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D E C I S I O N
of 12 December 2005

Case Number: T 0034/04 - 3.2.02

Application Number: 97915470.5

Publication Number: 0892858

IPC: C22C 21/06

Language of the proceedings: EN

Title of invention:
Aluminium-magnesium alloy plate or extrusion

Patentee:
Corus Aluminium Walzprodukte GmbH

Opponent:
PECHINEY

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step - (yes) after amendment"

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0034/04 - 3.2.02

D E C I S I O N
of the Technical Board of Appeal 3.2.02
of 12 December 2005

Appellant: (Proprietor of the patent)
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Decision under appeal:
Decision of the Opposition Division of the European Patent Office posted 5 December 2003 revoking European patent No. 0892858 pursuant to Article 102(1) EPC.

Composition of the Board:

Chairman: T. K. H. Kriner
Members: R. Ries
E. Dufrasne

Summary of Facts and Submissions

I. The grant of European patent No. 0 892 858 on the basis of European patent application No. 97915470.5 was mentioned on 2 November 2000.

II. The granted patent was opposed by the present respondent on the grounds that its subject matter lacked novelty and did not involve an inventive step (Article 100(a) EPC) and that the invention was insufficiently disclosed (Article 100(b) EPC).

III. With its decision posted on 5 December 2003, the Opposition Division held that the claimed subject matter of the independent claims of all requests lacked an inventive step and revoked the patent.

The following documents have been considered for the decision of the Opposition Division:

D1: H. S. Campbell: "Superior stress corrosion resistance of wrought aluminum magnesium alloys containing 1% Zn", The Metallurgy of Light Alloys, Conference Loughborough, March 1983, pages 82 to 100

D4: K. Van Horn: "Aluminum, volume 1: Properties, Physical Metallurgy and Phase Diagrams, American Society for Metals, 1967, page 208

D15: GB-A-2 024 861

D16: GB-A-1 003 264

In the Opposition Division's view, document D1 and in particular the composition of the AlMgZnMn alloy XBY in D1 reflected the closest prior art. Novelty was acknowledged due to the absence of zirconium (main and auxiliary requests) and the difference in the Zn-content of alloy XBY (1.0% Zn) and the one claimed in the patent (0.4 to 0.9% Zn) (auxiliary requests). As to inventive step, the addition of zirconium to alloy XBY was held obvious, e.g. from the teaching given in D4, in order to improve both the alloy's strength and resistance to cracking during welding. With respect to the Zn content of both alloys, no perceptible difference arising from the Zn content of alloy XBY (1.0%) and one containing 0.9% Zn was held to exist in practice, contrary to the explanations given on page 4, lines 31 to 33 in the patent specification where it is said that Zn above 0.9% may lead to corrosion in the heat affected zone (HAZ) of the weld. However, in the absence of any evidence in the patent specification, e.g. in the form of examples, showing that Zn-contents above 0,9% would actually lead to corrosion of the weld, no specific technical problem was held to be solved by reducing Zn from 1.0% to 0.9% as claimed. Hence, the Opposition Division concluded that this feature could not justify an inventive step.

IV. On 6 January 2004, the patentee (appellant) lodged an appeal against this decision. The prescribed fee was paid on 7 January 2004 and the written statement setting out the grounds of appeal was filed on 14 April 2004 within the time limit given in Article 108 EPC.

In its statement of grounds of appeal, the appellant disputed the position of the Opposition Division, in

particular that there was no discernable difference in the corrosion resistance arising from the Zn content of alloy XBY (1%) and a similar alloy containing 0.9% Zn. Enclosed with his statement, the appellant submitted the documents

D17: Alcan Welding Products, (one page)

D18: J. E. Hatch: "Aluminum: Properties and Physical Metallurgy, American Society for Metals, ISBN 0-87170-176-6, 1984, pages 226 and 240, and

D19: Affidavit of S. D. Meijers,

the latter comprising further comparative test results (D20) in order to provide adequate support for demonstrating the effect of Zn contents above and below 0.9% on the alloy's corrosion performance in the HAZ after welding. Given that document D1 failed to address the problem of exfoliation and pitting corrosion in the HAZ after welding Al-5.5%Mg-1%Zn alloys, the appellant argued that the technical disclosure of this document could not have been helpful to solve the identified problem in designing the claimed aluminium alloy composition, and neither could the teaching in any of the other documents.

The appellant therefore requested that

- the decision of the Opposition Division be set aside and

- the patent be maintained

- on the basis of claims according to the main request (= set of claims "A" corresponding to the auxiliary request filed on 29 May 2002) or, alternatively,
- on the basis of the claims according to a first (set of claims "B"), second (set of claims "C") or third auxiliary request (set of claims "D").

Oral proceedings were requested in case the Board could not comply with any of the appellant's requests.

