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Bezeichnung der Erfindung: Heat treatment of aluminium alloys

Title of invention:

Titre de l'invention :

Klassifikation / Classification / Classement : C22F 1/04

ENTSCHEIDUNG / DECISION

vom / of / du 26 June 1990

Anmelder / Applicant / Demandeur :

Patentinhaber / Proprietor of the patent /

Titulaire du brevet :

Alcan International Limited

Einsprechender / Opponent / Opposant :

Pechiney

Stichwort / Headword / Référence : Aluminium alloys/ALCAN

EPÜ / EPC / CBE Articles 56, 101(2), 113 and 114(2), Rule 67

Schlagwort / Keyword / Mot clé :

"Inventive step (confirmed)"

"Reimbursement of appeal fee refused"

Leitsatz / Headnote / Sommaire



Case Number : T 22/89 - 3.3.1

DECISION
of the Technical Board of Appeal 3.3.1
of 26 June 1990

Appellant : Alcan International Limited
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Decision under appeal : Decision of the Opposition Division of the European
Patent Office dated 11 November 1988 revoking
European patent No. 0 090 583 pursuant to
Article 102(1) EPC.

Composition of the Board :

Chairman : K.J.A. Jahn

Members : R.W. Andrews

W. Moser

Summary of Facts and Submissions

I. The mention of the grant of European patent No. 0 090 583, in respect of European patent application No. 83 301 598.5, filed on 22 March 1983 and claiming priority of 31 March 1982 from a prior application filed in the United Kingdom, was announced on 27 August 1986 (cf. Bulletin 86/35).

II. A notice of opposition was filed on 20 May 1987 in which the revocation of the patent was requested on the ground that its subject-matter did not involve an inventive step. The opposition was supported, *inter alia*, by

(1) FR-A-2 318 238.

After expiry of the time allowed for filing the notice of opposition, the Respondant (Opponent) referred in his letter of 28 March 1988 to

(10) Properties Related to Fracture Toughness, J.T. Staley, ASTM STP 605, 1976, pages 71-75, and

(11) FR-A-2 278 785.

III. On 6 April 1988, under the cover of a brief communication from DG 2 of the EPO saying "please take note", copies of the Respondent's letter dated 28 March 1988 and of documents (10) and (11) were sent to the Appellant.

IV. By a decision dated 11 November 1988 the Opposition Division revoked the disputed patent. The Opposition Division concluded that the claimed subject-matter did not involve an inventive step since, in view of the general

teaching of document (10) relating to increasing the toughness of wrought, high-strength aluminium alloys, the skilled person would not require any inventive thinking to apply this teaching to a closely related alloy of a specific composition. The duration and temperature of homogenisation treatment required to bring detrimental constituents into solution could be determined without undue burden.

The Opposition Division also considered that, in the solid state, Al-Li-Mg-Cu alloys do not have a special position compared with lithium-free Al alloys comprising copper and magnesium in view of, for example, document (11) and the fact that the Aluminium Association has incorporated these alloys into already existing classes.

- V. An appeal was lodged against this decision on 5 January 1989 and the prescribed fee was duly paid. In the Statement of Grounds of Appeal filed on 10 March 1989 and in a letter filed on 15 June 1990, the Appellant referred to

(12) Aluminium-Lithium Alloys, Proceedings of the First International Aluminium-Lithium Conference, 19-21 May 1980, pages 325-346 and

(16) Technical Report 84030, March 1984, Aluminium Alloys Containing Lithium - RAE Sheet Alloys, pages 1, 32 and 38 to 40 respectively.

In his written submissions and during the oral proceedings held on 26 June 1990, the Appellant contended that the problem addressed by the disputed patent is to improve the fracture toughness of Li-Al alloys which are intended for use in the aircraft industry. Although documents (10) and Aluminium Alloys in the Aircraft Industries, pages 31 and

32, 1978 (13) refer to fracture toughness, neither of the documents are concerned with Al-Li alloys and would not suggest that the use of high temperature homogenisation of the ingot would solve this problem. In fact, document (10) is irrelevant, since this document is concerned with thermal mechanical treatments to improve fracture toughness of lithium free Al alloys and provides the skilled person with no reason to increase the temperature of homogenisation.

