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D E C I S I O N
of 2 March 2004

Case Number: T 0851/00 - 3.3.7

Application Number: 94305638.2

Publication Number: 0640390

IPC: B01J 35/04

Language of the proceedings: EN

Title of invention:
Catalytic converters - metal foil material for use therein, and a method of making the material

Patentee:
Engineered Materials Solutions, Inc.

Opponent:
UGINE SA

Headword:
-

Relevant legal provisions:
EPC Art. 54(2)

Keyword:
"Novelty (no)"

Decisions cited:
-

Catchword:
-

Case Number: T 0851/00 - 3.3.7

D E C I S I O N
of the Technical Board of Appeal 3.3.7
of 2 March 2004

Appellant: (Proprietor of the patent)	Engineered Materials Solutions, Inc. 39 Perry Avenue MS4-14 Attleboro, MA 02703 (US)
Representative:	Darby, David Thomas Abel & Imray 20 Red Lion Street London WC1R 4PQ (GB)
Respondent: (Opponent)	UGINE SA Immeuble "La Pacific" 11/13 cours Valmy La Défense 7 F-92800 Puteaux (FR)
Representative:	Plaisant, Sophie Marie Usinor DIR-PI Immeuble "La Pacific" - TSA 10001 F-92070 La Défense Cédex (FR)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted 29 June 2000 revoking European patent No. 0640390 pursuant to Article 102(1) EPC.**

Composition of the Board:

Chairman: R. E. Teschemacher
Members: B. J. M. Struif
G. Santavicca

Summary of Facts and Submissions

I. The mention of the grant of European patent No. 0 640 390 with respect to European patent application No. 94 305 638.2, filed on 29 July 1994, was published on 29 April 1998 on the basis of fifteen claims. Claim 1 read as follows:

"A method for making a foil substrate material for catalytic converters comprising the steps of:
providing a layer of a first material chosen from the group consisting of chromium containing ferrous metals and aluminum and aluminum alloys, sandwiching said layer of first material between first and second layers of a second material chosen from the group consisting of chromium containing ferrous metals and aluminum and aluminum alloys not chosen for the first material, metallurgically bonding said layers together by reducing the thickness of said layers thereby forming a multilayer composite material of said first and second materials, reducing the thickness of the composite material to the final desired thickness for the foil substrate material and heating said composite material at a temperature between 900°C and 1200°C for a sufficient period of time to cause diffusion of metal constituents of said layers throughout the composite thereby providing a uniform solid solution material for the foil substrate."

Claims 2 to 13 were dependent on claim 1.

Claim 14 read as follows:

"A foil substrate material for catalytic converters made according to the method of any one of claims 1 to 13."

Claim 15 read as follows:

"A catalytic converter comprising a frame with a plurality of layers of foil substrate material made according to the method of claim 13."

II. On 29 January 1999 a notice of opposition was filed against the granted patent, in which the revocation of the patent in its entirety was requested on the grounds pursuant to Article 100(a) EPC with respect to lack of novelty and inventive step. The opposition was supported *inter alia* by the following documents:

D1: JP-A-2 133 562, French translation, JAPIO and WPIL Abstracts

D2: US-A-3 912 152

During the opposition proceedings the following further documents were cited:

D10: US-A-2 753 623

D11: GB-A-1 458 997

D12: L.R. Vaidyanath et al., "Pressure Welding by Rolling", British Welding Journal, January 1959, p. 13-28

D13: K.J.B. McEwan et al., "Pressure Welding of Dissimilar Metals", British Welding Journal, July 1962, p. 406-420

D14: R.C. Pendrous et al., "Cold roll and indent welding of some metals", Metals Technology, July 1984, Vol. 11, p. 280-289

III. In a decision notified on 29 June 2000, the opposition division found that the patent should be revoked. That decision was based on the following requests:

- claims 1 to 15 as granted (main request)

- a set of claims 1 and 2 as filed with the letter dated 29 February 2000 and claims 3 to 15 as granted (first auxiliary request),

- claims 1 to 13 as granted (second auxiliary request),

- a set of claims 1 and 2 as filed with the letter dated 29 February 2000 and claims 3 to 13 as granted (third auxiliary request),

- a set of claims 1 and 2 as filed during the oral proceedings before the opposition division and claims 3 to 15 as granted (fourth auxiliary request),

- a set of claims 1 and 2 as filed during the oral proceedings before the opposition division and claims 3 to 13 as granted (fifth auxiliary request).

