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File Number: T 0624/91 - 3.2.2
Application No.: 84 115 928.8
Publication No.: 0 156 995
Title of invention: Aluminium-lithium alloy (3)

Classification: C22C 21/00

D E C I S I O N
of 16 June 1993

Applicant: ALUMINUM COMPANY OF AMERICA

Headword:

EPC Articles 54(2), 56 and 123(2)

Keyword: "Originally disclosed, novelty and inventive step (yes; after amendment)"

Catchwords

*Point-like disclosures for alloy compositions in the state of the art must be interpreted as average or nominal values within a small range in view of known fluctuations in **reproducibility** and in analytical results (cf. point 3.2 of the Reasons), unless there is evidence available to the contrary.*

Case Number : T 0624/91 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 16 June 1993

Appellant : ALUMINUM COMPANY OF AMERICA
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Pennsylvania (US)

Representative : Madgwick, Paul Roland
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Decision under appeal : Decision of the Examining Division 2.1.06.017 of
the European Patent Office dated 5 March 1991
refusing European patent application
No. 84 115 928.8 pursuant to Article 97(1) EPC.

Composition of the Board :

Chairman : G.S.A. Szabo
Members : W.D. Weiß
G. Davies

Summary of Facts and Submissions

- I. European patent application 84 115 928.8, filed on 20 December 1984 and published on 9 October 1985 under No. 0 156 995, was refused by a decision of the Examining Division, dated 5 March 1991.
- II. The reasons given for the decision were that Claim 1, submitted during the oral proceedings before the Examining Division held on 15 May 1990, did not meet the requirements of Article 123(2) EPC.

Moreover, the Examining Division cited the documents

(2) Aluminum-Lithium Alloys II, Proceedings of the Sec. Int. Al-Li Conference, Monterey, California, April 12-14, 1983, p. 255-285: R. Kar, J.W. Bohlen and G.R. Chanani: Correlation of microstructures, ageing treatments and properties of Al-Li-Cu-Mg-Zr I/M and P/M alloys; and

(1bis) B. Noble and G.E. Thompson, Metal Science Journal, 1972, Vol. 6, p. 167-174

and stated that the subject-matter of Claim 1 was not novel with respect to document (2) or at least did not involve an inventive step having regard to a combination of documents (1bis) and (2).

- III. A Notice of Appeal was filed against this decision on 2 May 1991, and the appeal fee was paid simultaneously. The Statement of Grounds was filed on 5 July 1991.

IV. In reply to a communication from the Board dated 15 December 1992, the Appellant filed an amended set of 14 claims together with amended pages 2, 3, and 4 of the description on 26 April 1993. On 1 June 1993, the Appellant requested by telecopy to amend this version of the application documents further.

Claim 1 in this final version reads as follows:

"1. A process of manufacturing products from an aluminium alloy having lithium together with copper and the grain refiner zirconium as obligatory alloying elements, said process comprising the steps of:

a) preparing an alloy of the following composition:

<u>Element</u>	<u>Amount (wt.%)</u>
Li	2.0 to 2.4
Mg	0 to 0.9
Cu	2.3 to 2.7
Zr present up to a maximum of	0.12
Fe plus Si maximum	0.30
Other trace elements maximum	0.25
Al	balance;

- b) casting the alloy into an ingot;
- c) homogenising the ingot;
- d) forming an article;
- e) subjecting the article to a solution heat treatment;
- f) quenching the article in a quenching medium; and
- g) ageing the article."

V. Consequently, the Appellant requests grant of the patent on the basis of the following documents:

Claims: 1 to 14 filed on 26 April 1993, by letter of the same date, under the provision that in Claim 1, line 3, "zirconium as main" is changed to "with copper and the grain refiner zirconium as obligatory";

Description: pages 1 and 5, filed on 20 July 1987, by letter of the same date, pages 2 to 4 filed on 26 April 1993, by letter of the same date, under the provision that on page 1, line 3, "magnesium and" is deleted and that on page 2, line 13, "magnesium and copper as main" is changed to "with copper and the grain refiner zirconium as obligatory".

