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**Datasheet for the decision
of 4 July 2011**

Case Number: T 1415/09 - 3.2.08

Application Number: 04709120.2

Publication Number: 1597404

IPC: C22C 38/40

Language of the proceedings: EN

Title of invention:

Fine-grained martensitic stainless steel and method thereof

Applicant:

Advanced Steel Technology LLC

Headword:

-

Relevant legal provisions:

EPC Art. 54, 56, 84, 123(2)

EPC R. 139

Relevant legal provisions (EPC 1973):

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Keyword:

"Amendments - added subject-matter (no)"

"Novelty (yes) - after amendment"

"Inventive step (yes) - after amendment"

Decisions cited:

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Catchword:

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Case Number: T 1415/09 - 3.2.08

D E C I S I O N
of the Technical Board of Appeal 3.2.08
of 4 July 2011

Appellant: Advanced Steel Technology LLC
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Representative: Hedley, Nicholas James Matthew
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 13 February 2009
refusing European patent application
No. 04709120.2 pursuant to Article 97(2) EPC.

Composition of the Board:

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

Summary of Facts and Submissions

- I. By its decision posted 13 February 2009, the examining division refused European patent application 04709120.2.

With respect to claim 1 of the main request and the auxiliary request then on file, the examining division raised objections under Articles 123(2), 54 and 56 EPC. In particular the subject matter of claim 1 of both requests was held to lack novelty over the disclosure of document

D2: R. L. Klueh et al.: "A potential new ferritic/martensitic steel for fusion applications", Journal of Nuclear Materials 283 - 287 (2000), pages 697 to 701.

The examining division inter alia held that a punctual overlap for Ni existed between the composition of steel A-21 in D2 comprising 1% Ni and the claimed steel comprising more than 1% to less than 7% Ni. Based on the same reasoning, the hot working temperature range of 700 to 1000°C disclosed in document D2 was held to overlap with the claimed temperature range of higher than 1000°C for hot working. Moreover, the strain rate of the process known from D2 was rated to fall within the claimed range of at least 15%, because such a true strain resulted from a thickness reduction of 2.6 mm of the initial 17.5 mm thick plate of D2 which was quite common when hot working such products.

Even if novelty were accepted, the subject matter of claim 1 of both requests was held to lack inventive step vis-à-vis the technical teaching of document D2

combined with the general knowledge of a skilled person. Starting from D2 and faced with the problem of improving the steel's strength and toughness, the person skilled in the art would consider modifying the parameters of the thermomechanical treatment of D2 and thereby would, as one alternative parameter, also consider the deformation rate (strain rate) during hot deformation and optimize the strain rate.

- II. The appellant (applicant) lodged an appeal against the decision of the examining division, which was received at the European Patent Office on 10 April 2009. The appeal fee was paid on the same date.

The statement setting out the grounds of appeal was received on 23 June 2009.

In addition to document D2, the appellant referred to the following documents:

D3: K. J. Irvine et al.: "The physical metallurgy of 12% chromium steels", Journal of The Iron and Steel Institute, August 1960, pages 386 to 405;

D4: ASTM Designation E112 - 96 (Reapproved 2004): Standard Test Methods for Determining Average Grain Size, page 1 to 24.

- III. In response to the Board's provisional opinion given in the official communication annexed to the summons to oral proceedings, the appellant enclosed with its letter dated 15 June 2011 amended sets of claims according to the main and the first to third auxiliary requests.

A revised description which was adapted to the amended claims was submitted with the appellant's letter dated 22 June 2011.

IV. The appellant requested that

- the decision under appeal be set aside and
- the patent be granted on the basis of the claims 1 to 6 according to the main request submitted on 15 June 2011 or, alternatively, on the basis of the claims 1 to 6 according to one of the first to third auxiliary requests, all submitted on 15 June 2011.

Oral proceedings were requested, should the Board not follow the above requests.

