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D E C I S I O N
of 14 October 1994

Case Number: T 0465/92 - 3.2.2

Application Number: 86307485.2

Publication Number: 0222479

IPC: C22F 1/05

Language of the proceedings: EN

Title of invention:
Al-Mg-Si extrusion alloy and method

Patentee:
ALCAN INTERNATIONAL LIMITED

Opponent:
0I: Alusuisse-Lonza Services AG
0II: Julius & August Erbslöh GmbH & Co
0III: Vereinigte Aluminium-Werke AG, Berlin und Bonn
0IV: Hoogovens Groep BV

Headword:
Aluminium alloys/ALCAN

Relevant legal provisions:
EPC Art. 54, 56, 125
EPC R. 27(1)(c)

Keyword:
"Inventive step (yes)"
"Problem and solution approach not always appropriate"

Decisions cited:
T 0001/80, T 0020/81, T 0326/87, T 0248/85, T 0495/91, T 0246/91, T 0741/91

Headnote:

The "problem and solution approach" is no more than one possible route for the assessment of inventiveness. Accordingly, its use is not a sine qua non when deciding inventiveness under Article 56 EPC.

Case Number: T 0465/92 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 14 October 1994

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Decision under appeal: **Decision of the Opposition Division of the European Patent Office dated 12 February 1992, issued in writing on 14 April 1992, revoking European patent No. 0 222 479 pursuant to Article 102(1) EPC.**

Composition of the Board:

Chairman: H. Seidenschwarz
Members: R. Lunzer
J. Van Moer

Summary of Facts and Submissions

I. European patent No. 222 479 was granted on 6 September 1989 on the basis of application No. 86 307 485.2 filed on 30 September 1986, claiming a priority date of 30 September 1985 derived from GB Application No. 8 524 077. The patent as granted had 14 claims, of which independent Claims 1 and 8 were in the following form:

"1. An extrusion ingot of an Al-Mg-Si alloy which contains Mg_2Si particles characterised in that substantially all of the magnesium in the alloy is present in the form of particles having an average diameter of at least 0.1 µm of beta'-phase Mg_2Si and that beta-phase Mg_2Si is substantially absent.

8. A method of forming an extrusion ingot as claimed in any one of Claims 1 to 7, which method comprises the steps of:-

- Casting an ingot of the Al-Mg-Si alloy,
- Homogenising the ingot,
- Cooling the homogenised ingot to a temperature of 250°C to 425°C at a cooling rate of at least 400°C/h,
- Holding the ingot at a holding temperature of from 250°C to 425°C for a time to precipitate substantially all the Mg as beta'-phase Mg_2Si in the substantial absence of beta'phase Mg_2Si,
- Cooling the ingot."

It is clear from the wording of Claim 1 and from the description as a whole that the final reference in Claim 8 to "beta'-phase" Mg_2Si must be a typographical

error, and that "beta-phase" must have been intended. Such a clear and trivial error does not call for reprinting the specification.

II. Oppositions were filed by four parties on the grounds of Article 100(a) and 100(b) EPC, alleging lack of novelty (Article 54 EPC), lack of any inventive step (Article 56 EPC) and insufficiency of disclosure (Article 83 EPC). In the Decision under appeal particular reference was made to the following documents:

(1) US-A-3 816 190
(5) Zeitschrift Metallkunde, volume 70, 1979, No. 8, pages 528-535
(6) Mondolfo "Aluminium Alloys: Structure and Properties" 1976, pages 566-577
(7) Prospectus "Continuous Homogenising Equipment for Aluminium Extrusion Logs and Billets" (date of publication not established) published by Hertwich Engineering, Braunau, Austria, and
(8) Journal of Japan Institute of Light Metals, volume 26, 1976, pages 327-335 (in Japanese with translation filed by OIV.

III. By its decision given orally on 12 February 1992, and issued in writing on 14 April 1992, the Opposition Division revoked the patent. Although the objection under Article 83 EPC had been withdrawn at the oral proceedings, and Claim 8 was treated as novel and inventive over the cited prior art, Claim 1 was found to lack novelty over the disclosure of document (8). In reaching that conclusion, the Opposition Division interpreted the stated length of the beta''-phase

particles of 0.1 µm as being in fact their diameter, and consequently found that a beta'-phase structure claimed must include a large number of particles of beta''-phase.

