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Datasheet for the decision of 3 May 2016

Case Number: T 2044/11 - 3.2.08

Application Number: 97938239.7

Publication Number: 0928234

IPC: B23K20/02, B21D26/02

Language of the proceedings: EN

Title of invention:
DIFFUSION BONDING OF METALS

Patent Proprietor:
The Boeing Company

Opponents:
AIRBUS SAS/AIRBUS OPERATIONS/AIRBUS OPERATIONS Ltd
AIRBUS OPERATIONS GmbH/AIRBUS OPERATIONS S.L.

Headword:

Relevant legal provisions:
EPC Art. 100(b), 100(a), 57, 56
RPBA Art. 12

Keyword:
Grounds for opposition - insufficiency of disclosure (no)
Inventive step - (yes)
Late-filed argument

Decisions cited:

Catchword:

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Case Number: T 2044/11 - 3.2.08

D E C I S I O N
of Technical Board of Appeal 3.2.08
of 3 May 2016

Appellant: (Patent Proprietor)	The Boeing Company 100 North Riverside Plaza Chicago, IL 60606-1596 (US)
Representative:	Boult Wade Tennant Verulam Gardens 70 Gray's Inn Road London WC1X 8BT (GB)
Respondents: (Opponents)	AIRBUS SAS/AIRBUS OPERATIONS/AIRBUS OPERATIONS Ltd AIRBUS OPERATIONS GmbH/AIRBUS OPERATIONS S.L. 1 Rond-Point Maurice Bellonte 316 route de Bayonne/New Filton House Filton/Kreetslag 10/Avenida de John Lennon S/N F-31700 Blagnac/F-31060 Toulouse GB-Bristol BS99 7AR/D-21129 Hamburg Madrid, ES (FR)
Representative:	Santarelli 49, avenue des Champs-Elysées 75008 Paris (FR)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 7 July 2011 revoking European patent No. 0928234 pursuant to Article 101(3)(b) EPC.**

Composition of the Board:

Chairwoman	P. Acton
Members:	M. Alvazzi Delfrate
	D. T. Keeling

Summary of Facts and Submissions

I. By its decision posted on 7 July 2011 the opposition division revoked European patent No. 9 282 34.

The opposition division found that the claimed invention was sufficiently disclosed and industrially applicable but that the subject-matter of claim 1 lacked an inventive step in view of the combination of E1 and E3.

II. The appellant (patent proprietor) lodged an appeal against that decision in the prescribed form and within the prescribed time limit.

III. Oral proceedings before the Board of Appeal were held on 3 May 2016.

The appellant requested that the decision under appeal be set aside and that the patent be maintained according to the main request or one of auxiliary requests 1 and 2, all filed with letter dated 4 March 2016.

The respondents (opponents) requested that the appeal be dismissed. Further they requested that the line of argumentation set forth in the appellant's letter of 4 March 2016 not be admitted into the proceedings or that, if it was admitted, the case be remitted to the opposition division.

IV. The **main request** differs from the patent as granted solely by the deletion of a dependent claim. Its independent claim 1 reads as follows:

"Method of making superplastically formed, diffusion bonded structure using at least two sheets (10, 12) of superplastic and diffusion bondable metal alloys, comprising the steps of:

(a) cleaning the metal sheets (10, 12);

(b) aligning the sheets (10, 12) to provide intimate contact between the sheets (10, 12) at selected locations;

(c) welding the sheets (10, 12) to form a pack (30) to make a gas-tight seal while providing forming gas inlets (54) into a cavity between the sheets (10, 12);

(d) positioning a template (52) having a desired compression diffusion bonding pattern corresponding to the locations of intimate contact between the sheets (10, 12) on the exterior of the pack (30) in a press between opposed dies (58, 60);

(e) optionally, providing holes within the template (52) between compression pad ups for the alloys to form into, thereby establishing a part definition;

(f) purging the cavity of contaminants by evacuating the cavity or by introducing an inert gas to the cavity;

(g) heating the pack (30) to a diffusion bonding temperature for the alloy;

(h) pressing the sheets (10, 12) together through the template (52) to bring the sheets (10, 12) into intimate contact at the locations to form diffusion bonds (44) while applying gas pressure to the cavity to

inflate the pack (30) to prevent diffusion bonding in areas of the pack (30) that register with the holes in the template (52), characterized by the further step of using a titanium spacer (56) between the pack (30) and opposed dies (58, 60) to null deformities between the dies (58, 60) and to ensure sufficient diffusion bonding pressure through the template (52)."

