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**Datasheet for the decision
of 1 February 2013**

Case Number: T 0733/11 - 3.2.08
Application Number: 03026532.6
Publication Number: 1422301
IPC: C22B 9/20, C22C 38/10,
C21C 7/04
Language of the proceedings: EN

Title of invention:

Maraging steel and method of producing the same

Patentee:

HITACHI METALS, LTD.

Opponent:

Aperam Alloys Imphy

Headword:

-

Relevant legal provisions:

EPC Art. 100(a), 100(b), 114(2)
RPBA Art. 12(4)

Keyword:

"Admission of late-filed documents (no)"
"Admission of new ground of opposition (no)"
"Novelty, inventive step (yes)"
"Sufficiency of disclosure (yes)"

Decisions cited:

G 10/91

Catchword:

-



Case Number: T 0733/11 - 3.2.08

DECISION
of the Technical Board of Appeal 3.2.08
of 1 February 2013

Appellant: Aperam Alloys Imphy
(Opponent) 1-5, rue Luigi Cherubini
F-93200 Saint Denis (FR)

Representative: Neyret, Daniel Jean Marie
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Respondent: HITACHI METALS, LTD.
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Tokyo (JP)

Representative: Strehl Schübel-Hopf & Partner
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Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 3 February 2011
rejecting the opposition filed against European
patent No. 1422301 pursuant to Article 101(2)
EPC.

Composition of the Board:

Chairman: T. Kriner
Members: R. Ries
D. T. Keeling

Summary of Facts and Submissions

I. By its decision posted on 3 February 2011 the opposition division rejected the opposition against European patent No. 1 422 301. In its decision, the opposition division focussed on documents

- D1: FR-A-1 605 168;
- D2: JP-A-56-090957;
- D3: US-A-3 650 311;
- D4: G. Béranger et al.; (Editeurs scientifiques): "Les aciers spéciaux", Technique et Documentation, ISBN 2-7430-0222-0, Lavoisier, Londres, Paris, New York, 11 rue Lavoisier, F 75384, Paris Cedex 08; 1997, page 259;
- D5: EP-A-0 051 401,

which were submitted within the nine month opposition period. It was held that the subject matter of claim 1 was novel and involved an inventive step with respect to the technical teaching given in documents D1 to D5.

The opposition division further held that the documents

- D6: EP-A-1 679 384
- D7: A. Mitchell et al.: "The magnesium problem in superalloys", Superalloys 1988, The Metallurgical Society, 1988, pages 407 to 416;
- D8: A. Michell: "Some observations on inclusion behaviour in special melting processes", Advances in Special Electrometallurgy, 1992, 8(4), pages 323 to 331;

- D9: D. J. Dyson et al.: "Studies in development of clean steels, Part 2 Use of chemical analyses", *Ironmaking and Steelmaking*, 1998, vol. 26, No. 4, pages 279 to 286;
- D10: Georgy Y. Pervushin and H. Suito: "Effect of Primary Deoxidation Products of Al₂O₃, ZrO₂, Ce₂O₃ and MgO on TiN Precipitation in Fe-10mass% Ni Alloy", *ISIJ Intern.* volume 21(2001), No. 7, pages 748 to 756;
- D11: FR-A-2 438 091;
- D12: FR-A-1 331 278,

all submitted after the expiry of the nine-month opposition period, were late-filed. An appraisal according to Article 114 EPC had shown that documents D6 to D12 were not more pertinent than the technical teaching given in documents D1 to D5 and, therefore, this evidence was not held relevant for the decision. Consequently, the opposition division decided not to admit documents D6 to D12 into the opposition proceedings

Contrary to the opponent's position, the opposition division further reasoned that the patent described at least one way of obtaining the claimed maraging steel in a manner sufficiently clear and complete that a person skilled in the art could carry out the invention. The opposition division thus concluded that, in accordance with the considerations given in decision G 10/91, the new ground of opposition pursuant to Article 100(b) EPC, which had been submitted by the opponent after the expiry of the nine month opposition period, was *prima facie* not relevant. Consequently, the

new ground of opposition under Article 100(b) EPC was not admitted into the opposition proceedings either.