Claim 1 of the first and third auxiliary request differed from claim 1 as granted in that the following features were introduced after the term "foil substrate material" and at the end of the claim, respectively:

- ... "without thermal treatment that would cause formation of intermetallic constituents of the first and second materials..."

- ...", characterized in that metallurgical bonding is effected by reducing the thickness of said layers".

Claim 1 of the fourth and fifth auxiliary request differed from claim 1 of the first and third auxiliary request in that the following feature was introduced at the end of the claim:

- ...", without heat treatment".

The opposition division held that:

(a) The modified claims of the first and third to fifth auxiliary requests were in compliance with the requirements of Article 123(2) and (3) EPC.

(b) The claimed subject-matter of all requests was not novel over D1, in particular example 4, since D1 disclosed all features of the claimed method including the formation of a metallurgical bond between the different metallic layers by cold rolling. Although D1 did not explicitly refer to the term "metallurgical bond", the patentee's argument that in D1 a mechanical bond was only formed after the thickness reduction, could not be accepted, because in D1 the thickness reduction was higher than 30%, in particular 48%. That later reduction ratio was close to 50% specified for an indent-welding process in D14 and well above 25% for a high purity grade aluminium according to D13, which ratios were considered to be sufficient to provide a metallurgical bond. Furthermore, the patentee's argument that the metallurgical bonding required a specific surface preparation was not reflected by any features of claim 1.

(c) The amendments in the auxiliary requests provided no distinguishing feature over D1, since the method of D1 provided a metallurgical bond between the layers by thickness reduction with or without intermediate annealing and since the annealing step between the first and the second reduction step was only a preferred feature of D1.

IV. On 24 August 2000 the patentee (appellant) filed a notice of appeal against the above decision and paid the prescribed fee on the same day. The statement setting out the grounds of appeal was filed on 25 October 2000. The appellant maintained its requests underlying the decision under appeal and submitted a further document:

D15: M. G. Nicholas et al., "Roll Bonding of Aluminium", British Welding Journal, August 1962, p. 469 to 475

V. On 2 February 2004, in reply to a communication of the board dated 17 November 2003, the appellant withdrew the main request and auxiliary requests 1 to 5 underlying the decision under appeal and filed a new main request and a new first auxiliary request. Furthermore, he submitted an English translation of JP-A-233562/1990 (D1) to which in the following further reference was made. In the main request claim 1 corresponded to claim 1 as granted. In the first auxiliary request claim 1 contained the following feature put at the end of claim 1 as granted:

", the method being carried out without heat treatment of the composite material before reducing it to its final desired thickness".

VI. Oral proceedings were held on 2 March 2004. The appellant submitted SEM photographs as Figures 1 to 4.

VII. The appellant argued in substance as follows:

(a) The finding in the decision under appeal that claim 1 as granted lacked novelty was reached on a misunderstanding of the facts and was wrong in law. In particular, the feature "metallurgically bonding said layers together by reducing the thickness of said layers thereby forming a multilayer composite material of said first and second materials" was not directly and unambiguously derivable from D1. Although the term "pressure welding" described a process in which a "metallurgical bond" was produced, the strength of the bond was influenced by the process conditions, such as the reduction ratio, the surface roughness, the cleaning steps and the thickness of the starting layers. The term "metallurgical bonding" was illustrated by the SEM photographs submitted in the oral proceedings, which photographs were taken from samples prepared under the conditions of the patent in suit. They showed that with a reduction ratio of only 48% the roughened surface of stainless steel had entrapped the roughened surface of aluminium and provided only a mechanical bond, whilst with a higher reduction ratio interdiffusion took place, which formed a metallurgical bond.