V. Independent claims 1, 13 and 15 of the set of claims "A" (main request) read as follows:

"1. Aluminium-magnesium alloy in the form of a plate or an extrusion, having the following composition in weight percent:

Mg	5.0 - 6.0
Mn	>0.6 - 1.2
Zn	0.4 - 0.9
Zr	0.05 - 0.25
Cr	0.3 max.
Ti	0.2 max.
Fe	0.5 max.
Si	0.5 max.
Cu	0.4 max.
Ag	0.4 max.

balance Al and inevitable impurities."

"13. Welded structure comprising at least one welded plate or extrusion made of aluminium-magnesium alloy according to any one of claims 1 to 12."

"15. Use of an aluminium-magnesium alloy according to any one of claims 1 to 14 at an operating temperature greater than 80°C".

VI. In reply to the grounds of appeal, the respondent (opponent) referred to documents D1 and D4 and further submitted the documents

X1: R. Dif, J. C. Ehrstrom, G. M. Raynaud: "The Effect of Zinc Additions on the Corrosion Properties of Aluminium-Magnesium Alloys", Proceedings of ICAA-6, 1998, pages 1489 to 1494 (published after the priority date of the opposed patent)

X2: ASTM International, Standard Test Method for Visual Assessment of Exfoliation Corrosion Susceptibility of 5XXX Series Aluminium Alloys (ASSET Test) Designation G 66-99; current edition approved April 10, 1999, published June 1999 (after the priority date of the patent)

X3: Handbook ASM volume 30, 1990, page 584.

The respondent expressed serious doubts about the quality of the photographs of the patentee's comparative tests and whether or not they actually showed exfoliation corrosion. In this context the respondent relied on document X2 explaining the difference between "pitting" and "exfoliation", and on the statements in the post-published document X1 according to which exfoliation corrosion only occurred when the alloy was susceptible to intergranular corrosion and had an elongated grain structure. In the recrystallized HAZ, however, the grain structure was no

longer elongated and therefore unable to entail exfoliation corrosion. The respondent therefore concluded that galvanic corrosion rather than exfoliation corrosion was observed in the comparative samples.

Moreover, it held that the corrosion resistance of the HAZ in the weld joint was not only influenced by the Zn-content in the base material but was also determined by the composition of the filler wire and/or by the selected welding conditions. Hence, no difference was seen between the corrosion resistance of alloy XBY of D1 comprising 1.0% Zn and the range of Zn restricted to 0.4 to 0.9 according to the patent.

As to the zirconium content, the respondent referred to document D18 explaining that Zr and Cr in principle exhibited the same metallurgical phenomenon: both components were used to produce a fine precipitate of intermetallics which inhibited the nucleation and grain growth during recrystallisation. Moreover, no difference in the corrosion performance was seen between the comparative samples comprising Zr or comprising Cr. Substituting chromium with zirconium was therefore not held to involve an inventive step.

The respondent therefore requested that the appeal be dismissed.

Reasons for the Decision

1. The appeal is admissible.

2. *Amendments (Article 123(3) EPC)*

Claim 1 of the main request (set of claims "A") results from a combination of claims 1 and 7 as granted. Claims 2 to 15 correspond to claims 2 to 5, and 8 to 17, respectively, in the form as granted. Consequently, there are no formal objections to the claims of set "A".

3. *The patent*

The patent at issue concerns the composition of an aluminium alloy in the form of a plate or an extrusion comprising Mg, Mn, Zn and Zr as compulsory components within specific ranges. Compared to standard alloy AA5083, the claimed alloy can provide a higher strength without impairing its resistance to corrosion, in particular in the welded joints, in the work hardened (H) and soft temper (O) condition. In addition, the alloy exhibits an improved resistance to long term stress and exfoliation corrosion at temperatures above 80°C (see the patent specification, paragraphs [0009], [0010].

4. *Novelty*

The Board concurs with the Opposition Division's assessment that none of the available documents discloses an AlMgMnZr alloy satisfying all the compositional requirements of the alloy defined in claim 1 of the patent. Besides, the respondent (opponent) withdrew his objection based on the lack of novelty at the opposition proceedings. Given this situation there is no need to deal with the question of novelty any further.

5. *The closest prior art*

Like the patent under consideration, document D1 discloses AlMgZnMnCr alloys which are hot and cold rolled into plate and sheet material (thickness 1.2 mm). The tested alloys, however, fail to comprise zirconium as a compulsory element, and are restricted to essentially two different types of "low" and "high" manganese alloys:

(i) Zn-free alloys comprising 0.005% Zn as an impurity and
(ii) alloys comprising 1.0 or 1.1% Zn.

