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Datasheet for the decision of 4 August 2009

Case Number: T 1270/08 - 3.2.06

Application Number: 01126193.0

Publication Number: 1190808

IPC: B23K 20/12

Language of the proceedings: EN

Title of invention:
Friction stir welding method, and a composite body produced thereby

Patentee:
Hitachi, Ltd.

Opponent:
Siemens

Headword:
-

Relevant legal provisions:
-

Relevant legal provisions (EPC 1973):
EPC Art. 56

Keyword:
"Inventive step (yes)"

Decisions cited:
T 0763/04

Catchword:
-

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Case Number: T 1270/08 **-** 3.2.06

D E C I S I O N
of the Technical Board of Appeal 3.2.06
of 4 August 2009

Appellant: (Opponent)
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Decision under appeal:
Decision of the Opposition Division of the European Patent Office posted 8 May 2008 rejecting the opposition filed against European patent No. 1190808 pursuant to Article 102(2) EPC.

Composition of the Board:

Chairman: P. Alting Van Geusau
Members: G. Pricolo
W. Sekretaruk

Summary of Facts and Submissions

I. The appeal is from the decision of the Opposition Division posted on 8 May 2008 to reject the opposition filed against European patent No. 1 190 808 granted in respect of European patent application No. 01 126 193.0.

II. Claim 1 as granted reads as follows:

"1. A method of manufacturing a composite body having a welded zone at which two members (31, 32) are joined by welding, comprising the steps of
(i) arranging said members (31, 32) edge-to-edge for welding so that said two members, where the welded zone is to be formed, have first surfaces and have second surfaces at the opposite side of said members from said first surfaces, said first surfaces being, as seen in cross-section across the zone to be welded, co-linear with each other across the zone to be welded
(ii) performing a friction stir welding process by inserting a friction stir welding probe (50) into said members at said second surfaces thereof, so as to unite the two members by forming, in said friction stir welding process, a welding bead (45),
characterised in that
each said member (31, 32) has on said second surface thereof a raised portion acting as a material flow compensation portion at its edge at which the member is to be welded, said friction stir welding probe (45) entering said raised portions so that a gap between the members is filled by flow of material, said welding bead (45) which is formed, extending through said members from said second surfaces thereof to said first surfaces thereof, and said first surfaces providing a

flat surface after the friction stir welding, as seen in cross-section across the welded zone; and in that said first surfaces provide in the welded composite body an exterior face of the body at the welded zone."

III. In coming to its decision the Opposition Division held that the claimed subject-matter was novel and inventive over the available prior art including:

D1: JP-A-52-123358;

D2: DE-C-877 004;

D3: CH-A-307 388;

D4: US-A-3 779 446;

D5: "Friction Stir Process Welds Aluminum Alloys", by C.J. Dawes and W.M. Thomas, published in "Welding Journal", March 1996, pages 41-45.

The Opposition Division held that document D5 represented the closest prior art because it was the sole piece of prior art dealing with a method for joining two members arranged edge-to-edge by friction stir welding. In particular, D1 and D4 dealt with friction heating but not friction stir welding. The subject-matter of claim 1 differed from the conventional friction stir butt welding method according to D5 in that each member to be welded had a raised portion acting as material flow compensation portion at its edge, the friction stir welding probe entering said raised portions so that a gap between the members was filled by flow of material, whereby a flat

surface was provided after welding. The Opposition Division held that the distinguishing features solved the problem of obviating the inconvenient deformation of the joint region due to downward material flow and that the claimed solution to this problem was not suggested by the cited prior art. Dl disclosed a lap welding method in which the lower workpiece was provided with a pin extending through an opening of the upper workpiece, and bonding was carried out by softening and deforming the pin by the heat generated by a friction tool contacting the top surfaces of the pin. This method was not a friction stir welding method, because the tool did not enter the workpieces to stir their material, and was not suitable for a butt configuration. Documents D2 and D3 related to fusion welding of three workpieces, wherein a portion of one workpiece was used as a filler material during welding. Figure 3 of document D4 disclosed a joint configuration with raised edge portions. The raised portion were "gripped" and bonded by thermo-compression welding, the heat being generated by friction or by resistance. The material of the raised portion was not intended to flow down, and was not stirred.

