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**Datasheet for the decision
of 9 June 2009**

Case Number: T 1720/07 - 3.2.07

Application Number: 03735696.1

Publication Number: 1520062

IPC: C23C 28/02

Language of the proceedings: EN

Title of invention:
Highly Oxidation resistant component

Applicant:
SIEMENS AKTIENGESELLSCHAFT

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56

Keyword:
"Novelty (yes)"
"Inventive step (all requests - no)"

Decisions cited:
-

Catchword:
-



Case Number: T 1720/07 - 3.2.07

D E C I S I O N
of the Technical Board of Appeal 3.2.07
of 9 June 2009

Appellant: SIEMENS AKTIENGESELLSCHAFT
Wittelsbacherplatz 2
D-80333 München (DE)

Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 4 April 2007
refusing European patent application
No. 03735696.1 pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: H.-P. Felgenhauer
Members: H. Hahn
E. Dufrasne

Summary of Facts and Submissions

- I. The applicant lodged an appeal against the decision of the Examining Division to refuse the European patent application No. 03 735 696.1.

The Examining Division held that the claims 1-9 of the single request as filed at the oral proceedings of 5 February 2007 met the requirements of Article 123(2) EPC. It considered further that the subject-matter of claims 1 and 4 lacked clarity and that the subject-matter of claim 1 was novel with respect to the cited prior art. The subject-matter of claim 1 was, however, considered to lack inventive step with respect to a combination of D1 (Patent Abstracts of Japan vol. 1997, no. 10, 31 October 1997 & JP-A-09 157 866)/D1" (English translation thereof) and D6 (EP-A-1 167 575).

- II. With its notice of appeal dated 6 February 2007 (sic, filed 13 April 2007) the appellant requested to set aside the decision and to grant a patent on the basis of claims 1-9 of the main request, alternatively on the basis of claims 1-9 of the auxiliary request, both as submitted together with the notice of appeal. In case that the Board should consider a decision other than according to the aforementioned requests, oral proceedings were requested.

- III. With a communication dated 18 February 2009 and annexed to the summons for oral proceedings the Board gave its preliminary opinion with respect to claims 1-9 of the main request and claims 1-9 of the auxiliary request.

The Board indicated i.a. that the claims of the main request appear to comply with Article 123(2) EPC while claim 1 of the auxiliary request appears to contravene Article 123(2) EPC. Furthermore, claims 1-5, 7 and 8 of the main request and of the auxiliary request appear to contravene Article 84 EPC.

With respect to the issue of inventive step the Board indicated that the problem-solution approach had to be considered. Thus starting from the closest prior art D1 and taking account of the problem to be solved - based on the effect of the distinguishing features - it had to be discussed at the oral proceedings whether or not the available prior art D6 renders the subject-matter claimed obvious.

The subject-matter of claim 1 of the main request appeared to differ from the superalloy substrate having two coating layers of D1 in that the outer β -NiAl-layer is thinner than the underlying CoNiCrAlY layer. The objective problem starting from D1 may therefore be defined as the provision of a coated component which is suitable for having applied a thermal barrier coating (TBC).

It was considered that the person skilled in the art would reduce the thickness of this (brittle) β -NiAl-layer if it was intended to only serve as an adhesion layer for a commonly used TBC layer, as known in the art.

D6 suggested the addition of about 2-15 at% Cr and about 0.1-1.2 at% Zr into the β -NiAl-layer bond coat in order to improve the spallation resistance of the TBC

layer. The Board also considered that the person skilled in the art is expected to apply only such a thickness of the layer which is necessary for the intended purpose. According to the examples of D6 the β -NiAl-layer was applied as a bond coat in a thickness of about 50 μm to the substrate (Rene N5 alloy) with a subsequently applied TBC layer having a thickness of about 125 μm .

With respect to the feature the "outer layer zone (19) is thinner than the intermediate layer (16)" the Board considered that **no effect** has been disclosed at all, particularly if one considers that the two layers may have about the same thickness. There are no experimental data which would prove that a component having such a thickness relationship has an improved spallation resistance compared to that of the closest prior art D1. The same held true with respect to any further alloying elements in the β -NiAl-layer and their possible amounts. The applicant has also not submitted any data concerning comparative tests with respect to D1 and any effect related to the thickness ranges of claim 1 of the auxiliary request when compared to those known from the examples of D1, let alone that there occurs an effect only within said thickness ranges.