Claim 1 of the main request reads as follows:

" A method of producing an alloy comprising:
preparing an alloy comprising (wt%):
greater than 0.05% and less than 0.15% C;
greater than 7.5% and less than 15% Cr;
greater than 1% and less than 7% Ni;
less than 10% Co;
less than 5% Cu;
less than 5% Mn;
less than 1.5% Si;
less than 4%(Mo + W);
greater than 0.01% and less than 0.75% Ti;
less than 0.2% Al, wherein (Al + Si + Ti) > 0.01%;
less than 2% V;
less than 0.1% N;

0.135% < (1.17 Ti + 0.6 Nb + 0.6% Zr + 0.31 Ta + 0.31 Hf) < 1 %;
less than 0.05% S;
less than 0.1% of each member of the group consisting of Ca, Ce, Mg, Sc, Y, La, Be, and B;
less than 0.1% of each member of the group consisting of P, Sn, Sb, Pb, O and other impurities; and
the balance Fe;
thermal mechanically treating by austenitizing the alloy at a temperature greater than 1000°C
hot working the alloy at a temperature greater than 1000°C to impart a true strain of greater than 0.15 (15%); and
cooling the alloy to room temperature to obtain a fine-grained martensitic microstructure in which the ASTM grain size number is greater than or equal to 5, wherein the alloy comprises secondary MX particles."

The auxiliary requests are not relevant to the present decision.

V. The appellant's arguments can be summarized as follows:

In revised claim 1, the elemental ranges of the claimed alloy composition, all expressed in wt%, were based on claims 126, 127 and paragraph [00069] of the application as originally filed. Hence the subject matter of claim 1 complied with the requirement of Article 123(2) EPC.

As to the novelty of the process set out in claim 1, document D2 did not describe an alloy comprising more than 1% Ni and did not disclose a hot working temperature greater than 1000°C to impart a true strain

of greater than 0.15 (15%) as did the claimed method. Moreover, the cooling step to obtain a fine-grained martensitic microstructure having an ASTM grain size number greater than or equal to 5 was not disclosed in D2.

With respect to inventive step, the skilled person putting into practice the technical teaching of D2 had no motivation to increase the Ni-content in this steel composition above 1%, since doing so resulted in a decrease of the A_{c1} point which would limit the maximum operation temperature to less than 650°C and, in consequence thereof, make the steel incompatible with the intended use for fusion application. Moreover, there was no inducement in document D2 to increase the hot working temperature to above 1000°C.

The present claims therefore met the requirements of Article 123(2), 54 and 56 EPC.

Reasons for the Decision

1. The appeal is admissible.
2. Amendments; Article 123(2) EPC, Article 84 EPC:
 - 2.1 The subject matter of claim 1 is supported by the original claims 116, 126, 127 and by the technical information given in paragraphs [00058], [00059] and [00063] of the published application (WO-A2-2004/072308; in the following cited as WO-A2 publication)

Claims 2 to 6 are supported by paragraph [00075] of the WO A2 publication.

2.2 With respect to clarity, claim 1 clearly defines the process parameters of the steps to be carried out. It also defines the elemental ranges of the composition of the stainless steel alloy which are all given in wt%. The same statement applies to the dependent claims 2 to 6.

2.3 Consequently, there are no formal objections to the amended claims under Article 123(2) and 84 EPC.

3. Novelty; Article 54 EPC:

3.1 Document D2 describes a stainless steel alloy called A-21 consisting of (in wt %) Fe-9.5%Cr-3Co-1Ni-0.6Mo-0.3Ti-0.07C that was produced as 17.5 mm thick plate and austenitized at a temperature higher than 1100°C to dissolve the carbides. The austenitization step was followed by cooling to an intermediate temperature ranging from 700 to 1000°C and hot working the steel in the austenitic condition. After hot-working, the steel was cooled to ambient temperature to transform the matrix to martensite. Finally, the steel was tempered in the temperature range of 650 to 750°C for one hour. Optical microscopy indicated that the steel had a 100% martensite structure with a prior austenite grain size of 5 to 15 µm including titanium carbide (TiC) precipitates. The TiC particle size varied from about 5 to 20 nm (D2, paragraph 2: experimental procedure; and paragraph 3.1: Results- Microstructure).