Reasons for the Decision

1. The Appeal is admissible.
2. *Amendments*

Claim 1 is based on the original Claims 1 and 2 together with features from the disclosure on page 2, last paragraph, page 3, lines 8 and 9, page 3, line 23, to page 4, line 13, of the original description. Claims 2 and 8 originate from the original Claims 7 and 3, respectively. The Claims 3 to 7 are based on page 3, the first two paragraphs, Claims 9 to 13 on page 4, second paragraph, and Claims 14 and 15 on page 2, last paragraph, of the description as originally filed.

Therefore, the current version of the claims and of the description adapted thereto does not contravene Article 123(2) EPC.

3. *Closest State of the Art*

- 3.1 Document (2) (page 266, penultimate paragraph) discloses an aluminium I/M (ingot metallurgy) alloy with the trade name "NOR 81" having a nominal composition of 2.5% Li, 2.5% Cu, 0.5% Mg, 0.15 Zr, and the rest Al. Aiming at this nominal composition, an alloy was produced by the British Aluminium Company the chemical composition of which was determined analytically by two independent sources, British Aluminium Co. and ANAMET (pages 257 and 258, the chapter "Material and Characterization Methods"). Whereas the British Aluminium Analysis apparently coincides with the nominal composition aimed at, the ANAMET analysis states a composition of 2.35% Li, 2.90% Cu 0.56% Mg 0.19% Zr, balance aluminium. The contents of Fe and Si have not been evaluated. Since, however, the alloy NOR 81 is intended to have a high fracture toughness, a skilled person will imply that the contents of iron and silicon, which are generally known to reduce the fracture toughness by the formation of intermetallic phases, have to be kept low.
- 3.2 This disclosure of document (2) points to a well-known situation with which the metallurgist is confronted during his daily work.

Whenever the metallurgist aims at producing an alloy in correspondence with a given nominal composition, the composition of the final product will deviate somewhat

from this target or even be undefined within certain narrow limits. One reason for this is that the metallurgical production process is not ideally reproducible, and the actual composition of different batches aiming at the same nominal composition will be spread over a certain area around this target. The actual composition of one batch may even vary to some extent owing to inhomogeneities in the material. In addition, the analysis of the material is subject to errors which depend on and are typical of the particular analytical method used. These reasons may be responsible also for the fact that two analyses of the same material may lead to such deviating results as those conducted by British Aluminium Co. and by ANAMET as reported in Table I of document (D2).

In his Grounds of Appeal (see page 4), the Respondent takes this fact into account by stating that the zirconium contents of his comparative tests are only certain within standard deviations of about 4% and even about 9%, respectively. In relation to a total content of about 2.5% for lithium, a distance of 0.1% constitutes a deviation of only about 4%. Having to hand an alloy with an analysed lithium content lying in the range between 2.4% and 2.5% and the other constituents corresponding to NOR 81 and having in mind the above considerations, nobody would be able to decide, if this were an alloy prepared to fit the nominal composition of NOR 81 or to aim at the upper limit of the lithium content according to Claim 1 of the main request.

Consequently, the nominal composition of NOR 81 according to document (D2) not only discloses the

composition as a specific point, which nobody would be able to realise in practice, but also a certain range around this average or nominal composition, into which the majority of the analyses of those alloys fall, which were prepared aiming at the nominal composition and using the care usual in this art when producing and analysing the alloy.

4. *Novelty*

Taking into account the above considerations, the nominal composition of the alloy NOR 81 disclosed in document (2) includes compositions of which the contents of Li, Cu, Mg, Si, Fe and Al lie in the ranges indicated in Claim 1.

