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Datasheet for the decision of 28 October 2021

Case Number: T 0522/17 - 3.2.06

Application Number: 08250742.7

Publication Number: 1967699

IPC: F01D11/00, F01D11/12

Language of the proceedings: EN

Title of invention:
Gas turbine engine with an abradable seal

Patent Proprietor:
Raytheon Technologies Corporation

Opponent:
Siemens Aktiengesellschaft

Headword:

Relevant legal provisions:
EPC Art. 100(c)
RPBA 2020 Art. 13(1)
RPBA Art. 13(3)

Keyword:

Decisions cited:
G 0002/10

Catchword:

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Case Number: T 0522/17 - 3.2.06

D E C I S I O N
of Technical Board of Appeal 3.2.06
of 28 October 2021

Appellant: (Opponent)	Siemens Aktiengesellschaft Werner-von-Siemens-Straße 1 80333 München (DE)
Representative:	PATERIS Patentanwälte PartmbB Markgrafenstrasse 22 10117 Berlin (DE)
Respondent: (Patent Proprietor)	Raytheon Technologies Corporation 10 Farm Springs Road Farmington, CT 06032 (US)
Representative:	Dehns St. Bride's House 10 Salisbury Square London EC4Y 8JD (GB)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 30 January 2017 rejecting the opposition filed against European patent No. 1967699 pursuant to Article 101(2) EPC.**

Composition of the Board:

Chairman	M. Harrison
Members:	P. Cipriano
	W. Ungler

Summary of Facts and Submissions

I. An appeal was filed by the appellant (opponent) against the decision of the opposition division rejecting the opposition to European patent No. 1 967 699. It requested that the decision under appeal be set aside and the patent be revoked.

II. With its reply, the respondent (patent proprietor) requested that the appeal be dismissed or that the patent be maintained according to one of auxiliary requests 1 to 13 filed therewith.

III. The Board issued a summons to oral proceedings and a subsequent communication dated 30 April 2020 containing its provisional opinion, in which it indicated *inter alia* that the application as filed did not seem to provide a basis for a gas turbine engine with the combination of features of claim 1 of the main request.

IV. With letter dated 4 May 2020, the respondent filed new auxiliary requests 1a, 3a, 8a and 10a.

V. Oral proceedings were held before the Board on 28 October 2021, during which the appellant withdrew auxiliary requests 1 to 13, maintained auxiliary requests 1a, 3a, 8a and 10a and filed auxiliary request 1b.

The final requests were:

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

The respondent (patent proprietor) requested that the appeal be dismissed (main request),
auxiliarily that the patent be maintained on the basis of one of auxiliary requests 1a, 3a, 8a and 10a filed with letter of 4 May 2020, or
on the basis of auxiliary request 1b filed during the oral proceedings of 28 October 2021.

VI. Claim 1 of the main request reads as follows:
"A gas turbine engine (10), comprising:
a plurality of adjacent rotor stages
an airfoil (25) having a radial outward end (34) and a radial inward end (36); and
a seal member (32) adjacent to said radial inward end (36) of said airfoil (25), wherein said seal member (32) is coated with an abrasive material (46) and said seal member (32) includes a rotor seal land extending between adjacent rotor stages,
characterised in that a tip (38) of said radial inward end (36) of said airfoil (25) is coated with an abradable material (42) and said abradable material (42) includes zirconium oxide comprising yttria stabilized zirconia."

The text of claim 1 of auxiliary requests 1a, 3a, 8a, 10a and 1b is appended at the end of the decision.

VII. The appellant's arguments relevant to the present decision may be summarised as follows:

Main request - Article 100(c) EPC

The ground for opposition under Article 100(c) EPC was prejudicial to maintenance of the patent.

Claim 1 as filed was amended from a gas turbine engine component to a more general gas turbine. There was no basis in the application as filed for a gas turbine with the combination of features of claim 1, namely without defining further features of original claim 12.

Claim 1 also defined a plurality of rotor stages. Whilst the terminology "rotor stages" *per se* was originally disclosed, this was only together with other components and in the context of prior art gas turbines and not as a single disclosure with the description of the invention from page 3 onwards.

There was no basis for the feature "a rotor seal land extending between adjacent rotor stages". Original claim 3 defined a rotor seal land but not specifically defined as extending between "rotor stages".

The description was not a repository of features from where features could be combined if the skilled person found it "reasonable", as the respondent argued. There must be a direct and unambiguous disclosure of the claimed combination of features from the whole context of the application .