II. On 31 March 2011, the appellant (opponent) lodged an appeal against this decision, paying the appeal fee on the same date.

The statement setting out the grounds of appeal was received at the EPO on 7 June 2011. In its statement, the appellant referred to the grounds of opposition under Article 100(a) EPC and cited documents D1 to D12. Additionally it referred to the ground of opposition under Article 100(b) EPC.

III. The parties made the following requests:

The appellant requested that

- the decision under appeal be set aside and
- the patent be revoked.

The respondent (patent proprietor) requested that

- the appeal be dismissed and
- oral proceeding be hold, should the Board consider deciding differently.

IV. Claims 1 and 2 read as follows:

"1. A maraging steel comprising, by mass percent,
C: not more than 0.01%;
Ni: 8.0 to 22.0%;
Co: 5.0 to 20.0%;
Mo: 2.0 to 9.0%;
Ti: from more than 0 to not more than 2.0%;
Al: not more than 1.7%;

Mg: more than 0 to less than 10 ppm;

O: less than 10 ppm;

N: less than 15 ppm;

the balance being Fe and incidental impurities,
the maraging steel containing nitride inclusions having
a maximum length of 15 μm and oxide inclusions having a
maximum length of 20 μm ,
wherein the oxide inclusions comprise spinel-form
inclusions and alumina inclusions in which the content
rate of the spinel-form inclusions having a length of
not less than 10 μm to the total content of spinel-form
inclusions having a length of not less than 10 μm and
alumina inclusions having a length of not less than
10 μm is more than 0.33."

"2. A thin strip made from the maraging steel defined
in claim 1 and having a thickness of not more than 0.5
mm."

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

Sufficiency of disclosure; Article 100(b) EPC

In its response to the notice of opposition, the
respondent itself admitted that the claimed steel was
not automatically obtained by vacuum remelting the
consumable electrode comprising at least 5 ppm Mg.
Rather, controlling numerous process parameters such as
the shape of the inclusions, the speed of decomposition
and crystallisation of the inclusions when remelting
the consumable electrode was necessary. The patent,
however, did not disclose any precise details about
these parameters so that the skilled person was not
able to reproduce the claimed steel.

In addition, the patent was insufficiently disclosed in the light of the technical teaching given in document D6 which, although post published, emphasized that the claimed maraging steel was not obtained simply by vacuum arc remelting (VAR) unless specific process parameters were carefully controlled. Objection therefore arose under Article 100(b) EPC.

Given this situation and having regard to the considerations laid down in decision G 10/91, the opposition division had been obliged to introduce the ground of opposition under Article 100(b) EPC on its own motion. Moreover, given that the opposition division dealt with this ground of opposition under point 3 of its decision, this issue was expected to be dealt with also by the Board of Appeal in the appeal proceedings.

Novelty; Article 100(a) EPC

D1 disclosed the composition of a maraging steel comprising magnesium in a range of 0 to 0.025 wt% Mg, which overlapped that of the claimed steel (D1, page 3, last paragraph). The known steel was produced by vacuum melting whereby the amounts of oxygen and nitrogen were restricted to levels as low as possible (D1, page 4, lines 6 to 11; page 6 last paragraph). Since the same process was used and the composition of the maraging steel was identical with that claimed in the patent, the subject matter of claim 1 lacked novelty over D1.

Document D2 disclosed a maraging steel of the claimed type, comprising 0.001 to 0.1 % Mg. Specifically, the

exemplifying steels 7, 10 and 12 given in Table 1 included 10 ppm, 10 ppm and 20 ppm Mg, respectively. Typically, maraging steels were produced under vacuum to reduce the risk of unwanted oxidation. Hence, the formation of the same type and shape of inclusions as defined in the claimed steel was to be expected. The claimed maraging steel therefore lacked novelty over the disclosure of D2.

Document D3 described electro-slag-remelting (ESR) of a maraging steel comprising 18% Ni (D3, column 9, lines 39 and 67). Since the ESR slag comprised magnesium, this element was also present in the final ingot. It therefore had to be concluded that the same steel as claimed was produced by the known ESR process. The claimed maraging steel therefore lacked novelty with respect to D3.

