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D E C I S I O N
of 19 March 2004

Case Number: T 1063/01 - 3.2.2

Application Number: 95932521.8

Publication Number: 0733127

IPC: C22C 21/02

Language of the proceedings: EN

Title of invention:
Lead-free 6XXX aluminium alloy

Applicant:
ALUMINIUM COMPANY OF AMERICA

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (no)"

Decisions cited:
-

Catchword:
-

Case Number: T 1063/01 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 19 March 2004

Appellant: ALUMINIUM COMPANY OF AMERICA
Alcoa Technical Center,
100 Technical Drive
Alcoa Center,
Pennsylvania 15069-0001 (US)

Representative: Ebner von Eschenbach, Jennifer
Ladas & Parry
Dachauerstrasse 37
D-80335 München (DE)

Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 28 March 2001 refusing European application No. 95932521.8 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: W. D. Weiß
Members: R. Ries
E. Dufrasne

Summary of Facts and Submissions

I. This appeal is against the decision of the examining division dated 28 March 2001 to refuse European patent application No. 92 932 521.8.

The ground of refusal was that the subject matter set out in the claims of

- the main, first and second auxiliary request lacked clarity (Article 84 EPC),

- the main and first to third auxiliary request did not satisfy the requirements of Article 123(2) EPC, and

- the fourth auxiliary request lacked novelty (Article 54 EPC) or an inventive step (Article 56 EPC), respectively, having regard to document

D1: US-A-5 282 909

II. On 17 May 2001 the appellant (applicant) lodged an appeal against the decision and paid the prescribed fee on the same day. A statement setting out the Grounds for appeal was submitted on 2 August 2001.

III. In a communication annexed to the summons to attend oral proceedings, the Board referred to document

D3: Aluminium Taschenbuch, 14th edtion, 1983, Tables 14.1 and 14.12.

IV. In its responses dated 19 February 2004 and 10 March 2004, the appellant referred to the documents

D4: Power Point Screens, showing A-, B- and C-rated alloys and the machinability comparison between alloys 6020, 2011 and 6262 and

D5: Aluminum standards and data, 1998, Metric SI, The Aluminum Association, 1998, pages 1.6 to 1-9

and submitted the auxiliary requests A to R and A1 to R1, respectively.

V. At the end of the oral proceedings which took place on 19 March 2004, the appellant requested that the decision under appeal be set aside and a patent be granted on the basis of the amended set of claims M filed during the oral proceedings (main request), or, alternatively, on the basis of sets of claims N, Q and R accordingly amended, or on the basis of sets M1, N1, Q1 and R1 which are to correspond to sets M, N, Q and R, the independent claims of which having been further limited by the features concerning the nature of the temper defined in the respective dependent claims.

VI. Independent claim 1 of the main request M reads as follows:

"1. An aluminum-based alloy with improved machining properties having a lead content of less than 0.1 wt% which consists of 0.45 to 0.7% copper, 0.9 to 1.3 wt% tin, 0.65 to 1.35 wt% magnesium, 0.4 to 1.1 wt% silicon, 0.002 to 0.35% wt% manganese, up to 0.5 wt% iron, up to

0.15 wt% chromium and up to 0.15 wt% titanium, the balance being aluminum."

Claim 1 of auxiliary request N reads (distinguishing features from request M in bold letters):

"1. An aluminum-based alloy with improved machining properties having a lead content of less than 0.1 wt% which consists of 0.45 to 0.7% copper, 0.9 to 1.3 wt% tin, **0.7 to 0.9 wt% magnesium, 0.45 to 0.75 wt% silicon**, 0.002 to 0.35% wt% manganese, up to 0.5 wt% iron, up to 0.15 wt% chromium and up to 0.15 wt% titanium, the balance being aluminum."

Claim 1 of auxiliary request Q reads:

"1. An aluminum-based alloy with improved machining properties having a lead content of less than 0.1 wt% which consists of 0.45 to 0.7% copper, 0.9 to 1.3 wt% tin, 0.65 to 1.35 wt% magnesium, 0.4 to 1.1 wt% silicon, **0.35% wt% manganese**, up to 0.5 wt% iron, up to 0.15 wt% chromium and up to 0.15 wt% titanium, the balance being aluminum."

Claim 1 of auxiliary request R reads:

"1. An aluminum-based alloy with improved machining properties having a lead content of less than 0.1 wt% which consists of 0.45 to 0.7% copper, 0.9 to 1.3 wt% tin, **0.7 to 0.9 wt% magnesium, 0.45 to 0.75 wt% silicon**, **0.35% wt% manganese**, up to 0.5 wt% iron, up to 0.15 wt% chromium and up to 0.15 wt% titanium, the balance being aluminum."