Admittance of auxiliary requests 1a, 3a, 8a and 10a

The filing of auxiliary requests 1a, 3a, 8a and 10a was an amendment to the respondent's appeal case that could have been filed earlier. They should thus not be admitted.

Also,the addition of further features from pages 2 and 3 of the description gave rise to new problems under Article 123(2) EPC. The combination of features of

claim 1 was *prima facie* not directly and unambiguously derivable from the passages cited by the respondent.

Admittance of auxiliary request 1b

Auxiliary request 1b should not be admitted into the proceedings.

The objections regarding extension of subject-matter had been put forward already with the grounds of appeal such that this request should have been filed much earlier. The large number of amendments made to the wording of claim 1 was such that the appellant would not be able to deal with them during the oral proceedings.

VIII. The respondent's arguments relevant to the present decision may be summarised as follows:

Main request - Article 100(c) EPC

The ground for opposition under Article 100(c) EPC was not prejudicial to maintenance of the patent.

The application as filed clearly taught that the problem solved by the invention arose in rotor seal lands that extend between adjacent rotor stages. The application as amended restricted the claims to such rotor seal lands, but no new technical information was provided as a result of that amendment. The dependency of claim 3 on claim 1 already made it clear that the rotor seal lands were not necessarily linked with the compressor stator vane and therefore no new technical information was present in the amended text when compared with the original.

The disclosure from page 3 onwards concerned compressor stages instead of rotor stages as mentioned on page 1, but the passage on page 6, lines 8-16 of the original application, taught the skilled person that the components could be any other components of a gas turbine engine.

The paragraphs from page 1, line 5 to page 2, line 7, set up the invention by disclosing the skilled person's common general knowledge relevant for the understanding of the invention, and would thus be understood as being part of the invention. Taking into consideration the explanation on page 6 of the original application, the skilled person would therefore reasonably have understood that the components mentioned in those paragraphs (including for example the rotor seal lands) were applicable to the other sections of the turbine and thus to rotor stages in general.

Further, originally filed claim 3 was also directed to rotor seal lands and was dependent on claim 1 or 2, with only claim 2 introducing the feature that the airfoil was a compressor stator vane. The dependency of claim 3 directly on claim 1 therefore already taught the skilled person that the rotor seal lands were not necessarily linked with the compressor stator vane.

Admittance of auxiliary requests 1a, 3a, 8a and 10a

The amendments in auxiliary request 1a *prima facie* overcame the issues raised by the appellant and did not give rise to new objections. The same applied to auxiliary requests 3a, 8a, and 10a.

Admittance of auxiliary request 1b

Auxiliary request 1b should be admitted into the proceedings.

The auxiliary request had been filed at this point in order not to overload the Board, i.e. for reasons of procedural economy; it clearly addressed the objection of extension of subject-matter. The basis for the amendments was clear and unburdensome to verify such that no adjournment was required.

Reasons for the Decision

1. Main request - Article 100(c) EPC

1.1 Claim 1 has been amended to include *inter alia* the following features:
- a plurality of adjacent rotor stages,
- that the seal member (32) includes a rotor seal land extending between adjacent rotor stages.

1.2 It has not been contested that these two features are literally disclosed on page 1, lines 21-23 of the description as originally filed.

1.3 The respondent argued that the paragraphs from page 1, line 5 to page 2, line 7, set up the invention by disclosing the skilled person's common general knowledge relevant for its understanding. According to the respondent, the disclosure from page 3 onwards concerned compressor stages, but the passage on page 6, lines 8-16 taught the skilled person that the component could be any other component of a gas turbine engine. It was further argued that from page 1, lines 5 and 6, the skilled person would reasonably understand that the

sub-components described on page 1 (including for example the rotor seal lands) were implicit to any gas turbine engine and thus applicable to the other sections of the turbine and therefore to rotor stages in general.

1.3.1 Even if it were accepted that the disclosure applied to other sections of the gas turbine engine, the added features are nevertheless disclosed on page 1 only in a more specific context together with other features, such as "cantilevered" compressor "stator vanes attached at their radial outer end". These features have however not been included in claim 1. Therefore, even if the paragraphs from page 1, line 5 to page 2, line 7, were considered to set up the invention by disclosing the skilled person's common general knowledge relevant for its understanding, they directly and unambiguously only provide a disclosure of a much more specific gas turbine.