3.2 The method set out in claim 1 of the present application differs from the disclosure of document D2 in that the alloy produced according to the claimed method

- (i) comprises nickel in amounts ranging from greater than 1% to less than 7%;
- (ii) is hot worked at a temperature higher than 1000°C to impart a true strain of greater than 0.15 (15%) and
- (iii) exhibits a martensitic microstructure obtained after cooling to ambient temperature having an ASTM grain size number ≥ 5 .

It is noted that the process set out in claim 1 excludes using a steel alloy comprising 1% Ni. Rather more, claim 1 explicitly defines the presence of Ni in amounts of more than 1% to less than 7% in the martensitic steel. It is, therefore, concluded that there is no punctual overlap at 1% Ni.

In addition, the claimed method excludes hot working at a temperature of 1000°C or below. Contrary thereto, the teaching of document D2 unambiguously requires cooling the austenized alloy down to an intermediate temperature ranging from 700 to 1000°C, and working the steel within that range rather than hot working the alloy above 1000°C, as does the claimed method. Also in this respect, the claimed method is clearly distinguished from the prior art D2.

Moreover, D2 fails to disclose any specific information about the true stain imparted by the hot working step, contrary to the claimed method which requires to impart a true strain of greater than 0.15 (15%) during hot working.

As to the microstructure, D2 mentions a prior austenite grain size of 5 to 15 μm in the tempered martensite, but remains silent about the actual grain size of the martensite structure. In view of the appellant's argument based on document D4, page 3, paragraph 4.4, dealing with the estimation of the average grain size in heavily cold worked material, it remains undemonstrated whether the grain size given in D2 and that obtained by the claimed process are identical or even comparable after hot working the steel at different temperature levels.

Given the above mentioned technical differences, the subject matter of claim 1 is novel over the technical disclosure of document D2.

4. Inventive step; Article 56 EPC:

4.1 Document D2 aims at providing a high chromium martensitic stainless steel exhibiting at temperatures higher than 600°C , a high Charpy impact toughness, a high strength and high creep-rupture properties (D2, abstract). To this end, the A-21 steel composition is strengthened by a fine distribution of TiC precipitates formed by thermomechanical treatment between 700 to 1000°C . The properties of the A-21 steel obtained by this treatment are to allow for a significantly higher operation temperature (e.g. $>650^{\circ}\text{C}$) of a fusion power plant (D2, Abstract; section 1, Introduction, in particular last paragraph; section 4, first paragraph and section 5, Summary and conclusion).

4.2 By contrast, the claimed method aims at providing a martensitic stainless steel whose carefully balanced composition results, after a thermal treatment and hot working at temperatures above 1000°C, in a fine-grained microstructure exhibiting good tensile properties at room temperature, a high impact toughness at low temperature and a good corrosion resistance at elevated temperatures (WO-A2 publication, paragraph [00028]).

Bearing in mind the different objects addressed in D2 and the present application (improvement of the high temperature properties versus good mechanical properties at low temperatures but improved corrosion resistance at high temperature), document D2 fails to give any suggestion towards the problem to be solved by the method claimed in the present application. No reason whatsoever or clear inducement is found anywhere in this document, taken individually or in combination with the basic knowledge of a person skilled in the art, (i) to increase the Ni-content to fall within a range above 1% to less than 7% and (ii) to raise the temperature of the hot working step to above 1000°C as set out in claim 1 in order to obtain the above mentioned balance of mechanical and anti-corrosion properties. Moreover, the examples demonstrate that this problem is solved by the method according the invention.

4.3 Given this situation, the process set out in claim 1 involves an inventive step with respect to the technical disclosure of document D2 taken individually or in combination with the background knowledge of a person skilled in the art.

Dependent claims 2 to 6 relate to preferred embodiments of the method set out in claim 1 and are, therefore, also allowable.

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 first instance with the order to grant a patent on the basis of claims 1 to 6 of the main request submitted on 15 June 2011 and to adapt the description accordingly.

The Registrar:

The Chairman:

V. Commare

T. Kriner