In addition, the subject matter of claim 1 was anticipated by the technical disclosure of D11 or D12.

Inventive step

Document D1 as the closest prior art was silent on the shape and form of the non-metallic inclusions in the steel. Starting from this prior art, the problem underlying the patent at issue thus resided in improving the steel's resistance to fatigue fracture which was adversely affected by the presence of large residual non-metallic inclusions. The problem was solved by vacuum arc remelting a consumable electrode, a process which was well known to the skilled person and commonly carried out to reduce the amount of non-metallic inclusions (the patent specification,

paragraph [0005]). The skilled person further knew, e.g. by the disclosure of D8 or D10, respectively, that the steel's cleanliness could be improved by adding magnesium. Vacuum arc remelting a consumable electrode and adding magnesium, a step which was specifically mentioned also in document D1, were therefore obvious for the skilled person to solve the identified problem.

As reflected in paragraph [0027] of the patent specification, vacuum electroslag remelting (ESR) represented an alternative process to VAR. Document D3 described ESR of 18% Ni maraging steel in column 9, lines 39 and 37. Starting from D1, the skilled person therefore would use the commonly known ESR process and re-melt a consumable electrode to improve the steel's cleanliness.

Moreover, the claimed maraging steel was obvious from the combined teaching of D1 and D5, the latter describing a cobalt-free maraging steel produced by (a) providing a vacuum induction melted consumable electrode followed by (b) VAR and adding Mg as a deoxidising agent (D5, page 4, lines 26 to 32). Cobalt as alloying element did not promote or adversely affect the formation of the non-metallic inclusions, but merely contributed to improving the steel's mechanical properties, as it was evident from document D1, page 5, lines 1 to 7. Combining the technical teaching of D5 and D1 thus led in an obvious way to the claimed maraging steel.

Moreover, the claimed maraging steel did not involve an inventive step by combining the technical disclosure of D1 or D2 with that of either D11 or D12, respectively.

VI. The respondent's arguments are summarized as follows:

The appellant's submissions provided with its grounds of appeal did not contain substantial arguments other than those which were already dealt with in detail in the opposition proceedings.

As to the appellant's objection under Article 100(b) EPC, the patent specification referred to the presence of inclusion-forming components such as oxygen and nitrogen as well as to the role of magnesium, the vacuum level, the projection current and the effects exerted by these parameters on the melting and coagulation speed of the non-metallic inclusions in the vacuum melting process. Based on this detailed technical information taught by the patent specification, the skilled person was able to put into practice the claimed maraging steel.

Turning to the issue of novelty, none of the cited documents disclosed in detail the type of the non-metallic inclusions defined in the patent, i.e. the size of inclusions and rate of the spinel-form and alumina inclusions. The claimed subject matter was therefore novel.

As to inventive step and starting from document D1 as the closest prior art, none of the remaining documents aimed at providing and controlling the state of the claimed non-metallic type of inclusions as claimed in the patent by carefully controlling the amounts of oxygen, nitrogen, magnesium etc. during vacuum induction melting (VIM) and VAR of the claimed maraging

steel. Contrary to the appellant's allegations, the claimed subject matter therefore also involved an inventive step.

Reasons for the Decision

1. The appeal is admissible.
2. Admissibility of the late-filed documents
 - 2.1 Documents D6 to D12 were filed during the opposition proceedings but after the nine month opposition period. According to established case-law of the Boards of Appeal, 6th edition, 2010, VII.C.1.4.1, in proceedings before the opposition divisions, late-filed facts, evidence and arguments that went beyond the "indication of the facts, evidence and arguments" presented as part of the notice of opposition pursuant to Rule 76(c) EPC in support of the grounds of opposition on which the opposition was based should only exceptionally be admitted into the proceedings if, prima facie, there were reasons to suspect that such late-filed documents would prejudice the maintenance of the patent in suit. In any case, the opposition division is obliged to give reasons for its decision to disregard evidence not submitted in due time under Article 114(2) EPC, if the opponent remained of the view that it was relevant.