Thus it has been indicated that it seemed that the appeal has to be rejected.

- IV. With letter dated 26 February 2009 the appellant submitted new sets of claims as an amended main request together with first to eleventh auxiliary requests and a modified description in combination with arguments concerning the allowability of the amendments made

therein and concerning the patentability of the subject-matter of these claims, as response to the Board's communication.

- V. Oral proceedings before the Board were held on 9 June 2009. The issue of inventive step was discussed with respect to a combination of D1 and D6 and the common general knowledge of the person skilled in the art. Taking account of this inventive step discussion with respect to the main and first to seventh auxiliary requests the appellant replaced the eighth and ninth auxiliary requests by slightly modified versions and withdrew the tenth and eleventh auxiliary requests filed with letter dated 26 February 2009.

The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of the main request filed with letter dated 26 February 2009, or of one of the first to seventh auxiliary requests, filed at the same date, or of the eighth or ninth auxiliary request, filed during the oral proceedings.

At the end of the oral proceedings the Board announced its decision.

- VI. Claim 1 of the main request reads as follows (amendments as compared to claim 1 underlying the impugned decision are in bold with deletions in brackets; emphasis added by the Board):

"1. Highly oxidation resistant component (1), having a substrate (4), a protective layer (17), which consists of an intermediate NiCoCrAlY layer zone (16) on the

substrate (4), and an outer layer zone (19) which is onto the intermediate NiCoCrAlY layer zone (16), which consists at least of the elements Ni and Al **and further alloying elements, especially Co, Cr** and possesses the structure of the phase β -NiAl **[and,]** whereby the Al content lays in the range between 21wt% and 37wt%, wherein the protective layer (17) consists of two separated layer[s] **zones (16, 19) [and],** wherein the outer layer zone (19) is thinner than the intermediate layer (16) on **[or near]** the substrate (4) **[, wherein the layer (16) has a thickness from 100 μ m to 500 μ m and the layer (19) has a thickness from 1 μ m to 75 μ m]."**

VII. Claim 1 of the first auxiliary request reads as follows (amendments as compared to claim 1 of the main request are in bold with deletions in brackets; emphasis added by the Board):

" 1. Highly oxidation resistant component (1), having a substrate (4), a protective layer (17), which consists of an intermediate NiCoCrAlY layer zone (16) on the substrate (4), and an outer layer zone (19) which is onto the intermediate NiCoCrAlY layer zone (16), which consists at least of the elements Ni and Al and further alloying elements, especially Co, Cr and possesses the structure of the phase β -NiAl, **and** whereby the Al content lays in the range between 21wt% and 37wt%, wherein the protective layer (17) consists of two separated layer zone[s](16, 19) wherein the outer layer zone (19) **has a thickness between 1 μ m and 75 μ m and the intermediate layer (16) has a thickness of 100 μ m to 500 μ m [is thinner than the intermediate layer (16) on the substrate (4)]."**

- VIII. Claim 1 of the second auxiliary request differs from claim 1 of the main request in that the feature ", wherein on the outer layer zone (19) a thermal barrier coating (13) is formed" has been added as the final feature.
- IX. Claim 1 of the third auxiliary request differs from claim 1 of the first auxiliary request in that the further feature ", wherein on the outer layer zone (19) a thermal barrier coating (13) is formed" has been added at the end of the claim.
- X. Claim 1 of the fourth auxiliary request differs from claim 1 of the main request in that the feature "wherein the intermediate NiCoCrAlY-layer zone (16) has the composition (in wt%): 10% - 50% Co, 10% - 40% Cr, 6% - 15% Al, 0,02% - 0,5% Y, Ni base," has been inserted between the terms "an intermediate NiCoCrAlY layer zone (16) on the substrate (4)," and "and an outer layer zone (19) which is onto ...".
- XI. Claim 1 of the fifth auxiliary request differs from claim 1 of the first auxiliary request in that the feature "wherein the intermediate NiCoCrAlY-layer zone (16) has the composition (in wt%): 10% - 50% Co, 10% - 40% Cr, 6% - 15% Al, 0,02% - 0,5% Y, Ni base," has been inserted between the terms "an intermediate NiCoCrAlY layer zone (16) on the substrate (4)," and "and an outer layer zone (19) which is onto ...".
- XII. Claim 1 of the sixth auxiliary request differs from claim 1 of the second auxiliary request in that the feature "wherein the intermediate NiCoCrAlY-layer zone

(16) has the composition (in wt%): 10% - 50% Co, 10% - 40% Cr, 6% - 15% Al, 0,02% - 0,5% Y, Ni base," has been inserted between the terms "an intermediate NiCoCrAlY layer zone (16) on the substrate (4)," and "and an outer layer zone (19) which is onto ...".

