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Datasheet for the decision of 29 March 2011

Case Number: T 1160/09 - 3.2.08

Application Number: 03258048.2

Publication Number: 1437421

IPC: C22C 1/10

Language of the proceedings: EN

Title of invention:
Method for producing a titanium-base alloy having an oxide dispersion therein

Applicant:
GENERAL ELECTRIC COMPANY

Headword:
-

Relevant legal provisions:
EPC Art. 54(3), 56, 123(2)

Relevant legal provisions (EPC 1973):
EPC Art. 87

Keyword:
"Novelty (yes) after amendment"
"Inventive step (yes) after amendment"

Decisions cited:
-

Catchword:
-

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Case Number: T 1160/09 - 3.2.08

D E C I S I O N
of the Technical Board of Appeal 3.2.08
of 29 March 2011

Appellant: GENERAL ELECTRIC COMPANY
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 4 December 2008 refusing European patent application No. 03258048.2 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman: T. Kriner
Members: R. Ries
A. Pignatelli

Summary of Facts and Submissions

I. By its decision dated 4 December 2008 the examining division refused European patent application No. 03 258 048.2 on the ground of lack of novelty of the subject matter of claim 1 then on file over the technical disclosure of document

D1: WO-A-03/106080.

The examining division held that US patent application number US 10/329,143 filed on 23 December 2002, on which the priority right claimed for the present application is based, related to the same subject matter as the subject matter disclosed in the priority document US 10/172,217 dated 14 June 2002 for document D1 published on 24 December 2003. As a result, the priority document US 10/329,143 was not regarded as being the first application for claiming a right of priority and thus could not serve as a basis for claiming a valid priority right (Article 87 EPC 1973). The filing date of the present European patent application was consequently 19 December 2003 and, therefore, document D1 was held to belong to the state of the art as defined under Article 54(3) EPC. Since document D1, in particular claims 12 and 17 in combination with pages 11 and 12, were found to anticipate the method set out in claim 1 then on file, the application was refused.

In the additional remarks not forming part of the decision, the examining division also regarded the subject matter of claims 1 to 5 then on file as

deprived of novelty by the technical disclosure of document

D2: US-A-4 373 947.

Moreover, the article set out in claims 9 and 10 then on file was found to be anticipated by the disclosure of document

D3: US-A-5 409 518.

II. The appellant (applicant) lodged an appeal against the decision of the examining division, which was received at the European Patent Office on 23 February 2009 and the appeal fee was paid on the same date. The statement setting out the grounds of appeal was received on 20 April 2009.

III. In response to the Board's official communications, the appellant submitted a revised set of claims and a description adapted thereto.

The appellant requested that the decision of the examining division be set aside and a patent be granted on the basis of:

Claims 1 to 3 submitted with letter dated 17 March 2011;

Description:

pages 1, 6 to 9, 14 and 15 as originally filed;
pages 2 to 5, 10 to 13 and 16 submitted with letter dated 17 March 2011;

Figures: 1/3 to 3/3 as originally filed.

The appellant withdrew its request for oral proceedings in its letter dated 17 March 2011, should the present claims be allowable.

Independent claim 1 reads as follows:

"1. A method for producing a gas turbine engine component (80) made of constituent elements in constituent-element proportions, comprising the steps of:
furnishing at least one nonmetallic precursor compound, wherein all of the nonmetallic precursor compounds collectively contain the constituent elements in their respective constituent-element proportions, wherein the constituent elements comprise:

a titanium-base alloy, and

a stable-oxide-forming additive element selected from the group consisting of magnesium, calcium, scandium, yttrium, lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium, and mixtures thereof, and wherein at least one additive element is present at a level greater than its room-temperature solid solubility limit in the titanium-base alloy;

chemically reducing the precursor compounds while controlling the oxygen content to produce an alloy material, without melting the alloy material, and reacting the stable-oxide-forming additive element with oxygen to form a stable oxide in the titanium-based alloy;

consolidating the alloy material to produce a gas turbine engine component (80), without melting the

alloy material and without melting the gas turbine engine component (80)."

Dependent claims 2 and 3 relate to preferred embodiments of the process set out in claim 1.

