

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
18 December 2008 (18.12.2008)

PCT

(10) International Publication Number
WO 2008/152103 A4

(51) International Patent Classification:
B29C 70/44 (2006.01)

(21) International Application Number:
PCT/EP2008/057405

(22) International Filing Date: 12 June 2008 (12.06.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10 2007 027 113.3 13 June 2007 (13.06.2007) DE
60/943,707 13 June 2007 (13.06.2007) US

(71) Applicant (for all designated States except US): **AIRBUS DEUTSCHLAND GMBH** [DE/DE]; Kreetslag 10, 21129 Hamburg (DE).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **VAN VUEGT, Carsten** [DE/DE]; Meinkenstrasse 2, 28199 Bremen (DE). **MEYER, Christoph** [DE/DE]; Alter Postweg 18, 32351 Stemwede (DE). **LONSDORFER, Georg** [DE/DE]; Am Hohenwedel 20, 21682 Stade (DE). **MEYN, Thomas** [DE/DE]; Hemsothstrasse 17, 21769 Lamstedt (DE). **FELDERHOFF, Helmut** [DE/DE]; Bahnhofstrasse 14, 28816 Stuhr (DE).

(74) Agent: **PECKMANN, Ralf**; Reinhard, Skuhra, Weise & Partner GbR, Friedrichstrasse 31, 80801 München (DE).

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

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

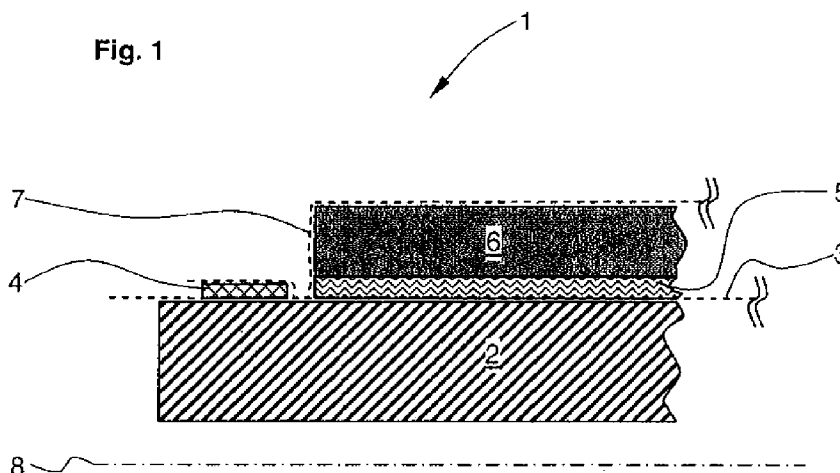
Published:

- with international search report
- with amended claims and statement

[Continued on next page]

(54) Title: METHOD FOR PRODUCING FUSELAGE CELL SECTIONS FOR AIRCRAFT WITH COMPOSITE FIBRE MATERIALS, AND A DEVICE

Fig. 1



(57) Abstract: The invention relates to a production method for producing seamless, integral and essentially hollow cylindrical components 5, in particular fuselage sections of aircraft. The method comprises the following steps: a) Application of a first vacuum film 3 to a stable winding core 2 and evacuation of the first vacuum film 3, b) depositing of the fuselage section 5 in laminated fashion on the winding core 2 by winding the same, c) aeration of the first vacuum film 3, d) application of an outer mould 6, that is unstable compared to the stable winding core, to the fuselage section 5, wherein the winding core 2 stabilises the outer mould 6, e) application of a second vacuum film 7 to the outer mould 6 and evaluation of the second vacuum film 7 in order to draw the fuselage section 5 closer to the outer mould 6 and detach it from the winding core 2 at least in regions, f) hardening of the entire arrangement in an autoclave to produce the finished fuselage section. This gives rise to a high surface quality of the component 5. Moreover, very high dimensional stability is achieved, particularly in terms of a cross-sectional geometry of the component 5 that is to be adhered to. In addition the invention relates to a device for executing the method.

WO 2008/152103 A4



(88) Date of publication of the international search report:
12 February 2009

Date of publication of the amended claims and statement:
26 March 2009

AMENDED CLAIMS
received by the International Bureau on 23 January 2009 (23.01.2009)