IV. An appeal against that decision was filed on 15 May 1992, the appeal fee was paid on the same day, and the Statement of Grounds of Appeal was filed on 18 August 1992. With its Statement, the Appellant filed a revised translation of the whole of document (8), which clarified certain points. It argued in its written submissions, and at the oral proceedings held on 14 October 1994 that although it had been contended that Photo 2(b) of Document (8) showed a structure which deprived Claim 1 of novelty, that could not be so because the procedure followed in arriving at that structure had been repeated, and the results were contained in an Experimental Report by Court and Liu, filed during the opposition with the Appellant's letter of 20 January 1992. It showed that a structure consisting of a large proportion of beta''-phase Mg_2Si resulted from following the procedural steps identified in document (8). In order to overcome the finding of lack of novelty on the part of the Opposition Division, based on the misinterpretation of what was meant by the diameter of the beta''-phase particles, the Appellant offered at the oral proceedings to introduce into Claim 1 the amendment that the particles, whose diameter was specified in Claim 1, were "elongated" particles.

The Appellant objected to the introduction into the appeal by the Respondent OI of document

(9) Metallurgia i Metallovedenie Tsvetnykh Splavov (Metallurgy and Metallography of Nonferrous Alloys) 1982, pages 223 - 230 by Elganin et al (with a German translation)

the English language abstract of which had been cited before the first instance, but contended that if that publication were to be admitted, for completeness an English language paper published some four years earlier by substantially the same team of workers ought also to be taken into consideration, viz: document

(11) Isvetnye Metally/Non-Ferrous Metals, "Heterogenising as a way of Increasing Aluminium Alloy Ingot Deformability in Extrusion" by Elganin et al UDC 669.715:621.78.

The heterogenisation treatment of documents (9) and (11) was aimed at ensuring that a substantial proportion of the Mg_2Si was precipitated from the solid solution, and remained out of solution during extrusion. That was confirmed in the table of results shown at page 5 of the (English) translation of document (9). These figures showed that the ultimate tensile strengths of extrudates formed from homogenised ingots were 40% greater than those of the extrusions formed from heterogenised ingots. That was because heterogenisation as there disclosed kept the Mg_2Si in the precipitated form, i.e. out of the solid solution. That teaching was in complete contrast to the alleged invention, in which the particles of Mg_2Si were so finely divided that these alloying components remained out of solution during initial deformation, thus permitting increased extrusion speeds, but then went

into solution at the higher temperatures reached as the metal passed through the extrusion die, so that maximum mechanical properties could be achieved by subsequent age hardening, without needing a further solution treatment to bring the Mg_2Si back into solid solution.

Although documents (9) and (11) suggested that a considerable increase in extrusion speed could be attained in accordance with their teachings, that was achieved at the price of needing to subject the extruded products to a further solution treatment, to bring the Mg_2Si back into solid solution, before they could be age hardened. It was clear that the ingots considered by these prior art documents contained at all times a considerable proportion of Mg_2Si present in the beta-phase form, which was not removed during the relatively mild homogenisation, and remained after extrusion. For those reasons, documents (9) and (11) did not in any way suggest the new teachings of the present invention, which aimed at bringing substantially all of the magnesium in the alloy into the form of beta'-phase Mg_2Si particles prior to extrusion.

Regarding inventiveness, neither document (8) nor the Elganin documents (9) and (11), nor any other of the many documents which had been cited, pointed at all in the direction of ensuring that the ingot prior to extrusion was in the condition identified in the product Claim 1 or process Claim 8, i.e. of having the Mg_2Si present in the beta'-phase form to the substantial exclusion of other forms.

V. The Respondent OI argued in its counterstatement, filed on 29 December 1992, and during the oral proceedings, that Claims 1 and 8 lacked novelty having regard to the disclosure of Photo 2(b) of document (8), which disclosed a structure in which most of the magnesium in the alloy had been precipitated as beta'-phase Mg_2Si particles. Novelty was also denied on the basis of documents (9) and (11), it being contended that identical measures, i.e., homogenising at elevated temperature; rapid cooling to a temperature of 350°C; holding at that temperature for an hour; and then cooling, were steps which were substantially identical to those proposed by the patent in suit, and were intended to have the same effect, i.e. to make extrusion easier. Thus the product and process of the alleged invention were indistinguishable from these disclosures.

