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**Datasheet for the decision
of 10 December 2021**

Case Number: T 0101 / 18 - 3.2.03

Application Number: 07253963.8

Publication Number: 1908856

IPC: C23C4/02, C23C4/10, C23C4/18,
C23C28/00

Language of the proceedings: EN

Title of invention:

Segmented abradable coatings and process(es) for applying the same

Patent Proprietor:

Raytheon Technologies Corporation

Opponent:

Siemens Aktiengesellschaft

Headword:

Relevant legal provisions:

RPBA 2020 Art. 13(2)

EPC Art. 56, 100(b)

Keyword:

Sufficiency of disclosure - enabling disclosure (no) - main request (no)

Amendment to appeal case - suitability of amendment to resolve issues raised (yes)

Inventive step - non-obvious modification

Amendment after summons - exceptional circumstances (yes)

Decisions cited:

T 0172/17, J 0014/19

Catchword:



Beschwerdekkammern

Boards of Appeal

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Case Number: T 0101/18 - 3.2.03

D E C I S I O N of Technical Board of Appeal 3.2.03 of 10 December 2021

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Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted on 30 October 2017 rejecting the opposition filed against European patent No. 1908856 pursuant to Article 101(2) EPC.**

Composition of the Board:

Chairman C. Herberhold
Members: B. Miller
N. Obrovski

Summary of Facts and Submissions

- I. European patent No. 1 908 856 B1 ("the patent") relates to segmented abradable ceramic coatings comprising yttria-stabilised zirconia layers.
- II. An opposition was filed against the patent, based on the grounds of Article 100(b) and (c) EPC and Article 100(a) EPC in conjunction with Article 56 EPC. The opposition division concluded that the patent met the requirements of the EPC and rejected the opposition.
- III. This decision was appealed by the opponent ("the appellant"). In the statement setting out the grounds of appeal it requested that the decision under appeal be set aside and that the patent be revoked. In particular, the appellant contested the sufficiency of disclosure of claims 21 and 22 and the non-obviousness of claim 1 as granted.
- IV. With the summons to oral proceedings, the Board sent a communication pursuant to Articles 15(1) and 17(2) of the Rules of Procedure of the Boards of Appeal (RPBA) 2020 indicating to the parties its preliminary opinion of the case that the subject-matter of claim 1 of the main request involved an inventive step and that the subject-matter of claims 21 and 22 was insufficiently disclosed.
- V. With its submission dated 13 August 2021, the patent proprietor ("the respondent") filed an auxiliary request.

VI. Oral proceedings were held on 10 December 2021 as a videoconference with the agreement of both parties.

At the end of the oral proceedings, the following requests were confirmed by the parties:

The appellant requested that the decision under appeal be set aside and that the patent be revoked.

The respondent requested that the appeal be dismissed and that the patent be maintained as granted (main request) or, alternatively, on the basis of the auxiliary request filed with the submission dated 13 August 2021 and the description and figures of the patent specification.

VII. Evidence cited in the decision

The appellant referred to the following documents, which had already been cited during the opposition proceedings:

D1: EP 0 765 951 A2;
D2: EP 0926 254 A2;
D3: EP 1013795 A1.

VIII. The independent claims of the patent and of the auxiliary request read as follows:

Claim 1:

"A segmented abradable ceramic coating, comprising:
a bond coat layer (24; 46);
at least one segmented 7 weight percent yttria-stabilized zirconia layer (28; 48) disposed upon said bond coat layer;

characterised by further comprising:
at least one 12 weight percent yttria-stabilized
zirconia layer (30; 50) disposed upon said at least one
segmented 7 weight percent yttria-stabilized zirconia
layer."

Claim 6:

"A coated article (20; 40), comprising:
a substrate (22; 42) having at least one surface (24;
44); and
a segmented abradable ceramic coating as claimed in any
preceding claim, wherein said bond coat layer (26; 46)
is disposed upon said at least one surface."

Claim 9:

"A process for applying a segmented ceramic coating on
an article, comprising:

- (i) depositing an amount of bond coat material
sufficient to form a bond coat layer upon at least one
surface of an article (10);
- (ii) depositing an amount of 7 weight percent yttria-
stabilized zirconia sufficient to form a 7 weight
percent yttria-stabilized zirconia layer upon said bond
coat layer (12);
- (iii) heating said article to expand said 7 weight
percent yttria-stabilized zirconia layer and promote
vertical crack propagation therein to form a segmented
7 weight percent yttria-stabilized zirconia layer (14);
- (iv) depositing an amount of 12 weight percent yttria-
stabilized zirconia sufficient to form a 12 weight
percent yttria-stabilized zirconia layer upon said
segmented 7 weight percent yttria-stabilized zirconia
layer to form a coated article (16); and
- (v) heating treating said coated article (18)."