According to D11, which was closely related to D1, cold rolling at a thickness reduction ratio of 30 to 40% only produced mechanical bonds, which, by a subsequent heat treatment at high temperature of 300 to 450°C, formed a metallurgical bonding. In D1 similar temperatures were exemplified for an intermediate annealing, which was thus necessary to prevent exfoliation in the next step. That problem however only occurred with a mechanical bond.

A thickness reduction of 48% according to D1 was not sufficient to provide a metallurgical bond, since according to D14, even at 47% deformation, just below the threshold value of 50%, no apparent bonding had occurred. According to the patent in suit a metallurgical bond was only formed at a reduction ratio above 60%.

Furthermore, the cleaning treatment in D1 was insufficient to achieve a metallurgical bonding by thickness reduction. According to D15 degreasing the aluminum sheet with chlorinated solvents as used in D1 was detrimental, contaminated the surface and raised the threshold deformation. In this respect a proper surface preparation prior to metallurgical bonding by thickness reduction, such as scratch-brushing or a similar dedicated treatment, was necessary, as done in D10 to which the patent in suit made reference. Since D1 did not disclose the necessary process conditions, there was no enabling disclosure in D1 that a metallurgical bond was formed. Consequently, claim 1 of the main request was novel.

(b) As regards claim 1 of the auxiliary request, any heat treatment prior to the final thickness reduction step was excluded. According to D1, an annealing step was necessary to provide a metallurgical bonding by diffusion. Thus, that additional feature provided a distinction over D1.

VIII. The arguments of the respondent (opponent) can be summarised as follows:

(a) New Figures 1 to 4 were filed late so that no counter experiments could be made. Furthermore, there was no information whether or not the surface preparation steps were carried out according to the patent in suit. A reproduction of the teaching of D1 had not been made. Therefore, the figures should be disregarded.

(b) According to the patent in suit, the term "metallurgical bonding" related to a composite, which was capable of being continuously rolled to the final desired gauge after bonding without the need for any thermal treatment, which could cause the formation of intermetallics of the metal constituents. According to D1 the pressure welding step produced a metallurgical bonding, wherein these terms implied the same technical effect. The patent in suit did not disclose any necessary minimum process conditions, by which a metallurgical bond could be formed. D1 contained three independent process claims, which implied that an annealing step was not necessary. Since claim 1 in suit did not exclude any annealing step, also claim 3 of D1 anticipated the patent. In a first thickness reduction step the sheets were pressure-welded and thus metallurgically bonded. According to D1 a reduction ratio of higher than 30% was necessary to obtain a pressure-welded or metallurgically bonded composite, the layers of which were perfectly in adherence. Since according to D11 a cold pressure bond was formed by a reduction ratio of 30 to 40%, the reduction ratio of 48% in D1 was sufficient to obtain a metallurgical bond. In this respect, the patent in suit did not specify any minimum reduction rate.

In D1, the annealing step was only an optional feature to improve the adherence of the layers, but was not obligatory. Furthermore, the conditions of surface preparation before reducing the thickness according to the embodiments of D1 were similar to those of the patent in suit, such as wire brushing and suitable cleaning. In addition, surface preparation conditions were not specified in the claims and they were known to the skilled person. Although in D15 trichloro ethylene was described as susceptible for contaminating the surface, in D1 trichloro ethane was used, which was a different solvent.