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

Revised claims 1 to 3 recited that the component produced by the claimed process was a gas turbine engine component and that the additive oxide-forming element produced a stable oxide dispersion within the titanium alloy-based gas turbine engine component. This was achieved in particular by controlling the oxygen content during the reducing step.

None of the cited documents disclosed a wholly meltless process in which a stable oxide dispersion was provided within a titanium alloy-based gas turbine engine component with a view to addressing the problem of reducing the instance of alpha phase formation and improving the mechanical properties.

Novelty and inventive step were therefore given.

Reasons for the Decision

1. The appeal is admissible.

2. Amendments; Article 123(2) EPC:

The subject matter of present claim 1 results from the combined subject matter of original claims 1 and 4 and

the technical disclosure given on page 7, first full and last paragraphs, and Figure 5 of the application as filed. The technical features of the revised claims fully comply with those given in the priority document US 10/329,143 dated 23 December 2002. Reference is made to claims 1 and 4, paragraphs [0013], [0020], [0026] and Figure 5 of the priority document US 10/329,143.

The description has been adapted to the wording of the revised claims and includes an acknowledgement of the relevant prior art (document D1).

Hence, there are no formal objections to the present claims and the description under Article 123(2) EPC.

3. The present application:

3.1 The application under consideration relates to the preparation of titanium-based alloy gas turbine engine components such as compressor and fan disks which are essentially free of mechanical defects, such as cracks and voids, and chemical defects, such as hard alpha defects (low-density inclusions) and high density inclusions. These components are required to exhibit a good combination of mechanical properties, in particular high creep strength, in the temperature range up to about 700°C (1300°F), a good resistance to environmental damage from oxidation and low incidence of defects (the application as filed, page 1, paragraph 4 to page 2, second full paragraph).

These objectives are achieved by the claimed process, in particular by controlling the oxygen content during the step of reducing the non-metallic precursor

compound mixture. As this is done, the oxygen reacts with the stable forming additive elements, which are present at a level greater than the room temperature solubility limit in the titanium base alloy, to produce a substantially uniformly distributed oxide dispersion in the metallic alloy matrix (the application as filed, page 4, last paragraph to page 5, line 5).

4. Priority right; disclosure of document D1:

4.1 Article 87 EPC (1973) makes clear that only the first application filed, in or for a State party to the Paris Convention can serve as a basis for claiming a right of priority. If, apart from the application whose priority is being claimed in the subsequent European application, an earlier previous application was also filed, it must be established whether the invention claimed in the subsequent application was disclosed in the earlier application, which would render a priority based on the later previous application invalid. The question is whether the person skilled in the art can derive the subject matter of the claim of the subsequent application directly and unambiguously, using common general knowledge, from the previous application or only from the later one.

4.2 Document D1 as well as its priority document US 10/172,217 disclose a method of preparing an article made of titanium alloyed with an alloying element for producing a gas turbine engine component, the method comprising the steps of

(a) providing a chemically reducible non-metallic precursor compound of a titanium-base metal

(b) providing a chemically reducible non-metallic alloying element precursor compound that is thermophysically melt-incompatible with the Ti-base metal;

(c) mixing the base-metal precursor compound and the alloying-element precursor compound to form a compound mixture; thereafter

(d) chemically reducing the non-metallic precursor compound mixture to produce an alloy material without melting the alloy material;

(e) consolidating the alloy material to produce a gas turbine engine component without melting the metallic article (D1, page 8, first paragraph; claim 12).

Although document D1 describes the addition of thermophysically melt-incompatible alloying elements such as cerium, gadolinum, lanthanum and neodymium as well as calcium, this document fails to disclose the step of controlling the oxygen content while reducing the mixture of the non-metallic precursor compound mixture to provide a stable oxide dispersion in the Ti-base alloy matrix. As a preferred embodiment, claim 16 of D1 teaches that, during the reduction step, the reducible non-metallic alloying elements chemically react with titanium in a liquid phase to form chemical compounds including Ti and the alloying element. As an example, document D1 discloses the formation of a finely divided dispersion of lithium and calcium in titanium (D1, page 11, last paragraph to page 12, first and third paragraphs).