Even if the alleged invention were to be regarded as novel over the disclosure of these two documents, such as on the basis either that the rate of cooling specified in Claim 8 was not disclosed as such, or that the degree of homogenisation would not have been sufficient to have brought all the precipitated beta phase into solution if the processing conditions disclosed had been followed, there could be no inventive step in either the product or process claims because the skilled worker would be well aware of the undesirable effect of cooling too slowly, and likewise would select a temperature of homogenisation by reference to commonly available works of reference to suit the alloy being treated. In particular a document which had been cited in the opposition ("Microstructural Science" Vol. 5, published by

Elsevier (North Holland, New York, 1977) pages 203-208) mentioned the alloys of the present alleged invention as being amongst the most commonly used, and suggested at page 207 a homogenisation temperature of 600°C.

VI. The Respondent OIV did not appear at the oral proceedings. It argued in its counterstatement, filed on 8 March 1993, that the Opposition Division had failed to deal with its objection to the novelty of Claim 1 having regard to the disclosure of documents (1), (5), (6), and (8), and had likewise ignored its objections to the inventiveness of Claims 1 and 8, and in particular the attack on Claim 8 based on the combination of document (8) with document

(10) US-A-3 222 227,

which had been cited before the first instance, and was mentioned in the description of the patent in suit (page 2 line 30) but not mentioned in the decision under appeal. That prior patent was concerned with the problem of improving the speed of extrusion attainable with Al-Mg-Si alloys, and proposed that the Mg_2Si should take the form of small or very fine readily dissolvable precipitated particles. It was obvious to replace the method of forming fine particles disclosed in document (10) with the alternative method disclosed in document (8). Claim 8 was also lacking in novelty over the disclosure of document (5), which showed how to obtain the Mg_2Si precipitate in the beta'-phase form. Novelty was also challenged on the basis of document (7), which was applicable to 6063 type alloys, and showed in Diagram 2 as curve 'e' a sequence of heating; soaking; rapid cooling to a temperature of

about 330°C; holding at that temperature for an extended time interval; and subsequent cooling, thus disclosing all the features of Claim 8. In addition it was contended that the Board ought not to admit into the appeal the revised translation of document of document (8) mentioned in IV. above, nor certain transmission electron micrographs, filed by the Appellant with its grounds of appeal.

VII. The Opponents OII and OIII did not file any written observations on the appeal, and although duly summoned, did not appear at the oral proceedings.

VIII. The Appellant (patentee) requested that the decision under appeal be set aside and that the patent be maintained as granted, or, alternatively, according to auxiliary requests filed on 28 June 1993. The Respondents OI and OIV requested that the appeal be dismissed, while in addition Respondent OIV requested that the documents mentioned at the end of paragraph VI above be excluded from the appeal.

Reasons for the Decision

1. The appeal is admissible.

2. *Admissibility of late filed documents*

Document (9) was introduced into the appeal by the Respondent OI with its counterstatement. Although the Appellant had sought to include document (11) in response thereto, as a preliminary issue in the oral proceedings Respondent OI asked that both should be

excluded from the appeal. The Board admitted both, taking into account their relevance, and also the fact that document (9) was introduced at a relatively early stage during the appeal, so that the Appellant had had sufficient time to carry out further experiments had it been so minded. So far as concerned the objections raised by the Respondent OIV to documents filed by the Appellant with its Statement Grounds of Appeal, these were admitted by the Board because the objection to their introduction was based essentially on the lateness of their introduction, whereas in the Board's view it was reasonable to file them at that stage.

3. *Terminology*

The alleged invention is defined in terms of the magnesium being present in the form of beta'-phase Mg_2Si particles. At page 3 line 59 to page 4 line 6 of the description, the patent in suit identifies three known forms of Mg_2Si precipitates as taking the forms of beta-, beta'- and beta''-phases, indicating that they tend to form by precipitation from solid solution respectively at the temperatures of 400-480°C, 300-350°C, and at around 180°C, the actual temperature ranges being influenced by the alloy composition. The respective space latices are, in the above order, cubic, hexagonal and hexagonal. Regarding their respective particle sizes, the beta-phase particles are said to be initially of sub-micron size, but grow rapidly; beta'- phase particles are 3 to 4 µm long by 0.5 µm wide; while beta''-phase particles take the form of needles of less than 0.1 µm in length. These designations and the respective size ranges for the different beta-phases are in line with those used in

other prior art documents; cf. e.g. document (6) page 570.

