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Datasheet for the decision of 29 October 2010

Case Number: T 2196/08 - 3.2.08

Application Number: 02727102.2

Publication Number: 1392877

IPC: C22C 21/02

Language of the proceedings: EN

Title of invention:
Process for making aluminum alloy sheet having excellent bendability

Applicant:
Novelis Inc.

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56, 82, 84, 123(2)

Relevant legal provisions (EPC 1973):
EPC Art.

Keyword:
-

Decisions cited:
-

Catchword:
-

Case Number: T 2196/08 **-** 3.2.08

D E C I S I O N
of the Technical Board of Appeal 3.2.08
of 29 October 2010

Appellant: Novelis Inc.
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Representative: Knowles, James Atherton
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 11 July 2008 refusing European patent application No. 02727102.2 pursuant to Article 97(1) EPC.**

Composition of the Board:

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

Summary of Facts and Submissions

I. The appellant (applicant) lodged an appeal against the decision of the examining division dated 11 July 2008 to refuse European patent application No. 02727102.2.

In its decision, the examining division focused on the documents

D1: US-A-5 266 130;

D4: US-A-5 616 189 and

D8: WO-A-98/37251.

Starting from the disclosure of document D1 as the closest prior art, the technical problem to be solved by the application was identified in a process of providing an aluminium sheet exhibiting excellent formability in the T4 temper and, at the same time, having excellent bake hardening ability so that it was suitable for producing automotive parts. The examining division held that the solution to this problem as set out in the claimed process was obvious from the combined technical teaching given in documents D1 and D8 and that the subject-matter of all claims of the main and the auxiliary requests then on file therefore did not involve an inventive step. Moreover, the examining division held that both requests lacked unity.

II. The appeal was received at the European Patent Office on 8 September 2008 and the appeal fee was paid on the same date. The statement setting out the grounds of appeal was received on 11 November 2008.

In addition to the documents D1, D4 and D8, the appellant referred in appeal, amongst other things, to document

E2: Declaration of P. Wycliffe, (3 pages) submitted on 29 September 2010.

III. Oral proceedings took place before the Board on 29 October 2010.

The appellant (applicant) requested that the decision under appeal be set aside and a patent be granted on the basis of the request (claims 1 to 12) filed during the oral proceedings.

Independent claim 1 reads as follows:

"1. A process of producing an aluminium alloy sheet having excellent bendability for use in forming panels for automobiles, the process comprising the steps of:
semi-continuously casting an AA 6000 series aluminium alloy comprising 0.50 to 0.75 by weight Mg, 0.7 to 0.85% by weight Si, 0.1 to 0.3% by weight Fe, 0.15 to 0.35% by weight Mn, optionally 0.2 to 0.4% Cu and the balance Al and incidental impurities,
subjecting the cast alloy ingot to homogenization hot rolling and cold rolling, followed by solution heat treatment of the formed sheet,
quenching the heat treated sheet to a temperature of 60-120°C and coiling the sheet at a coiling temperature of 60-120°C, and

pre-aging the coil by slowly cooling the coil from an initial coil temperature of 60-120°C to room temperature at a cooling rate of less than 10°C/hr."

The dependent claims 2 to 12 relate to preferred embodiments of the process set out in claim 1.

IV. The appellant's arguments are summarized as follows:

Contrary to the position of the examining division, document D8 qualified as the closest prior art. This document related to a process similar to that claimed for producing aluminium alloy sheet suitable for forming into automobile parts without exhibiting undesirable roping effects. To this end, D8 disclosed an Al-MgSi alloy of the AA6XXX series wherein the range for manganese was limited to 0 to 0.15% by weight.

Starting from D8, the problem underlying the present invention was to provide an improved bendability/low yield strength of the as-produced Al alloy sheet and a high yield strength after paint baking. This problem was solved by careful selection of the composition of the Al alloy defined in claim 1. In particular, Mn in the range of 0.15 to 0.35% Mn was required for the MgSiFeMn-Al alloy composition used in the process of claim 1.