Documents D12 to D14 cited by the appellant did not show that the bond obtained by the first reduction step in D1 was not a metallurgical bond. In D12 to D14 the term "metallurgical bond" was not used but the term "pressure welding", which was identical to that mentioned in D1. Furthermore, if according to D11 the thickness of the Al layer was much thinner than that of the substrate material, a cold pressure bond could be obtained at a relative low reduction. Consequently, a metallurgical bond could also be obtained at a reduction ratio lower than 50%.

(c) As regards the first auxiliary request, since the intermediate annealing mentioned in D1 was not an obligatory feature, the amended feature did not provide a further distinction over D1.

IX. The appellant requested that the decision under appeal be set aside and that the patent be maintained as granted with the proviso that claims 14 and 15 be deleted or, alternatively, on the basis of claim 1 according to the first (sole) auxiliary request submitted with the letter dated 2 February 2004 and claims 2 to 13 as granted.

X. The respondent requested that the appeal be dismissed.

Reasons for the Decision

1. The appeal is admissible.

Novelty (Main request)

2. D1 contains three independent process claims for manufacturing high Al-content stainless steel sheet. In particular claim 2 reads as follows:

"A method for manufacturing high Al-content stainless steel sheet, including:
stacking an Al sheet at least on one surface of the stainless steel sheet so as to have a ratio corresponding to an amount of Al to be contained;
allowing a stacked body going through between rolls, and thereby obtaining a pressure-welded laminate sheet;
further rolling an obtained pressure-welded laminate sheet to a target thickness; and
subsequently applying a diffusion process to the obtained pressure-welded laminate sheet at a temperature in the range of 600 to 1300 degree centigrade under conditions that allow an Al layer to form an alloy without melting."

Thus, according to the method of claim 2, an intermediate annealing is not obligatory.

Independent claim 3 differs from independent claim 2 in that after the feature "further rolling … to a target thickness" the following feature has been added: "at this time before or in the middle of the rolling, applying an intermediate annealing at a temperature in the range of 250 to 550 degree centigrade;".

2.1 According to the description of D1, prior to rolling, surfaces to be faced of both sheets are preferably to be cleansed. When these stacked sheets are pressure-welded with rolls, if the rolling reduction ratio is less than 30%, it is difficult to obtain an excellent pressure-welded state between the stainless steel sheet and Al. Accordingly, it is necessary to raise the rolling reduction ratio to 30% or more and thereby a pressure-welded laminate between steel and Al can be obtained (paragraph, bridging pages 7 and 8). The adhesion properties of the pressure-welded laminate can be improved by an annealing process. Although the annealing process is not necessarily required for all, when a thickness of the pressure-welded sheet exceeds 1.5 mm, in the subsequent cold rolling to further reduce the thickness there may occur peeling at the adhesion. In order to hinder this from occurring, the annealing is preferably applied (page 8, first complete paragraph). Hence, the description of D1 confirms that annealing is only an optional feature.

2.2 According to the samples 1 to 4 of embodiment 1 of D1, a core material of JIS SUS 430 (a ferritic stainless steel as also disclosed in the patent in suit, column 3, lines 24 to 26) is polished by a roll with a wire brush and the Al sheet is degreased with trichloro ethane. On both surfaces of the core material, Al is stacked and the combined body is passed through a four stage rolling machine, rolled at a rolling reduction ratio of 35 to 48% to a thickness as shown in table 1 and pressure welded, followed by winding to a coiler. The obtained coil of the pressure-welded sheet is cast into a batch annealing furnace followed by the intermediate annealing at 350 degrees centigrade for 10 hrs, further followed by cold rolling to a thickness of 0.30 mm.

According to embodiment 2, the pressure-welded rolled sheet of sample Nos. 1 and 3 of embodiment 1 are cold-rolled to a thickness of 0.3 mm, then heated at a temperature of 650 degrees centigrade for 1 hr followed by applying a diffusion process at a temperature of 1100 degrees centigrade for 2 hrs in a vacuum and thereby a high Al-content stainless steel sheet is prepared in which Al is uniformly diffused.