4. *Proposed amendment of Claim 1*

The Appellant sought at the start of the oral proceedings to introduce the word "**elongated**" into Claim 1 to define the beta'-phase particles having an average diameter of at least 0.1 µm, in an effort to overcome lack of novelty found by the Opposition Division based on its interpretation of the definition of the beta''-phase as including particles having a **diameter** of 0.1 µm. At page 4 line 3 of the description that phase is defined as taking the form of "needles, less than 0.1 µm in length". In the Board's view that definition is clear beyond all doubt, and refers to needles of the stated **length**. Being needles, they may be expected to have a diameter of the order of 0.01 to 0.001 µm. There is thus no overlap between the sizes of the beta'- and beta''-phases as defined. As the scope of Claim 1 is in this regard clear, and does not embrace beta''-phase particles, the proposed amendment is neither appropriate nor necessary to dispose of the present opposition, and is therefore inadmissible (cf. T 95/87, OJ EPO 1990, 470).

5. *The alleged invention*

5.1 Age hardened aluminium alloys have been widely used for many years. In conventional practice, following extrusion the products need to undergo the following steps; (i) a solution treatment involving heating to a temperature, depending on the alloy composition, above 500°C, and holding at that temperature for long enough

for the alloying elements present in the form of relatively large precipitated particles to be taken into solid solution; (ii) quenching to room temperature, so as to keep the alloying constituents in solid solution; and (iii) reheating to a much lower temperature, of the order of 200°C, at which the alloying elements tend to precipitate as submicroscopic particles. These submicroscopic particles stress the atomic lattice to such an extent that the strength of the extrusions is much increased.

5.2 Product Claim 1, and process Claim 8, of the patent in suit are concerned respectively with an ingot, and a process of forming an ingot, in which substantially all of the magnesium is present in the ingot ready for extrusion in the form of beta'-phase Mg_2Si. As is explained at page 2 lines 19 to 26, the objectives of the alleged invention are to minimise the yield stress of the extrusion ingot at elevated temperature, so as to maximise ease of extrusion, while at the same time taking the Mg_2Si into the solid solution as the temperature rises during the short interval while the metal passes through the extrusion die. It is quenched as it emerges from the extrusion die, and is thus ready for age hardening, i.e. without the need for an additional solution heat treatment between extrusion and age hardening. As is explained more fully in the Appellant's letter of 5 April 1994, the 6000 series alloys are used for low cost, low to medium strength extrusions of the kind used for architectural purposes such as in window frames. It is desirable to extrude as rapidly as possible so as to maximise the utilisation of costly extrusion presses, and to avoid the cost of a solution treatment after extrusion.

5.3 This is achieved in accordance with the alleged invention, avoiding the need for the above-mentioned steps (i) and (ii), the extrusions being in a condition ready for age hardening (description of the patent in suit page 2 lines 15 to 26). The numerous Examples demonstrate in a way which the Board finds credible that the desired effects, i.e. ease of extrusion coupled with obtaining an extruded product ready for age hardening without the need for further solution heat treatment, are attained by using an ingot as defined in Claim 1, produced such as by the steps defined in Claim 8.

5.4 The essential feature, which is common to product Claim 1 and method Claim 8, is that substantially all of the Mg in the alloy is present in the ingot in the form of beta'-phase Mg_2Si particles.

6. *The disclosure of Document (8) (revised translation)*

6.1 Document (8) was relied on by the Respondents OI and OIV in attacking both novelty and inventiveness. It is a research paper, the title of which indicates that it is concerned with an investigation of the effects of precipitation on extrudability. More specifically, at page 1 last paragraph it deals with the problem of trying to attain higher productivity during extrusion based on lower deformation resistance.

6.2 At page 2 reference is made to the general knowledge in the industry that solution strengthening by the presence of Mg and Si in solid solution can be reduced by precipitating them as a coarse Mg_2Si phase, but the authors had found that the critical extrusion speed was

lowered, instead of increased, due to tearing at the surface of the extrusion.

6.3 It is clear that the precipitation of a coarse Mg_2Si here discussed, and which resulted in tearing at the surface, is precipitation of the relatively large particles identified in the patent in suit and elsewhere as the beta phase form. The experimental work carried out by the authors is evaluated in the section headed, "4. Consideration", beginning at page 17. In these experiments, described particularly in relation to Figure 3, samples were solution treated at 575°C for 24 hours, water quenched, and then reheated and held at temperatures separated by steps of 50°C between 300 and 450°C. The microstructures produced from the tests carried out on full scale ingots are shown in "Photo 2". Based thereon the Respondent OI contended that Claim 1 lacked novelty because the structure disclosed in Photo 2(b) was that of an ingot having a microstructure which satisfied all the requirements of Claim 1 in suit, i.e. that the Mg_2Si was in the beta'-phase form.

