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Datasheet for the decision of 4 May 2022

Case Number: T 0604/21 - 3.3.05

Application Number: 15184357.0

Publication Number: 2995695

IPC: C22C14/00, C22F1/18

Language of the proceedings: EN

Title of invention:
METHOD FOR PROCESSING TITANIUM ALUMINIDE INTERMETALLIC COMPOSITIONS

Patent Proprietor:
General Electric Company

Opponent:
Raytheon Technologies Corporation

Headword:
titanium aluminide intermetallic compositions/GENERAL ELECTRIC

Relevant legal provisions:
EPC Art. 56

Keyword:
Inventive step - main request (yes)

Decisions cited:

Catchword:

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Case Number: T 0604/21 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 4 May 2022

Appellant: (Opponent)	Raytheon Technologies Corporation Pratt & Whitney 400 Main Street East Hartford, CT 06118 (US)
Representative:	Dehns St. Bride's House 10 Salisbury Square London EC4Y 8JD (GB)
Respondent: (Patent Proprietor)	General Electric Company 1 River Road Schenectady, NY 12345 (US)
Representative:	Hoffmann Eitle Patent- und Rechtsanwälte PartmbB Arabellastraße 30 81925 München (DE)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 9 March 2021 rejecting the opposition filed against European patent No. 2995695 pursuant to Article 101(2) EPC.**

Composition of the Board:

Chairman	P. Guntz
Members:	T. Burkhardt
	S. Besselmann

Summary of Facts and Submissions

I. The opponent's (appellant's) appeal is against the opposition division's decision to reject the opposition against European patent No. EP 2 995 695 B1.

II. The following documents were among those discussed at the opposition stage:

D1 US 2008/0041506 A1
D2 US 7,704,339 B2

III. Independent claim 1 of the main request (patent as granted) reads as follows:

"1. A method of processing a titanium aluminide intermetallic composition based on a TiAl intermetallic compound to yield a duplex microstructure containing equiaxed and lamellar morphologies of the gamma TiAl phase, the method comprising:

hot isostatic pressing the titanium aluminide intermetallic composition;
cooling the titanium aluminide intermetallic composition;
heat treating the titanium aluminide intermetallic composition at a temperature of at least 1260°C for 2.5 to 5 hours;
cooling the titanium aluminide intermetallic composition to a temperature of not less than 1150°C;

holding the titanium aluminide intermetallic composition at a hold temperature of 1150 to 1200°C for a duration of two to six hours; and then cooling the titanium aluminide intermetallic composition to room temperature;
wherein the titanium aluminide intermetallic composition exhibits the duplex microstructure following the step of cooling the titanium aluminide intermetallic composition to room temperature; and

wherein the titanium aluminide intermetallic composition consists of titanium and aluminum in amounts to yield the TiAl intermetallic compound, one or more of chromium, niobium and tantalum, and incidental impurities."

Dependent claim 2 relates to a preferred embodiment.

IV. In the appellant's view, the subject-matter of claim 1 of the patent as granted lacks inventive step in view of D2 in combination with D1 (Article 56 EPC).

V. In a communication under Article 15(1) RPBA 2020, the parties were informed of the board's preliminary opinion that the appeal would probably be dismissed.

VI. The appellant requests that the decision under appeal be set aside and the patent in suit be revoked.

The patent proprietor (respondent) requests that the appeal be dismissed. In the alternative, the respondent requests that the patent be maintained in amended form on the basis of one of seven auxiliary requests as submitted with the reply to the statement setting out the grounds of appeal.

VII. Oral proceedings were conducted on 4 May 2022, at the end of which the following decision was announced.

Reasons for the Decision

Main request (claims as granted)

1. Inventive step

In the appellant's view, the subject-matter of claim 1 lacks inventive step in view of D2 as the closest prior art in combination with D1.

However, as set out below, the main request does meet the requirements of Article 56 EPC.

1.1 The invention relates to a method for processing a titanium aluminide intermetallic composition.

1.2 In the appellant's view, D2 is to be considered the closest prior art.

D2 relates to a method of processing a titanium aluminide intermetallic composition (column 1, lines 6 to 8).

With reference to Figure 2 and column 6, lines 10 to 55, D2 indicates that a "duplex microstructure" is yielded (see in particular lines 49 and 50).

The method comprises the following steps:

- heat treating (in the following called "first heat treating step") of the titanium aluminide intermetallic composition at a temperature T1 about 20°C to 30°C above the alpha transus temperature for up to 2 hours (see the heating to and maintaining at T1 in Figure 2 as well as column 6, lines 35 to 38)

The alpha transus temperature lying between 1310°C and 1320°C (column 3, lines 35 and 36, and column 5, lines 29 and 30), T1 is hence within the claimed range of at least 1260°C.

- cooling the composition to a temperature T2 of about 900°C to 1200°C (see the quenching to T2 in Figure 2 as well as column 6, lines 38 to 43)

- holding the composition (in the following called "second heat treating step") at a temperature T3 of 30°C to 60°C below the alpha transus temperature - T3 hence being between 1250°C and 1290°C - for up to 4 hours (heating to and maintaining at T3 in Figure 2 as well as column 6, lines 43 to 49), and

- cooling the composition to room temperature (last cooling step in Figure 2 as well as column 6, lines 53 to 55).

Furthermore, the intermetallic composition consists of titanium, aluminium and tantalum (column 6, lines 12 to 14).

