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**Datasheet for the decision
of 24 November 2009**

Case Number: T 0378/08 - 3.2.06

Application Number: 99202375.4

Publication Number: 0972605

IPC: B23K 20/12

Language of the proceedings: EN

Title of invention:

Integral corrosion protection of friction stir welded joints

Patentee:

The Boeing Company

Opponent:

AIRBUS SAS/AIRBUS OPERATION/AIRBUS OPERATIONS Ltd

Headword:

-

Relevant legal provisions:

EPC Art. 123(2), 84, 56, 111(1)

RPBA Art. 13(1)

Relevant legal provisions (EPC 1973):

-

Keyword:

"Oral submissions by accompanying person - (refused)"

"Late-filed request and documents"

"Amendments"

"Inventive step (yes)"

"Remittal (yes, for adaptation of the description and figures)"

Decisions cited:

G 0004/95

Catchword:

-



Case Number: T 0378/08 - 3.2.06

DECISION
of the Technical Board of Appeal 3.2.06
of 24 November 2009

Appellant:
(Opponent)

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Respondent:
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Decision under appeal:

Interlocutory decision of the Opposition
Division of the European Patent Office posted
10 December 2007 concerning maintenance of
European patent No. 0972605 in amended form.

Composition of the Board:

Chairman: P. Alting van Geusau
Members: G. Pricolo
R. Menapace

Summary of Facts and Submissions

- I. The appeal lies against the interlocutory decision of the Opposition Division posted on 10 December 2007 maintaining European patent No. 0 972 605 in amended form on the basis of the patent proprietor's first auxiliary request.
- II. The Opposition Division came to the conclusion that the European patent disclosed the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art, and that the claimed subject-matter involved an inventive step over the cited prior art, including:

D1 : EP-A-797 043;

D2 : GB-A-452 539;

D4 : EP-A-752 926.

In coming to its decision, the Opposition Division disregarded the documents filed by the opponent after expiry of the nine-month opposition period in accordance with Article 99(1) EPC, including document:

D13 : Article "An introduction to friction stir welding and its development", by C.J. Dawes, published in *Welding & Metal Fabrication*, January 1995.

- III. The opponent lodged an appeal against this decision. The notice of appeal was received at the EPO on 19 February 2008 and the appeal fee was paid on the same day. With its statement setting out the grounds of

appeal, received at the EPO on 18 April 2008, the appellant (opponent) filed the new document:

D14 : DE-C1-42 16 533.

IV. In the communication accompanying the summons to oral proceedings, the Board expressed the preliminary opinion that the findings of the Opposition Division in respect of sufficiency of disclosure appeared correct. However, the subject-matter of independent claims 14, 16 and 19 did not appear to involve an inventive step.

V. Oral proceedings, at the end of which the decision of the Board was announced, took place on 24 November 2009.

The appellant (opponent) requested that the decision under appeal be set aside and that the European patent be revoked.

During the oral proceedings, the representative of the respondent (patentee) requested that the person accompanying her be allowed to make oral submissions. The respondent also requested that the decision under appeal be set aside and the patent be maintained with the claims 1 to 5 filed during the oral proceedings.

VI. Independent claims 1 and 5 according to the respondent's sole request read as follows:

"1. A method of friction stir welding two aluminium alloy workpieces (10, 124; 50, 52) together, the method comprising: positioning the workpieces in contact with each other to define a joint (184; 54) therebetween along which the workpieces are to be welded together;

defining a weld zone spanning the joint between the workpieces which is to be rendered plastic for creating a metallurgical bond between the workpieces along the joint; covering the outer surface of the weld zone which is to be contacted by the friction stir welding tool shoulder during welding with a layer of material (264; 56); and friction stir welding the workpieces together along the joint so as to plasticize the metal in the weld zone, wherein the layer of material is formed on a non-alloyed aluminium material and friction stir welding causes plastic flow of the corrosion-resistant material along the outer surface (24) of the weld zone (22) and metallurgical bonding of the corrosion-resistant material with a portion of the plasticized metal so as to create a corrosion-resistant material covering the outer surface of the joint; wherein the step of positioning the workpieces comprises positioning the workpieces in edge-abutting relation to define a butt joint therebetween, wherein the weld zone is comprised of abutting portions of both workpieces such that the outer surface of the weld zone comprises outer surfaces of both workpieces on opposite sides of the joint, and wherein the step of covering the outer surface of the weld zone comprises covering outer surfaces of both workpieces to cover the weld zone; and wherein the step of covering the outer surface of the weld zone comprises applying a single continuous corrosion-resistant material layer over the outer surfaces of the workpieces spanning the joint."

