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Datasheet for the decision of 26 July 2012

Case Number: T 2369/09 - 3.2.06

Application Number: 02254349.0

Publication Number: 1286020

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Language of the proceedings: EN

Title of invention:
Method for repairing an apertured gas turbine component

Patentee:
United Technologies Corporation

Opponent:
SIEMENS AKTIENGESELLSCHAFT

Headword:
-

Relevant legal provisions:
EPC Art. 123(2)
EPC 1973 Art. 56, 84

Keyword:
"Amendments - allowable (yes)"
"Inventive step - (yes)"

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 2369/09 - 3.2.06

D E C I S I O N
of the Technical Board of Appeal 3.2.06
of 26 July 2012

Appellant: (Opponent)
SIEMENS AKTIENGESELLSCHAFT
Postfach 22 16 34
D-80506 München (DE)

Respondent: (Patent Proprietor)
United Technologies Corporation
United Technologies Building
1 Financial Plaza
Hartford, CT 06101 (US)

Representative:
Leckey, David Herbert
Dehns
St Bride's House
10 Salisbury Square
London EC4Y 8JD (GB)

Decision under appeal:
Interlocutory decision of the Opposition Division of the European Patent Office posted 13 November 2009 concerning maintenance of European patent No. 1286020 in amended form.

Composition of the Board:

Chairman: M. Harrison
Members: G. de Crignis
W. Sekretaruk

Summary of Facts and Submissions

I. By way of its interlocutory decision posted on 13 November 2009, the opposition division found that European Patent No. 1 286 020 in an amended form met the requirements of the European Patent Convention (EPC).

II. The appellant (opponent) filed an appeal against this decision and in its statement setting out the grounds of appeal requested that the decision be set aside and the patent be revoked.

III. In a communication annexed to the summons to oral proceedings, the Board stated *inter alia* that the requirement of Article 123(2) EPC appeared not to be met.

IV. With its letter of 26 June 2012, the respondent filed amended claims in the form of a main request and first to fifteenth auxiliary requests.

V. Oral proceedings were held before the Board on 26 July 2012.

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

The respondent requested that the patent be maintained on the basis of claims 1 to 6 of the fourteenth auxiliary request of 26 June 2012; description, columns 1 - 4 with insertion page A and columns 5 - 14, all of 26 July 2012; drawings, Figures 1 - 7 as granted.

Claim 1 of this request reads (after correction of the submitted request so as to replace the underlined words "of" and "have" in the expressions "inner metering portion (60) of an outlet" and "being a metering passage have a predetermined throat area", by "to" and "having" respectively, such that the version is consistent with the discussed subject-matter - in accordance with the parties' acknowledgement):

"A method for repairing defects in an article, said article being a gas turbine vane, the article comprising a substrate (58) and an existing coating (44) on a surface of the substrate, the article including a first plurality of cooling holes (18) extending from the substrate and the existing coating and having a predetermined air flow requirement, the plurality of cooling holes having an outer shaped portion (52) and an inner metering portion (60), said outer shaped portion (52) being an axially diverging diffusion passage which extends from the end of the inner metering portion to an outlet (77) at the exterior surface of the article and said metering portion (60) being a metering passage having a predetermined throat area, the method comprising:

removing the existing coating (44);

recoating the surface of the article with a non-original coating;

reworking the cooling holes (18) that meet a predetermined inspection criteria to remove the excess nonoriginal coating deposited in the outer shaped portion (52) of the cooling holes using electrical discharge machining by:

receiving an electrode (62) having only a shaped diffuser portion (70) with a preselected shape in said outer shaped portion (52) of the cooling holes; and

restoring said outer shaped portion (52) of the cooling holes to meet the predetermined air flow requirement; and further comprising:
propelling a stream of abrasive particles into the inner metering portion (60) of the plurality of cooling holes (18) to remove excess nonoriginal coating from the inner metering portions of the plurality of cooling holes."