Although document D1 was concerned with a similar problem as the invention, it related to a process of producing Al-sheets of an overlapping composition, having excellent shape fixability and bake hardenability. The examining division referred in its decision specifically to the composition of example E

(0.20% Mn) given in D1, Table 1, which satisfied the elemental ranges of the claimed Al-alloy including that of Mn. Example E was however produced by a process different from that used in D8 and also according to claim 1 of the application. In particular, example E was quenched in a first stage cooling to 150°C followed by a second stage cooling down to 50°C. To solve the identified problem, the skilled person had no reason to turn to the teaching of document D1, in particular to resort to example E, and to combine it with the technical disclosure of document D8 which restricted manganese to a range of 0.15% or less.

Document D4, on the other hand, was concerned with Al sheet material produced by twin belt casting rather than semi-continuous direct chill (DC) casting. However, the twin belt casting process was totally different from the semi-continuous DC casting technique used in D8 and also in the claimed process. As was also confirmed by document E2, twin belt casting and DC casting resulted in different textures and consequently in different mechanical properties of the final Al-sheet material. Again, the skilled person had no reason for combining the teaching of documents D8 and D4, and even if he did, he would not have arrived at the process defined in claim 1 of the present application.

Consequently, the claimed process was novel and involved an inventive step over the cited prior art.

Reasons for the Decision

1. The appeal is admissible.

2. Amendments:

Present claim 1, which corresponds to the wording of claim 1 of the International publication, has been amended by the introduction of the technical term "homogenization" before the hot rolling step. The homogenization treatment before hot rolling the cast ingot is disclosed on page 4, lines 22, 23 of the International publication.

For the sake of clarity, the relative term "about" before the temperature ranges in claim 1 has been deleted, and the same amendment has been carried out in dependent claims 5 and 6.

The description has been suitably adapted to the present claims. Embodiments of the process no longer falling within the scope of present claim 1 have been cancelled or identified as comparative.

Hence, there are no objections to the amendments to the claims and the description, in particular with respect to Articles 84 and 123(2) EPC.

3. Unity:

Since the present request comprises only a single independent claim, the objection of the examining division with respect to Article 82 EPC is no longer relevant.

4. Prior art; novelty:

4.1 Document D8 discloses a process of producing an aluminium alloy sheet obtained from direct chill (DC) cast ingots, which corresponds to the semi-continuous casting step set out in claim 1 of the application. The process disclosed in D8 aims at reducing or eliminating the phenomenon called "roping" while maintaining the desirable T4/T8X characteristics. Aluminium sheet produced from (DC) cast ingots often entails the problem of roping, ridging or "paint brush" which means the formation of narrow bands having a different crystallographic structure from that of the remaining metal from the rolling operation and generally aligned in the rolling direction (see D8, page 3, last paragraph to page 4, line 2; page 5, lines 3 to 6). To cope with this phenomenon, D8 proposes a process comprising the steps of:

- DC casting an aluminium alloy comprising (by weight) 0.4 to 1.1% magnesium, 0.3 to 1.4% silicon, 0 to 0.4% iron, 0 to 0.15% manganese, 0 to 1.0% copper, the balance being aluminium and incidental impurities (0 to 0.15% collective total);
- subjecting the cast ingot to homogenization, hot and cold rolling, followed by solution heat treatment;
- quenching the product to a coiling temperature above 50°C and coiling the sheet at a temperature preferably ranging from 55 to 85°C and
- pre-aging the coil by slowly cooling it from the initial coil temperature to room temperature at a cooling rate of 10°C/hr to improve the T8X temper characteristics (see D8, claim 1).