"5. A method of friction stir welding two corrosion resistant precipitation hardened high-strength aluminium alloy workpieces (64, 66) together along a lap joint therebetween the method comprising:

positioning the workpieces in overlapping relation with each other wherein a strip (68) of non-alloyed aluminium corrosion-resistant material is interposed between overlapping portions of the workpieces to form a lap joint along which the workpieces are to be welded together; and friction stir welding the workpieces together along the joint so as to plasticize the metal in the weld zone and in the non-alloyed aluminium corrosion-resistant material strip, the corrosion-resistant material strip metallurgically bonding with a portion of the plasticized metal so as to create a zone of corrosion-resistant material surrounding the weld zone at the lap joint such that the joint has a metallurgically bonded layer of corrosion-resistant material surrounding the joint."

VII. The appellant made a general objection to the admissibility of requests filed by the respondent at the oral proceedings.

Its arguments against the respondent's request as admitted by the Board during the oral proceedings may be summarized as follows:

Claim 5 referred to the embodiment in accordance with Figs. 9A and 9B, in which a layer of non-alloyed aluminium material was interposed between overlapping portions of the workpieces to be welded. There was no disclosure in the application as filed that in this specific embodiment the layer could be a strip. Therefore, the amendment made to claim 5 consisting of replacing the term "layer" with "strip" violated Article 123(2) EPC. Claim 5 was further amended by reciting "corrosion resistant precipitation hardened

high-strength aluminium alloy". This amendment was objectionable under Article 84 EPC because it did not introduce clear limitations for the aluminium alloy. In particular, the resistance to corrosion was not an intrinsic feature of the aluminum alloy, but depended on the corrosive environment. Furthermore, the term "high-strength" did not introduce a clear limitation since it was a relative term.

The subject-matter of claim 1 lacked an inventive step in the light of D1. This document, in the embodiment according to Fig. 13, disclosed the provision of an additional plate covering the abutting portions of the workpieces. The skilled person would obviously consider providing a plate made of pure aluminium, since it was common general knowledge that an additional layer of pure aluminium could be used to protect the underlying aluminium alloy from corrosion. Precisely this knowledge was at the basis of the manufacture of Alclad sheets consisting of a core of aluminium alloy and a cladding of pure aluminium. Furthermore, this measure was disclosed by document D14. Although in D14 the layer of pure aluminium was welded to the workpieces after they were butt-welded together, the skilled person knew that friction stir welding could be used for various joint configurations, as disclosed e.g. by D4, and in particular for multiple layer welding, and therefore would obviously consider welding the additional plate during the step of butt welding the workpieces by friction stir welding.

The subject-matter of claim 5 did not involve an inventive step either. According to the method of claim 5, the additional layer of pure aluminium was

interposed between overlapping portions of the workpieces to be welded together. This constituted an obvious modification of the welding method according to the embodiment of Fig. 13 of D1, consisting of forming a lap joint rather than a butt joint. Clearly, in the case of a lap joint, the additional plate would have to be provided between the workpieces.

VIII. The respondent's reply may be summarized as follows:

The application as filed disclosed that the embodiment according to Figs. 9A and 9B was a variation of the lap method described with reference to Figs. 7 and 8A, in which a strip of non-alloyed aluminium corrosion-resistant material was used. Therefore, the layer interposed between the workpieces at the lap joint in the embodiment of Figs. 9A and 9B was clearly a strip. Accordingly, the amendment made to claim 5 consisting of replacing the term "layer" with "strip" did not introduce subject-matter extending beyond the content of the application as filed. Furthermore, it was clear for a skilled person what limitations were introduced in claim 5 by the expression "corrosion resistant precipitation hardened high-strength" aluminium alloy.

