prior art document D4 would not discourage the skilled person from arriving at the claimed solution.

Moreover, the board does not accept the further submission that the combination of a braided glass fibre layer and a layer of graphite material of document D5 was comparable to the single braided layer

with interwoven zero-degree fibres of document D4. Document D5 discloses the interleaving of woven graphite/fibreglass sheets between layers of braided glass fibre. Hence, by contrast to the interwoven zero-degree fibres of document D4, there is no interweaving between the fibres of the braided and the woven layers. Even if the woven graphite/fibreglass sheets of document D5 have a relatively small number of cross-woven fibreglass threads compared to the number of axial carbon tows (cf. D5, paragraph [0023]), the sheet is nevertheless to be considered a woven fabric (cf. D5, paragraph [0019], first sentence), i.e. having warp and woof fibres. By proposing the interleaving of woven strengthening sheets between braiding layers, document D5 actually points the skilled person to the principle underlying the claimed solution. Regarding the further issue that the braiding layers of document D5 were pre-braided (and thus not braided *in situ)* and that the woven strengthening sheets of document D5 were not provided locally on the first braiding layer, it is observed that both features are disclosed in document D4, which forms the closest prior art. Their absence in document D5 cannot render the claimed subject-matter inventive.

It has to be concluded that neither of the distinguishing features (1) and (2) involves an inventive contribution over the prior art. The subject-matter of claim 1 of the main request is therefore not based on an inventive step, Article 56 EPC 1973.

2. First auxiliary request

2.1 Claim amendments

Compared with the main request, the subject-matter of claim 1 of the first auxiliary request contains the additional feature that the strengthening body comprises a stack of fabric layers. A basis for this limitation can be found in original claim 2. Claim 1 of the first auxiliary request is thus in line with the provisions of Article 123(2) EPC.

2.2 Inventive step

2.2.1 The amendment to claim 1 according to the first auxiliary request does not substantially alter the objective of the claimed method. Hence, document D4 also represents the closest prior art for the subject-matter of claim 1 of the first auxiliary request.

2.2.2 In addition to the distinguishing features (1) and (2) already discussed above in the context of the main request, the subject-matter of claim 1 of the first auxiliary request further differs from the content of document D4 in the feature of

(3) the strengthening body comprising a stack of layers.

2.2.3 In the judgement of the board, a person skilled in composite moulding would be aware that the design of fibre-reinforced composite parts, in particular regarding the material, location, number and orientation of the fabric layers, is determined, *inter alia*, by the structural requirements of the part. Thus,

the skilled person would generally consider applying additional fabric layers if required in view of the structural properties to be achieved by the fibre-reinforced composite part. Moreover, the board does not share the appellant's view that the terminology "stack of fabric layers" in its ordinary meaning necessarily implies a pre-produced component made of interconnected layers.

It has to be concluded that the additional feature of the strengthening body comprising a stack of fabric layers does not involve an inventive contribution over the prior art. The subject-matter of claim 1 of the first auxiliary request is therefore also not based on an inventive step, Article 56 EPC 1973.

3. Second auxiliary request

3.1 Admissibility of the request

The second auxiliary request was filed within the time period set in the board's communication under Article 15(1) RPBA. With the proposed amendments, the claims are limited to the only embodiment presented in the application as originally filed. The board considers this further limitation of the claims to constitute an appropriate reaction to its provisional opinion on the higher-ranking requests. Moreover, the amendments did not raise unexpected issues requiring the oral proceedings to be adjourned. The second auxiliary request was thus admitted into the proceedings under Article 13(3) RPBA.

3.2 Claim amendments

Compared with the first auxiliary request, the subject-matter of claim 1 of the second auxiliary request contains the further limitation that the hollow fibre-reinforced structural member forms part of a landing gear of an air vehicle. A basis for this feature can be found on page 1, lines 5 to 16 of the published application as originally filed. Hence, the requirements of Article 123(2) EPC are met.

3.3 Remittal of the case

The objections of lack of inventive step raised in the impugned decision are possibly not immediately applicable with respect to a claim directed to a method of manufacturing a hollow fibre-reinforced member as part of a landing gear of an air vehicle. For this reason it is appropriate that the further substantive examination of the case be carried out by the examining division. In this way the applicant's right to have two levels of jurisdiction will be safeguarded. Therefore, the case is remitted to the examining division under Article 111(1) EPC 1973 for further prosecution.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance for further prosecution.

The Registrar: The Chairman:

D. Meyfarth M. Poock

Decision electronically authenticated