The auxiliary requests are not relevant for the present decision.

V. The following documents played a role for the present decision:

E1: US -A- 3,927,817;
E2: US -A- 4,426,032;
E3: US -A- 4,197,977;
E4: US -A- 4,087,037;
E5: US -A- 4,204,628;
E6: US -A- 4,315,591;
E7: US -A- 5,226,578;
E8: EP -A- 0 399 772; and
E9: US -A- 5,467,626.

VI. The arguments of the respondents can be summarised as follows:

Article 100(b) EPC and industrial applicability (Articles 100(a) EPC and 57 EPC)

Reference was made to the submissions in the written procedure. In writing it was argued that the patent did not provide any indication as to how the titanium spacer could null deformities between the dies. At most said deformities could be reduced by the presence of a spacer. Moreover, in the patent it was not clear how

this could be obtained while at the same time ensuring sufficient diffusion bonding pressure through the template and there was no information as to how to position the peaks of the dies and the template. For these reasons the claimed invention was not sufficiently disclosed and, since it was impossible to put it into practice, not industrially applicable.

Request to disregard the arguments in the letter of 4 March 2016 or to remit the case for further prosecution

In the letter of 4 March 2016 the appellant submitted for the first time that the method of claim 1 was distinguished from the closest prior art not only by its characterising features but also by some of the features of the preamble. This belated submission should be disregarded, because otherwise the Board would be confronted with an issue that had not been considered by the opposition division.

Should the Board nevertheless decide to consider these submissions it was requested that the case be remitted to the opposition division for further prosecution in order to have the benefit of two instances on this matter.

Inventive step

The method of the embodiment disclosed on column 10, lines 33-47 of E1 represented the closest prior art. This method exhibited all the features of the preamble of claim 1. The pack was sealed before the insertion into the forming apparatus, which was shown in Figures 7 and 8. Since several passages of E1 disclosed that the sheets of the pack could be joined by welding, it was clear that welding could be used also in order to

realise said seal. The upper tooling frame 140 shown in Figures 7 and 8 could be considered as a template between the dies represented by the platens shown in Figure 2, with the chambers 144 to be regarded as holes in the template. It was true that in this embodiment the superplastic expansion was started before the diffusion bonding. This however did not exclude that the gas pressure was still applied while diffusion bonding was performed, resulting also in this phase in some amount of expansion. Indeed, maintaining the gas pressure during diffusion bonding was necessary to avoid a collapse of the structure at the diffusion bonding temperature.

Starting from this prior art process, as already explained in the decision under appeal, it was obvious to provide the feature of the characterising part in order to compensate for the non-uniformities of the dies. Metal sheets between the dies and the workpiece were known from each of E2 to E8. In particular, E3 disclosed an arrangement with a titanium sheet providing the same advantages as in the claimed invention.

As to the alleged further distinguishing features, even if their novelty were to be acknowledged, they could not justify an inventive step, because they related to standard measures. In particular, the use of a template between the dies was well known, for instance from E9. Although this document related only to superplastic forming, the person skilled in the art knew, as shown by E2, column 1, lines 18-24, that superplastic forming and diffusion bonding could be combined in a single process, so that it was obvious to use a template similar to that shown by E9 in this combined process.

Thus, the subject-matter of claim 1 did not involve an inventive step.