In view of oxidation problems, local melting (liquifaction), which is detrimental due to the hydrogen content of the Al-Li alloys at the claimed priority date, lack of detailed data relating to the complex alloys in question and no realisation that an improvement in fracture toughness would be achieved, the Appellant argued that the skilled person would be discouraged from increasing the homogenisation temperatures above those conventionally used.

The Appellant also submitted that Al-Li-Cu-Mg alloys have an exceptional position compared with lithium-free aluminium alloys and that it was unexpected that such alloys could be homogenised at such high temperatures, giving advantages in the treated alloy which are unexpected, but avoiding disadvantages which might have been expected.

VI. Furthermore, the Appellant requested reimbursement of the appeal fee, on the ground that several substantial procedural violations had been committed by the Opposition Division, namely:

- The Opposition Division failed to invite the Appellant to file observations on the letter dated 28 March 1988 (from the Respondent); thus violating Article 101(2) EPC.

- The Opposition Division revoked the patent on the basis of grounds or evidence submitted by the Respondent in his letter of 28 March 1988, on which the Appellant had not had an opportunity to present his comments; thus violating Article 113(1) EPC.

- The Opposition Division accepted without question facts and evidence first submitted by the Respondent in his letter of 28 March 1988 (long after the opposition term expired), thus violating Article 114(2) EPC. In this connection, the Opposition Division has a discretion whether or not to admit late filed facts and evidence; but it must exercise that discretion positively. In the present case, late filed facts and evidence have apparently been admitted without question.

VII. In his observations in reply and during the oral proceedings, the Respondent contended that from the point of view of the effects of heat treatments in the mass, the alloys referred to in the present Claim 1 behave similarly to the alloys of the 2000 and 7000-series and, therefore, the teaching with respect to these alloys can be directly transferred to the present alloys. Moreover, since both homogenisation and solution heat treatment are concerned with diffusion in the solid state, metallurgically they may be considered to be equivalent to each other.

With respect to document (10), the Respondent alleged that this document clearly teaches that an improvement in toughness is obtained by reducing the quantity and size of the insoluble and soluble particles. The reduction in quantity and size of the latter particles is clearly obtained by dissolving them as completely as possible by

homogenisation at temperatures as high as possible and/or for times as long as possible. This procedure is well-known in the metallurgy of aluminium alloys and it is not inventive to apply the teaching of document (10) to the specific alloys, even in the absence of any mention of Al-Li alloys.

In view of the graphs and experimental evidence relating to the homogenisation of the alloy 8090 at 530°C for six hours, the Respondent argued that oxidation during homogenisation was not a problem.

VIII. The Appellant requested that the decision under appeal be set aside and that the patent be maintained on the basis of Claims 1 to 5 filed on 10 March 1989. Independent Claim 1 of these claims reads as follows:

"A procedure for the homogenisation of ingots of ternary and quaternary alloys in the system Al-Li-Cu-Mg which comprises heating the as-cast alloy ingot to a temperature of at least 530°C, but below the melting point of solid intermetallic phases contained therein, wherein the ingot temperature is raised at a rate not exceeding 50°C/hr during the heating of the ingot from 400°C to 530°C, and maintaining the as-cast alloy ingot at a temperature above 530°C until the solid intermetallic phases have entered solid solution in the alloy and then cooling the ingot, said ingot being formed of an alloy having either of the following composition ranges:-

- (1) 1-3% Li, 0.5-2% Cu, 0.2-2% Mg;
- (2) 1-3% Li, 2-4% Mg, below 0.1% Cu and having a total Li + Mg content of no more than 6.0%;

the remainder of each of the above being Al, containing other elements in amounts in the following ranges:

(Zr + Mn + Cr) 0-0.6%, (Fe + Si) 0-0.4%, impurities up to 0.15% total (up to 0.05% each)."