Compared with claim 1 according to requests M, N, Q and R, claim 1 of auxiliary requests M1, N1, Q1 and R1 additionally comprise the wording (in bold letters):

"1. An aluminum-based alloy … the balance being aluminum, **wherein the alloy has been thermally processed to a temper selected from the group consisting of T3, T4, T451, T4511, T6, T651, T6510, T6511, T8, T851 and T9.**"

VII. The applicant argued as follows:

Document D1 describes an aluminium alloy extrusion material destined to produce fuel distribution pipes. It explains in column 3, lines 52 to 54 that copper should not exceed 0.5% or the corrosion resistance will deteriorate. Hence a person skilled in the art would not add copper in the claimed amount ranging from 0.45 to 0.7%. Moreover, none of the examples given in document D1 completely falls within the elemental ranges set out in claim 1 of all requests.

A further distinction resides in the addition of manganese to the claimed alloy. Although document D1 describes Mn as a permissible impurity that could be tolerated up to 0.2%, manganese is a compulsory component in the claimed alloy. Within 0.002 to 0.35%, manganese adds strength, recrystallisation and abrasion resistance to the alloy which is important when forming an Al-alloy for screw machine stock with excellent machinability and machining forces. Consequently, the disclosure in document D1 of extruding an aluminium alloy and drilling holes would not make it obvious how

to obtain screw stock material in the form of rods, wire or bars.

Moreover, the examples set out in document D1 disclose a high temperature ageing treatment to obtain T5 refined sample material. The T5 treatment means that after hot forming the alloy is quenched and aged. It does, however, not include a solution heat treatment step, which is indispensable in the claimed T3, T4, T6, T8 and T9 temper.

Given these distinguishing features and the different purposes, the claimed subject is novel and also involves an inventive step with respect to the technical teaching given in document D1.

Reasons for the Decision

1. The appeal is admissible.

2. There is no formal objection to the amended claims according to the main request M and the auxiliary requests N, Q and R as well as M1, N1, Q1 and R1. Hence, the requirements of Article 123(2) EPC are satisfied.

3. *The application*

The present application aims at providing a lead free-substitute for alloy AA2011 and/or AA6262 which exhibit a high machinability expressed by the chip size, surface finish, etc, and wherein critical or even toxic components like lead, cadmium, bismuth, nickel and zirconium can be dispensed with (cf. the application,

page 3, paragraphs 3 and 4). This object is achieved, as defined in claim 1 of the main request M, by an aluminium alloy chemistry consisting of Cu, Sn, Mg, Si and Mn as mandatory components and further including optional components selected from Fe, Cr, Ti and also Pb. The claimed alloy which is suitable for making screw machine stock and wire, rod or bar products is processed by casting, preheating, extrusion, solution heat-treating, cold finishing and thermally treating to obtain a T3, T8, T851 or T9 product, or by extruding into various product shapes without cold finishing, followed by a T451, T6, T6510 or T6511 temper treatment (cf. the specification, page 4, line 31 to page 5, line 13 and page 6, lines 21 to 30).

4. *The prior art*

4.1 Likewise, document D1 discloses a Pb-free and Bi-free Al-Mg-Si-Cu-Sn alloy which exhibits an excellent machinability, expressed by a very low surface roughness after machining and a good chip separation property. This alloy is designed as an alternative to the Pb- and Bi-bearing machinable alloy AA6262, a comparative reference alloy also referred to in the application (cf. D1, column 1, lines 50 to column 2, lines 11; cf. the application page 3, lines 9 to 20). The problem addressed by the application and document D1 is therefore the same. Given this situation, document D1 represents the closest prior art.

A comparison between the composition of the claimed alloy and that known from D1 is given in the following Table (in weight percent):

	application	document D1		
	Claim 1, request M	broad	Ex. 4	Ex. 8
Cu	0.45-0.7	0.1-0.5	0.49	0,33
Sn	0.9-1.3	0.3-1.0	0.51	0.98
Mg	0.65-1.35	0.6-1.5	0.98	0.99
Si	0.4-1.1	0.3-1.0	0.51	0.61
Mn	0.002-0.35	≤0.2	residual	residual
	optionally:			
Pb	<0.1	--	--	--
Fe	≤0.5	≤0.7	--	--
Cr	≤0.15	≤0.2	--	--
Ti	≤0.15	≤0.2	0.022	0.019
Al	balance	balance	balance	balance

4.2 As can be seen, an overlap exists between the elemental ranges of the claimed alloy and the corresponding ranges of the one known from document D1. It is also noted that the composition of at least Examples 4 and 8 approximates to the claimed ranges. Although manganese has not been determined in these examples, it is tolerated as a residual impurity up to 0.2% Mn (cf. D1, column 3, lines 20 to 25). It is further noted that, depending on the purity level of the selected aluminium base material (cf. e.g. D3, 14.4, A: Aluminium unalloyed), manganese can be present up to 0.05% for Al99.50% or up to 0.01% for Al99.90%. It, therefore, can be duly assumed that the examples given in document D1 actually comprise manganese in amounts either falling within or being close to the claimed range of 0.002 to 0.35%.