6.4 To meet that contention, the Appellant had filed before the first instance the Experimental Report mentioned in paragraph IV above. That Report showed that by repeating all of the process steps disclosed in document (8), a micro-structure was obtained which contained a substantial proportion of beta''-phase. As the Report is inherently credible, and has not been challenged by the Respondents filing any counter-experiments, the Board accepts that the method there disclosed, which unlike the alleged invention involves a quenching step between solution treatment

and precipitation, could result in the different microstructure found in the Experimental Report. Consequently it has not been shown that document (8) deprives Claim 1 of novelty. The novelty of Claim 8 is unaffected by this disclosure because the sequence of steps disclosed is different.

6.5 So far as concerns the inventiveness of Claims 1 and 8 in relation to document (8), the question is whether this document contains any pointer in the direction of achieving a structure in which substantially all the Mg_2Si is in the form of beta'-phase particles, as required by both of the independent Claims 1 and 8.

6.6 Turning therefore to the practical teachings of document (8), at page 18 (centre of the page) the authors found a completely reciprocal relation between the critical extrusion speed, and deformation resistance, of the precipitation treated ingots. The lower the deformation resistance, the more the extrusion speed had to be reduced to avoid surface tearing. That negative view is emphasised at page 19 last paragraph, where mention is made of the known fact, based on other publications, that although precipitation treated ingots have lower deformation resistance, higher extrusion speeds are not achieved due to problems with the surface quality of the extruded product. A negative view is expressed at page 20 under the heading, "5. Conclusion". Rather than suggesting that the answer might lie in going over to precipitates having smaller particle size, the final paragraph of this paper indicates that tearing at the surface still occurs even where the particle size is smaller than that of the Mg_2Si with which the

deformation resistance of the ingot is decreased, and it ends with the explicit advice that workers in this field would be wise to go on using water quenched ingots, or forced air cooled ingots, in which the solute atoms are **retained in solid solution**, in order to achieve the best combination of extrusion speed and surface quality.

6.7 In summary, this paper, although containing a detailed review of the subject of precipitation heat treatments with a view to improving extrusion performance, came to a wholly negative conclusion as to their usefulness. It therefore does not afford any pointer in the direction of the alleged inventions as claimed in Claims 1 or 8.

7. *The disclosures of Documents (9) AND (11)*

7.1.1 Document (9), first cited on appeal, and document (11) introduced in consequence thereof by the Appellant, both stem from substantially the same team of workers headed by Elganin, the second of these papers being literature reference (3) in the first, and published some four years earlier. Not only is there that cross-reference, but the two reports can legitimately be read together because they relate essentially to the same proposals.

7.1.2 In the present case, the Board faces an unusual difficulty in relation to this prior art, because in essence it discloses a process which is almost identical to that claimed in Claim 8, whereas the results which are said to be achieved are very different from those said to be achieved in the patent in suit. Understandably, the Respondent OI relied on

the substantial identity of the process conditions as depriving the alleged invention of novelty, or if not of inventiveness, while the Appellant stressed the entirely different effects said to have been achieved, as showing that the attack on both grounds must fail.

7.1.3 More specifically, the Respondent OI drew attention to the teaching of document (9) (page 2 of the English translation) to the effect that the ingots, which had been solution treated, were then held at the temperature of minimum stability of the solid solution for 1 to 2 hours, i.e. under exactly the same conditions which, according to the patent in suit give rise to a beta'-phase precipitate. The need for rapid cooling from the homogenisation temperature to the heterogenisation temperature is stressed at page 8 (last paragraph) of the translation. Actual figures for times and temperatures of the treatment are to be seen in the Table at page 72 of document (11), which shows solution treatment for 4 hours at 520°C, followed by rapid cooling and heterogenising for 1 hour at 350°C. As the treatment was identical, or almost identical to that used in the patent in suit, and as it was applied to alloys (AD 33 and AD 35) of the same composition, the Respondent argued that the effects must be identical.