It is not disputed that the method steps indicated in Claim 1 follow the same ingot metallurgy route which is used according to document (2) (page 256, penultimate paragraph, to page 258, paragraph 3).

However, the process is applied in the present application to alloys having an obligatory zirconium content which is clearly lower than the one of the NOR 81 alloy disclosed in document (2).

An I/M alloy with such a composition, including a specified content of the grain refiner zirconium but only to a maximum of 0.12%, is not disclosed by any other prepublished document cited in the search report or by the Appellant himself during the examination procedure.

Consequently, the subject-matter of Claim 1 is novel.

5. *Technical Problem and Solution*

Age hardening aluminium alloys, in particular AlZnMg(Cu)-alloys, have traditionally been used as light-weight structural materials in the aircraft industry, primarily in the wing, body and empennage. As a consequence of the need to further reduce the specific weight of these materials without reducing the strength and fracture toughness, AlLi structural materials, like the NOR 81 alloy disclosed in document (2) have been developed which, in the year 1983, were considered to be good candidates for an I/M processed alloy exhibiting a reasonable compromise between requirements of strength, ductility and fracture toughness (page 256, second paragraph as well as pages 283/284). Although no numerical values of fracture toughness are disclosed for the material NOR 81, these sceptical comments in document (2) seem to conclude that the material was still unsatisfactory in this respect.

Starting from document (2) as the closest prior art, therefore, the technical problem of producing an I/M AlLi alloy with an improved fracture toughness combined with high strength properties still remained.

The solution offered by Claim 1 consists in that an I/M process, which follows the same sequence of steps as disclosed in document (2), is applied to an alloy which has an obligatory content of the grain refiner zirconium with a maximum of 0.12%. Moreover, the centre of the range for the lithium content has been shifted to the

lower nominal value of 2.2% compared with the respective value of 2.5% of the known NOR 81 material. Although this feature alone would not have been apt to avoid a novelty objection when taking into account an overlap of composition which is due to the inevitable uncertainty inherent in the usual alloying and analysing techniques, it had to be considered in combination with the reduced zirconium content for establishing novelty and for assessing inventive step.

6. *Inventive Step*

Document (2), in its "Summary and Conclusions" (pages 283/284), states that the I/M alloy NOR 81 does have a potential in terms of achieving properties suitable for airframe materials because of the optimum combination of the ductility and strength properties obtained. The reported test results do not, however, include values of fracture toughness. The only conclusion that can be drawn from this cautious formulation is that NOR 81 was not yet considered suitable to be used as an airframe material on an industrial scale. Document (2) does not contain any hint that a reduction of the content of the obligatory grain refiner zirconium, together with a slight reduction of the nominal content of lithium would be a way to arrive at such an industrially applicable material.

Document (1) was published more than 10 years before document (2) and, hence, reflects a still earlier stage on the way to an industrially applicable structural I/M material on an AlLi basis for airframes. This document reports about the precipitation characteristics of

zirconium free alloys which also deviate in their copper and lithium contents from the subject-matter of Claim 1. Moreover, since the influence of the precipitation behaviour on the various mechanical parameters had not yet been investigated, this document is merely of scientific importance and does not contain any practical teaching which could possibly lead to the solution of the patent in suit.

The Board has also examined the other documents cited during the examination proceedings and finds that they do not contain any relevant additional information in this respect.

It is, therefore, the view of the Board that the claimed invention is not rendered obvious by the available known art and hence involves the required inventive step (Article 56 EPC).

Thus Claim 1 defines a patentable invention within the meaning of Article 52(1) EPC.

7. Dependent Claims 2 to 14 represent particular embodiments of the invention defined in Claim 1. They are, therefore, likewise allowable.

The description corresponds to the claims.

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 that further prosecution be based on the text of the application as defined in point V of the Facts and Submissions and that a patent be granted on the basis thereof, subject to compliance with the formal requirements.

The Registrar:

The Chairman:

S. Fabiani

G. Szabo