XIII. Claim 1 of the seventh auxiliary request differs from claim 1 of the third auxiliary request in that the feature "wherein the intermediate NiCoCrAlY-layer zone (16) has the composition (in wt%): 10% - 50% Co, 10% - 40% Cr, 6% - 15% Al, 0,02% - 0,5% Y, Ni base," has been inserted between the terms "an intermediate NiCoCrAlY layer zone (16) on the substrate (4)," and "and an outer layer zone (19) which is onto ...".

XIV. Claim 1 of the eighth auxiliary request differs from claim 1 of the second auxiliary request in that the term ", especially" of the feature "and further alloying elements, especially Co, Cr ..." has been deleted and that the feature ", wherein the outer layer zone (19) contains at least one further element (in wt%): 0,1% - 2% Si, 0,2% - 8% Ta or 0,2% - 5% Re" has been added at the end of the claim.

XV. Claim 1 of the ninth auxiliary request differs from claim 1 of the third auxiliary request in that the term ", especially" of the feature "and further alloying elements, especially Co, Cr ..." has been deleted and that the feature ", wherein the outer layer zone (19) contains at least one further element (in wt%): 0,1% - 2% Si, 0,2% - 8% Ta or 0,2% - 5% Re" has been added as the final feature.

XVI. The appellant argued essentially as follows:

The subject-matter of claim 1 of the main request differs from the coated turbine components of D1 in that the thickness of the outer β -NiAl layer zone (19) of the two layer system is thinner than the one of the underlying NiCoCrAlY-layer zone (16) and that its composition is different from that according to D1 since it comprises further alloying elements such as Co and Cr. These further alloying elements according to claim 1 are homogeneously distributed in the layer and are not derived by diffusion from the underlying NiCoCrAlY-layer as is the case according to D1. The person skilled in the art is taught by the description of the present application that only those elements can be added in certain amounts which do not destroy the said β -NiAl phase structure. The presence of Co and Cr in said β -NiAl layer zone also serves to reduce diffusion from the underlying NiCoCrAlY layer zone. An addition of Yttrium (as a getter element) is not necessary since the aluminium of the β -NiAl allows the good formation of an aluminium oxide layer, i.e. the thermally grown oxide layer (TGO). This TGO layer grows during the use of the turbine components. D1 proposes the deposition of a thick β -NiAl layer, i.e. about 200-300 μm (see examples), but the aluminium comprised therein will be consumed during the use of the component and would eventually destroy the β -NiAl phase structure. Thicker layers, however, are more likely to tend to spall. D1 does not aim to improve the protecting mechanism of the layer system and does not suggest any thermal barrier coating (TBC) layer. D1 does not give any incentive to the person skilled in the art to reduce the layer thickness of said β -NiAl

layer. The objective technical problem with respect to D1 is seen in the provision of a protecting layer system having a long service life time while maintaining the phase structure thereof. It is admitted that no comparative examples with respect to D1 have been submitted. D6 suggests β -NiAl layers - without any underlying MCrAlY layer - which are much thinner than those of D1, i.e. about 10-125 μm (see column 5, lines 51 to 57). The teaching of D6 is to adapt the layer thickness according to the operating conditions. Since the combination of D1 and D6 does not lead to the subject-matter of claim 1 it involves an inventive step.

The same arguments as with respect to the main request are the more valid for the subject-matter of claim 1 of the first auxiliary request which specifies the thicknesses of the two layer zones. D1 is totally silent in this respect.

The additional feature of claim 1 concerning the outermost TBC layer according to the second and third auxiliary request enhances the clarity, furthermore such an embodiment is not suggested by D1.

The additional feature of claim 1 concerning the NiCoCrAlY composition according to the fourth to seventh auxiliary requests aims to further distinguish the claimed subject-matter over D1 which discloses a Co-based MCrAlY alloy.