VI. The arguments of the appellant may be summarised as follows:

The subject-matter of claim 1 was not disclosed in the application as originally filed insofar as the claimed combination of features was concerned (Article 123(2) EPC).

Claim 1 included the feature "outer shaped portion (52) being an axially diverging diffusion passage which extends from the end of the inner metering portion to an outlet (77) at the exterior surface of the article and said metering portion (60) being a metering passage having a predetermined throat area". However, in paragraph [0032] of the patent in suit which was cited as a basis of this feature, it was disclosed that "the diffusion passage 52 is axially diverging, nonregulatory and extends from the inlet 76 to an outlet 77 at the exterior surface 78 of the vane 10". Hence, the term "nonregulatory" had also to be included in claim 1.

Further, the last sentence of paragraph [0032] disclosed an "inner shaped portion" of the diffusion passage, which was identified in the Figures by reference numeral 80, and an "inner metering portion" of the metering passage, which was identified in the Figures by reference numeral 82. It was also noted that the Figures showed no build-up of non-original material on the "inner" diffusion portion which thus emphasised that this was a specific part of the diffusion passage separate to the outer part. These features were thus disclosed in combination with other features of the claim and could not be omitted without contravening Article 123(2) EPC.

Further, since the claim defined an "outer shaped portion", it was also evident that a full definition of the diffusion passage had necessarily to include the "inner shaped portion" at least to fulfil the requirement of clarity in Article 84 EPC 1973.

Additionally, the request had been filed at a very late stage and should not be admitted into proceedings. The respondent had had ample opportunity to file this request earlier and due to the difficulties under Article 123(2) EPC and Article 84 EPC 1973, the requests were *prima facie* not allowable.

When considering inventive step, it should be taken into account when interpreting the claim and having regard to the feature "reworking the cooling holes that meet a predetermined inspection criteria", that it was neither disclosed nor clear which inspection criteria were to be considered. In the granted patent, paragraphs [0039] and [0040] referred to the inspection

before recoating whereas the claimed feature referred to inspection for reworking which was after recoating. The only inspection criteria disclosed in the patent in suit was the decision as to whether the holes were fully clogged and thus needed re-manufacturing or whether they were partly clogged and should be reworked and then such disclosure was anyway only in a specific context.

Further, concerning the feature "receiving an electrode (62) having only a shaped diffuser portion (70)", the wording of this feature was not literally disclosed and also did not limit the shape of the electrode to a specific shape; an electrode of any shape could be understood to fall within this term.

D6: US-A-6 154 959

represented the closest prior art for consideration of inventive step. Starting from D6, the objective problem to be solved was to adapt the re-opening process to the particular form of the cooling holes. Such adaptation required the use of a suitable electrode. D6 did not disclose any shape or form of the electrodes nor of the holes because the skilled person was well-aware that the electrodes had to be adapted to the shape of the holes to be opened. Therefore, no inventive step was necessary when starting from D6 and merely applying the general knowledge of the skilled person.

There was no difference between re-manufacturing and re-opening since the process steps were the same. Therefore, the skilled person took into account the teaching of

D4: US-A-5 605 639

which disclosed a multiple-piece electrode having a comb-like structure of teeth allowing the insertion of a movable rod. When extracting the rods from the teeth, the same geometry of the electrodes as shown in Figure 7 of the patent in suit was disclosed. Therefore, when starting from D6 and desiring to rework a partially blocked cooling hole of a conical form, the skilled person would immediately recognize that the use of the teeth portion of the electrodes of D4 sufficed to arrive at the desired result and that a rod could then be used separately. D4 even taught this specifically in column 3, lines 31 and 32, which explained that the rod only eroded the work piece which had been "previously formed by the shaped tooth". The skilled person was thus instructed to carry out a first step without a rod to form the diffused hole. Since the diffused hole was then "formed", it was a proper reading of D4 that the rod had to be used by itself afterwards, since otherwise the erosion would continue around the tooth portion. With the knowledge that EDM was time-consuming, the skilled person would be led to use only the teeth portion when the metering portion of the hole was not clogged and could be reworked via a simple and cost-effective grit blasting operation, as part of his common general knowledge or from well-known prior art, e.g. from

E11: EP-A-0 761 386.