IX. The appellant's arguments can be summarised as follows.

(a) Main request - sufficiency

The patent did not provide any information as to how specifically the heat treatment of the coated article should be performed in order to form a segmented yttria-stabilised zirconia (YSZ) layer having a thickness as defined in claims 21 and 22.

(b) Admittance of the auxiliary request

The auxiliary request was submitted only after the summons to oral proceedings had been issued and thus was late-filed. Hence, it should not be admitted into the proceedings under Article 13(2) RPBA 2020.

(c) Auxiliary request - inventive step

D1 disclosed a segmented abradable ceramic coating comprising a bond coat, a segmented zirconia base coat foundation layer stabilised with 6 to 8 weight percent of yttria, a graded interlayer and an abradable top layer, wherein the latter two comprise a blend of yttria-stabilised zirconia.

The subject-matter of claim 1 differed from the coating of D1 in that the coating comprised a 7 weight percent yttria-stabilised zirconia (7YSZ) layer and a 12 weight percent yttria-stabilised zirconia (12YSZ) layer.

The problem to be solved could be formulated as how a more stable thermal insulation of the ceramic layer can be provided.

Starting from document D1, the skilled person would have consulted D2 or D3, since they both related to thermal insulation coatings for gas turbine parts.

Although D2 referred to an abrasive coating while D1 aimed at an abradable coating, the skilled person would nevertheless have taken D2 into account when starting from D1, since D1 mentioned both abrasive and abradable coatings.

Furthermore, the terms "abradable" and "abrasive" have relative meanings. They do not refer to intrinsic properties associated with a particular material. Thus, the skilled person would not have simply disregarded D2 because of those vague and relative terms.

D2 and D3 described the advantageous properties of a coating layer of 12YSZ and thus provided an incentive for the skilled person to use such a layer to further improve the coating described in D1.

X. The respondent's counter arguments to each of the above points can be summarised as follows.

(a) Main request - sufficiency

The contested patent described in detail in paragraph [0024] how a segmented 7 weight percent yttria-stabilised zirconia layer could be obtained. The further heat treatment step was described in paragraph [0028].

Therefore, the skilled person was able to obtain sufficient information from the patent as to how to perform the process defined in claims 21 and 22 as granted.

(b) Admittance of the auxiliary request

The auxiliary request corresponded to the granted claims, except that claims 21 and 22 had been deleted. Aside from the fact that such a deletion of dependent claims does not constitute an amendment of the appeal case within the meaning of Article 13 RPBA 2020, the auxiliary request clearly and obviously overcame the sufficiency objection without introducing any new issues or points of discussion into the proceedings. The deletion of the dependent claims was therefore not detrimental to procedural economy and instead actually simplified the matters to be discussed.

(c) Auxiliary request - inventive step

The patent and D1 aimed at a segmented abradable ceramic coating. D2, however, related to an abrasive coating for gas turbine blade tips. Although the terms "abrasive" and "abradable" are relative terms, in a technical context they have opposite meanings for the skilled person. Therefore, D2 would not be consulted by the skilled person when starting from D1.

Even if D2 were to be considered by the skilled person, it disclosed, similar to D3, a thermal coating comprising a single layer. Neither D2 nor D3 provided an incentive for the skilled person to use a 12 weight percent yttria-stabilised zirconia layer as the top layer in the multi-layered coating described in D1.

Reasons for the Decision

1. Main request - sufficiency
- 1.1 It is uncontested that a coating comprising a segmented yttria-stabilised zirconia (YSZ) layer can be obtained by the skilled person by using a conventional plasma spray coating process in line with the disclosure in paragraphs [0018] to [0027] of the patent.
- 1.2 Claims 21 and 22 define preferred process steps of the process for applying a segmented ceramic coating on an article as defined in claim 9 as granted.

They read as follows:

Claim 21:

"The process of any of claims 9 to 20, wherein heat treating said coated article (18) comprises forming a segmented 7 weight percent yttria-stabilized zirconia layer having a thickness of about 1 mil (0.0254 mm) to about 60 mils (1.524 mm)."

Claim 22:

"The process of any of claims 9 to 21, wherein heat treating said coated article (18) comprises forming a segmented 12 weight percent yttria-stabilized zirconia layer having a thickness of about 1 mil (0.0254mm) to about 60 mils (1.524 mm)."

Thus, not only do both claims define the thickness of the segmented YSZ layer, as is argued by the

respondent, but in addition they also define that there is a specific link between the final heat treatment (step V of claim 9) of the completely coated article and the formation of a segmented YSZ layer having the claimed thickness.