The additional elements in the β -NiAl layer zone according to claim 1 of the eighth and ninth auxiliary requests improve the adhesion of the β -NiAl layer. The objective problem is to improve the life time of the

components which have a good adherent aluminium oxide (TGO) layer. Although the description does not disclose this effect of the additional elements it is derivable when considering the whole disclosure and particularly the technical problem as defined therein in combination with said outermost TBC layer. It is, however, admitted that said effect is not explicitly mentioned in the application as originally filed and that no test reports have been submitted. Nevertheless, the subject-matter of claim 1 of any of the eighth and the ninth auxiliary requests involves an inventive step.

Reasons for the Decision

1. *Allowability of amendments (Articles 84 and 123(2) EPC)*

Since the Board came to the conclusion that the subject-matter of claim 1 of all requests lacks an inventive step (see point 3 below) there was no need to verify the compliance of each of these requests with respect to Articles 84 and 123(2) EPC.

2. Novelty (Article 54 EPC)

2.1 The subject-matter of claim 1 of the main request is novel with respect to the disclosure of D1 since the outer β -NiAl layer is thinner than the underlying NiCoCrAlY layer (see examples). All other cited documents are not relevant since they do not disclose the required combination of said two layers.

Claim 1 of the main request thus complies with Article 54 EPC.

2.2 The above conclusion applies *mutatis mutandis* to claim 1 of the first to ninth auxiliary requests for being narrower in scope than claim 1 of the main request (see points VII to XV above). Consequently, the subject-matter of claim 1 of the first to ninth auxiliary requests is considered to be novel (Article 54 EPC).

3. *Inventive step (Article 56 EPC)*

Main request

3.1 The Board comes to the conclusion that claim 1 of the main request lacks an inventive step over the disclosure of D1 in combination with D6 and the common general knowledge available to the skilled person for the reasons that follow:

3.2 D1 is considered to represent the closest prior art with respect to a highly oxidation resistant component such as stationary blades of a gas turbine having a substrate and a protective layer consisting of an intermediate NiCoCrAlY layer zone on said substrate and an outer β -NiAl layer which consists of at least the elements Ni and Al (see English translation D1", paragraphs [0001] to [0003]; claim 2).

3.2.1 The Board considers that the general teaching of D1 is the provision of a single phase β -NiAl layer on the base material, preferably by applying an intervening MCrAlY layer on the substrate which has a good adhesion and phase stability with the base material, and then to apply said single phase β -NiAl layer which produces an Al₂O₃-rich film (see D1", paragraphs [0012] to [0015];

and claims 1 and 2). The said β -NiAl layer can contain 42-55 at% Al (see D1", paragraphs [0017] and [0019]). According to said preferred teaching of D1 there are thus two layers for which the thickness is not defined.

3.2.2 According to the examples of D1 made with a substrate of the Ni-based alloy IN738LC the first embodiment was made without an intermediate MCrAlY layer and the β -NiAl layer had a thickness of 300 μm , while the second to fourth embodiment had an intermediate CoNiCrAlY layer of 100 μm thickness in combination with an outer β -NiAl layer having a thickness of 200 μm (see D1", Table 1, samples 2 to 4). Oxidation and high temperature corrosion tests were then performed with said test pieces. These test pieces had no thermal barrier coating (TBC) layer applied so that said outermost β -NiAl layer - on which the aluminium oxide layer is formed - was intended to serve as an environmental coating (see D1", paragraph [0036]). This intended use of the β -NiAl layer implies a certain thickness of the outer layer.

D1 states with respect to said embodiments that the substrate comprises two layers (or layer zones), namely the intermediate MCrAlY layer (according to the examples CoNiCrAlY containing [in wt%] 31-32 Ni, 20-33 Cr, 7-9 Al, 0.25-0.65 Y and the remainder Co) and a single phase β -NiAl-layer (see D1", paragraph [0022] and Figure 3). The β -NiAl layer - as correctly argued by the Examining Division (see decision under appeal, points 3.3.4 and 3.3.5 of the reasons) - will therefore contain a certain amount of Cr and Co due to diffusion from said CoNiCrAlY layer which occurred when the specified heat treatment was carried out at a

temperature of $1120 \pm 15^\circ\text{C}$ for 2 hours (see D1", paragraphs [0021], [0022] and [0029]).