VII. The arguments of the appellant can be summarised as follows:

Article 100(b) EPC and industrial applicability

Reference was in particular made to the findings of the opposition division and to the notification of the Board of Appeal of 15 September 2015. The wording "to null deformities between the dies (58, 60) and to ensure sufficient diffusion bonding pressure through the template (52)" did not mean that the dies themselves were modified to null the deformities but merely defined the purpose of the spacer. The person skilled in the art would know how to provide the conditions needed for the titanium spacer to be soft enough to deform and null the deformities, yet still be rigid enough to allow transmission of the pressure needed for the diffusion bonding. As to the peaks, they were not mentioned in the claims. Therefore, the claimed invention was sufficiently disclosed and it was possible to apply it industrially.

Request to disregard the arguments in the letter of 4 March 2016 or to remit the case for further prosecution

It was true that the argument that the method of claim 1 was distinguished from the closest prior art also by some of the features of the preamble was submitted late. However, this complied with an indication of the Board in its communication that also some features of the preamble were to be considered. Indeed this was always necessary in order to examine inventive step. Moreover, the respondents had enough time to consider

and react to these late submissions which should, as a consequence, be admitted into the proceedings.

Furthermore, there was no reason to remit the case to the opposition division to consider these new arguments because there was no absolute right to have an issue decided by two instances. Such a remittal would lead, in view of the age of the patent, to the case not being finally decided before the expiry of the term of the patent.

Inventive step

The embodiment disclosed on column 10, lines 33-47, of E1 represented the closest prior art. Over this prior art the claimed method was distinguished not only by the characterising features but also by some features of the preamble. E1 did not disclose that the seal realised in said embodiment prior to diffusion bonding was obtained by welding. Moreover, the forming apparatus shown in Figures 7 and 8 and used in this embodiment exhibited two dies, represented by the upper and the lower tooling frames, but no template between them. The platens shown in Figure 2 which pressed together the frames could not be regarded as dies because they had no influence on the shape of the formed workpiece. Finally, in this embodiment superplastic expansion was performed before and not while diffusion bonding.

Starting from this prior art, the claimed invention solved the problem of the provision of a reliable method that enabled the rapid fabrication of bound panels using inexpensive tooling. This problem was solved in particular thanks to the use of a template having a desired compression diffusion bonding pattern

corresponding to the locations of intimate contact between the sheets in a press between opposed dies and a titanium spacer between the pack and opposed dies.

The claimed solution was not rendered obvious by the prior art. It was not disputed that the use of inserts between press dies was known, for instance from E9. However, the prior art did not disclose that use for diffusion bonding. As to the metal sheets between the dies and the workpiece, it was true that E3 disclosed titanium sheets in such a position. However, the titanium sheets, called "slip sheets" in this document, had not the same function as the titanium spacer of the patent in suit. Instead this function was performed in E9 by the glass pad.

Therefore, the subject-matter of claim 1 involved an inventive step.

Reasons for the Decision

1. Article 100(b) EPC and industrial applicability

The wording "to null deformities between the dies (58, 60) and to ensure sufficient diffusion bonding pressure through the template (52)" relates to the result to be achieved by the use of a Ti spacer. However, since this wording does not define the amount of reduction of the deformities or the pressure to be ensured, it merely brings out a result that would be achieved under normal diffusion bonding conditions by the use of a titanium spacer. Therefore, since the person skilled in the art

would have no difficulty in choosing a Ti spacer to be used in the claimed method, this feature is sufficiently disclosed.

As to the positioning of the peaks of the dies and the template, the claim does not recite any limitation in this respect, so that any position is in accordance with the claim. Accordingly, also this aspect of the claimed invention is sufficiently disclosed.

Therefore, the patent discloses the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art.

Accordingly, there is no difficulty in carrying out the invention, which, as a consequence, is also industrially applicable.

2. Request to disregard the arguments in the letter of 4 March 2016 or to remit the case for further prosecution

2.1 It is true that the argument that the method of claim 1 is distinguished from the closest prior art not only by its characterising features but also by some of the features of the preamble was not submitted in the statement of grounds of appeal, contrary to Article 12(2) RPBA, but for the first time (in opposition and appeal) in the letter of 4 March 2016.