The Appellant once again requested the reimbursement of the appeal fee, adjournment if documents submitted by the Respondent during oral proceedings were to be considered by the Board and that the documents filed on 13 June 1990 should be considered by the Board.

The Respondent requested that the appeal be dismissed.

- IX. At the conclusion of the oral proceedings, the Board's decision was announced.

Reasons for the Decision

1. The appeal complies with Articles 106 to 108 and Rule 64 EPC and is, therefore, admissible.
2. There are no formal objections to the present claims under Article 123 EPC, since they are supported by the original disclosure and do not extend the protection conferred. Thus, Claim 1 represents a combination of Claims 1 and 2 as filed and granted, apart from the deletion of the reference to aluminium alloys containing 1 to 3% lithium, 0.5 to 4% copper and up to 0.2% magnesium. Claims 2 to 5 correspond to Claims 3 to 6 as filed and granted.
3. The patent in suit is concerned with a procedure for homogenisation of ingots of specific ternary and quaternary alloys in the system Al-Li-Cu-Mg. This initial thermal

operation is applied to ingots prior to hot working with the main aim of improved workability.

- 3.1 It was undisputed that the prior art homogenisation procedures for these alloys in question involved heating the ingots for prolonged periods of time at temperatures below about 500°C (cf. disputed patent, page 3, lines 37 and 38). For certain ternary Al-Li-Mg alloys containing 2.0 to 5.0% magnesium, it was also known to initially heat the ingots for 12 hours at about 455°C and then for a further 12 hours at about 515°C (cf. disputed patent, page 2, lines 12 to 14).

However, it was considered that these prior art homogenisation procedures were unsatisfactory because the desired combination of mechanical properties required for use in the aircraft industry was not developed during subsequent thermomechanical treatment. In particular, it was believed that the fracture toughness of the alloys was too low.

- 3.2 In the light of this prior art, the technical problem underlying the disputed patent may be seen in providing a procedure for the homogenisation of ingots of ternary and quaternary alloys of the specified composition in the system Al-Li-Cu-Mg which gives rise to a product having an improved fracture toughness without any appreciable deterioration in the values for proof stress, ultimate tensile strength and percentage elongation.

According to the patent in suit, the technical problem is solved by a homogenisation procedure comprising raising the temperature of an ingot of a specified composition at a rate not exceeding 50°C/h during its heating from 400°C to 530°C, maintaining it at a temperature of at least 530°C, but below the melting point of solid intermetallic phases

contained therein, until the solid intermetallic phases have entered solid solution in the alloy and then cooling the said ingot.

- 3.3 In view of the results shown in Table 2 on page 4 of the disputed patent, the Board is satisfied that the above-defined technical problem is credibly solved.
4. After examination of the cited prior art, the Board has reached the conclusion that the claimed subject-matter is novel. Since novelty is not disputed, it is not necessary to consider this matter in detail.
5. It still remains to be examined whether the requirement of inventive step is met by the subject-matter of the disputed patent.
- 5.1 Document (10) discusses the relationship between three microstructural features and the toughness of wrought, high-strength aluminium alloys, with particular reference to 2xxx and 7xxx alloys. It should be pointed out that the presence of lithium is excluded from such alloys since aluminium alloys containing lithium are classified as 8xxx alloys, for example, 8090. According to page 72 of this document, the three microstructural features are defined as constituents, dispersoids and hardening precipitates. The constituent particles are classified as
- (i) insoluble constituent particles formed by combination of elements, such as iron and silicon, with other elements in the alloy composition and
 - (ii) intermetallic constituents, which are at least partially soluble, such as those formed with the elements zinc, magnesium and copper.

With respect to the insoluble constituents, the document states that decreasing the iron and silicon contents of the alloy increases its toughness (cf. page 73, lines 5 to 7). With regard to the intermetallic constituent particles the author of this document says that thermal mechanical treatments prior to solution heat treatment can also increase toughness by modifying the size, distribution and volume fraction of the partially soluble constituent particles (cf. page 73, lines 11 to 14).