There was no reason for the skilled person to consider replacing the additional plate of aluminium alloy covering the abutting portions of the workpieces in the embodiment according to Fig. 13 of D1 by a plate of non-alloyed aluminium alloy. According to D1, the purpose of the additional plate was to make up for the material that was plasticized and flowed out of the weld zone and not to improve the resistance to corrosion at the weld zone. For this purpose there were

a number of other measures that the skilled person would consider, such as providing a protective layer of paint. D14 did not suggest the claimed solution either. Indeed, according to this document, which did not relate to friction stir welding, a layer of pure aluminium was provided over the weld zone only after the weld was formed. In fact, the recognition that friction stir welding allowed simultaneously forming the weld and providing the corrosion-protective layer was not rendered obvious by the prior art.

Reasons for the Decision

1. The appeal is admissible.
2. *Oral submissions by the accompanying person*
 - 2.1 The presence of the person accompanying the professional representative of the respondent at the oral proceedings was announced by letter dated 23 October 2009. The last paragraph of this letter reads as follows: "*Please be informed that I will be accompanied by Mr. M. Beck who has a bachelor in law and is preparing for the EQE. I assume that you will allow him to make oral submissions during the hearing, under my continuing responsibility and control*". The letter did not specify the subject-matter of the proposed oral submissions.

During the oral proceedings the professional representative specified that the accompanying person would present arguments in respect of inventive step. She submitted that the accompanying person had followed

the case in the past and had excellent technical knowledge of the matters at issue. Moreover, since the accompanying person was preparing for the European Qualifying Examination, he should be given a training opportunity.

- 2.2 The Board, having regard to the requirements set out in G 4/95 for an accompanying person to be allowed to make oral submissions, rejected the respondent's request for the following reasons.

The letter of 23 October 2009 did not include a formal request to allow the accompanying person to make oral submissions and in any case the generally-worded statement of the respondent did not specify the subject-matter of the proposed oral submissions (points 2(b)(i) and (ii) of the Headnote of G 4/95). More details were given for the first time at the oral proceedings. At that time the professional representative, however, did not convince the Board of the presence of exceptional circumstances justifying the accompanying person to make oral submissions, and the appellant did not give its agreement to the making of the oral submissions requested (point 2(b)(iii) of the Headnote of G 4/95). No reasons were given why the professional representative herself might not be in a position to fully present her case on inventive step. Furthermore, although it is not denied that oral proceedings before the European Patent Office might, under appropriate circumstances, provide a possible training opportunity for prospective professional representatives (e.g. when they are present as members of the public), this must remain subordinate to the conduct of oral proceedings in accordance with its true

purpose, which does not include the training of future professional representatives.

3. *Admissibility of the respondent's request*

3.1 The respondent's request filed at the oral proceedings constitutes an amendment to its case which, according to Article 13(1) of the Rules of Procedure of the Boards of Appeal (RPBA), may be admitted and considered at the Board's discretion.

3.2 During the oral proceedings the Board gave a negative opinion on inventive step of the subject-matter of claims which had been filed with previous requests of the respondent. This opinion was based, in particular, on the arguments that the skilled person would consider joining Alclad sheets by friction stir welding (these comprise, in accordance with common general knowledge in the aeronautical field, a core of aluminium alloy and a cladding of non-alloyed aluminium), and that, if the non-alloyed aluminium cladding were disrupted, then it would be obvious to consider using a thicker aluminium cladding layer. The latter argument was raised by the appellant for the first time at the oral proceedings. The amendments made in accordance with the present request aimed at distinguishing the claimed subject-matter from the welding of Alclad sheets, since the claims required either the provision of a single continuous layer of non-alloyed aluminium material spanning the joint (claim 1) or the provision of a strip of non-alloyed aluminium corrosion-resistant material (claim 5). Furthermore, the amendments made did not introduce complex subject-matter; in particular, claim 1 combined granted claims 1 to 3. For these

reasons the Board decided to admit the respondent's request filed at the oral proceedings.