7.1.4 In contrast, the Appellant stressed that these documents were concerned with what their authors termed "heterogenisation". The 520°C homogenising temperature was not sufficient to effect complete solution of the precipitated alloying elements, as was confirmed by the rest of the disclosures of documents (9) and (11), which emphasised the relatively **large size of the**

precipitated particles. This aspect was stressed in document (11) page 72 (lower half of the page), and in document (9) page 3, where the particle diameter was said to be in range of 1-5 µm, on page 4 last paragraph which referred to the "coarser particles liberated during heterogenisation", and perhaps most strongly by the experimental comparison of the tensile strengths of homogenised and heterogenised water quenched extrusions shown on page 5. These showed a 30-40% greater tensile strength for the homogenised extrusions of AD 33 and AD 35 alloys, confirming that the large particles of beta-phase were not taken back into solution during extrusion, in contrast with the effect on the fine beta'-phase particles in accordance with the alleged invention.

7.2 Impact of Documents (9) and (11) on novelty and inventiveness

7.2.1 Regarding the novelty of Claim 1, the Board is satisfied that there is no disclosure in either of these documents of a microstructure in which the Mg_2Si is present in the beta'-phase form to the substantial exclusion of other forms. As to the novelty of Claim 8, although it is arguable that identical process steps must have identical effects, the Board observes that the processes are not quite identical, because the 520°C solution treatment step according to the Table at page 72 of document (11) is on the low side for the second step in Claim 8, of "homogenising the ingot". Although the holding temperatures during the precipitation step specified in the patent in suit are indistinguishable from those disclosed, it remains an inescapable fact that the micro-structures said to have

been attained in these citations are not the same as that required by Claim 8. Why there is such a surprising difference between the effect of almost equivalent treatments described in this prior art on the one hand, and in the patent in suit on the other, is a matter on which the Board does not speculate.

7.2.2 The Respondent OI argued that if the skilled worker observed that homogenisation was incomplete at 520°C, he would know as a matter of course that the remedy was to increase the temperature to whatever extent was needed to attain the desired homogenisation. However, while both Claims 1 and 8 in suit specify the attainment of a microstructure in which the Mg_2Si is present in the beta'-phase form, these citations aim to achieve coarser beta-phase particles for the sake of ensuring that they are **not dissolved** during extrusion. Consequently, if a skilled worker were to have followed the instructions of these documents, and to have found that the ingot had the microstructure claimed by the patent in suit, he might reasonably have inferred that he had failed effectively to have put their teachings into effect. Accordingly, the Board is satisfied that these two disclosures, which point clearly away from obtaining the beta'-phase form of Mg_2Si, do not make the alleged inventions of Claims 1 and 8 obvious.

8. *Objections raised by the Respondent OIV*

8.1 The Respondent OIV challenged in its written counterstatement the novelty of Claim 8 on the basis of documents (1), (5), (7), and (10), and its inventiveness on the basis of document (10). Against Claim 1 it alleged lack of novelty on the basis of

documents (1), (5) and (6), apart from relying on document (8) discussed in detail above.

8.2 Document (1) concerns a method of heat-treatment of aluminium alloys. Its stated objective is to improve the extrusion characteristics of the Al-Mg-Si alloys. To that end, it proposes a sequence of homogenisation at a temperature of 570 to 580°C, followed by cooling at a speed of at least 100°C/h down to 230-270°C, and exemplifies a rate of cooling of some 320°C/h (col. 2 line 35). At column 1 line 35 there is the seemingly contradictory teaching that the Mg and Si are separated in the form of "finest particles", but that on heating they do not go completely into solution. That suggests that the particles cannot be in the readily soluble beta''-phase form. Taking into account the rates of cooling actually disclosed, it would seem in the light of the "Mg_2Si Continuous Cooling Transformation Diagram" (provided by the Appellant with its Grounds of appeal) that the microstructure would in all probability be a mixture of beta- and beta'-phase forms, which would explain why the particles did not go into solution. The teaching of this document differs significantly from the alleged invention both in the rate of cooling proposed, and the absence of any holding step in the region of 300°C. It therefore does not deprive the invention of Claims 1 and 8 of novelty as is alleged.