The claimed process differs from D8 by the composition of the selected aluminium alloy, which is much narrower in its elemental ranges than that specified in the broad disclosure of D8. It therefore has to be scrutinized whether the Al alloy used in the claimed process satisfies the three criteria for selection inventions, i.e. to be (i) a narrow sub-range, (ii) sufficiently far removed from the known range and (iii) not an arbitrary selection (see Case Law of the Boards of Appeal, 5th edition December 2006, I.C.4.2.1 and 4.2.2).

As to criterion (i), the lower limit of the claimed range for Mn (0.15%) is identical to the maximum amount of Mn permissible according to D8 which represents the smallest possible overlap with the composition of the Al alloy used in D8. It is also noted that none of the examples given in Table 1 of D8 falls within or comes close to the elemental ranges of the composition of the Al alloy used in the claimed process (criterion ii). Turning to criterion (iii), the application mentions on page 10, lines 3 to 7 of the application that increased addition of Mn in the range of 0.15 to 0.35% results in improving the bendability properties of the Al sheet, in particular in that its surface remains free from "rumpling", which is a precursor to residual crack formation. This means that the composition of the aluminium alloy used in the claimed process has not been selected arbitrarily (criterion iii).

Given that all three postulates for the novelty of a selected sub-range are met, the claimed process is novel over D8.

4.2 Document D1 discloses a process for manufacturing an aluminium alloy sheet material having excellent shape fixability and bake hardenability. The process comprises the steps of:
semi-continuous casting an Al alloy comprising (by weight) 0.2 to 1.4% Mg, 0.4 to 1.7% Si, 0 to 0.5% Mn, 0 to 1.00% Cu, 0 to 0.20% Cr, 0 to 0.20% V, balance Al and residual impurities,
homogenization of the ingot, hot and cold rolling, solution heat treating;
a first stage cooling at a cooling rate of 200°C/min to 60 to 250°C, followed by
a second stage cooling at different cooling rates set out in Figure 2 (see D1, claim 1; column 3, lines 62 to column 4, line 22; column 6, examples).

Among the numerous examples given in Table 1 of D1, only example E satisfies the elemental ranges of the Al-alloy composition required for the claimed process. However, the heat treatment (iv) specified in Table 2 of D1 is different from the claimed process in that the sheet material is cooled down to 150°C in the first stage followed by the second stage cooling to 50°C. By contrast, the quenching and pre-aging steps set out in claim 1 of the application require cooling the sheet to 60 to 120°C, coiling the sheet within this temperature range and slowly cooling the coil to room temperature at a cooling rate of less than 10°C/hr. Consequently, the claimed process is novel over D1.

4.3 Document D4 provides, according to one aspect of it, a process of imparting T4 and potential TX8 properties suitable for automotive applications to a sheet of an

Al-alloy comprising (by weight) 0.4 to 1.0% Mg, 0.2 to 1.4% Si, 0 to 2.0% Cu, 0 to 0.4% Fe, 0 to 0.4% Mn, 0 to 0.3% Zn, 0 to 0.3% (Cr+Ti+Zr+V), balance Al and unavoidable impurities (see D4, column 2, lines 18 to 43; embodiment (3)). As set out in D4, column 3, lines 17 to 21, the alloy sheet may either be produced by belt casting followed by hot and cold rolling or by conventional means such as DC casting followed by scalping, homogenization, hot and cold rolling.

However, the evaluation of the technical contents of document D4 unambiguously shows that its basic object is to provide aluminium alloys that can be made into strip by a belt casting procedure for subsequent conversion to sheet material, i.e. a process which avoids the need for scalping the (DC) cast ingot and homogenization before hot rolling (see D4, column 2, lines 2 to 8). Preferably the twin belt casting process is used (see D4, column 2, lines 18 to 29; column 3, lines 22 to 38; column 6, lines 1 to 12; column 7, lines 11 to 21, 39 to 41; column 10, lines 3 to 19; claims 1, 9, 27, 28, 29). All the examples in D4 were processed by belt casting, but only for comparison, Table 3 also includes the properties of DC cast material of Alloys #1 (conventional alloy AA6111) and #3 (see D4 column 10, lines 20 to 29; lines 54 to 56). Neither of examples #1 and #3 falls within the elemental ranges of the Al alloy used for the claimed process. In particular the Mn content of 0.03% in example #3 falls far outside the Mn range specified for the claimed Al-alloy. Consequently, the claimed process is not anticipated by the disclosure of document D4 either.