4. *Admissibility of documents D13 and D14*

- 4.1 The appellant requested that document D13, filed after expiry of the time limit set in Article 99(1) EPC and disregarded by the Opposition Division pursuant to Article 114(2) EPC, be introduced into the proceedings.

In the Board's view the Opposition Division did not exercise its discretion wrongly. D13 relates to friction stir welding and, as argued by the appellant, specifically discloses multiple lap welding (see Fig. 6). Friction stir welding of more than two layers is, however, already disclosed by document D1 (see Fig. 13). The appellant further submitted (see table 1) that D13 was relevant because it disclosed that friction stir welding might find an application in various industries. This is however an undisputed fact and is irrelevant to the arguments submitted. Therefore, the Board decided to uphold the discretionary decision of the Opposition Division to disregard document D13.

- 4.2 As regards document D14, the Board decided to introduce it into the proceedings because the respondent did not object and because D14 is relevant to the amendments made. D14 indeed discloses a method in which a strip of pure aluminium (i.e. a non-alloyed aluminium material) is used for protecting a welded joint from corrosion (see col. 3, line 36).

5. *Amendments*

5.1 The Board is satisfied that the amendments made by the respondent meet the requirements of Article 123(2) and (3) EPC. The appellant has not disputed the compliance with the requirements of Article 123(2) EPC in respect of claim 1, which consists of the combination of granted claims 1 to 3, but did so in respect of claim 5 due to the replacement of the term "layer" by the term "strip". Claim 5 is based on granted claim 14 and reflects the lap welding method described with reference to Figs. 9A and 9B.

The application as filed discloses (see page 11, line 4 ff.) a strip as the layer of corrosion-resistant material for the embodiment of Figs. 7, 8A and 8B relating to a lap joint. According to this embodiment, the strip is affixed to the outer surface of the upper workpiece. The application as filed further discloses a variation of this embodiment, depicted in Figs. 9A and 9B (see page 11, line 31 ff.), in which a layer of corrosion-resistant material is interposed between the workpieces at the lap joint, whereby a continuous layer of non-alloyed aluminium remains intact at the joint after welding. Fig. 9A shows that the layer of corrosion-resistant material (68) is only present in the overlapping zone of the two workpieces. Therefore, considering that in the embodiment of Figs. 9A and 9B the corrosion-resistant layer has a limited transversal extension and forms a continuous layer in the longitudinal direction (the direction of welding), and that the embodiment of Figs. 9A and 9B is a variation of the embodiment of Figs. 7 to 8B, it is clear that in

the embodiment of Figs. 9A and 9B too, the layer of corrosion-resistant material is a strip.

- 5.2 Claim 5 is further amended over claim 14 as granted by reciting that the aluminium alloy of the workpieces is a corrosion-resistant precipitation hardened high-strength aluminium alloy. This feature is disclosed, in a general context (thus also applying to the embodiment according to claim 5), on page 2, lines 30 to 32, of the application as filed.

The appellant objected to this feature under Article 84 EPC as introducing no clear limitations.

It is accepted that the terms "corrosion-resistant" and "high-strength" are relative terms. However, their lack of precision does not entail a lack of clarity within the meaning of Article 84 EPC. The skilled person is indeed aware that precipitation hardened aluminium alloys are generally regarded as high-strength aluminium alloys (precipitation hardening in fact is one of the most widely used mechanisms for the strengthening of metal alloys). The skilled person is also aware that some aluminium alloys can be classified as corrosion-resistant due to their corrosion-resistant properties. The skilled person thus understands the meaning of the above-mentioned terms in the given context so that the claim as now worded is susceptible of an interpretation which strikes an appropriate balance between legal certainty and fair protection.

6. *Novelty*

Novelty of the claimed subject-matter has not been challenged by the appellant and the Board is satisfied that novelty of the subject-matter of the independent claims 1 and 5 is given.