1. A method for producing an integral fuselage section for an aircraft, having a composite fibre material, comprising the following steps:
- 10 a) application of a first vacuum film (3) to a stable winding core (2) and evacuation of the first vacuum film (3),
- b) depositing of the fuselage section (5) in layers on the winding core (2) by wrapping the same,
- c) application of an outer mould (6) that is unstable compared to the stable winding
15 core, to the fuselage section (5), wherein the winding core (2) stabilises the outer mould (6),
- d) application of a second vacuum film (7) to the outer mould (6),
- e) aeration of the first vacuum film (3) and evacuation of the second vacuum film (7) in order to draw the fuselage section (5) closer to the outer mould (6) and
20 detach it from the winding core (2) at least in one region,
- f) curing of the entire arrangement in an autoclave to produce the finished fuselage section.
2. The method according to Claim 1, **characterised in that** a plurality of stiffening
25 elements (25, 27), in particular stringers, are inserted in recesses (24) in the winding core (2) before the fuselage section (5) is deposited, wherein the recesses (24) run essentially parallel to a longitudinal winding core axis (8).
3. The method according to Claim 1 or 2, **characterised in that** support elements
30 (26, 28, 29) are arranged in the region of the stiffening elements (25, 27).
4. The method according to Claim 1 to 3, **characterised in that** winding core (2) is collapsed inwards to remove the fuselage section (5) after the fuselage section (5) has cured in the autoclave.
- 35
5. The method according to one of Claims 1 to 4, **characterised in that** the outer mould (6) is formed along longitudinal flanges (21, 22) by joining at least two bent

pressure plates (9, 10).

6. The method according to one of Claims 1 to 5, **characterised in that** the first vacuum film (3), when applied to the winding core (2), is sealed by means of a sealant (4), in particular by means of a double adhesive tape.

7. The method according to one of Claims 1 to 6, **characterised in that** the second vacuum film (7) is sealed against the first vacuum film (3) and the winding core (2) by means of a sealant (4).

10

8. The method according to one of Claims 1 to 7, **characterised in that** the depositing of the fuselage section (5) in layers is carried out with at least one prepreg strip material deposited on the winding core (2), which material is formed with carbon fibres which are impregnated with a hardenable epoxy resin.

15

9. A device (1), for executing the method according to Claims 1 to 8, comprising:

- a) a stable winding core (2) surrounded in a pressure-tight manner by a first vacuum film (3), for depositing a fuselage section (5),
- b) an outer mould (6) that is unstable compared to the stable winding core (2), enclosing the fuselage section (5) deposited on the winding core (2), wherein the winding core (2) stabilises the outer mould (6),
- c) a second vacuum film (7) which encloses the outer mould (6) in a pressure-tight manner, and
- d) at least one sealant (4) for sealing the first and second vacuum film (3, 7) against the winding core (2).

25

10. The device (1) according to Claim 9, **characterised in that** the at least one sealant (4) is at least one double adhesive tape.

11. The device (1) according to Claim 9 or 10, **characterised in that** the winding core (2) has a plurality of recesses (24) running parallel to a longitudinal winding core axis (8) for receiving stiffening profiles (25, 27).

12. The device (1) according to one of Claims 9 to 11, **characterised in that** the winding core (2) is formed with at least three inwardly movable winding core segments (15-20) in order to be able to remove the fuselage section (5).

35

13. The device (1) according to one of Claims 9 to 12, **characterised in that** the outer mould (6) is formed with at least two bent pressure plates (9, 10) which can be connected along longitudinal flanges (21, 22).

5

14. The device (1) according to one of Claims 9 to 13, **characterised in that** the bent pressure plates (9, 10) are formed with a composite fibre material and the winding core (2) is formed with a metal alloy, in particular a nickel₃₆ alloy, having a low thermal expansion.

Statement under Art 19(1) PCT

In newly submitted independent claim 1 the succession of steps described in the claim was brought in correlation with the steps described in the description on page 7, lines 30 to 31. Further, the definition of the detachment of the fuselage section from the winding core is changed from "at least in regions" to "at least in one region". The disclosure of Fig. 4, which is currently on file, describes the fuselage section as being detached from the winding core at least in one region. Since the outer mould is not supported by a scaffold system or the like it is necessary that the fuselage section and the winding core respectively touch the outer mould at least in one region being on an upper section of the outer mould. After applying the vacuum between the first and the second vacuum film the fuselage section is detached from the winding core at least in one region being on the lower section of the winding core (see Fig. 4). The expression "at least in regions" results from a mistranslation of the German expression "zumindest bereichsweise", which is used in the German patent application.

In newly submitted dependent claim 7 the article of sealant is changed from the definite form to the indefinite form to overcome the Examiners objection of the subject-matter of claim 7 being unclear.

In newly submitted independent claim 9 the expression "in particular" is cancelled.

In newly submitted claim 14 a parenthesis is supplemented.

The expressions "stable winding core", "unstable compared to the stable winding core" and "the winding core stabilizes the outer mould" used in claims 1 and 9 are maintained unchanged. These expressions are based on description page 3, lines 19 to 21, where the winding core is described as to be preferably formed of a metal material, description page 3,

lines 15 and 16, where the outer mould pressure plates are described as to be preferably produced with a carbon fiber reinforced epoxy resin, and description page 8, lines 1 and 2, where the limited natural stability of the outer mould and its necessary stabilization by the winding core is described. In particular a synopsis of these text passages shows that the expressions "stable winding core", "unstable outer mould", and "the winding core stabilizes the outer mould" are not vague and unclear since they only describe features of the winding core and the outer mould that are seen in relation to each other. These expressions do not describe material characteristics like stiffness, for example.