2.3 Since embodiment 2 refers to pressure-welded sheets according to table 1, which however are not yet annealed, and since no further annealing is mentioned when cold rolling said pressure-welded starting material, it is not apparent that in embodiment 2 an intermediate annealing is used. In any case, if an intermediate annealing was supposed in favour of the appellant, no different conclusion on novelty would be reached by the board.

2.4 From the above it follows that D1 describes all the process steps defined in claim 1 as granted except that, with respect to the first thickness reduction step, the term pressure-welded instead of the term "metallurgical bonding" is mentioned. Thus, the first question to be answered is, whether or not the term "metallurgical bonding" when interpreted in the light of the patent specification, provides a distinction of the claimed method from that of D1.

2.4.1 There is no definition of the term "metallurgical bonding" in the patent in suit. However, some relation between that bonding and the starting thickness is mentioned. The purpose of choosing the initial starting thicknesses of the layers is to determine two important material characteristics of the final composite. The first is to determine the ultimate chemistry of the final composite after thermal reaction, the second is to provide a bonded composite which is capable of being reasonably continuously rolled to the final desired gauge after bonding without the need of any thermal treatment which could cause the formation of intermetallics of the metal constituents. This second characteristic is important in being able to produce the material economically in large production quantities (column 3, line 53 to column 4, line 6). Thus, the patent in suit provides an indication that the initial starting thicknesses are of importance so that after bonding the sheets can be rolled continuously to the final thickness without the necessity of a further intermediate heat treatment. Since in D1 the intermediate annealing is not necessary (see points 2 and 2.1), the interpretation of the term "metallurgical bonding" according to the patent in suit cannot provide any distinction over the teaching of D1.

2.4.2 In addition, the patent in suit does not define the minimum conditions under which a metallurgical bond can be formed. In particular, the degree of thickness reduction is not defined but only exemplified and not related to any specific strength of the metallurgical bond. Thus, the functional term "metallurgical bonding" used in the patent in suit has no relation to any minimum degree of thickness reduction or bond strength.

2.4.3 It is not disputed between the parties that the term "metallurgical bonding" is an accepted term in the art. Further, both parties at the oral proceedings stated that "pressure welding" is used as a synonym for producing a "metallurgical bonding". In that respect reference is made to the proprietor's statement in the letter dated 29 February 2000 where it reads: "It has been known for many years that in metallurgical bonding, or pressure welding as it is otherwise termed, a number of factors are critical to success". This fact was also confirmed by the technical expert of the proprietor during the oral proceedings stating that in pressure welding processes a metallurgical bond is formed. From the above it follows that the term "pressure welding" describes a specific welding process in which a "metallurgical bond" is produced. In that sense both terms imply the same effect.

2.4.4 In D1 the term "pressure welded" is expressly used so that above a 30% thickness reduction by rolling an excellent pressure-welded state between stainless steel and Al is obtained (page 8, first complete paragraph). According to the embodiments of D1, which use a thickness reduction ratio of 35 to 48% in the first reduction step, a pressure-welded sheet is disclosed (see page 13, lines 1 to 5, table 1). Thus, D1 specifies a minimum degree of thickness reduction but no upper limit necessary to obtain a good pressure-welded state.

2.4.5 It follows from the above that D1 discloses a metallurgical bonded sheet of stainless steel and Al, whereby the pressure-welded sheet obtained according to D1 also fulfils the function as described in the patent in suit, ie the further reduction of the pressure-welded sheet can be carried out without any heat treatment (claim 2 of D1 and page 8, first complete paragraph, first sentence).

2.4.6 Therefore, D1 describes all the process features of the claimed subject-matter, including a "metallurgical bond" which is described as "pressure-welded state" and achieved by pressure welding during the first thickness reduction step.