4.3 Referring to the specification page 7, lines 26, the appellant has argued that manganese improves the alloy's strength, recrystallisation behaviour and abrasion resistance and that this favourable influence of manganese is not mentioned in document D1.

According to the specification, however, manganese *is merely believed to* add to the alloy's mechanical properties. No proof is discernable from examples a to o, comprising manganese up to 0.015 at most (i.e. in amounts of the impurity level), that this element actually exhibits a positive effect as to the alloy's mechanical properties.

4.4 The appellant further argued that in D1, copper is restricted to 0.5% so as not to impair the alloy's corrosion resistance and that the elemental overlap for copper between the claimed composition and that disclosed in D1 is very small (0.05% Cu). Bearing in mind this maximum limit of 0.5% Cu in document D1, a skilled person would be led to select an alloy composition comprising copper beyond that limit, i.e. within the range of 0.45 to 0.7% claimed in the present application.

The Board however, cannot agree with the appellant's argument. As specified on page 3, line 34 to page 4, line 2 the claimed composition has been designed to improve in the first place the machinability, whereas other properties, e.g. strength, of the finished product were considered less critical. As set out in document D1, column 2, lines 48 to 54, copper has the effect to improve the chip separation property and strength but - on the other hand - deteriorates the alloy's corrosion resistance when added in amounts exceeding 0.5%. Thus, if the metallurgical expert finds a lower corrosion resistance acceptable and less critical to the final product, then he would seriously consider adding copper to the alloy in amounts higher than 0.5% and consequently work within the claimed

range so as to further improve the alloy's chip separation property. It is noted in this context that among the 15 examples a-o given in the application, six (6) samples a, c, f, j, l, and n actually comprise less than 0.5% Cu and in the remaining examples, copper is present between 0.56 and 0.66%. This shows that the claimed alloy comprises copper either within or close to the copper range specified in document D1.

4.5 In conclusion, the machinable aluminium based alloy set out in claim 1 of the main request M does not comprise technical features justifying an inventive step vis-à-vis the aluminium alloy known from document D1. Claim 1 of the main request is, therefore, not allowable for lack of inventive step of its subject matter.

5. *Auxiliary requests N, Q and R*

5.1 The same reasoning also applies to the alloy composition specified in claim 1 of request N in which magnesium is more restricted to 0.7 to 0.9% and Si to 0.45 to 0.75%. The restricted ranges are completely within the ranges for Si and Mg of the alloy specified in document D1. No improvement of the alloy's properties compared to those obtained with the broader alloy composition according to the main request or to the characteristics of the alloy known from document D1 is discernable by this limitation. Hence, claim 1 of request N is not allowable for lack of inventive step of its subject matter either.

5.2 In claim 1 of auxiliary requests Q and R manganese is reduced to the single value of 0.35% which corresponds to the upper limit of the range for Mn. Although there

is formal support for this restriction, the sequence of requests shows that manganese is less important to the alloy's properties, the more so since the application emphasizes on page 4, lines 23/34 that, on a preferred basis, manganese should be kept within 0.01 to 0.05%. Moreover, none of the examples actually comprises an amount of 0.35% Mn. Consequently, no inventive merit can be seen in restricting manganese to the single high value of 0.35%.

5.3 According to claim 1 of auxiliary requests M1, N1, Q1 and R1, the screw machine stock made from the claimed alloy has been thermally processed to obtain a T3, T4, T6, T8 or T9 product, respectively. The appellant has pointed out that, contrary to the claimed temper treatment, document D1 merely discloses a T5 tempering step.

It is common practice and well known to those skilled in the art that the aluminium alloys of the claimed type are precipitation hardened or aged to improve the mechanical performance. Having regard to the required mechanical properties of the aluminium alloy stock material aimed at, it is within a skilled person's competence to select the appropriate temper treatment T1 to T10 (cf. D4, page 1-7). If, as in document D1, the desired final product allows quenching from the hot forming temperature followed by artificial ageing, a solution heat treatment can be dispensed with. Consequently, a T5 (or T1, T2 or T10) temper is selected in order to save time and cost. If, on the other hand, the hot forming temperature turns out to be insufficient to completely bring into solution the alloying elements, a separate solution heat treatment

is to be carried out in order to enable the desired precipitation hardening during the ageing step and to warrant a high quality of the final product. In view of these considerations, no inventive step can be seen in particularly selecting a T6 instead of a T5 temper. Consequently, the claim 1 of the request M1, N1, Q1 and R1, respectively, does not add patentable subject matter either.

6. In conclusion, none of the requests is allowable.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

V. Commare W. D. Weiß

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