Preferably, hot isostatic pressing (HIP) is carried out in D2 to remove porosity from the cast, preferably concurrently with the second heat treating step (i.e. step (e) in D2), when "alpha plates in the massively

transformed gamma microstructure" precipitate (column 4, lines 4 to 7, column 6, lines 28 to 33, and column 7, line 61, to column 8, line 3).

The respondent contests the view that D2 can be considered the closest prior art, mainly because the duplex structure of D2 is allegedly different from the claimed microstructure with "equiaxed and lamellar morphologies of the gamma TiAl phase".

However, since D2 also relates to a TiAl intermetallic composition with a duplex microstructure and since it has numerous features in common with the subject-matter of claim 1 of the patent in suit, it is an appropriate starting point for assessing inventive step.

Whether the duplex structure of D2 really contains "equiaxed and lamellar morphologies of the gamma TiAl phase" as claimed is not decisive, since an inventive step can be acknowledged in any case, as will be explained below.

1.3 According to the patent in suit, the technical problem to be solved is to reliably obtain the desired duplex microstructure in a method with increased flexibility while also being able to recover the related additional energy needed to some degree (paragraphs [0010] and [0020] of the patent in suit).

1.4 It is proposed to solve this problem by the method of claim 1, characterised by the following features:

- the HIP step is carried out as a distinct, first step of the method and is followed by a first cooling step. As explained above, an HIP step in D2, if present, is instead carried out concurrently with the second heat

treating step. This distinguishing feature has not been disputed. A first cooling step is not disclosed in D2

- a first heat treating step with a duration of 2.5 to 5 hours. The corresponding heating step in D2 to T1 takes up to 2 hours (column 6, line 38). This distinguishing feature has not been contested either

- cooling to a temperature of not less than 1150°C. The corresponding step in D2 cools down the composition to temperature T2 in an overlapping range between 900°C and 1200°C (column 6, lines 38 to 43)

- a second heat treating step at a temperature of between 1150°C and 1200°C for a duration of 2 to 6 hours. By contrast, the corresponding step in D2 takes place at a higher temperature T3 (i.e. between 1250°C and 1290°C) and moreover has an overlapping duration of up to 4 hours (column 6, lines 43 to 49). This distinguishing feature has not been contested either

1.5 For the following reasons, it can be accepted that the problem has been successfully solved.

- Regarding the increased flexibility of the method, by separating the HIP treatment from the second heat treating step, the temperatures of the different method steps can indeed be fixed independently from each other, as explained in paragraph [0020] of the patent in suit with regard to the difference between Figures 4 and 5. Furthermore, a certain amount of the heat liberated in the cooling step following the HIP step can be recovered in the subsequent first heat treating step. The increased flexibility and the possibility of recovering some heat have not been contested.

- Regarding the reliability of obtaining the claimed duplex structure, the respondent explained convincingly that several factors contributed to a reduced risk of not obtaining the desired duplex structure when following the method steps of claim 1:

Firstly, areas of the alloy may have solidified very rapidly after casting. The initial HIP and associated cooling step lead to an equilibration of the cast article before it is submitted to the first heat treating step and thus to improved uniformity of the microstructure (paragraphs [0010] and [0016]).

Secondly, the duration of the first heat treating step of claim 1 is longer than that of D2. This favours reaching equilibrium.

Thirdly, the range of the duration of the second heat treating step of claim 1, while overlapping with that of D2, excludes a duration below two hours, contrary to D2. This also favours reaching equilibrium.

It is thus credible that the claimed process in its entirety provides for better equilibration and thus increased uniformity, and that this in turn increases the reliability of obtaining the desired duplex structure. The appellant has provided no evidence to refute this, e.g. in the form of experimental results.

1.6 The appellant referred to paragraph [0047] of D1 to argue that putting the HIP treatment at the beginning of the method was merely an arbitrary modification.

While that passage indeed mentions the possibility of HIP treatment "before the alloy is heat treated", the

further option of HIP treatment "at the same time as the alloy is aged after quenching" is clearly preferred, as is indicated by the expression "more preferably" and the related advantage that "it dispenses with the requirement for a separate HIP step".

Yet, carrying out the HIP treatment during ageing after quenching precisely corresponds to the second heat treating step of D2 at T3 disclosed in column 6, lines 43 to 49, and in column 4, lines 4 to 7.

Consequently, the skilled person is dissuaded from moving the HIP step to the beginning of the method.

There is also no indication that HIP treatment as a first method step would allow for an increase in the flexibility of the method while the losses of energy remain limited, nor that it would contribute to the equilibration of the cast article.

The skilled person would moreover have to add a first cooling step after the HIP step to arrive at the subject-matter of claim 1 of the patent in suit. However, there is no indication in this regard. Such a cooling step following the HIP step would not be implicit either, since the skilled person could also carry out the HIP step at an intermediate temperature and continue heating to arrive at the temperature of the first heat treating step; in this event, an intermediate cooling step is not necessary.

There is also no indication in the available prior art that increasing the durations of the first and second heat treating steps, the second heat treatment step furthermore involving a different temperature from that

disclosed in D2, increases the reliability of the method to obtain the claimed duplex structure.

1.7 Therefore, the subject-matter of claim 1, and thereby also that of dependent claim 2, involves an inventive step (Article 56 EPC).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

C. Vodz P. Guntz

Decision electronically authenticated