2.5 According to the appellant's arguments, D11 to D14 demonstrate that in D1 no metallurgical bonding can be achieved.

2.5.1 D11 discloses a process for producing metal composite material, comprising applying an aluminium foil to a surface of a substrate material consisting of a metal other than aluminium, cold pressure bonding said aluminium foil to said metal substrate material at a draft of from 5% to 40% and subjecting said bonded material to a diffusion heat treatment at a temperature lower than both the melting points of said aluminium foil and said substrate material (claim 1). The cold pressure bonding is effected by cold rolling. Said diffusion heat treatment is not lower than 200°C, in particular from 300 to 450°C (claims 3 and 4). By the diffusion heat treatment the aluminium foil and the substrate material can diffuse into each other so as to form a diffusion layer in the intersurface portion thereof. Furthermore, no intermetallic compound is produced in the diffusion layer (page 3, lines 24 to 31). Since the bonding of the aluminium layer to the other metal material is realized through the thin aluminium layer which is firmly bonded to the other material through the diffusion layer, the bonding strength of the resulting composite material is very high (page 4, lines 23 to 29).

2.5.2 Although in D11 a metallurgical firm bonding layer can be obtained by diffusion heat treatment (page 3, lines 71 to 75), it is nevertheless stated that at a certain degree of thickness reduction a "cold pressure bond" can be achieved (page 2, lines 104 to 107). Since in D1, the thickness reduction ratio is higher than 40%, it cannot be derived from D11 that under the conditions of D1 a pressure-welded state cannot be achieved.

2.5.3 In D12 the mechanism of pressure welding in roll bonding has been investigated. Based on the experimental tests, bond strengths are measured for aluminium, copper, lead, tin and zinc welded at room temperature. It is reported that in all cases a 60-70% reduction in thickness was required to approach the solid metal strength although the threshold deformation required for the initiation of bonding varies (page 13, abstract; page 28, conclusion (1)). Although no positive bond strength was observed for aluminium composites for a deformation less than 40%, above said value a positive bond strength is observed (see page 15, left column, last paragraph; Figure 3). Since according to the patent in suit it is not required that in the first reduction step the solid metal strength should be achieved, the smaller threshold deformation is sufficient. Consequently, it has not been shown that at a thickness reduction according to samples 2 to 4 of D1, which is well above 40%, no pressure-welded or metallurgically bonded state in line with D12 was achieved.

2.5.4 D13 concerns pressure welding of dissimilar metals and illustrates different conditions which may have an effect on the welding properties. According to D13 the effect of metal purity of aluminium has been investigated. It was found that bonding with super purity metal commenced at 25% deformation whereas under similar conditions 40% deformation was required for commercial purity material (page 408, paragraph, "metal purity"). Thus, whilst the threshold deformation of 40% is necessary to initiate welding for aluminium at room temperature, strengths approximating those of the solid metal require deformations as high as 70% (page 407, left column, last sentence; right column, "Autogenous roll bonding of aluminium at room temperature", first sentence). These findings are in line with those given in D12 so that a reduction ratio above 40% as illustrated in the embodiments of D1 is sufficient to initiate a metallurgical bond.

2.5.5 D14 discloses cold roll and indent welding of some metals, including copper, brass, aluminium and stainless steel. Aluminium/stainless steel composites were successfully roll bonded at deformations greater then 50 to 55% (see page 281, right column, "Bonding testing"). The starting thickness of the aluminium sheet is 1.0 mm and that of the stainless steel is 0.8 mm (see page 281, table 1). In D1 the starting thickness of the steel sheet is 1 mm and that of the Al sheet is 0.05 to 0.2 mm. Consequently, in D1 the starting thickness of the sheets to be pressure rolled is more than 50% (1.8-1.2/1.2) thinner than that of D14. It is however well known that a decreased thickness has an enhanced effect on the bond strength (D12, Figure 18). In addition, the tests in D14 have been carried out with an austenitic steel (page 280, right column experimental techniques, first paragraph) different from a JIS SUS 430 steel, which is ferritic, used in D1.