However, in order to examine inventive step it is normally necessary to analyse which features of the claimed subject-matter are disclosed by the closest prior art. Indeed, the Board, in the communication of 15 September 2015, point 4, had explicitly pointed out that also some features of the preamble of claim 1 were to be considered.

Moreover, this new line of argument was submitted two months in advance of the oral proceedings, so that the respondent had undisputedly enough time to react and no delay in the proceedings was caused by this belated submission.

Therefore, the Board decided to admit the arguments in respect of the features in the preamble of claim 1 into the proceedings.

2.2 The respondent had requested that in this event the case should be remitted to the opposition division for further prosecution in order to have the benefit of two instances on this matter.

However, even without taking into account the fact that a remittal for further prosecution would almost certainly lead to a final decision on the case being taken after the expiry of the term of the patent (whose date of filing is 11 August 1997), the Board sees no reason for such a remittal.

Not only there is no absolute right to have an issue decided by two instances but, in the present case, the issue whether the features of the preamble of claim 1 are disclosed in E1 has already been considered and decided upon, albeit in the light of different arguments, by the opposition division (see appealed decision, point 4.1, first sentence).

Therefore, the Board decided not to remit the case to the opposition division for further prosecution.

3. Inventive step

3.1 E1 relates to a method for fabrication of metallic sandwich structures in which metal blanks, preferably of a titanium alloy, are joined at selected areas, preferably by diffusion bonding, and expanded superplastically to form a desired sandwich structure (abstract). E1 discloses several embodiments of this method. The Board concurs with the parties that the embodiment disclosed on column 10, lines 33-47 (which comprises also some of the features disclosed in general in the preceding passage starting on column 10, line 20), represents the closest prior art for the claimed method because it exhibits most features in common with said method. In this embodiment, which makes use of the forming apparatus shown in Figures 7 and 8, metal sheets (134, 136) formed in a stack (132) are joined by diffusion bonding. It is implicit that this comprises the steps of (a) cleaning the metal sheets and (b) aligning the sheets to provide intimate contact between the sheets at selected locations because these steps are necessary to properly join the sheets.

According to column 10, lines 33-36, superplastic expansion is performed prior to diffusion bonding of the stack. This requires previously sealing the surrounding area around the stack without applying pressure to the stack. Accordingly, E1 discloses forming a pack to make a gas-tight seal while providing forming gas inlets into a cavity between the sheets (see also Figures 7 and 8) but this passage does not specify how the gas-tight seal is obtained. It is true that E1 mentions several times welding or spot welding, alongside diffusion bonding and brazing, as a possible technique for joining the metal sheets (column 4, lines

55-56; column 5, lines 9-11, lines 32-34 and lines 65-68; column 9, lines 35-37). However, none of these passages discloses that welding is used to provide the seal of the embodiment of column 10, lines 33-47. Therefore, E1 does not disclose the step of (c) welding the sheets to form a pack to make a gas-tight seal while providing forming gas inlets into a cavity between the sheets.

The forming apparatus shown in Figures 7 and 8 utilises a lower tooling frame 150 and an upper tooling frame 140 with chambers 144 in which the pack is expanded. The tooling frames can be pressed together by means of platens (50), as shown in Figure 2. The platens however do not have any relationship with the shape of the structure to be produced, which is completely determined by the shape of the tooling frames. Therefore, the platens cannot be regarded as dies. Rather, in the apparatus of Figures 7 and 8 the dies are represented by the tooling frames 140 and 150. Since in this embodiment no further shaping element is positioned between them, E1 does not disclose the step of (d) positioning a template having a desired compression diffusion bonding pattern corresponding to the locations of intimate contact between the sheets on the exterior of the pack in a press between opposed dies.

The method of E1 further involves (f) purging the cavity of contaminants by introducing an inert gas into the cavity and (g) heating the pack to a diffusion bonding temperature for the alloy (column 10, lines 20-47).