4.4 In view of these considerations, the process set out in claim 1 is novel.

5. Inventive step:

5.1 Starting from document D8 as the closest prior art, the technical problem underlying the present application resides in providing a process resulting in Al sheet which is obtained from DC cast ingots and exhibits an improved bendability, in particular which is free from visible rumpling on its surface and residual cracking.

The key feature to solve this problem resides in carefully selecting the chemistry of the aluminium alloy used for the claimed process. Vis-à-vis the alloy used in document D8, the narrowly restricted ranges for Mg and Si and, in particular, the increased addition of manganese falling within the range of 0.15 to 0.35% contributes to preventing rumpling and cracking during bending of the sheet. It is apparent from the description, page 9 and 10, example 2 and Figure 1, that the identified problem has been successfully solved.

5.2 None of the documents D8, D1 nor D4 addresses the bendability problem of "rumpling". Document D8 aims at reducing the "roping" effect without adversely affecting other properties such as the bake hardening response. To this end, manganese in the alloy used in D8 has been restricted to 0 to 0.15% and, even more preferably, to 0.07 to 0.10% Mn (see D8, claim 4). Consequently, document D8 unequivocally dissuades from adding manganese in amounts higher than 0.15%.

In the case of document D1, a process different from the claimed pre-ageing treatment is used. It is undisputed that document D1 relates to producing Al sheet from semi-continuously (DC) cast ingots of an Al alloy overlapping the claimed composition and actually includes one example (E) falling within the elemental ranges of the Al-alloy used in the claimed process. However, nothing is found anywhere in this document that would prompt the skilled person to turn to this example, in particular to select a Mn-content in the range of 0.15 to 0.35% and to restrict the ranges for Mg and Si in order to solve the problem of rumpling. As previously mentioned in more detail, D1 is concerned with a cooling regimen which is different from the pre-aging treatment carried out in document D8 which, more importantly, dissuades from adding Mn in amounts higher than 0.15%. Hence, there is no reason to pick features from document D1 to associate with the teaching of document D8, and even if this were done, the claimed process would not be arrived at.

A similar situation exists with document D4 which concerns (CC) continuous casting (twin belt casting) rather than DC, as does the claimed process. Belt casters produce strip that can be either directly cold rolled or may be hot rolled with an in-line rolling mill to reduce the thickness of the as-cast slab after it is solidified but before it cools. Belt casting thus dispenses with the need for subsequent scalping of the resulting ingot and homogenizing it before hot rolling. Reference is made in this context to D4, column 2, lines 1 to 8; column 6, lines 1 to 12. By contrast, the hot rolling step in DC cast ingots is always preceded by scalping and a homogenization treatment. This means that the thermal history of DC and CC material is significantly different and this is reflected in the microstructure and the mechanical properties of the final product, in particular the bendability properties. This finding is corroborated by the test results presented by the appellant in document E2. Consequently, document D4 teaches away from using DC to produce Al sheet material. Given this situation, there is no reason to transfer the disclosure of this document to the teaching of neither of documents D8 or D1 which are both concerned with DC.

5.3 In conclusion, since the problem addressed by the present application is not realised in any of documents D8, D1 or D4 and since any combination thereof is not obvious, the subject matter of claim 1 involves an inventive step.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of the first instance with the order to grant a patent on the basis of the following documents:

   - claims 1 to 12 filed during the oral proceedings;

   - description, pages 1 to 24 filed during the oral proceedings; and

   - Figures 1 to 13 of the application as published.

The Registrar: The Chairman:

V. Commare T. Kriner