In the Board's opinion, the Appellant is correct in his contention that the expression "thermal mechanical treatments" in this context means treatments involving deformation and heat. Justification for this opinion is to be found on page 74 of this document where it is stated that the volume fraction, size and distribution of the dispersoid particles which form during the ingot preheat treatment, a recognised synonym for homogenisation, can be modified somewhat by thermal mechanical treatments.

Therefore, the document teaches the use of thermal mechanical treatments as a means of increasing the toughness of lithium-free, wrought, high-strength aluminium alloys. Thus, even if the skilled person were to consider transferring the teaching of document (10) to the alloys specified in the present Claim 1, he would not spend time investigating the homogenisation treatment of said alloys, but would concentrate his attention on the thermal mechanical heat treatment of the alloys after conventional homogenisation. Therefore, the disclosure of document (10) would not suggest the proposed solution to the technical problem of improving the fracture toughness of the specified aluminium-lithium alloys.

- 5.2 Document (1) discloses the homogenising of aluminium alloys by heating the alloy to a temperature above the eutectic

melting temperature but below the incipient melting temperature under conditions of thermodynamic equilibrium so that the meta-stable phases in the alloy are melted and absorbed into the bulk alloy (cf. Claim 1). Although document (1) is a patent of addition to document (11) in which lithium is mentioned as one of many optional allowable alloy components (cf. Claim 2), the later patent is wholly silent with respect to aluminium alloys containing lithium. The omission of any reference to lithium in the patent of addition would certainly not encourage the skilled person to transfer the teaching of document (1) to the aluminium-lithium alloys specified in the present Claim 1.

Moreover, before the claimed priority date of the disputed patent, the skilled person was aware that aluminium alloys containing lithium offered an attractive combination of mechanical properties. However, they are highly reactive and oxidise rapidly at high temperatures resulting in severe difficulties in conventional melting and casting. Furthermore, it was also known that oxidation problems were not limited to the molten state and could occur during fabrication and heat treatment, resulting in the production of a friable non-protective oxide and loss of lithium from the alloy (cf. first paragraph on page 326 of document (12)).

In the light of this, the skilled person would be extremely reluctant to employ homogenisation temperatures higher than those conventionally used, particularly in the absence of any realisation that this procedure would lead to any improvement in the fracture toughness of the products.

Although it may be true that the oxidation problem is, in fact, not so serious as the skilled person may have expected, nevertheless, in the absence of any reason to

suppose that an increase in the homogenisation temperature would solve the present technical problem, the skilled person would not have done so in view of the disadvantages expected to result therefrom.

The skilled person would also be dissuaded from raising the homogenisation temperature above those conventionally used for aluminium-lithium alloys because of the danger of the liquation of the phases. Although, if the hydrogen content of an alloy is low, the formation of transitory liquation is innocuous, the Board accepts that aluminium-lithium alloys at the priority date of the disputed patent contained appreciable amounts of hydrogen and, therefore, liquation of phases during homogenisation heat treatment would have been a problem.

- 5.3 Document (11) is concerned with the solution heat treatment of aluminium alloys containing one or more hardening elements in an amount sufficient to at least saturate the solid solution at its eutectic melting temperature. The amount of hydrogen in the alloy capable of being released in gaseous form during the heat treatment being less than 0.5 ppm (cf. Claim 1). According to Claim 2, the hardening elements are selected from copper, magnesium, silicon, zinc, silver and lithium. The solution heat treatment is carried out at a temperature between the eutectic melting temperature and the incipient melting temperature under conditions of thermodynamic equilibrium so that the metastable liquid phases initially formed are resorbed (cf. Claim 1). In the Examples of this document, the alloys are subjected to homogenisation at temperatures of 500° C or below and working before undergoing the claimed solution heat treatment.

All those distinct treatments and the conditions applied therein are vital for production of a high performance

aluminium alloy. Therefore, in the absence of any inducement to deviate from the teaching of document (11), if the skilled person were to transfer this teaching to the alloys specified in the present Claim 1, he would homogenise the ingots in a known manner before carrying out the solution heat treatment disclosed in this document on worked alloy. The Respondent's argument that the taking into solution of intermetallic constituents during both homogenisation and solution heat treatment obeys the law of diffusion is in the Board's view not persuasive, since it equates both treatments and disregards the importance of the performance of each individual treatment in the prescribed sequence and is based more on hindsight than the actual circumstances at the claimed priority date.