VII. The arguments of the respondent may be summarised as follows:

The request should be admitted under Article 13 RPBA because it met all objections in the communication. The form of the amendments was such that nothing would be of surprise for the Board or the appellant.

The features inserted into claim 1 were disclosed in paragraphs [0001], [0018], [0019], [0024], [0031], [0052] and [0056] of the A2-publication; the requirement of Article 123(2) EPC was thus met. In particular, the last sentence in paragraph [0031] merely contained a further definition of features which were already implicit from the aforegoing description. Since claim 1 now required that the axially diverging diffusion passage extended from the metering passage to the external surface of the component, the skilled person would also implicitly understand the diffusion passage to be non-regulatory. Therefore, it was not necessary to recite this feature in claim 1. Any clarity objection could only validly be made against amendments to the claims and not against features of the granted claims, and the requirement of clarity was also met in regard to the amendments.

With regard to inventive step and when starting from D6, the skilled person would not be led, without requiring an inventive step, to a solution involving the use of an electrode having only a teeth-shaped portion for a diffusion part of the cooling holes. No suggestion of a method without the use of the rod portion of the electrode was present in D4.

Reasons for the Decision

1. *Admittance of the request*

The request was filed after the communication of the Board annexed to the summons. Hence, according to Article 13(1) of the Rules of Procedure of the Boards of Appeal (RPBA), it lies within the discretion of the Board to admit such a request into the proceedings. Since claim 1 of this request was amended in a way to address all objections mentioned in the communication of the Board, some of which were raised for the first time in that communication (e.g. the objection under Article 123(2) EPC that claim 1 lacked a limitation of the article to being a gas turbine vane and the exterior surface thereof only being disclosed as being part of a turbine vane) – and notably by adopting wording taken as far as possible from the relevant part of the description - and which involved amendments which did not introduce new objections (see below), the request was admitted into the proceedings.

Although the appellant argued that ample time had been available to file such a response after the appellant's grounds of appeal had been filed, the requirement to deal with the further objections raised only by the Board meant that the only opportunity to overcome these objections arose after the Board's communication had been received.

2. *Amendments*

2.1 The amendments to claim 1 with regard to claim 1 as originally filed are the following (in italics):

(a) "*said article being a gas turbine vane*";

(b) "*said outer shaped portion (52) being an axially diverging diffusion passage which extends from the end of the inner metering portion (60) to an outlet (77) at the exterior surface of the article and said metering portion (60) being a metering passage having a predetermined throat area*";

(c) "*reworking the cooling holes (18) that meet a predetermined inspection criteria to remove the excess nonoriginal coating deposited in the outer shaped portion (52) of the cooling holes using electrical discharge machining by:*";

(d) "receiving an electrode (62) having only a shaped *diffuser* portion (70) with a preselected shape in said outer shaped portion (52) of the cooling holes";

(e) "*and further comprising:*
propelling a stream of abrasive particles into the inner metering portion (60) of the plurality of cooling holes (18) to remove excess nonoriginal coating from the inner metering portions of the plurality of cooling holes."

Further minor amendments were also made, which however have no significance for the subject-matter of the claim and concerning which the appellant also raised no objections, such as for example the use of the expression "the cooling holes" in the step of restoring the outer shaped portion, rather than again defining "the plurality of cooling holes", whereby however it is

implicit that the terminology "the cooling holes" is evidently referring to "the plurality of cooling holes" defined previously.