7. *Inventive step*

7.1 In agreement with the reasoning of the Opposition Division (point 4.2 of the decision under appeal), document D1 can be regarded as the closest prior art in respect of the subject-matter of claim 1. Using the wording of claim 1 of the patent in suit, and having regard to the embodiment according to Fig. 13 of D1, this document discloses a method of friction stir welding two aluminium alloy workpieces (honeycomb panels 80a, 80b with face plates 81, see col. 1, l. 7; col. 7, l. 34-36) together, the method comprising: positioning the workpieces in contact with each other to define a joint therebetween along which the workpieces are to be welded together; defining a weld zone spanning the joint between the workpieces which is to be rendered plastic for creating a metallurgical bond between the workpieces along the joint; covering the outer surface of the weld zone which is to be contacted by the friction stir welding tool shoulder during welding with a layer of material (86); friction stir welding the workpieces together along the joint so as to plasticize the metal in the weld zone (see claim 30), wherein friction stir welding causes plastic flow of the material along the outer surface of the weld zone and metallurgical bonding of the material with a portion of the plasticized metal so as to create

a material covering the outer surface of the joint (col. 8, l. 7 to 10); wherein the step of positioning the workpieces comprises positioning the workpieces in edge-abutting relation to define a butt joint therebetween, wherein the weld zone is comprised of abutting portions of both workpieces such that the outer surface of the weld zone comprises outer surfaces of both workpieces on opposite sides of the joint, and wherein the step of covering the outer surface of the weld zone comprises covering outer surfaces of both workpieces to cover the weld zone; and wherein the step of covering the outer surface of the weld zone comprises applying a single continuous material layer (the plate 86) over the outer surfaces of the workpieces spanning the joint.

- 7.2 The subject-matter of claim 1 is distinguished therefrom in that the layer of material is formed of a corrosion-resistant non-alloyed aluminium material.

This has the effect that the material in the weld zone, which tends to become altered in the process of being welded, is protected against exposure to corrosive agents (see par. [0007] of the patent in suit).

Therefore, the objective technical problem consists in protecting the weld zone against corrosion.

- 7.3 The problem underlying the invention according to D1 is to minimize deformation of the joint region when hollow workpieces, such as honeycomb panels, are friction-welded (see col. 1, lines 34 to 46). A teaching of D1 for solving this problem consists in providing the members at the joint region with a raised portion that

protrudes toward the friction welding tool side (see col. 1, lines 54 to 56). In particular, in the embodiment of Fig. 13, the raised portion is provided by a plate 86 which covers the outer surface of the weld zone and thus forms the layer of material recited by claim 1 of the current request. Since the purpose of the plate 86 (see D1, col. 8, lines 7 to 10) is exclusively to make up for the material that is plasticized and flows out, such that there is little deformation of the joint, there is no motivation for the skilled person to consider using a non-alloyed aluminium material for the plate. He would rather consider using the same aluminium alloy that constitutes the workpieces. D1 is moreover silent on any measures for protecting the weld zone against corrosion. Therefore D1 does not suggest to the skilled person the provision of a plate of non-alloyed aluminium alloy in order to solve the above-mentioned technical problem.

Nor is this solution suggested by document D14. This document discloses using a strip of pure aluminium (i.e. a non-alloyed aluminium material) to protect the welded joint from corrosion (see col. 3, line 36). However, the general teaching of D14 (see claim 1) is to apply the strip to the joint after welding, by detonation-cladding. Moreover, according to D14, the strip is made of the same material as the workpieces to be welded, or of a more alloyed and more resistant material (see claim 1). Therefore, D14 suggests cladding a strip of aluminium alloy onto the weld zone of the welded workpiece according to Fig. 13 of D1 (i.e. on the plate 86 welded by friction stir welding to the honeycomb

panels 80a, 80b), but does not suggest pure aluminium as the material for the plate 86.

The solution in accordance with claim 1 is not suggested either by the known measure of applying a pure aluminium layer to aluminium alloy sheets in order to increase their resistance to corrosion (this measure is known from D2, which dates from 1934, and is typical of Alclad sheets, which are commonly used in the aeronautical industry). This prior art knowledge would suggest to the skilled person the provision of a pure aluminium layer onto the weld zone after joining the honeycomb panels 80a, 80b and the plate 86 by friction stir welding, but does not suggest pure aluminium as the material for the plate 86.