In addition, the Board finds that the passage on page 6, lines 8-16, stating that "the invention... is applicable to any gas turbine engine component" can only unambiguously be understood to refer to claim 1 as originally filed, i.e. the component with the combination of features of claim 1 as originally filed can be any used with any slider seal type engagement, and not to the common general knowledge in the passages from page 1, line 5 to page 2, line 7.

1.4 The respondent additionally argued that these amendments were allowable since they did not introduce new technical information, i.e. the skilled person was taught nothing new by restricting the claim to rotor seal lands and rotor stages instead of compressor stages. Further, originally filed claim 3 was directed

to a rotor seal land and was dependent on claim 1 or 2, with only claim 2 introducing the airfoil being a compressor stator vane. The dependency of claim 3 directly on claim 1 therefore already provided the information that the rotor seal lands were not necessarily linked with the compressor stator vane.

1.4.1 The Board does not find this argument convincing.

Although it is the case that after any amendment, the skilled person must not be presented with new technical information, this technical information in the case of a positive feature is given by what the skilled person would derive directly and unambiguously, using common general knowledge, from the whole application as filed. With respect to the new combination of features which is defined after the introduction of a feature, it therefore still needs to be examined whether that combination is disclosed in the application as filed (see e.g. G 2/10, Reasons 4.5.1 and 4.5.2).

The Board finds that the combination of originally filed claims 1 and 3 is directed to a gas turbine component and not a gas turbine engine comprising a plurality of adjacent rotor stages, nor does it define between which components the rotor seal land extends. The gas turbine engine originally claimed is defined in independent claim 12, which is much more specific than the one of claim 1 and also does not define "rotor stages". The only disclosure of rotor stages and of a seal land extending between rotor stages is on page 1, which describes a more specific arrangement of the rotor seal lands than the one defined in claim 1 and notably only in the context of a compressor stator vane (see items 1.2 and 1.3 above).

The skilled person would therefore not derive directly and unambiguously from the combination of claims 1 and 3 (even taking into consideration the disclosure on page 1) the combination of features defined in claim 1 of the main request.

1.5 For the reasons stated above, the ground of opposition under Article 100(c) EPC is prejudicial to maintenance of the patent. Thus, the main request is not allowable.

2. Admittance of auxiliary requests 1a, 3a, 8a and 10a

2.1 Auxiliary requests 1a, 3a, 8a and 10a were filed with letter dated 4 May 2020 in reply to the preliminary opinion of the Board and due to the amendments made therein constitute an amendment to the respondent's appeal case.

2.2 Article 13(1) RPBA 2020 stipulates that any amendment to a party's appeal case may be admitted only at the Board's discretion. This discretion is to be exercised in view of, *inter alia*, the current state of the proceedings, whether the amendment is detrimental to procedural economy, the suitability of the amendment to resolve the issues which were admissibly raised and whether the party has demonstrated that any such amendment, *prima facie*, overcomes the issues raised by another party in the appeal proceedings or by the Board and does not give rise to new objections.

2.3 The respondent argued that several passages on pages 1 to 5 in addition to Figure 1 (for the feature that the casing extends circumferentially) and specifically page 3, lines 30-31, which disclosed the feature of the airfoil "radial inward end directly opposite to the radial outward end", provided a basis for the

combination of features of claim 1 of auxiliary request 1a.

2.3.1 The Board does not agree that the subject-matter of claim 1 is *prima facie* directly and unambiguously derivable from the basis provided by the respondent. Even if it were accepted that the cited paragraphs on page 1 were considered common general knowledge applicable to the invention as described in Figure 1 and page 3 onwards, the skilled person would still not directly and unambiguously derive the specific combination of features of claim 1 from the description as a whole.

For example, page 3, lines 30-31, discloses specifically that the radial inward end of the airfoil is directly opposite of the radial outward end. This feature is also defined in claim 1 and is more specific than the airfoils described on page 1, lines 12-16. On the other hand, the paragraph bridging pages 3 and 4 of the description discloses more specifically that a rotor seal land extends between adjacent disk rims 30. However, claim 1 of this request defines a more generic extension between rotor stages as disclosed on page 1, lines 22-23.

The Board cannot recognize, at least *prima facie*, why the more generic rotor seal lands of the compressor stator vanes disclosed on page 1 form a single disclosure with the more specific airfoils disclosed on page 3, lines 30-31.