Although the patent discloses that the thickness of the YSZ layer is determined by the conditions of the plasma spray coating process, see paragraphs [0018] to [0027] of the patent, it does not provide any information as to how the thickness of the coated article can be further adjusted merely by way of a final heating step, as required by claims 21 and 22.

Moreover, it has not been demonstrated that the skilled person can rely on general knowledge in order to perform the process steps as defined in claims 21 and 22. In particular, the skilled person does not know the conditions in which the already coated article, having a thickness resulting from the conditions of the plasma spraying process, has to be heated in order to achieve segmentation, while at the same time obtaining the thickness as defined in claims 21 and 22.

According to paragraph [0028] of the patent, a final heat treatment can result in stress relief. However, stress relief is not the same as segmentation and usually does not allow significant adjustments of the thickness as required by claims 21 and 22. Instead, segmentation is achieved by monitoring the temperature during the plasma spraying process and is helped by heating the article during the plasma spraying, see paragraph [0023] of the patent.

Defining on the one hand the heating conditions for the plasma spraying process and on the other hand the

heating conditions for a final stress relief does not constitute an incentive for a further heating step to be performed on the final coated article for a completely different purpose.

Consequently, the skilled person is confronted, with undue burden, with finding the appropriate conditions for a final heat treatment of the coated article which results in segmentation and an adjustment of the thickness of the coating to obtain the values defined in claims 21 and 22.

The ground of opposition pursuant to Article 100(b) EPC thus prejudices the maintenance of the patent as granted.

2. Auxiliary request - admittance

2.1 As the auxiliary request was filed after the the summons to attend oral proceedings before the Board had been issued, Article 13(2) RPBA 2020 applies. According to this provision, any amendment to a party's appeal case shall, in principle, not be taken into account unless there are exceptional circumstances, which have been justified with cogent reasons by the party concerned.

2.2 Any part of a party's appeal case which is not directed to the requests, facts, objections, arguments and evidence contained in the statement of grounds of appeal or the reply thereto constitutes an amendment to a party's appeal case within the meaning of Article 13(1) and (2) RPBA 2020. This includes the filing of an amended claim request (see J 14/19, Reasons 1.4 and 1.5).

2.3 In view of the above and contrary to the respondent's assertion, the deletion of one or more claims in a claim request also constitutes an amendment of the appeal case within the meaning of Article 13(1) and (2) RPBA 2020. The assessment of the effect of such a claim amendment on the appeal proceedings, for example in terms of procedural economy, is in the Board's view no longer part of the question of whether the amendment constitutes an amendment of the party's appeal case within the meaning of Article 13(1) and (2) RPBA 2020. Instead, this assessment concerns the question of whether or not the amended claim request is to be admitted into the appeal proceedings by the Board when exercising its discretion.

2.4 In this context, the Board reiterates the fact that the Board's decision on whether or not to admit an amendment to a party's appeal case is a discretionary one under Article 13(2) RPBA 2020 as well. Moreover, when exercising its discretion under Article 13(2) RPBA 2020, the Board may also rely on criteria as set out in Article 13(1) RPBA 2020 (see T 172/17, Reasons 5.4).

2.5 In the case at hand, the Board had indicated in its communication under Article 15(1) RPBA 2020 that the subject-matter of claim 1 of the main request (patent as granted) involved an inventive step, and that the subject-matter of claims 21 and 22 was insufficiently disclosed. In reaction thereto, the respondent filed the auxiliary request. The auxiliary request corresponds to the main request, with the only difference being that dependent claims 21 and 22 - i.e. the only claims the Board considered to have been validly objected to - have been deleted. The amendment in the auxiliary request directly addresses the objection of insufficient disclosure, which the Board

had considered valid, and it is immediately apparent why the amendment overcomes that objection. The amendment is also strictly limited to overcoming this objection. It does not shift the discussion or give rise to any new objections. Furthermore, the amendment did not create any additional burden for the other party. Overall, although the respondent amended its appeal case only in reaction to the Board's preliminary opinion, it did so in a manner which clearly served procedural economy.

2.6 The Board considered the above circumstances to be exceptional under Article 13(2) RPBA 2020. It therefore exercised its discretion under that provision to take the auxiliary request in the appeal proceedings into account.

3. Auxiliary request - inventive step

3.1 The patent aims at thermally resistant abradable ceramic coatings. D1 addresses the same general problem and, in line with the arguments of the parties and the reasoning of the contested decision, it is regarded as an appropriate starting point for the assessment of inventive step.