2.2 It was undisputed that features a) and e) are disclosed in originally filed claims 8 and 2 respectively.

2.3 Feature (b)

2.3.1 Concerning this feature, paragraph [0031] of the published A2-application discloses that the "*diffusion passage 52 is axially diverging, nonregulatory and extends from the inlet 76 to an outlet 77 of the exterior surface 78 of the vane*". It is however not necessary to include the term "nonregulatory" into the wording of claim 1 because it is already defined that the outer shaped portion is an axially diverging diffusion passage which extends from the end of the inner metering portion to an outlet at the exterior surface, and that the metering portion is a metering passage having a predetermined throat area. Such definition implies a non-regulatory passage of the air flow in the diverging portion since the regulatory function is performed in the metering portion by virtue of its predetermined throat area from which diverging of the passage starts, and since no further narrowing of the passage can be present due to the diffusion passage finishing at the external surface. Hence, the term "nonregulatory" is implicitly included in the wording of claim 1 and it is thus not necessary to include such term to meet the requirement of Article 123(2) EPC.

2.3.2 Additionally, concerning feature (b) and the extension of the metering portion as well as the complete definition of the passage as disclosed, paragraph [0031] of the A2-publication further discloses that the "*diffusion hole 18, shown in Fig. 4, has a metering passage 60 in fluid communication with a diffusion passage (mouth) 52, each having a predetermined geometry. The metering passage has an inlet 76 with a predetermined throat area, shown as At, where the throat area At provides a predetermined air flow requirement .... . The diffusion passage 52 also includes an inner shaped portion (inner diffuser portion) 80 while the metering passage includes an inner metering portion 82*."

Since the "outer shaped portion 52" and the "inner metering portion 60" already formed part of the granted claim 1, clarity of these terms is not open to objection, since raising a clarity objection to these terms would be tantamount to raising a clarity objection to the wording of granted claims, noting that clarity is not a ground of opposition. Although the wording of the paragraph cited above *per se* might not express in the most logical manner the intended limitations of outer and inner "shaped portions" or "diffusion passage" or "metering passage" or "inner metering portion", there would be no doubt for the skilled person when reading the above cited paragraph in proper context - in particular when seen in combination with the sketch shown in Figure 4 to which it refers - that the outer shaped portion 52 is formed in direct connection to the inner metering portion 60 of a constant throat area, that the "inner shaped portion" is merely the inner surface of the metering

passage, that the metering passage has to have an inlet 76 and that there is no separate inner or outer metering portion or passage, but simply one diffusion passage. Indeed, the Board finds this is the only technically reasonable interpretation of this passage. Thus, no contravention of Article 123(2) EPC can be seen in regard to this feature.

Likewise, in regard to the appellant's objections under Article 84 EPC 1973 about the lack of clarity in the definition of the various portions of the passage, the Board finds such objections non-persuasive. Since the diffusion passage is now defined via its entire length, any perceived lack of clarity due to the inclusion of an "outer" shaped portion without an "inner shaped portion" does not hold. Likewise, although in the aforementioned passage of the description it is disclosed that the diffusion passage 52 extends "from the inlet 76", this is seemingly erroneous or merely unspecific in relation to what is shown in the Figure to which this relates, and is anyway unnecessary in the claim since this now specifies the entire extent of the cooling hole and thus defines correctly where the outer shaped portion being the diffusion portion starts and finishes.

2.4 Feature (c) is disclosed in paragraphs [0047] and [0055] of the published A2-application. Although these paragraphs do not describe any specific inspection criteria, they refer to the step of "reworking" being applied for cooling holes which are only partially clogged, and that re-manufacturing would be used for those cooling holes being completely clogged. Hence, inspection criteria are implicitly present and although

no specific details of the inspection criteria for the cooling holes are defined in the claim or stated in the description, the inspection must - when given a sensible interpretation – involve such criteria which allow a decision to be reached as to whether the holes should be re-worked or not. In regard to the consideration of inventive step however (see *infra*), this does however result commensurately in a very broad interpretation of the terminology "inspection criteria", such that even a result of the inspection being that all of the cooling holes are to be re-worked is not something excluded by the result of such inspection.