In particular the "high" manganese alloys comprising 0.72 to 0.86% Mn and 1.0% to 1.1% Zn come close the claimed alloy composition (see D1, page 83, Preparation of the materials; Table 1; page 84, second paragraph). The Opposition Division particularly relied upon alloy XBY comprising Al-5.5Mg-1.0Zn-0.72Mn-0.10Cr. Moreover, the effects of manganese and zinc additions on the tensile strength and stress corrosion susceptibility of welded Al-Mg alloys have been investigated in D1 (see in particular D1, page 91: Welded materials). The other documents are more remote in that they are concerned with technical background knowledge given in the reference textbooks D4, D17, D18, X3) or relate to aluminium alloy compositions far outside the one claimed (D15, D16). Therefore, the Opposition Division's assessment, which was shared by the respondent, to regard document D1 as representing the closest prior art cannot be objected to.

6. *Comparative tests*

6.1 The central plank on which the Opposition Division has chosen to construct its reasoning on inventive step of the former auxiliary request 1 (now main request) is the set of premises that no discernable difference in technical effect arises from the Zn contents of alloy XBY and one containing 0.4 to 0.9% Zn as defined in claim 1 and, as such, no technical problem is solved by reducing Zn from 1.0% to 0.9% or below. An inventive step based on this technical feature has therefore been denied.

6.2 To meet the Opposition Division's objection in the appealed decision, the patentee submitted comparative tests (D19, D20) in which alloy XBY (Al-1.0Zn-5.5Mg-0.72Mn-0.10Cr-0.17Fe-0.17Si) as a reference composition is compared with aluminium alloys comprising 0.87% Zn with or without Zr as claimed. The tests exhibited a qualitative improvement in the alloy's corrosion resistance, in particular to pitting and exfoliation in the O and H temper condition for the AlMgMn alloys having 0.87% Zn. A similar effect was found to exist also for Zr-containing variants of the tested alloys.

6.3 In the respondent's position, exfoliation corrosion did not occur unless the aluminium alloy exhibits a fibred structure which, however, did not exist in the HAZ due to the local heat input during welding. In the respondent's conclusion, "galvanic" corrosion occurred in the comparative tests rather than "exfoliation" corrosion as alleged by the patentee. It referred in this context to the documents X1 and X3. The

comparative test results were therefore called into question by the respondent.

6.4 In the Board's view, a difference in the corrosion performance is discernable to exist between the test specimen according to the patent and the comparative specimen comprising 1.0% Zn. Based on the test results, the Board, therefore, does not see any reason to doubt the explanations given on page 4, lines 31 to 33 of the patent specification for limiting the Zn-content of the alloy to not more than 0.9% to improve the alloy's corrosion resistance in the welded joint.

Moreover, the patentee's argument that the welding conditions do not lead always to a complete recrystallization and some orientated grain structure resulting from the rolling or extrusion operation may be retained in the HAZ so that exfoliation corrosion may occur appears to be well founded. The Board is reinforced in its opinion in particular by the explanations given in the post published document X1. Although X1 confirms on page 1491, lines 12 to 10 from the bottom that in the recrystallized HAZ the grain structure is no longer able to entail exfoliation corrosion, severe pitting and exfoliation corrosion was nevertheless observed in a narrow band situated in the HAZ a few millimeters from the weld joint after a 7 days ageing at 100°C (see X1, page 1491, last paragraph). This finding appears to comply with the appellant's observations described in the Meijers affidavit (D19, D20), where pit blistering on the fusion line and in the HAZ and a preliminary stage of exfoliation corrosion in the 1.05% Zn containing specimen have been detected. On the basis of the

comparative results reported in the Meijers affidavit (D19, D20) and the explanations given in document X1 the Board has, therefore, no reason to doubt the correctness of the comparative test results and that the limitation of the zinc content below 0.9% could provide an effective improvement in the alloy's corrosion performance, irrespective of the type of corrosion that has been actually observed.

7. *Problem and solution*

Starting from the technical teaching given in document D1, the problem underlying the opposed patent thus resides in providing an AlMgMnZn alloy which exhibits a high proof and tensile strength without impairing the required resistance to pitting, exfoliation and intergranular corrosion, in particular in the HAZ after welding, and which is not prone to continuous grain boundary precipitations even after prolonged exposure at 100°C so that the alloy can be used at long term service temperatures above 80°C.

This problem is solved by the aluminium alloy composition set out in claim 1, in particular by restricting the Zn content to 0.4 to 0.9% to prevent corrosion in the HAZ of the weld and by adding 0.05 to 0.25% Zr.

