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Datasheet for the decision of 29 February 2012

Case Number: T 2130/08 - 3.5.04

Application Number: 04812435.8

Publication Number: 1692659

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Language of the proceedings: EN

Title of invention:
SYSTEMS AND METHODS FOR DETERMINING DEFECT CHARACTERISTICS OF A COMPOSITE STRUCTURE

Applicant:
The Boeing Company

Headword:

Relevant legal provisions:
EPC 1973 Art. 84, 56
EPC Art. 123(2)

Keyword:
Clarity of claims (after amendment - yes)
Inventive step (after amendment - yes)

Decisions cited:

Catchword:

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T2130/08 - 3.5.04

D E C I S I O N
of the Technical Board of Appeal 3.5.04
of 29 February 2012

Appellant: (Applicant)	The Boeing Company 100 North Riverside Plaza Chicago, IL 60606 (ETATS-UNIS D'AMERIQUE)
Representative:	McLeish, Nicholas Alistair Maxwell Boult Wade Tennant Verulam Gardens 70 Gray's Inn Road London WC1X 8BT (ROYAUME UNI)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted 23 April 2008 refusing European patent application No. 04812435.8 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman: F. Edlinger
Members: R. Gerdes
C. Vallet

Summary of Facts and Submissions

I. The appeal is against the decision of the examining division to refuse European patent application No. 04 812 435.8.

II. The examining division held in the decision under appeal that the application did not comply with Article 84 EPC because the subject-matter of claim 1 according to the applicant's sole request was not clear. In an obiter dictum, the examining division found that the claimed subject-matter was obvious in view of D5 and D1 or D2:

D1: US 5 562 788 A,
D2: EP 0 833 146 A2,
D5: US 5 831 865 A.

III. In a communication annexed to the summons to oral proceedings, the board introduced a new document D6, which was cited in the application by reference to its US application number:

D6: US 2002/0141632 A1.

IV. Oral proceedings were held on 29 February 2012. At the end of the oral proceedings the appellant requested that the decision under appeal be set aside and that a patent be granted in the following version:

Description:
Pages 4, 5, 8, 9 and 11 to 21 as originally filed.
Pages 1, 2 and 6 filed with letter of 20 March 2007.
Pages 3, 3a, 7 and 10 filed during oral proceedings of 29 February 2012.

Claims:
No. 1 to 5 filed during oral proceedings of 29 February 2012.
Drawings:
Sheets 1/14 to 14/14 as originally filed.

V. Claim 1 reads as follows:

"A method for determining a defect characteristic of a composite structure (22) comprising a plurality of tows (24) of composite material during the manufacture of the composite structure (22), the method comprising:
using a material placement head unit to lay down the plurality of tows (24) of composite material;
determining a linear velocity of the material placement head unit while laying down the plurality of tows (24);
detecting a defect (36) along one of the plurality of tows (24) in the composite structure (22);
using the linear velocity of the material placement head unit to determine a first linear distance (19) from a first reference point in the one tow to the defect (36);
determining a second lateral distance (21) from a second reference point of the composite structure to the defect (36);
using the first and second distances to establish a reference region of the composite structure (22), the reference region having a reference surface area; and
summing all of the defects detected within the reference region to produce a total defect count for the reference region and dividing the total defect count by the reference surface area to produce a defect density-per—unit area of the reference region as a first defect characteristic, or determining a width for each defect detected within the reference region and summing the widths of the defects within the reference

region to produce a width total for the reference region and dividing the width total by the reference surface area to determine a cumulative defect width-per-unit area of the reference region as a second defect characteristic;
comparing the defect density-per—unit area to a maximum allowable defect density-per-unit area or comparing the cumulative defect width-per-unit area to a maximum allowable cumulative defect width—per—unit area; and
halting the manufacture of the composite structure (22) if the defect density-per-unit area exceeds the maximum allowable defect density-per-unit area or the cumulative defect width-per-unit area exceeds the maximum allowable defect width-per-unit area."

Claims 2 to 5 depend on at least claim 1.

VI. In the decision under appeal the examining division stated that the expression "reference point" was misleading because for these points "it would be expected that their position would be substantially fixed, or at least clearly defined". The examining division also found that the term "area" was unclear because, in the context of the application, "this term may be construed to mean 'region', or 'size of a two-dimensional region'".

With respect to inventive step of the subject-matter of claim 1 underlying the decision under appeal, the examining division set out "Additional considerations" explaining that D5 disclosed the computation of a defect density per unit area on a wafer in a region around a defect. Even if the claims were restricted to a composite structure not covering a wafer, the person skilled in the art starting from either D1 or D2 would "know from D5 the alternative way of choosing the

defect position to determine an area to compute density".

VII. The appellant's arguments with respect to clarity and inventive step may be summarised as follows:

A reference point need not be fixed for all measurements. It can be fixed or clearly defined for a given measurement. Further objections with respect to clarity have been overcome by the amendments to the claims.

Claim 1 relates to a method for determining the defect characteristics defect density-per-unit area or cumulative defect width-per-unit area. The method is performed during the manufacture of a composite structure. The amended claims are restricted to a particular fabrication process involving laying down a plurality of tows of composite material. None of the documents on file suggests evaluation of defects in a reference area by determining distances during material placement as specified in claim 1. Due to the adaptation of the inspection to the manufacturing process, the inspection can be carried out on-line without slowing down the manufacturing process and thus reduce downtime of the machine.

Reasons for the Decision

1. The appeal is admissible.

2. Amendments

Independent claim 1 is based on claims 1 to 7 and 9 and paragraphs [0031], [0032], [0034], [0038], [0051],

[0052] and [0108] of the application as filed. Dependent claim 2 is based on claim 8 and paragraph [0048] as filed, whereas claims 3 to 5 correspond to claims 10, 12 and 13 as filed. Thus the amendments comply with Article 123(2) EPC.