2.5 In feature (d), only the word "diffuser" was added. Paragraph [0052] specifies that "the electrode 62 includes a diffuser portion 70" and that "the electrode 62 is chosen to restore the inner diffuser portion 80 of the respective diffusion hole 18 being repaired in region 50". The inclusion of the word "diffuser" thus meets the requirement of Article 123(2) EPC as it is disclosed specifically in the context now claimed.

2.6 Accordingly, all amendments are clear and are based upon the originally filed embodiment concerning the method of "reworking" of the gas turbine vane. The requirements of Article 84 EPC 1973 and Article 123(2) EPC are thus met.

3. Inventive step

3.1 D6 was cited by the appellant as representing the closest prior art. Indeed, D6 is the sole document cited in the proceedings which refers to a method for repairing defects in a gas turbine vane and thus is the

most appropriate starting point for consideration of inventive step. The method disclosed therein concerns the restoring of the cooling holes in a platform via known techniques such as, for example, laser drilling or electron discharge machining (see e.g. col. 7, lines 56 - 62). However, D6 neither discloses the shape of the applicable tool nor the geometry of the cooling holes. Concerning the use of abrasive particles, D6 states (in step 26) "restore contour to gaspath surfaces" and specifies in this context in the description (see col. 6, l. 24 - 29) the application of automated or manual beltsanding, which step is followed by laser cladding (step 28) and the restoration of the cooling holes (step 30).

3.2 In view of the terminology "inspection criteria" including also the possibility of choosing to rework all the cooling holes, the subject-matter of claim 1 differs from the disclosure in D6 only in that the geometry of the cooling holes to be reworked as well as the shape of the electrode to be applied are specified in a particular manner.

3.3 Due to the inclusion in claim 1 of the step defining use of abrasive particles for removing excess non-original coating from the inner metering portion, the form of the electrode used for re-working can then only reasonably be interpreted to exclude such forms of electrode that include an extension (e.g. a rod-like extension) on the front end thereof which would itself then perform the task of removing excess non-original coating from the same portion.

3.4 Taking into account the above specified difference, the objective problem may be seen as being to provide a suitable method for repair of diffuser cooling holes. The solution according to claim 1 is, having identified the cooling holes which can be reworked (i.e. as opposed to being re-manufactured), to provide a shaped electrode corresponding only to the outer shaped portion of the cooling holes (i.e. the part corresponding to the axially diverging part of the passage) and in a further step to propel a stream of abrasive particles to remove excess non-original coating from the inner metering portions of the cooling holes.

3.5 The skilled person searching for a solution to this problem finds no teaching in D6 relating to any particular form of shaped electrode. D6 simply mentions use of electron discharge machining as a known alternative to laser drilling (col. 7, l. 61) without specifying any details of same, in particular as regards the shape of the electrodes required.

3.6 The appellant argued that the claimed invention would not involve an inventive step due to the recognition that there were always differently shaped and differently clogged cooling holes in a gas turbine vane and that since D6 disclosed the possibility of reworking the holes, it would accordingly be clear to the skilled person that when there were holes which were not completely clogged, these holes had to be treated in a way to remove the incomplete clogging.

3.7 However, in D6, step 18 refers to the plugging and restoring of cooling holes. Thus, no suggestion of

identifying a plurality of cooling holes to be reworked is present and similarly there is no suggestion of dividing the method of restoration of the gas path surfaces, for any reason, into a two-step reworking restoration process of firstly applying electron discharge machining and subsequently applying a stream of abrasive particles into the inner metering portion of the cooling holes.

3.8 The appellant further argued that starting from D6, a skilled person would recognize, and this was also stated in the patent itself in paragraph [0016], that when restoring holes it was expensive to use a complicated electrode shape particularly when the outer part of the electrodes was fragile and not re-usable. The skilled person would then allegedly find the teaching in D4 that only the tooth-part of the electrodes disclosed therein would be suitable for reworking cooling holes without the rod portions being used. The Board however finds this argument unconvincing.