- 3.2.3 The general range of 42-55 at% Al of the β -NiAl layer according to D1 broadly overlaps with the range of 32-50 at% (= 21-37 wt%) Al according to the present application (see the published WO-A-2004 005581, page 5, lines 13 to 17).
- 3.2.4 The Board considers that the definitions "a protective **layer (17)** which consists of an intermediate NiCoCrAlY **layer zone (16)** on the substrate , and an outer **layer zone (19)**" and "wherein the protective layer (17) consists of two separated layer zones (16, 19)" comprised in claim 1 of the main request (and all auxiliary requests) make clear that the expression "layer zone" is fully exchangeable with the expression "layer" which has likewise been used in the present application. These two expressions are used to define the same element, i.e. a layer, since the said definition "a protective layer (17) which consists of ..." leaves no room for any further layer; furthermore the same reference signs (16) and (19) are used for both expressions in the application as originally filed (see WO-A-2004 005581, page 2, line 35 to page 3, line 14; page 4, lines 4 to 7 and lines 17 to 34; page 5, lines 1 to 17 and line 37; page 6, line 1 to 20; claims 1, 2 and 4 to 6 as originally filed).
- 3.3 The subject-matter of claim 1 of the main request is thus only distinguished from the highly oxidation resistant turbine component according to D1 in that the outer β -NiAl layer zone is thinner than the CoNiCrAlY layer zone.

This thinner outer layer zone is considered to reduce the costs of the coated turbine component and at the same time to increase the productivity of the described manufacturing process. Furthermore, a thinner β -NiAl layer zone on which the aluminium oxide (TGO) layer forms is considered to improve the spallation resistance of an - optional - outermost thermal barrier coating (TBC) which would allow using the coated component at higher operating temperatures.

3.3.1 The appellant argued that the objective technical problem with respect to D1 has to be seen in the provision of a protecting layer system having a long service life time while maintaining the phase structure thereof.

It admitted, however, that no comparative examples have been submitted which would demonstrate any such effect or any improvement compared with the closest prior art D1.

3.3.2 Since said alleged but unproven effect cannot be considered in formulating the problem a less ambiguous objective technical problem needs to be formulated.

3.4 The objective problem is therefore in view of D1 considered to be the provision of an alternative turbine component having an oxidation resistant protective layer with good bonding to the thermal barrier coating.

- 3.5 This problem is solved by the highly corrosion resistant component as defined in claim 1 of the main request.
- 3.5.1 It belongs to the common general knowledge of the person skilled in the art that the thickness of each individual layer of a protective layer system is selected according to its function and according to the intended use of the coated part (as indicated e.g. in D6, column 5, lines 51 to 57). Thus if the function of a layer in such a system is that of a bond coat it is clear to the person skilled in the art that the thickness of such a bond coat layer can be reduced and can be made relatively thin compared to e.g. a layer made from the same material which acts as an oxidation resistant environmental layer.
- 3.5.2 D6 teaches that the addition of about 2-15 at% Cr and about 0.1-1.2 at% Zr into the β -NiAl-layer bond coat improves the spallation resistance of a TBC layer applied to the superalloy substrates (see column 2, lines 36 to 40; column 3, line 35 to column 4, line 2 and lines 17 to 23; Figures 1 and 2). An adequate thickness of this bond layer is about 15 μm in order to protect the underlying substrate and provide an adequate supply of aluminium for oxide formation, though thicknesses of about 10 to about 125 μm are believed to be suitable (see column 5, lines 51 to 57). According to the examples a thickness of about 50 μm of the bond coat was applied (see column 7, paragraph [0022]).
- 3.5.3 Therefore the Board holds that the person skilled in the art - taking account of the above objective problem

- would start from the closest prior art D1 - which discloses a turbine component having a Ni-based alloy or Co-based superalloy substrate with an intermediate NiCoCrAlY layer zone and an outer β -NiAl layer zone - and would apply the teaching of D6, i.e. to add about 2-15 at% Cr and about 0.1-1.2 at% Zr into the β -NiAl layer zone bond coat (see D6, column 3, line 51 to column 4, line 2 and lines 17 to 23) in order to provide a good spallation resistance of the TBC layer of the coated component.

Depending on circumstances (e.g. the working environment of the component) the person skilled in the art will select a thickness of 100 μm for the CoNiCrAlY layer zone according to the preferred embodiments of the examples of D1 and the "adequate thickness of the bond coat layer of about 15 μm " according to D6 and thereby arrives at the subject-matter of claim 1 of the main request without any inventive skill.