3.2 D1 discloses in the example on pages 6 and 7 a nickel-based turbine duct segment comprising a coating system. The coating system comprises a bond coat and three ceramic layers comprising yttria-stabilised zirconia (YSZ), including:

- a segmented 6 to 8 weight percent YSZ base coat foundation layer disposed upon said bond coat layer,
- a graded interlayer of varied composition disposed upon said segmented 6 to 8 weight percent YSZ layer

- an abradable top layer comprising a blend of 7 weight percent YSZ (7YSZ) and 20 weight percent YSZ (20YSZ) (page 7, line 8).

3.3 It is uncontested by the appellant that the subject-matter of claim 1 differs from the embodiment of D1 in that:

- (i) the first YSZ layer contains 7 weight percent yttria (7YSZ) and
- (ii) the second YSZ layer contains 12 weight percent yttria (12YSZ).

3.4 The problem to be solved can be considered to be how a more stable thermal ceramic coating system can be provided, as argued by the appellant.

3.5 The solution to this problem as proposed by claim 1 is not obvious when considering D1 while taking into account D2 and D3.

3.5.1 D1 describes on page 7, lines 11 to 13, that the combination of all three ceramic layers contributes to achieving the desired properties.

Hence, D1 does not provide an incentive to modify one of the ceramic layers disclosed in the example and in particular it does not hint that the underlying problem could be solved by using a coating system comprising only the two ceramic layers as defined in claim 1.

3.5.2 D2 discloses in paragraphs [0011] to [0012] and examples 1 to 3 a thermal abrasive coating for blade tips.

Although terms such as "abrasive" and "abradable" are relative terms, they nevertheless provide a clear

teaching for the skilled person in a specific technical field. This is also confirmed by D1 on page 6, lines 5 to 7, where it discloses that the abradable "coating system is suited to interact with blade tips which are coated on their free end with an abrasive material" to provide an effective sealing system.

The skilled person would therefore not consider a document such as D2 which proposes abrasive coatings when aiming at the opposite, namely an abradable coating as disclosed in D1.

3.5.3 Should the skilled person nevertheless take D2 into account, they are taught by paragraphs [0011] and [0012] of D2 that a zirconia coating comprising 11 to 14 weight percent yttria has certain advantages such as a lower thermal conductivity compared to a zirconia coating comprising 6 to 9 weight percent yttria. Accordingly, the examples of D2 (see paragraphs [0049], [0054] and [0059]) describe a thermal barrier coating composed of a single layer of zirconia comprising 12 weight percent yttria (12YSZ).

However, D2 does not provide an incentive for the skilled person to consider an abrasive layer as a suitable alternative to the abradable top coating proposed by the example of D1. Such an incentive is not provided by D1 either. On the contrary, D1 emphasises that only a blend achieves the required balance between corrosion resistance and abradability (see page 7, lines 8 to 13). Hence, starting from D1 the skilled person has no incentive to replace the top coat of the coating system of D1 with the coating layer described in D2.

Even if the skilled person were to consider the thermally insulating coating described in D2 in spite of its abrasive nature, they would instead replace the base coat foundation layer or the graded interlayer of the coating system of the example of D1 with a layer of 12YSZ according to D2, since the 12YSZ layer serves at least the same purpose of providing thermostability as the base layer and the interlayer of the ceramic system of D1 together, see page 4, lines 28 to 31, and page 7, lines 11 to 12, of D1.

This, however, would not lead the skilled person to the subject-matter of claim 1 of the auxiliary request.

In summary, the subject-matter of claim 1 is not obvious when starting from D1 and taking D2 into consideration.

3.5.4 D3 discloses in paragraph [0018] a durable thermal barrier coating for a gas turbine blade surface comprising a columnar ceramic layer deposited on a bond coat. Depending on the temperature range in which the gas turbine is intended to be operated, the ceramic layer comprises preferably either 6 to 8 or 11 to 13 weight percent yttrium oxide (yttria).

D3 provides no incentive for the skilled person to combine an inner 7YSZ layer, which provides the desired toughness and durability, with an upper 12YSZ layer, which provides the desired crystalline structure, low thermal conductivity and insulating properties, in order to achieve an improved coating compared to the more complex coating systems disclosed in D1. In particular, it provides no incentive to replace only the top coat of the coating system of D1 with one of the coating layers as described in D3.

The argument of the appellant with regard to D3 is based on hindsight.

Thus, the subject-matter of claim 1 is not obvious when starting from D1 and taking D3 into consideration.

3.6 Hence, the ground of opposition pursuant to Article 100(a) EPC does not prejudice the maintenance of the patent in amended form on the basis of the auxiliary request.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the opposition division with the order to maintain the patent as amended in the following version:
 - claims 1-20 of the auxiliary request filed with the submission dated 13 August 2021
 - description and drawings of the patent specification

The Registrar:

The Chairman:



G. Nachtingall

C. Herberhold

Decision electronically authenticated