2.4 The same holds true for the sections of the gas turbine defined in claim 1. Page 2, lines 16-18, (that the respondent gave as the basis for the amendment) describes a gas turbine engine including an engine

casing and a compressor section, a combustor section and a turbine section within the engine casing but claim 1 defines more specifically that the engine casing extends *circumferentially* about an engine centerline axis.

The respondent argued that Figure 1 disclosed a casing around the whole center axis and thus served as a basis for this feature. However, if Figure 1 is used as the basis, this also discloses e.g. that the casing extends around a fan section 12 which is, however, not defined in claim 1. Figure 1 alone therefore does not provide a basis for the combination of features comprising the casing as defined in claim 1.

2.5 The amendments therefore *prima facie* do not overcome the objections raised by the appellant under Article 100(c) EPC.

2.6 The same reasons apply *mutatis mutandis* for auxiliary requests 3a, 8a and 10a, since they all contain the features discussed above under item 2.3. The respondent did not provide any specific arguments as to why the aforementioned objection would be overcome by these auxiliary requests, nor can the Board see that this would be the case.

2.7 The Board therefore exercised its discretion under Article 13(1) RPBA 2020 not to admit auxiliary requests 1a, 3a, 8a and 10a into the proceedings.

3. Admittance of auxiliary request 1b

3.1 The respondent filed auxiliary request 1b during the oral proceedings before the Board.

3.2 As stipulated in Article 25(3) RPBA 2020, since the summons to oral proceedings had been notified before the date of entry into force of the RPBA 2020 (1 January 2020), not only Article 13(1) RPBA 2020 but also Article 13 of the Rules of Procedure of the Boards of Appeal in the version valid until the date of the entry into force continue to apply.

According to Article 13(3) RPBA 2007, amendments sought to be made after oral proceedings have been arranged shall not be admitted if they raise issues which the Board or the other party or parties cannot reasonably be expected to deal with without adjournment of the oral proceedings.

3.3 The respondent argued that the request had been filed only during the oral proceedings in order not to overload the Board, i.e. for reasons of procedural economy. It further argued that it clearly addressed the objection on extension of subject-matter and that the basis for the amendments was clear and unburdensome to verify such that no adjournment was required.

3.3.1 The Board is not persuaded by these arguments. The respondent had been aware of all the objections and of the preliminary opinion of the Board for more than a year, during which time the respondent did file auxiliary requests, namely auxiliary requests 1a, 3a, 8a and 10a. The Board finds that the respondent had ample time and opportunity to address the underlying objections earlier and does not see a reason that would justify the filing of the request at this very late stage of proceedings. The Board also does not accept that procedural economy was enhanced by delaying the request until the oral proceedings, since the Board had already considered all the requests previously on file,

even those withdrawn during the appeal proceedings; the late filing of the request merely adds a further request to be considered by the Board and the appellant. The addition of (many) new features can only be seen as detrimental to procedural economy since the basis of each of these features alone and in combination must also be examined.

3.3.2 In addition, limiting claim 1 to what the respondent considered to be the disclosed specific embodiment resulted in the insertion of a large number of features from pages 3 and 4 of description into the claim. Contrary to the argument of the respondent, already the establishment of the basis of such a large number of features as well as the considerations required as to whether they had been at least correctly transposed into the claim placed a considerable burden on the appellant. In addition, these features had never been discussed before and the Board finds that the appellant could not be reasonably expected to have dealt with such subject-matter in the course of the oral proceedings without adjournment.

3.4 The Board therefore did not admit auxiliary request 1b into the proceedings (Article 13(1) RPBA 2020 and Article 13(3) RPBA 2007).

4. In the absence of a request which meets the requirements of the EPC, the patent must be revoked according to Article 101(3)(b) EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

The Registrar: The Chairman:

D. Grundner M. Harrison

Decision electronically authenticated

Claim 1 of auxiliary request 1a

CLAIMS - Auxiliary Request 1a

1. A gas turbine engine (10), comprising:

an engine casing (40) extending circumferentially about an engine centerline axis (A); and

a compressor section (14, 16), a combustor section (18) and a turbine section (20, 22) within said engine casing (40);

the compressor section comprising a plurality of adjacent rotor stages

an airfoil (25) extending between a radial outward end (34) and a radial inward end (36) directly opposite of the radial outward end (34), said airfoil (25) being a cantilevered compressor stator vane;

the cantilevered compressor stator vane fixed to the engine casing (40) at its radial outward end (34); and

a seal member (32) adjacent to said radial inward end (36) of said airfoil (25), wherein said seal member (32) is coated with an abrasive material (46) and

said seal member (32) includes a rotor seal land extending between adjacent rotor stages, characterized in that

a tip (38) of said radial inward end (36) of said airfoil (25) is coated with an abradable material (42) and

said abradable material (42) includes zirconium oxide comprising yttria stabilized zirconia.