3.5.4 The appellant's arguments with respect to D1 and D6 cannot hold. First of all, claim 1 does not contain any corresponding limitations. Claim 1 of the main request thus neither excludes an inhomogeneous distribution of alloying elements in said β -NiAl layer zone such as that of Co and Cr which is obtained by the diffusion of these elements from the NiCoCrAlY layer zone through the heat-treatment of the turbine component according to D1 (or during the use of said component) nor does it specify any concentration range of these alloying elements. Furthermore, the use of a ceramic thermal barrier coating system on gas turbine components represents a standard design feature in order to allow higher operating temperatures and is typically applied

on a bond coat (see D6, column 1, line 15 to column 2, line 52).

- 3.6 Claim 1 of the main request therefore does not comply with the requirements of Article 56 EPC. Consequently, the main request is not allowable.

First auxiliary request

- 3.7 Claim 1 of the first auxiliary request differs from that of claim 1 of the main request in that the thicknesses ranges of "100 μm to 500 μm " of the intermediate NiCoCrAlY layer zone and "between 1 μm and 75 μm " of the β -NiAl layer zone are defined (compare point VII above). However, as stated in point 3.5.3 above the person skilled in the art would arrive in an obvious manner at thicknesses values falling in these two ranges. Consequently, the above conclusion with respect to claim 1 of the main request applies *mutatis mutandis* to claim 1 of the first auxiliary request. Consequently, the first auxiliary request is not allowable.

Second auxiliary request

- 3.8 The conclusion of point 3.6 above applies *mutatis mutandis* to the subject-matter of claim 1 of the second auxiliary request which additionally defines the thermal barrier coating (see point VIII above). The reason is that the provision of a thermal barrier coating represents a standard design feature (see point 3.5.4 above). Consequently, the second auxiliary request is not allowable, either (Article 56 EPC).

Third auxiliary request

3.9 The conclusion of point 3.7 above applies *mutatis mutandis* to the subject-matter of claim 1 of the third auxiliary request which additionally defines the thermal barrier coating (see point IX above) for the reason indicated in point 3.8 above. Consequently, the third auxiliary request is likewise not allowable (Article 56 EPC).

Fourth to ninth auxiliary request

3.10 The subject-matters of claim 1 of the fourth to seventh auxiliary requests differ from the ones of claim 1 of the main to the third auxiliary requests, respectively, in that the composition of the intermediate NiCoCrAlY layer zone is further specified (see points X to XIII above).

3.10.1 The appellant has not submitted any data concerning comparative tests with respect to any effect related to this composition - which in the application as originally filed is stated to represent a conventional and typical MCrAlY composition (see WO-A-2004 005581, page 4, lines 16 to 21). For this composition no effect is described in the application as originally filed - as compared to the conventional composition disclosed in the examples of D1 for which it is stated that they have good adhesion and phase stability with the base material, although this lack of evidence had been mentioned by the Board in its communication annexed to the summons for the oral proceedings (see point III above).

3.10.2 Thus it is not apparent which objective technical problem is to be solved beyond the provision of an alternative composition. It is, moreover, considered to be obvious for the person skilled in the art to select other conventional MCrAlY compositions for the intermediate layer zone, such as the claimed one, which have a good adhesion and phase stability with the base material and also with the β -NiAl layer zone.

3.10.3 Consequently, the subject-matter of claim 1 of the fourth to seventh auxiliary requests is considered to lack an inventive step (Article 56 EPC). The fourth to seventh auxiliary requests are thus not allowable.

3.11 The subject-matter of claim 1 of the eighth and ninth auxiliary requests additionally specifies - compared to claim 1 of the second and third auxiliary requests, respectively - that the β -NiAl layer zone comprises Co and Cr and that the outer layer zone contains Si, Ta or Re in the specified amounts (see points XIV and XV above).

The appellant argued in this respect that the addition of these elements to the β -NiAl layer zone would improve the adhesion of the TGO layer. However, the Board cannot acknowledge any effect concerning the addition of these elements in the specified amounts since the application as originally filed is silent in this respect and the appellant has not submitted any evidence such as comparative experiments which would prove any such effect although this lack of evidence has been noted by the Board in its communication (see point III above).

The Board therefore concludes that it is obvious to arrive at the alternative compositions according to the subject-matter of claim 1 of the eighth and ninth auxiliary requests on the basis of the cited prior art, particularly D1 and D6 as already indicated in points 3.2 to 3.5.3 above. The eighth and ninth auxiliary requests are thus not allowable, due to lack of inventive step (Article 56 EPC).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

V. Commare

H.P. Felgenhauer