- 5.4 Document (13) reports the measures taken to improve the toughness properties of certain lithium-free aluminium alloys. The document speaks of improved or better homogenisation (cf. paragraphs numbered 1, 2 and 4 on page 31) and gives details in Table 1 on page 32 of the conditions used for homogenisation of certain alloys. For the alloy Alcoa 7475 sheet, it discloses homogenisation at 454° to 460°C for four hours and heating slowly to 504 to 538°C at a rate of 65.5°C/min (presumably a misprint for hour). However, this document does not foreshadow that the homogenisation procedure of the present Claim 1 using different aluminium alloys would solve the technical problem underlying the patent in suit.
- 5.5 Since in the Board's opinion the transfer of the prior art teaching relating to lithium-free aluminium alloys to aluminium-lithium alloys would not have aided the skilled person in his search for a solution to the technical problem underlying the disputed patent, the question of whether aluminium-lithium alloys have an exceptional

position compared to lithium-free aluminium alloys containing magnesium and/or copper is immaterial.

6. Therefore, in the Board's judgement, the proposed solution to the above-defined technical problem is not obvious in the light of the cited prior art. The subject-matter of Claim 1 is allowable. Dependent Claims 2 to 5, which relate to preferred embodiments of the process claimed in Claim 1, are also acceptable in view of the allowability of this claim.

7. In view of the above finding, the Appellant's request for an adjournment and consideration of document (16) may be rejected.
 - 7.1 Document (16), which was published after the claimed priority date of the disputed patent, discloses in Table 5 the homogenisation, forging and rollings schedules for aluminium-lithium alloys falling within the terms of the present Claim 1. This document could only provide evidence that at some time before 27 March 1984, the Royal Aircraft Establishment was homogenising aluminium-lithium alloys at temperatures below 500°C.

8. As regards the alleged substantial procedural violations invoked by the Appellant and his request for reimbursement of the appeal fee, the Board's comments are as follows:
 - 8.1 Although the expression "please take note" used in the above-mentioned communication does not represent an explicit invitation to file observations, it may not be construed, however as barring or even discouraging the party from making any comments. On the other hand, from the Opponent's letter dated 28 March 1988 it could be inferred that, with respect to the assessment of inventive step for the subject-matter claimed in the disputed patent in suit,

the teaching of document (10) would probably play a decisive role in the decision to be taken by the Opposition Division. Moreover, the Appellant had ample time (i. e. several months) to file observations if he had so wished. Consequently, the Appellant's argument that he had not had an opportunity to present his comments (cf. paragraph VI supra) cannot be accepted.

8.2 It ensues that, in the present case, Article 113(1) EPC has not been controvened. As a consequence, no violation of Article 101(2) EPC occurred because, in this context, Article 101(2) EPC has to be considered in relation to Article 113 EPC.

8.3 In the Opposition Division's judgement the relevance of document (10) existed beyond any doubt. Consequently, in view of the principle of examination by the Opposition Division of its own motion (cf. Article 114(1) EPC), the Opposition Division had to admit this document even though it was not filed with the prescribed time limit. Thus, the Appellant's allegation that the Opposition Division accepted without question facts and evidence first submitted by the Opponent in this letter of 28 March 1988 (cf. paragraph VI supra) is not correct.

8.4 Since, in the Board's judgement, there were no substantial procedural violations within the meaning of Rule 69 EPC, the appeal fee cannot be reimbursed.

Order

For these reasons, it is decided that:

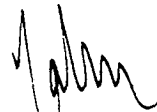
1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to maintain the patent on the basis of Claims 1 to 5 filed on 10 March 1989 and a description to be brought into agreement with the amended claims.
3. The other requests are rejected.

The Registrar:



M. Beer

The Chairman:



K.J.A. Jahn