The superplastic expansion is performed by applying gas pressure to the cavity to inflate the pack in areas of

the pack that register with the chambers (column 10, lines 20-47). However, in the embodiment of column 10, lines 33-47 this expansion is performed before diffusion bonding (while in the alternative embodiment of column 10, lines 20-32 the expansion follows the diffusion bonding). The respondent's argument that it is necessary to maintain the gas pressure also during the diffusion bonding to avoid collapsing of the structure is not convincing since the temperatures used during diffusion bonding (column 8, line 29-43) are, albeit high, well below the melting point so that no substantial deformation under the sole action of gravity will occur. Accordingly, E1 does not disclose (h) pressing the sheets together through the template to bring the sheets into intimate contact at the locations to form diffusion bonds while applying gas pressure to the cavity to inflate the pack to prevent diffusion bonding in areas of the pack that register with the holes in the template.

Finally, it is undisputed that E1 does not disclose the step of using a titanium spacer between the pack and opposed dies to null deformities between the dies and to ensure sufficient diffusion bonding pressure through the template.

3.2 Starting from the closest prior art the problem solved by the claimed invention is to provide a reliable method that enables the rapid fabrication of superplastically formed/diffusion bound panels using inexpensive tooling (paragraph [0008]).

This problem is solved by the method of claim 1, which, in contrast to the closest prior art, makes use of "a template (52) having a desired compression diffusion bonding pattern corresponding to the locations of

intimate contact between the sheets (10, 12) on the exterior of the pack (30) in a press between opposed dies (58, 60)" and "a titanium spacer (56) between the pack (30) and opposed dies (58, 60)".

The state-of-the-art method for compression diffusion bonding uses precision machined, matching, Corrosion Resistant Steel (CRES) dies having an interfacial grid pattern. The sheets of material to be formed are sandwiched between the dies and are compressed locally at the grid to create a diffusion bond. Forming the dies with the necessary grid pattern is a slow and expensive process because of the limitations on machining that CRES alloys impose (paragraph [0004] of the patent). By contrast, the present invention allows the use of inexpensive fabrication tools because it decouples the dies and the template with the grid for diffusion bonding. It is thus possible to construct numerous sets of tools at only a fraction of the cost of conventional SPF (superplastically forming) / DB (diffusion bonding) tools. Therefore, a supply of compression DB backup tools can be fabricated and kept in reserve in case those in use are damaged or become distorted (paragraph [0008] of the patent). Moreover, the template allows significantly higher pressures to be applied to the bond line, which reduces the time required for bonding and improves the quality of the bond (paragraph [0016] of the patent). Finally, the titanium spacer can null deformities between the dies and ensure sufficient diffusion bonding pressure through the template even when non perfectly machined dies are used.

3.3 The prior art does not render it obvious to solve the problem above according to claim 1.

Although the use of inserts between press dies, in particular for superplastic forming, was known, the prior art does not disclose the use of a template between opposed dies to apply pressure for diffusion bonding. In particular E9, paragraph bridging columns 1 and 2, relates to superplastic forming and the insert used in this document merely defines the shape to be obtained by this process. Therefore, even if it was known to combine diffusion bonding with superplastic forming the prior art did not teach to use a template to provide the necessary pressure for the diffusion bonding.

In respect of the titanium spacer the respondent pointed to the disclosure in E2 to E8 of metal sheets positioned between pressing dies and a workpiece to be formed. However, in E3, which is the sole of these documents disclosing the use of titanium sheets in a diffusion-bonding process (abstract and column 4, lines 4-6), the function of the titanium sheets, called "slip sheets", is not the same as in the patent in suit. As a matter of fact in E3 the equalisation of pressure is taken over by another component, namely the glass pad 22, which is also positioned between the dies and the workpiece (column 4, lines 48-50).

Therefore, none of the prior art documents teaches the use of a template and of a titanium spacer as stipulated by claim 1 to solve the problem above.

Hence, it can remain undecided whether applying the other distinguishing features to the method of the closest prior art was obvious.

Accordingly, the subject-matter of claim 1 involves an inventive step.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the Opposition Division with the order to maintain the patent on the basis of Claims 1 to 5 according to the Main Request, filed on 4 March 2016, and the description and drawings as granted.

The Registrar: The Chairwoman:

C. Moser P. Acton

Decision electronically authenticated