Furthermore, according to D14, surface preparation by wire brushing after vapour degreasing has been found essential in the formation of cold pressure welds (page 289, conclusion 1). The threshold deformation for cold welding is found to be dependent on the geometry of welding. Different degrees of welding configurations produce varying degrees of surface extension, the latter being necessary for subsequent extrusion of substrate. Threshhold deformation can therefore, only be used as a comparison of weldability for different material combinations provided the same welding technique and size of materials are used (page 289, conclusions 3). Thus, D14 cannot prove that under the conditions of cold pressure welding of D1, considering the different materials, the lower starting thickness of the sheet composite and the reduction ratios given therein, no pressure-welding bond can be obtained.

2.5.6 According to D15, no welding occurs when roll bonding aluminium specimens until a deformation of at least 40% has been imposed. As the deformation is increased above 40% the joint strength increases but does not become equal to that of solid metal until about 60 to 70%

deformation is attained (page 470, left column, first paragraph). This teaching is similar to that of D12 and D13.

2.5.7 In summary, from documents D11 to D15 it cannot be derived that under the conditions specified in D1 no pressure-welding bond can be achieved. Furthermore, since according to D1 an excellent pressure-welding bond is achieved when using a thickness reduction above 30% and since the claimed subject-matter neither defines any threshold deformation for obtaining a metallurgical bond, nor the bond strength thereof, the appellant's argument, that the term "metallurgical bonding" in the patent in suit relates to a specific bond strength, which requires a specific degree of thickness reduction, is not convincing.

2.6 The appellant further argued that the surface preparation conditions in D1 are not suitable to achieve a metallurgical bonding.

2.6.1 According to embodiment 1 of D1 a strip of JIS SUS 434 stainless steel was polished with a wire brush. Furthermore, the aluminium foils were spray degreased with trichloro ethane. According to the patent in suit the stainless steel is cleaned and brushed and two cleaned aluminium foils are used (column 5, line 56 to column 5, line 6). The patent in suit (column 5, lines 5 and 6) further refers to US-A-2 753 623 (D10), which specifically relates to cleaning interfacial surfaces prior to heating. According to D10 the surfaces must be sufficiently cleaned and free of bond-preventing contaminants such as oxides, organic matter or chemisorbed liquids and gases. A preferred way of removing such barrier films is the use of abrasion techniques such as wire brushing (column 2, line 61 to column 3, line 7). In the examples of D10 the "cleaning" is effected by either "wire brushing" (examples 1, 3 and 4) or by abrasion using a belt sander (examples 2 and 3). As confirmed by the appellant, also wire brushing has been used in the patent in suit when removing contaminants from the steel sheet. In this respect no difference from the method used in D1 can be seen. Whilst according to D1 the Al stripes are degreased with trichloro ethane, it cannot be derived from the patent in suit that degreasing with trichloro ethane is detrimental for obtaining a metallurgical bond.

2.6.2 According to D11, it is necessary that the aluminium foil and the substrate material is preliminarily cleaned by degreasing with an organic liquid, acid or alkaline aqueous solution, in order to attain a firm bond (page 2, lines 115 to 121).

2.6.3 According to D12, scratch-brushing combined with a degreasing treatment invariably gives the best bond strengths. The standard treatment of degreasing is trichloro ethylene followed by scratch-brushing. However, reversing the procedure, and degreasing after scratch-brushing, was found markedly to decrease the bond strengths obtained (page 24, Influence of surface contamination, first paragraph). According to D1, only the Al sheet has been degreased and the typical order of standard treatment has been observed, so that the detrimental conditions mentioned in D12 are not used.

2.6.4 Degreasing with trichloro ethane and wire brushing similar to D1 is also used in D14 (see page 280, right column second paragraph).