8.3 So far as concerns the novelty of Claim 1 in the light of the cited documents (5) and (6), in the Board's view, the novelty of an **extrusion ingot** having a specified composition and microstructure can no more be challenged on the basis of the prior disclosure of a **test specimen** having the same composition and

microstructure, than could the novelty of any other object of commerce based on the fact that the raw material from which it is made is known. That disposes of the objections to novelty based on document (5) (Figure 3b. on page 531), and document (6) (Figure 3.4.3(b) on page 568), which are said to disclose laboratory specimens having compositions and microstructures falling within the present Claim 1. In the light of that finding, the Board has no need to deal with the disputed issue as to whether microstructure in document (6) is beta'-phase, as actually stated in the caption to the photomicrograph, or beta''-phase, as is contended by the Appellant. As the precipitation is stated to have occurred at 450°K (i.e. 177°C) and a 40,000 fold magnification was needed to reveal the microstructure, the Board would readily accept the Appellant's argument if the point needed to be decided.

8.4 The disclosure of document (7), relied on as depriving Claim 8 of novelty, is in a different category from the scientific papers so far considered. It is an advertising brochure describing certain continuous homogenising furnaces. The most relevant part of this disclosure is curve 'e' of Diagram 2 on page 5, which shows the steps of successively heating to some 550°C; soaking at that temperature for some 4 hours; cooling very rapidly to some 330°C; retaining at that temperature for 3.5 hours; and then cooling to ambient temperatures. Thus it comes very close to the subject-matter of Claim 8, save that no alloy composition is identified in association with Diagram 2. On the previous page microstructures are shown illustrating the influence of cooling rate on the

microstructure of homogenised billets of alloy AA 6063, which is an alloy falling within the composition defined by Claim 1. The conditions there illustrated are (a) water quenched, (b) forced air cooled, and (c) cooled in static air, which in turn correspond to curves 'd', 'c' and 'b' of Diagram 2. Nothing is said about the possible composition of any alloy to be treated in accordance with curve 'e'. Whereas curves 'd', 'c' and 'b' each reflect commonly met cooling conditions, 'e' is a diagrammatic illustration of a more complex cooling regime. In the absence of any explicit link between curve 'e' and the alloy identified on the previous page, in the Board's view the skilled reader would regard that curve as a generalised suggestion of the kind of treatment to which aluminium alloys could be subjected, as distinguished from a concrete proposal that alloys of the composition identified on the previous page could usefully be subjected to a cooling regime corresponding to the times and temperatures shown in curve 'e'. Accordingly the Board has reached the conclusion that the disclosure of document (7) is too vague and unspecific to amount to a clear and unmistakable disclosure of the subject matter of Claim 8, which is a condition precedent to a finding that it lacks novelty (cf. T 56/87, OJ EPO 1990, 188, and T 450/89, 15 October 1991, not reported, par. 3.11). Although document (7) was not alleged to make the alleged invention obvious, for completeness it is added that such a challenge would have failed because the skilled reader would have regarded Diagram 2 as a general indication of the kind of heat treatments which can be achieved with the furnaces there described, without intending to suggest any specific treatment. It would

suggest to the skilled reader no more than that the furnaces discussed are capable of being used in whatever cooling regime he may have in mind.

8.5 Document (10) is cited against both the novelty and inventiveness of Claim 8. It is concerned with the ease of extrusion of Al-Mg-Si alloys, and stresses a desire to carry out the extrusion at lower temperatures and higher speeds than had been used hitherto (column 1 lines 39 and 45) rather than with reducing extrusion pressure. This finds confirmation particularly in the first table in column 8, which shows that higher breakout pressures were needed for Group A, the products made in accordance with its invention, which otherwise had generally better properties than the control Group B, as shown in the other tables. It proposes at column 3 lines lines 5 to 10 that the Mg and Si should be either retained in solution, or "present in the form of small or very fine readily dissolvable precipitate of Mg_2Si." That statement is clarified at column 4 line 75 to column 5 line 2, where small or fine particles are defined as those of about 0.03 micron down to submicroscopic sizes, perhaps 0.01 micron or less. This makes it plain that the aim is to keep the Mg either in solid solution, or in the form of a precipitate of Mg_2Si in the beta''-phase form. That proposal is to be contrasted with the present alleged invention, in which the presence of beta''-phase is avoided, and the extrusion pressure needed is reduced. Thus document (10) proposes achieving a wholly different microstructure from that sought in accordance with Claim 8. It does not deprive Claim 8 of novelty, nor suggest the invention at all.