IV. The appellant (opponent) lodged an appeal against this decision, received at the EPO on 2 July 2008, and simultaneously paid the appeal fee. The arguments of the appellant as set out in the statement setting out the grounds of appeal, received at the EPO on 5 September 2009, can be summarized as follows:

The skilled person would consider prior art relating to friction welding when dealing with a problem specific to friction stir welding, because, as explained in D5,

the friction stir welding process was a derivative of the conventional friction welding process. D1 and D4 related to friction welding, not merely to friction heating as stated by the Opposition Division in the decision under appeal, and therefore the skilled person would consider the disclosure of D1 and D4 when seeking to improve the friction stir welding process disclosed by D5. D1 taught the provision of a raised portion for filling a gap between the workpieces to be joined by the friction welding process. Thus, the combination of D5 and D1 would lead the skilled person to the subject-matter of claim 1. D4 disclosed the provision of raised portions on each of the workpieces to be joined by friction welding. Since D4 additionally disclosed the use of a friction welding tool rotating about its axis, it was clear for the skilled person that also friction stir welding was envisaged by D4 in addition to friction welding. Therefore, also a combination of D5 and D4 would lead the skilled person to the claimed subject-matter, as well as a combination of D5, D1 and D4.

V. In a letter dated 21 January 2009 filed in reply to the grounds of appeal, the patentee (respondent) stated that the decision of the Opposition Division was correct and correctly reasoned and pointed out that none of D1 to D4 involved friction stir welding and that none of these documents was applicable to friction stir welding. An auxiliary request of maintenance of the patent in amended form was filed with this letter.

VI. In an annex to the summons for oral proceedings pursuant to Article 15(1) Rules of Procedure of the boards of appeal the Board expressed its preliminary

opinion according to which the reasoning of the Opposition Division in the decision under appeal appeared correct. The Board explained that since D1 did not relate to edge-to-edge welding, it did not suggest the provision of raised portions acting as a material flow compensation portion at the edges of the members to be welded. As regards D4, although it disclosed in connection with the embodiments of Figs. 3 to 6 a method of friction welding the ends of tubing or the abutted portions of sheets or plates by friction welding, it did not disclose the provision of raised portions acting as material flow compensation portions. Fig. 3 of D4 showed abutted tubing flared portions, but these were the portions to be welded together.

VII. Oral proceedings, at the end of which the decision of the Board was announced, took place on 4 August 2009.

The appellant was absent at the oral proceedings as announced with letter dated 18 June 2009. The proceedings were thus continued in the absence of the appellant in accordance with Rule 115(2) EPC. The appellant requested that the decision under appeal be set aside and that the European patent be revoked.

The respondent requested that the appeal be dismissed or the European patent be maintained on the basis of the auxiliary request of 21 January 2009.

Reasons for the Decision

1. The appeal is admissible.

2. *Inventive step*

2.1 The Board agrees with the undisputed view of the Opposition Division that document D5 represents the closest prior art. This document discloses a method according to the preamble of claim 1 of the patent in suit, namely (see Figs. 2 and 7) a method of manufacturing a composite body having a welded zone at which two members are joined by welding, comprising the steps of arranging said members edge-to-edge for welding so that said two members, where the welded zone is to be formed, have first surfaces (lower surfaces) and have second surfaces (upper surfaces) at the opposite side of said members from said first surfaces, said first surfaces being, as seen in cross-section across the zone to be welded, co-linear with each other across the zone to be welded; performing a friction stir welding process by inserting a friction stir welding probe (tool) into said members at said second surfaces (upper surfaces) thereof, so as to unite the two members by forming, in said friction stir welding process, a welding bead. D5 further discloses (see Fig. 7a) the features of the characterizing portion of claim 1 according to which said welding bead which is formed extends through said members from said second surfaces (upper surfaces) thereof to said first surfaces (lower surfaces) thereof, and said first surfaces (lower surfaces) provide a flat surface after the friction stir welding, as seen in cross-section across the welded zone; and in that said first surfaces (lower surfaces) provide in the welded composite body an exterior face of the body at the welded zone (this feature relates to the intended use of the composite body and the lower surfaces of the welded body shown in

Fig. 7a of D5 are suitable for forming the exterior face of a - generally defined - composite body).

2.2 The subject-matter of claim 1 differs from the known friction stir welding method in that each said member has on said second surface thereof a raised portion acting as a material flow compensation portion at its edge at which the member is to be welded, said friction stir welding probe entering said raised portions so that a gap between the members is filled by flow of material.

2.3 In accordance with the wording of claim 1, these distinguishing features have the effect of filling the gap between the members. The distinguishing features moreover have the effect of reducing the formation of a sink at the weld bead, corresponding to the volume of lost material that has flowed down by the downward force exerted by the friction welding probe (see par. [0004] and [0024] of the patent in suit). Thus, as correctly stated by the opposition Division in the decision under appeal, the distinguishing features obviate the inconvenient deformation of the joint region due to the downward material flow.
Accordingly, the objective technical problem solved can be generally stated as improving weld formation.