2.6.5 According to D15, composites which have been exposed to trichloro ethylene vapour after scratch-brushing for 100 min are compared with those which have undergone the standard degreasing/scratching (page 472, Figure 7 and right column "effect of changing the contaminant"). The standard technique described in D15 is degreasing in a bath of trichloro ethylene vapour for half an hour followed by abrading with a rotating steel wire scratch brush (page 470, left column, Experimental Technique). However, in D1 trichloro ethane instead of trichloro ethylene is used. Thus, neither the same solvent nor any longer and detrimental exposure to that solvent after scratch brushing for 100 min is taught. Furthermore, it has not been shown that the skilled person being familiar with surface preparation conditions suitable for obtaining metallurgical bonding upon reading D1 will not use those, which are most suitable.

2.6.6 From the above it follows that D1 uses usual mechanical surface preparation conditions, in particular wire brushing, recommended for cold welding in D10, D12, D14 and D15. Furthermore, it has not been shown that degreasing with trichloro ethane is detrimental to metallurgical bonding. It is not apparent from the patent in suit, in which respect the surface preparation conditions differ from those specified in D1. Thus, there is no basis in the prior art and the patent in suit for the conclusion that the conditions used in D1 are detrimental for obtaining a good pressure-welded state.

2.7 The appellant's further argument that in D1 a metallurgical bonding is achieved only by an intermediate annealing is not convincing either.

2.7.1 According to D1 the intermediate annealing step is not obligatory but is preferably applied (see page 8, second paragraph, first sentence). This is also made clear by independent method claim 2 covering an embodiment which does not include any heat treatment prior to the reduction to the final thickness (see points 2 and 2.1). Consequently, D1 discloses a process providing a pressure-welded state without any intermediate annealing (paragraph, bridging pages 7 and 8). Thus, D1 teaches embodiments, which are not annealed.

2.7.2 In addition, it is noted that the method of granted claim 1 is defined by the term "comprising the steps of". Such a definition includes any further steps also an intermediate annealing step. The absence of a thermal heating step is mentioned only in dependent claim 2.

2.8 The appellant's last argument is based on Figures 1 to 4 submitted during oral proceedings. These submissions provide fresh facts and evidence at a very late stage of the proceedings. The SEM photographs are said to have been taken from samples which all have been prepared under the conditions of the patent in suit. Since according to the appellant no repetition of the teaching of D1 has been made, the relevance of the late filed evidence is not immediately apparent (compare Case Law, *supra*, VI.F.3.1.1 to 3.1.3). Furthermore, the respondent has neither had any possibility to check these results nor make counter experiments. Without technical advice no comment thereon could be expected from the representative. If the late filed submission was admitted, postponement of the oral proceedings would have become necessary, which is contrary to the procedural requirement that the proceedings be conducted expeditiously. Consequently, the late evidence is not taken into account (Article 114(2) EPC).

2.9 In summary, the appellant failed to show that D1 does not enable the skilled person to obtain the formation of a metallurgical bond in the first thickness reduction step. Hence, D1 is considered to disclose directly and unambiguously all the features of claim 1 so that the subject-matter of the main request is not novel according to Article 54(2) EPC.

Auxiliary request

Amendments

3. The amendment to claim 1 concerns the added feature "the method being carried out without heat treatment of the composite material before reducing it to its final desired thickness". That feature is based on the application as filed, page 3, lines 5 to 12 and last sentence, and leads to a restriction of the protection conferred by granted claim 1. Consequently, amended claim 1 of the auxiliary request meets the requirements of Article 123(2) and (3) EPC.

Novelty

4. Claim 1 of the auxiliary request differs from granted claim 1 only in that a heating step prior to the reduction to its final thickness is excluded. Such a step is not obligatory according to D1. Therefore, the same considerations already given for the main request apply *mutatis mutandis* (points 2, in particular 2.7.1). Consequently, the subject-matter of claim 1 of the first auxiliary request lacks novelty.

Order

For these reasons it is decided that:

The appeal is dismissed

The Registrar: The Chairman:

C. Eickhoff R. Teschemacher