Thus, it has to be assessed on appeal whether the opposition division exercised its discretion not to admit documents D6 to D12 correctly.

2.2 In point 2 of the Reasons for the Decision, the opposition division gave detailed reasons as to why late-filed documents D6 to D12 were not considered more relevant than the timely submitted citations D1 to D5. For the following reasons, the Board concurs with the opposition division's assessment of the technical relevance of documents D6 to 12 with respect to the claimed subject matter.

D6 was published in 2004, i.e. after the priority date of 7 February 2003 of the patent at issue. This document does not, therefore, represent prior art within the meaning of Article 54 EPC.

D7 teaches that magnesium is added to nickel-based superalloys to improve high temperature ductility and low-cycle fatigue strength (D7, Introduction). Although D7 describes the behaviour of magnesium during electron-beam melting (EB), vacuum arc remelting (VAR) and electro-slag remelting (ESR), this document merely teaches that it is possible to add magnesium to the ingot when conducting electro-slag remelting. D7 neither discloses the composition of the claimed maraging steel nor the type and dimensions of the non-metallic inclusions defined in claim 1 of the patent at issue.

D8 does not deal with maraging steels. Rather, this document is concerned with the inclusion behaviour in special melting processes such as electron-beam melting, in particular with the effect of Mg in superalloys (D8, page 327, first column, first full paragraph). It also mentions TiN inclusions having a nucleus of MgO and a special state of TiN having surrounding carbides (D8,

page 327, column 2, "Implications on superalloy processing").

D9 is not concerned with maraging steels either. Rather, this document describes a variety of analytical methods which generate chemical analysis and related information which can be used for identifying the type of inclusions in steels (D9, Conclusions).

D10 teaches the effect of deoxidising elements on a Fe-10% Ni alloy. This scientific publication describes the effect of primary deoxidation products of Al_2O_3 , ZrO_2 , Ce_2O_3 and MgO on TiN precipitation in a Fe-10 wt%Ni alloy. Since the composition of the steel cited in D10 is different from that of the claimed maraging steel, it is not possible to assess the behaviour of TiN and MgO in the claimed alloy.

D11 discloses the composition of soft steel, which is different from that of the claimed maraging steel. The molten steel in D11 is deoxidized by adding magnesium under pressure and thereafter is subjected to a vacuum treatment. Specifically, the process of D11 aims at decreasing the amount of inclusions. However, nothing is taught in D11 about the size of the non-metallic inclusions, the content rate of inclusions having the spinel-form inclusions or consisting of alumina and how to control the amount of these inclusions.

D12, which is prior art under Article 54(3) EPC, has to be considered only with respect to novelty. However, this document fails to disclose maraging steels and is silent on the content rate of the spinel-form and alumina inclusions.

2.3 Given this situation and having regard to Article 12(4) of the Rules of Procedure of the Boards of Appeal of the EPO (RPBA), according to which it is in the Board's discretion to hold inadmissible facts, evidence or requests which were not admitted in the first instance, the Board decides not to admit documents D6 to D12 into the appeal proceedings either.

Hence, only documents D1 to D5 will be considered in the present decision.

3. Admission of the new ground of opposition under Article 100(b) EPC

The ground of opposition under Article 100(b) EPC was not raised by the appellant in its notice of opposition. In the appellant's view, the patent proprietor, in its response dated 17 July 2009 to the statement of the grounds of opposition, itself had admitted that the claimed process was insufficiently described. The new ground of opposition therefore arose from the patent proprietor's response.

Moreover, the new ground of opposition was evident from post-published document D6 originating from the patent proprietor. According to D6, specific parameters must be adhered to in order to obtain the claimed maraging steel. The appellant argued that in this situation and following the considerations given in G 10/91, the opposition division was obliged to introduce the new ground of opposition into the proceedings on its own motion.

3.1 It is evident from point 3 of the minutes of the oral proceedings held before the opposition division that the late-filed ground of opposition under Article 100(b) EPC was amply discussed with the parties. After deliberation, the chairman announced that this ground was not admitted. A detailed reasoning as to why the late-filed ground under Article 100(b) EPC was held inadmissible was given in point 3 of the impugned decision. After having considered the opponent's arguments and having regard to the considerations given in decision G 10/91, the opposition division held that the patent described at least one way of obtaining the maraging steel composition in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art. The opposition division therefore decided not to admit the newly submitted ground into the opposition proceedings. The Board can see no reason to hold that the opposition division acted inappropriately in this regard.