8. *Inventive step*

8.1 As mentioned above, document D1 is focussed on the testing of AlMgMn alloys comprising either 1.0% Zn or on alloys including Zn as an impurity (Zn-free alloys). The authors conclude that the aluminium magnesium

alloys should contain ~0.8% Mn and ~1.0% Zn to obtain maximum strength and corrosion resistance (cf. D1, page 93, second paragraph below the Table). It is further stated on page 91, first paragraph of document D1, that welding does not appear to introduce stress corrosion susceptibility into those alloys which are resistant in the unwelded condition. In the outlook given in the section "Suggestions for further work" on page 93, third paragraph of D1, the authors feel prompted to expand the investigations on further testing AlMgMn-1%Zn alloys in the extruded condition and, in particular, to elucidate whether welding introduces any susceptibility to stress corrosion in these alloys when relatively heavy sections are concerned. Moreover, the need for a detailed study of the effect of Zn additions on the precipitation and the relationship of the precipitation on the stress corrosion susceptibility of the AlMgMn alloys is expressed (see D1, page 93, last paragraph). These are also the objects which are addressed by the patent at issue.

8.2 As to the Zn-content, the skilled reader was, however, left very well short of the direction he had to go when carrying out such further research. In particular, no suggestion or indication is found anywhere in document D1 that Zn additions below 1% could improve or adversely affect the alloy's susceptibility to stress corrosion cracking and exfoliation corrosion in the weld joint, and there is no pointer anywhere in this document that the limitation of the Zn content to 0.4 to 0.9% could effectively improve the corrosion performance and prevent the precipitation of a continuous network of anodic intermetallics on the

grain boundaries. Even after prolonged exposure at 100°C, the claimed alloy does not exhibit any continuous grain boundary precipitation so that the alloy is suitable for applications at service temperatures above 80°C. The well balanced aluminium alloy composition defined in claim 1 of the patent at issue therefore provides an excellent match in mechanical strength, corrosion resistance in the welded condition and phase stability at 100°C.

8.3 The textbook reference D4 relied upon by the Opposition Division and by the respondent to put in doubt inventive step merely mentions the grain refining effect of zirconium when added in small quantities up to 0.25% to aluminium and its alloys in general. It further points out that weld cracking can be reduced by using a filler wire comprising zirconium. However, no suggestion is given that zirconium should be added to the base material. More importantly, this document is silent about the influence of Zr on the corrosion performance of the weld joint and nothing is found about the interaction of Zr and Zn and the remaining components on these properties.

8.4 The Board concurs with the Opposition Division's assessment that neither of documents D15 and D16 could be helpful in solving the identified problem. According to document D15, page 1, lines 47 to 50 and page 2, lines 13 to 23, the AlMgMn alloy is Zr-free and preferably comprises 0.9 to 1.5% Zn. Document D16 is even more remote in that none of the exemplifying AlMgMn alloy compositions comprises additions of zinc and/or zirconium. Hence these documents lead away from

the AlMgMnZnZr alloy composition claimed in the patent at issue.

Document D17 discloses the composition of various aluminium welding filler materials including alloy AA5183. This filler is typically used for welding e.g. standard alloy AA5083 and it is likewise used for welding alloy XBY disclosed in D1 (cf. D1, page 91, 1. paragraph). The same filler is also applied in example 2 of the patent specification and in the comparative tests submitted by the patentee. In so doing, the influence of the filled material on the properties of the different base alloy compositions is excluded so that the corrosion properties of the welded products could be correctly compared.

The textbook reference D18 merely gives a general review about the effect of additions of Zr and Cr on aluminium alloys but fails to include any reference about the influence of Zn on the corrosion performance in the weld joint.

Document X2 relates to the ASTM Standard Test Method for Visual Assessment of exfoliation corrosion susceptibility (ASSET Test) used in the patent and the comparative experiments.

8.5 In conclusion, none of the available prior art documents taken individually or in combination could have provided any inducement for designing the aluminium alloy composition defined in claim 1 according to the main request. The subject matter of claim 1, therefore involves an inventive step.

9. The opponent's objection of insufficient disclosure pursuant to Article 100(b) was not repeated in its reply to the statement of grounds of appeal. Having regard at least to example 2 of the patent concerning a welded product and giving a clear teaching to restrict the Zn content to 0.8%, the Board does not see any reason to doubt that the claimed alloy composition, the welded structure comprising the alloy and the use of the alloy set out in independent claims 1, 13 and 15 can be put into practice by a person skilled in the art.

10. The dependent claims 2 to 12 relate to preferred embodiments of the alloy defined in claim 1. Claims 13, 14 and 15 are concerned with a welded structure comprising a plate or extrusion made of the claimed alloy, or with the use of the alloy at a temperature above 80°C. Hence these claims are likewise allowable.

11. Given this situation, there is no need to deal with the claims according the auxiliary requests (set of claims "B", "C" and "D").

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to maintain the patent in amended form with the following claims and a description to be adapted:

   Claims 1 to 15 (set of claims "A") according to the main request submitted on 16 April 2004.

The Registrar: The Chairman:

V. Commare T. K. H. Kriner