2.4 The appellant referred to documents D1 and D4. The Board agrees with the appellant that these documents deal with friction welding processes. This in fact is also the view of the Opposition Division: although on page 3 of the decision it is stated that "*D1 and D4 deal with friction heating*", on page 4, where these

documents are discussed in more detail, the term "*welding*" is mentioned in respect of both of them.

As correctly stated in the decision under appeal, neither D1 nor D4 disclose a friction stir welding process, i.e. a friction welding process in which a rotating tool (or probe) having a shoulder and a projecting pin is plunged into the joint line, whereby the friction heating produced by the rotating shoulder and pin heats and plasticizes the abutting joint faces, the plasticized material is crushed by the leading face of the pin profile and transported to the trailing face by a mechanical stirring and forging action imparted by the pin and its rotation. Consequently, a weld is formed as the tool moves away (see D5, page 42, "The Principle of Operation").

In particular, as can be seen from the figures, D1 refers to a friction joining method, in which a pin (A) upstanding from a lower plate (B') is put in correspondence of a hole (Aa) in an upper plate (B), the pin is heated by means of a rotating tool (C) and the material of the pin is forced to fill the hole (Figs. 3 and 5), thereby joining the two plates. Thus not only D1 does not relate to friction stir welding; it also does not relate to edge-to-edge welding.

As regards D4, it discloses a method of friction welding the ends of tubing or abutted portions of sheets or plates by friction welding (see Figs. 3 to 6 and col. 5, lines 38 to 44 and col. 6, lines 62 to 65). In the embodiment of Fig. 5, D4 discloses the use of a tool shown as a mandrel (87) which is positioned and moved so that the nose end (88) thereof is brought to

bear against both pieces (12a, 12b) to be welded where they abut each other and rotated at high speed while compressively engaging the assembly to generate sufficient heat to cause melting of the material of both members adjacent the abutted interface (see col. 6, line 62 to col. 7, line 23). The tool is not plunged into the joint line and therefore the process according to the embodiment of Fig. 5 is not a friction stir welding process. Furthermore, D4 does not disclose the provision of raised portions acting as material flow compensation portions on the surfaces of the members to be welded together. It is true that Fig. 3 shows abutted tubing flared portions (77 and 79), but these are the portions to be welded together and moreover the weld does not extend (see Fig. 4) up to the internal surface of the abutted parts.

Therefore, neither D1 nor D4 include any indication that would suggest to the skilled person the claimed solution to the technical problem of improving weld formation in friction stir welding of members arranged edge-to-edge for welding.

2.5 In its statement of grounds of appeal the appellant also referred to documents D2 and D3, however only in respect of the dependent claims. As correctly stated by the Opposition Division, these documents are not relevant to the solution of the technical problem underlying the patent in suit because they do not disclose the provision of raised portions at the edges of members to be welded as the source of filling material. In fact, D2 and D3 go in a different direction because they teach that the filling material is obtained from one of the workpieces that are joined.

D3 discloses (see Abb. 2) that the extremity of a partition wall (11) or (see Abb. 3) the extension of profiles (13) can provide material for filling a gap between two plates (9, 9) to be welded (see page 2, lines 101-118). A solution similar to that of D2 is shown in D3, where an additional T-profile is inserted between two plates to be welded (see the independent claim and figures).

2.6 It follows from the above, that the subject-matter of claim 1 and that of dependent claims 2 and 3 involves an inventive step (Article 56 EPC 1973).

3. *Procedural issue*

For the sake of completeness, the Board notes that the statement of grounds of appeal (page 2, first paragraph) includes, in addition to the arguments contesting the reasoning of the Opposition Division in the decision under appeal, a submission according to which the decision of the Opposition Division was identical to the provisional opinion set out in the communication dated 13 December 2007 and a thorough discussion of the issues could not take place during the oral proceedings before the Opposition Division. Although it is not clear whether with this submission the appellant intended to make an allegation that a substantial procedural violation had been made, the Board has considered this possibility. In the Board's view, if it was the appellant's intention to make such an allegation, then the allegation must be rejected as unfounded, because the appellant has neither indicated what facts and arguments that were clearly central to his case and which might speak against the decision

taken have been completely disregarded in the decision under appeal (see e.g. T 763/04, point 4.1), nor indicated why a thorough discussion of the issues did not take place during the oral proceedings. In fact, it appears from the minutes of oral proceedings, that have not been contested by the appellant, that the opponent was given the possibility of discussing inventive step and in particular of explaining why D1 to D4 were relevant to inventive step when taken in combination with D5.

Order

For these reasons it is decided that:

The appeal is dismissed

The Registrar: The Chairman:

M. Patin P. Alting van Geusau