8.6 Dealing briefly with the allegation of obviousness based on the combination of documents (8) and (10), it is true that while as mentioned in paragraph 6.3 above, document (8) discusses, without recommending, the precipitation of coarse Mg_2Si phase or beta-phase form, while document (10) commends the much more finely divided beta''-phase particles, it does not follow that these conflicting suggestions would impel the skilled reader towards the Aristotelian middle path, and towards the adoption of the intermediate sized beta'-phase form. Therefore the combination of these two documents does not lead towards the invention.

8.10 Accordingly the Board is satisfied that the objections of lack of novelty and lack of any inventive step have not been established.

9. *Avoidance of problem and solution analysis*

9.1 In dealing with the issue of inventiveness in the present case, the Board has avoided the so-called "problem and solution approach". Some decisions (T 1/80, OJ EPO 1981, 206, and T 20/81, OJ EPO 1982, 217, and especially T 248/85, OJ EPO 1986, 261) went so far as to suggest that the use that analysis is a sine qua non for the determination of inventiveness by the EPO. It is therefore arguable that although this Board is deviating only to the extent of not accepting the full breadth of an earlier interpretation of the Convention, reasoning should be given pursuant to Article 15.1 of the Rules of Procedure of the Boards of Appeal.

9.2 The Board sees no legal basis for imposing on the organs of the EPO one particular method for the assessment of inventiveness under Article 56 EPC, where that Article has left the methods open. Rule 27(1)(c), which has been invoked as a basis for the problem and solution approach, is concerned solely with the formulation of the description, not the assessment of inventiveness under Article 56 EPC. Thus the problem and solution approach ought to be considered as one amongst other possible approaches, each of which has its own advantages and drawbacks.

9.3 An opponent, whether before the Opposition Division or before a Board of Appeal, ought not to be tied down by having to select one or more citations as being closer than others, and thereby run the risk of failing in his opposition if the tribunal disagrees with that selection. Furthermore, it is a principle of procedural law generally recognised in all the Contracting States that a party to litigation is free to raise alternative lines of attack or defence. In accordance with Article 125 EPC, that principle is one which has to be applied by the EPO. Consequently, where as here, the patent has been maintained despite an opposition based on a reasonable selection of prior art, both sides are entitled to a decision of the Board of Appeal which deals independently with all the issues argued. A Board would be failing in its obligation to the parties and the public if it left open the possibility that a different result might have been reached if a different document had been selected as the closest prior art.

9.4 In the present case, most of the seven citations considered in detail above are directed to different

solutions to exactly the same problem as that solved by the present invention, i.e. heat treating Al-Mg-Si ingots to enhance the speed and ease with which they can subsequently be extruded. These cited documents advance different solutions to that problem, with the result that the issue of inventiveness depends solely on whether they contain any pointer towards the claimed step or not.

9.5 It is not appropriate here to enter into any detailed discussion of the merits and weaknesses of the problem and solution approach, save to observe that, as it relies on the results of a search made with actual knowledge of the invention, it is inherently based on hindsight, and therefore calls for care in its application in some circumstances. A further drawback is that it can result in complicated multi-step reasoning where the facts are clear, either for or against inventiveness. Thus, if an invention breaks entirely new ground, it may suffice to say that there is no close prior art, rather than constructing a problem based on what is tenuously regarded as the closest prior art.

9.6 The assessment of inventiveness which is required by Article 56 EPC is a matter of judgment. As reflected by some of the decisions of the Boards of Appeal, the problem and solution approach can entail the exercise of judgment in deciding what is to be treated as the so-called "objective" problem. Once that problem has been identified, in some cases little further judgment may be needed to decide the issue of obviousness. Nevertheless, problem and solution analysis does not remove the element of judgment inherent in the

assessment of inventiveness, but rather displaces it from the task set by the EPC, to another task which is inessential to Article 56 EPC. In that connection the Board sees a welcome trend in some recent unreported decisions, which have emphasised that the investigation of inventiveness should avoid formulating artificial and unrealistic technical problems, and should normally start from the technical problem identified in the patent in suit (cf. T 495/91, 20 July 1993; T 246/91, 14 September 1993; and T 741/91, 22 September 1993).

10. *Conclusion*

For the reasons given above, the Board rejects the objections under Articles 54 and 56 EPC, and considers the subject-matter respectively of Claims 1 and 8 to be patentable. The same applies to dependent Claims 2 to 7, together with 13 and 14, which are supported by Claim 1, and Claims 9 to 12, supported by Claim 8.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is maintained as granted.

The Registrar: The Chairman:

S. Fabiani H. Seidenschwarz