Finally, document D4 discloses various joint configurations suitable for friction stir welding (see Figs. 5a to 5e), but is silent on the provision of any additional layers of material in the weld zone.

Accordingly, the skilled person starting from document D1 would not arrive in an obvious manner at the subject-matter of claim 1.

- 7.4 The skilled person would not arrive in an obvious manner at the subject-matter of claim 1 even when starting from the known method of joining Alclad sheets by riveting (this being undisputedly common general knowledge of the skilled person in the aeronautical industry). In the Board's view, as expressed during the oral proceedings, the skilled person would consider using friction stir welding instead of riveting for joining Alclad sheets. If the friction stir welding

process were to disrupt the protective layer of pure aluminium, then the skilled person would recognize that this was due to the layer being too thin. Accordingly, he would provide a thicker layer. There is, however, no indication in the prior art suggesting first, the provision of an additional layer of non-alloyed aluminium material for covering the joint, and then, joining the Alclad sheets and the additional layer by friction stir welding.

7.5 Therefore, the subject-matter of claim 1 involves an inventive step (Article 56 EPC).

7.6 As already mentioned in the communication of the Board accompanying the summons to oral proceedings, in respect of claim 14 as granted, document D4 represents the closest prior art for the subject-matter of claim 5. Using the wording of this claim, D4 discloses a method of friction stir welding two aluminium alloy workpieces (see col. 4, lines 32 to 34) together along a lap joint therebetween (see claim 5), the method comprising: positioning the workpieces in overlapping relation with each other and friction stir welding the workpieces together along the joint so as to plasticize the metal in the weld zone and in the non-alloyed aluminium corrosion-resistant material strip.

7.7 The subject-matter of claim 5 is distinguished therefrom in that a strip of non-alloyed aluminium corrosion-resistant material is interposed between overlapping portions of the workpieces at the lap joint along which the workpieces are to be welded together; the friction stir welding plasticizing the metal in the non-alloyed aluminium material strip, whereby the

corrosion-resistant material strip metallurgically bonds with a portion of the plasticized metal so as to create a zone of corrosion-resistant material surrounding the weld zone at the lap joint such that the joint has a metallurgically bonded layer of corrosion-resistant material surrounding the joint.

This has the effect that the material in the weld zone, which tends to become altered in the process of being welded, is protected against exposure to corrosive agents (see par. [0014] of the patent in suit).

Therefore, the objective technical problem consists of protecting the weld zone against corrosion.

- 7.8 As explained above in connection with claim 1, there is no indication in the prior art that would suggest to the skilled person the provision of an additional layer of non-alloyed aluminium material covering the joint between two aluminium alloy workpieces that are to be butt welded by friction stir welding. Similarly, although it is known to weld by friction stir welding multiple metal layers (e.g. three layers as shown in Fig. 13 of D1), there is no indication in the prior art that would suggest to the skilled person the provision of an additional layer of non-alloyed aluminium material joint between overlapping portions of aluminium alloy workpieces that are to be lap welded by friction stir welding. It follows that, irrespective of whether D4 is taken as the closest prior art, or D1 as was done by the appellant, the subject-matter of claim 5 also involves an inventive step.

8. *Remittal*

From the above it follows that claims 1 and 5, together with dependent claims 2 to 4, form a suitable basis for maintenance of the patent in amended form. The description and the drawings, however, still have to be adapted to this new set of claims.

Several amendments are necessary because the description includes various embodiments that no longer fall under the scope of the claims. In fact, the description was not even adapted to the claims of the patent in the form as maintained by the Opposition Division (for instance, par. [0022] of the patent in the form allowed by the Opposition Division includes the possibility of a material of the layer being other than non-alloyed aluminium). Finally, both parties agreed that the case should be remitted for that purpose. Therefore, in order to give the parties sufficient opportunity to deal with this matter, the Board remits the case in accordance with Article 111(1) EPC to the Opposition Division.

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 with the order to maintain the patent with claims 1 to 5 filed during the oral proceedings before the Board (sole request) and a description yet to be adapted.

The Registrar:

The Chairman:

M. Patin

P. Alting van Geusau