3.2 The Board concurs with the assessment of the opposition division that the ground of insufficiency of disclosure, if relevant at all, could have been presented during the opposition period since the patent had not been amended and that it could not be derived for the first time from an interpretation of the patent proprietor's submissions in response to the grounds of opposition.

It is true that in point 2 of its response of 17 July 2009, the patent proprietor explained that the claimed steel was not obtained simply by specifying a specific amount of Mg and vacuum remelting the consumable electrode. In fact, other concomitant factors including the contents of inclusion-forming elements such as

oxygen and nitrogen, the size and shape of the non-metallic inclusions contained in the consumable electrode and the rate of decomposition and crystallisation of the inclusions during remelting the consumable electrode could affect the final state of the inclusions in the maraging steel.

It is, however, to be noted that the examples given in the patent specification in paragraphs [0080] to [0087] and Table 1 describe in detail all the process steps for (a) producing the vacuum induction melted consumable electrode and (b) of the VAR step. As regards the VIM first step, the description mentions control of the size of Ti-carbonitride inclusions such as TiCN and TiN (not more than 10 μm), the cast rate (2.5), the coagulation speed and the nitrogen content (15 ppm) in the raw material (paragraphs [0081] to [0085]). Turning to the VAR second step, the degree of vacuum (1.3 Pa) and the projection current (6.5 KA) when remelting the consumable electrode during VAR are described. In addition, the chemical compositions of the consumable electrodes produced (a) by VIM and (b) of the steels obtained by VAR are listed in detail in Table 1. Contrary to the appellant's arguments, the patent specification therefore describes in detail the concrete process parameters of the method which enable the skilled person to put into practice the maraging steel defined in claims 1 and 2.

- 3.3 The appellant further alleged that the person skilled in the art could not produce the claimed steel without knowing the specific process conditions disclosed in document D6 which dealt with the same technical field.

However, document D6 was filed and published after the priority date of the present patent at issue and appears to be concerned with a further development of the process claimed in the patent at issue. Therefore, this document does not represent prior art under Article 54 EPC and, in consequence thereof, is not relevant to the present patent.

3.4 Given that the appellant's arguments are unfounded, the opposition division exercised its discretion correctly not to admit the new ground of opposition into the opposition proceedings. For the same reasons, the Board decides not to admit the new ground of opposition under Article 100(b) EPC into the appeal proceedings as well.

4. Novelty; Article 100(a) EPC

The appellant argued that the subject matter of claim 1 lacked novelty with respect to any of documents D1 to D3. For the following reasons, the Board cannot agree with the appellant's assessment.

4.1 Although the NiCoMo steel composition referred to in document D1, page 3, last paragraph, could optionally include 0 to 250 ppm Mg, none of the examples actually comprises magnesium as an alloying element which is required to be present in the claimed steel in amounts of greater than 0 but less than 10 ppm. Moreover, no information whatsoever is found anywhere in D1 about the size of the nitride and oxide inclusions and on the content rate of the spinel-form inclusions, as required in the claimed maraging steel.

As to the appellant's argument that example 9 of the patent at issue comprised 11 ppm Mg and fell outside the claimed range of greater than 0 and less than 10 ppm Mg, reference is made to paragraphs [0066] and [0067] of the patent specification. There, the skilled reader is taught that from the viewpoint of toughness magnesium should be restricted to less than 15 ppm, with less than 10 ppm Mg being preferred according to originally filed claims 5 and 6.

- 4.2 D2, like D3, discloses neither the type and size of the nitride and oxide inclusions nor the content rate of the spinel-form and alumina inclusions. Both documents remain silent on the low levels for oxygen and nitrogen that are necessary to control the amount of the non-metallic inclusions in the claimed steel.

The Board therefore concurs with the assessment of the opposition division that the subject matter of claim 1 is novel over any of documents D1 to D3.