3. Clarity of the amended claims

3.1 Claim 1 has been substantially amended in the appeal proceedings to clarify the establishment of a reference region while composite material is laid down during manufacturing. It specifies that the first reference point and a detected defect determine a "first linear distance" "in the one tow" in which the defect was detected. The second reference point is positioned at a "second lateral distance" from the defect.

The first reference point is thus determined during manufacture and situated in the defective tow. Thus the first distance is determined in a direction in which the tows are laid. The second reference point is situated in one of the plurality of tows at a lateral distance (usually orthogonal to this direction) from the defective tow. As a consequence the position of the reference points changes depending on the position of the defect. The reference points are determined for a given measurement starting from the detection of a defect and define a reference region, characterised by linear and lateral distances, which is in turn used to determine the defect characteristic.

The board accepts the appellant's argument that the expression "reference point" does not imply that these points be fixed for all measurements. Instead, depending on the position of the defect, the reference points may be selected subject to the above

restrictions such that a suitable reference region can be determined during manufacture. As a consequence, the reference points can be positioned at the edge of the composite structure (see figures 1 and 12 and paragraphs [0052], [0055]) or within the composite structure (see paragraph [0056]).

3.2 Claim 1 specifies a "reference region of the composite structure" which has a "reference surface area" (i.e. a scalar value). According to the claim the reference region is established "using the first and second distances" and "all of the defects detected within the reference region" are summed "to produce a total defect count for the reference region" or a "width total for the reference region". Hence, the reference region identifies the "region of the composite structure which is currently under inspection for defects" (see paragraph [0051]).

3.3 In view of the above the board finds that claim 1 meets the requirements of Article 84 EPC 1973.

4. Inventive step

4.1 It is not disputed that D6, which was not taken into account by the examining division (see point III above), may be considered as reflecting the closest prior art with respect to the subject-matter of claim 1.

4.2 D6 discloses a method for the inspection of a composite structure which is formed in a fiber placement process using a plurality of tows of composite material. The tows are laid down using a material placement head which applies the tows side by side (see D6, paragraph [0003]). A camera is mounted to the frame

carrying the placement head and installed such as to provide images "immediately downstream of the nip at which a composite tow is joined with the underlying structure" (see paragraphs [0024] and [0025]). The camera continuously captures images of the structure and the strips and provides them to a processor. Defects are identified and displayed together with the image on a screen. The user interface of D6 also allows for selection of a region of the displayed image as an inspection area. A status indicator may indicate "whether a particular image area is acceptable or not acceptable based on predefined criteria" such as "acceptable tolerances of the maximum allowed defect width" (see paragraphs [0035], [0036], [0038] and [0039]).

4.3 D6 does not disclose the following features of claim 1:

(a) determining a linear velocity of the material placement head unit while laying down the plurality of tows,

(b) using the linear velocity of the material placement head unit to determine a first linear distance from a first reference point in the one tow to the defect,

(c) using the first and second distances to establish a reference region,

(d) using the specific defect characteristic "defect density-per-unit area" or "cumulative defect width-per-unit area", and

(e) halting the manufacture of the composite structure if the employed defect characteristic exceeds a threshold.

4.4 These differences allow for a more flexible measurement of defects during manufacture with fewer interruptions and without manual inspections (see paragraphs [0106] to [0108] of the description). The technical problem may therefore be seen as how to provide in an efficient manner a quantitative measure of defects in a manufacturing process as known from D6.

4.5 The choice of the reference area as specified in features (a) to (c) is neither disclosed nor suggested in D6 nor in any of the other documents on file. It allows for a measurement dependent on defect position during the placement of tows of a composite structure. Depending on the circumstances, such as the profile of the composite structure, this determination can be beneficial for the accuracy and efficiency of the method (see e.g. figure 12).

4.6 The board, therefore, finds that the subject-matter of claim 1 involves an inventive step starting from D6 as the closest prior art (Article 56 EPC 1973).

4.7 D1 discloses another method for the inspection of a composite surface. In the board's judgement it is less relevant than D6 and, likewise, does not disclose the particular determination of the reference area as in claim 1.

4.8 D2 shows an "electronic scanner of the type normally used to digitize documents" which "is passed over the surface to be surveyed". The scanned image is graphically displayed on a computer terminal display

(see column 2, lines 25 to 42). D2 likewise does not show the determination of a reference area based on a defect.

4.9 D5 shows the computation of defect density starting from a defect of interest. However, the defect is located in the centre of the inspected area on a wafer and not on its boundary. The purpose of D5, i.e. clustering defects in order to count them only as a low number of defects, does not correspond to the purpose of the claimed subject-matter, which is to halt the manufacture if the defect density exceeds a threshold.

4.10 Thus the board holds that the amended definition of the subject-matter for which protection is sought is not simply an alternative way of choosing the defect position, but is specially adapted to the particular manufacturing process of the composite structure. The board thus judges that, having regard to the state of the art, the subject-matter of claim 1 would not have been obvious to a person skilled in the art (Article 56 EPC 1973).

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to grant a patent in the following version:

Description:
Pages 4, 5, 8, 9 and 11 to 21 as originally filed.
Pages 1, 2 and 6 filed with letter of 20 March 2007.
Pages 3, 3a, 7 and 10 filed during oral proceedings of 29 February 2012.
Claims:
No. 1 to 5 filed during oral proceedings of 29 February 2012.
Drawings:
Sheets 1/14 to 14/14 as originally filed.

The Registrar: The Chairman:

K. Boelicke F. Edlinger

Decision electronically authenticated