4.3 The step of controlling the oxygen content while chemically reducing the non-metallic precursor compound mixture to a metallic alloy to provide a substantially uniformly distributed stable oxide dispersion in the titanium alloy matrix, as clearly set out in paragraphs [0013], [0020], and claim 4 of the priority document US 10/329 143 for the present application, is neither implicitly nor explicitly found anywhere in document D1 or its priority document US 10/172,217. Hence, the subject matter of claim 1 of the present application cannot be derived directly and unambiguously from the disclosure of document D1.

4.4 It is therefore concluded that the priority claimed for the present application is valid.

5. Novelty:

In view of above made considerations, the claimed process is clearly distinguished from the technical disclosure of D1 and, therefore, novel.

5.1 Document D2 discloses a process for preparing titanium-based alloy powders by the calcio-thermal reduction of oxides of the metals forming the alloy in the presence of neutral additives. In a first step, TiO_2 is mixed with the other components of the alloy, admixing an alkaline earth oxide or carbonate with the metal oxides and calcining the mixture. After cooling, the mixture is crushed and calcium is added in relation to the oxygen content of the oxides to be reduced (D2, abstract and column 3, lines 14 to 54). After heating, the mixture is leached to remove the calcium oxide. The Ti-alloy powder obtained is of a uniform structure and

composition, and the alloy is free of segregations of oxides, nitrides or carbides. The Ti-alloy powders of such uniformity and purity are suitable for the manufacture in the aircraft industry of parts which withstand high mechanical stresses (D2, column 2, lines 41 to 57).

The process of D2 does not comprise the step of controlling the oxygen content during the reducing step to provide a stable oxide dispersion in the Ti-base alloy. D2 further teaches that, during and after the reducing step, the melt temperature of the alloy is briefly exceeded. As a consequence and supported by the molten liquid calcium chloride and the action of the surface tension, particles of the alloy are formed in the desired form of an approximately spherical shape (D2, column 5, lines 20 to 26). D2 does not teach that the resulting Ti-based alloys comprise a uniformly distributed stable oxide dispersion (D2, column 5, line 67 to column 6, line 10). Hence, the claimed process is also novel over the technical disclosure of document D2.

5.2 Document D3 (cited by the examining division against product claims 9 and 10 then on file, which were subsequently cancelled) discloses a sintered Ti alloy comprising inter alia IIa group (Mg, Ca, Sr) and IIIa group elements (Sc, Y Ce) and having a three phase microstructure of alpha phase, beta phase and oxide particles (see D3, column 8, lines 24 to 34). The process of D3 aims at producing a composite material having good strength, ductility, stiffness and resistance to wear and heat (D3, column 23, lines 8 to 15).

The claimed process differs from the disclosure of this document in that the process of D3 starts from a metallic titanium powder which is mixed with a mother alloy powder for solid solution hardening, containing at least two metallic elements, and a boron powder. The mixture is then compacted and the green compact is sintered without pressure (D3, column 9, lines 47 to 63; column 11, lines 3 to 46; column 19, lines 19 to 26). The final product results in a titanium alloy comprising TiB particles and oxide particles so as to enhance the strength of the sintered alloy (D3, claims 1 and 3).

Consequently, the claimed process is also novel over D3.

6. Inventive step:

Given that, on the one hand, document D2 is concerned with the production of a titanium alloy powder which is free from segregations of oxides, carbides and hydrides and, on the other hand, document D3 relates to a sintered Ti alloy article comprising TiB and oxides dispersed therein, there is no reason to pick features from this document to associate with the teaching of document D2.

Even if this were done, the subject matter of claim 1 would not be reached since neither of these documents discloses the step of controlling the oxygen content while reducing the mixture of non-metallic precursor compounds to provide a uniform dispersion of oxides in the Ti alloy powder.

Consequently the subject matter of claim 1 also involves an inventive step within the meaning of Article 56 EPC.

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 the following documents:

   Claims 1 to 3 submitted with letter dated 17 March 2011;

   Description:
   pages 1, 6 to 9, 14 and 15 as originally filed;
   pages 2 to 5, 10 to 13, and 16 submitted with letter dated 17 March 2011;

   Figures: pages 1/3 to 3/3 as originally filed.

The Registrar: The Chairman:

V. Commare T. Kriner