- 4.3 As already pointed out in point 2.2. of this decision, the claimed subject matter is not anticipated by the technical disclosure of documents D11 and D12 either. Therefore, these documents are disregarded.

5. Inventive step; Article 100(a) EPC

The appellant argued that the claimed subject matter was obvious from D1, taken individually, or in combination with D3 or D5.

- 5.1 In fact, document D1 discloses the composition of a maraging steel comprising not more than 0.15% C, 14 to

22% Ni, 12 to 25% Co, 2 to 4% Mo, 0 to 0.4% Ti (preferably 0.05 to 0.2%), 0 to 0.4% Al, 0 to 0.025% Mg, up to 0.04% N (preferably less than 250 ppm N), oxygen as low as possible, the balance being Fe and incidental impurities (D1, pages 3 and 4). However, D1 remains silent on the cleanliness of the steel, in particular on the minimization or even elimination of non-metallic inclusions having a certain shape and structure.

As correctly pointed out by the appellant, the objective problem to be solved by the patent at issue, when starting from the technical disclosure of D1, resided in improving the steel's resistance to fatigue.

However, no pointer is found anywhere in D1 that by adding more than zero and less than 10 ppm Mg to the steel while simultaneously restricting the contents of oxygen and nitrogen to less than 10 ppm O and less than 15 ppm N the size and amounts of the non-metallic oxide and nitride inclusions were significantly reduced and that, in consequence thereof, the maraging steel exhibits a superior fatigue strength. This is all the more true since none of the examples in Table II of D1 even includes magnesium at all and defines the amounts of dissolved oxygen and nitrogen.

Document D3 is concerned with electroslog melting, refining and continuous casting of - amongst many other steels - maraging steels comprising 18 Ni. However, also D3 fails to give any hint or suggestion towards the problem to be solved by the patent at issue. In particular, on the basis of the technical teaching given in this document, the skilled person would not be prompted to add magnesium to the steel and to control

the levels of oxygen and nitrogen within the claimed range so that the shape and amount of the non-metallic oxide and nitride inclusions in the steel is restricted to the range defined in claim 1 of the patent at issue.

D5 relates to producing maraging steels by vacuum induction melting a consumable electrode which in a second process step is re-melted by VAR (D5, page 4, lines 26 to 32). Contrary to D1 and also to the patent at issue, D5 aims at providing a cobalt-free maraging steel comprising up to 0.05% C, 0.5 to 4% Mo, 16.5 to 21% Ni, 1.25 to 2.5% Ti, up to 1% Al, balance Fe and incidental elements (D5, claim 1). Apart from Al, other deoxidising agents such as Zr, B, Ca and Mg could be added without, however, giving specific examples. Moreover, nothing is taught in D5 about the fatigue properties, the cleanliness of the steel and the specific effects of Mg, N and O on the formation of non-metallic inclusions. There is no reason to pick features from document D5 to associate with the teaching of D1 and even if this were done, the subject matter of claim 1 of the patent at issue would not be reached. Consequently, the subject matter of claim 1 is not obvious from the combination of technical teaching given in D5 and D1.

5.2 Hence, neither D1 taken individually or in combination with D3 nor the teaching given D5 combined with that of D1, respectively, would lead in an obvious way to the claimed maraging steel and its non-metallic inclusion chemistry.

5.3 It is further noted that the combination of documents D1 or D2, respectively, with document D11, also

referred to by the appellant, would not lead to the claimed maraging steel either. Contrary to the technical teaching of document D1 disclosing the optional addition of 0 to 0.025% Mg, or to D2 which discloses the addition Ca and/or Mg in the range of 0.001 to 0.1% to improve the maraging steel's resistance to stress corrosion cracking, document D11 teaches to add calcium and/or magnesium under pressure as a deoxidation agent which is in the following vacuum treatment completely removed by vaporisation. Hence, the skilled person had no reason to combine the teaching of D1 or D2, respectively, with that of D11 and even if he did, the claimed steel composition would not be reached.

5.4 Consequently, the subject matter of claim 1 involves an inventive step.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

V. Commare

T. Kriner