3.8.1 First, D4 concerns initial production of cooling holes, not their reworking. Thus, the method disclosed relates to the production of the hole in its entirety. With this in mind, already at the outset it is evident that D4 does not give any teaching of using only one part of the multi-piece electrode disclosed therein. As shown in Figure 3 of D4, a comb-like structure of the multi-piece electrode comprises a row of three-dimensional shaped teeth to facilitate formation of diffusion holes, each tooth having its own rod portion which passes therethrough. The work piece is electrically-discharged-machined first with the shaped teeth and

then with the rod portions. An advantage of this sequence stated in D4 is the reduction of wear on the rod. The aim of D4 is to provide deep, smaller diameter diffusion holes (col. 2, l. 36 - 42) as it is concerned with the manufacturing process itself.

3.8.2 The appellant argued that D4 not only taught that the rod should be used separately from the teeth portions to save costs, but that D4 even required this when reading column 3, lines 28 to 34 in its correct context, since it stated that in an alternative to performing the whole process with the multi-piece electrode, the rod eroded the work piece beyond the diffused hole "previously formed by the shaped tooth", whereby it was allegedly implicit that the tooth-shaped part of the electrode was not present since otherwise the diffused hole would be further reduced when the rod was being used.

3.8.3 However, the Board finds this interpretation not to be supported, since the next sentence of the section cited from D4 states "This sequence increases electrode alignment and essentially eliminates tool marks around the metering hole". It is thus implicit that in this alternative process, whilst the diffusion part is formed first, the tooth shaped part is kept in place as it is the inner passage of the tooth shaped part that provides this electrode alignment. Hence, D4 provides no suggestion of a method of only using the tooth part by itself without also using the rod part. Whether the hole would be further reduced by the remaining presence of the shaped tooth (about which D4 is in fact silent), thus does not alter the conclusion that the tooth-shaped part of the electrode must be kept in place

while using the rod to ensure the correct alignment of the rod part.

3.8.4 Hence, there is no teaching of stopping the process after applying the tooth-shaped electrode and omitting the second step of using the rod. To the contrary, the use of the rod in order to proceed to produce a metering portion is mandatorily included. Additionally, it is not necessary to provide any selection or inspection criteria with regard to the cooling holes in D4, since D4 is not concerned at all with re-working but with the production process of the gas turbine component itself requiring, already at the outset, all holes to be formed in their entirety. Stopping the process after use of the tooth-like part of the multi-piece electrode and then using an alternative process for reworking the metering part of a diffusion passage is thus also not taught.

3.8.5 Although E11 teaches that excess overlay coating within metering holes *per se* may be removed by the use of flow of an abrasive slurry and hence the cooling holes may be "cleaned out", due already to the previous conclusion that the combination of D6 with D4 does not at all lead a skilled person to a two-step process without a rod portion, the mere disclosure of the application of an abrasive slurry for removing excess overlay coating within the cooling holes in E11 would not bring the skilled person any closer towards the claimed invention.

3.8.6 Hence, when starting from D6 and desiring to provide a method for a suitable repair of a particular kind of cooling hole, neither the omission of the rod nor the

application of a stream of abrasive particles into the inner metering portion in addition to the EDM-step is taught by D4. Hence, starting from D6 and combining this with the teaching of D4 (even when considering the teaching of E11) would not lead the skilled person to the claimed method unless an inventive step were used.

3.9 Based on the cited prior art and the arguments advanced in respect of inventive step, the Board therefore concludes that the subject-matter of claim 1 involves an inventive step and that the requirements of Article 56 EPC 1973 are fulfilled.

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 European patent with the following documents:
   - claims 1 - 6 of the fourteenth auxiliary request of 26 June 2012, wherein claim 1 is corrected so as to replace the words "of" and "have" respectively in the expressions "inner metering portion (60) of an outlet" and "being a metering passage have a predetermined throat area", by "to" and "having" respectively,
   - description, columns 1 - 4 with insertion page A and columns 5 - 14, all of 26 July 2012;
   - drawings, Figures 1 - 7 as granted.

The Registrar The Chairman

M. Patin M. Harrison