Claim 1 of auxiliary request 3a

CLAIMS - Auxiliary Request 3a

1. A gas turbine engine (10), comprising:

an engine casing (40) extending circumferentially about an engine centerline axis (A); and

a compressor section (14, 16), a combustor section (18) and a turbine section (20, 22) within said engine casing (40);

the compressor section comprising a plurality of adjacent rotor stages

an airfoil (25) extending between a radial outward end (34) and a radial inward end (36) directly opposite of the radial outward end (34), said airfoil (25) being a cantilevered compressor stator vane;

the cantilevered compressor stator vane fixed to the engine casing (40) at its radial outward end (34); and

a seal member (32) adjacent to said radial inward end (36) of said airfoil (25), wherein said seal member (32) is coated with an abrasive material (46) and

said seal member (32) includes a rotor seal land extending between adjacent rotor stages, characterized in that

a tip (38) of said radial inward end (36) of said airfoil (25) is coated with an abradable material (42),

said abradable material (42) includes zirconium oxide comprising yttria stabilized zirconia

and said abradable material and said abrasive material are composed of the same material.

Claim 1 of auxiliary request 8a

CLAIMS –Auxiliary Request 8a

1. A gas turbine engine (10), comprising:

an engine casing (40) extending circumferentially about an engine centerline axis (A); and

a compressor section (14, 16), a combustor section (18) and a turbine section (20, 22) within said engine casing (40);

the compressor section comprising a plurality of adjacent rotor stages

an airfoil (25) extending between a radial outward end (34) and a radial inward end (36) directly opposite of the radial outward end (34); said airfoil (25) being a cantilevered compressor stator vane;

the cantilevered compressor stator vane fixed to the engine casing (40) at its radial outward end (34); and

a seal member (32) adjacent to said radial inward end (36) of said airfoil (25), wherein said seal member (32) is coated with an abrasive material (46) and

said seal member (32) includes a rotor seal land extending between adjacent rotor stages, characterized in that

a tip (38) of said radial inward end (36) of said airfoil (25) is coated with an abradable material (42),

said abradable material (42) includes zirconium oxide comprising yttria stabilized zirconia,

said abrasive material (46) includes zirconium oxide comprising yttria stabilized zirconia, and

said abradable material is designed to deteriorate when subjected to friction and said abrasive material is designed to cause irritation to said abradable material.

Claim 1 of auxiliary request 10a

CLAIMS –Auxiliary Request 10a

1. A gas turbine engine (10), comprising:

an engine casing (40) extending circumferentially about an engine centerline axis (A); and

a compressor section (14, 16), a combustor section (18) and a turbine section (20, 22) within said engine casing (40);

the compressor section comprising a plurality of adjacent rotor stages, each rotor stage comprising a disk and each disk comprising a disk rim,

an airfoil (25) extending between a radial outward end (34) and a radial inward end (36) directly opposite of the radial outward end (34); said airfoil (25) being a cantilevered compressor stator vane;

the cantilevered compressor stator vane fixed to the engine casing (40) at its radial outward end (34); and

a seal member (32) adjacent to said radial inward end (36) of said airfoil (25), wherein said seal member (32) is coated with an abrasive material (46) and

said seal member (32) includes a rotor seal land extending from each disk rim between adjacent disk rims of adjacent rotor stages, characterized in that

a tip (38) of said radial inward end (36) of said airfoil (25) is coated with an abradable material (42)

said abradable material (42) includes zirconium oxide comprising yttria stabilized zirconia,

said abrasive material (46) includes zirconium oxide comprising yttria stabilized zirconia, and

said abradable material is designed to deteriorate when subjected to friction and said abrasive material is designed to cause irritation to said abradable material.

Claim 1 of auxiliary request 1b

CLAIMS - Auxiliary Request 1b

1. A gas turbine engine (10), comprising:

a fan section (12); a compressor section (14, 16), a combustor section (18) and a turbine section (20, 22) in serial flow communication; the compressor section (14, 16) comprising a low pressure compressor (14) and a high pressure compressor (16), the combustor section comprising a combustor (18), the turbine section comprising a high pressure turbine (20) and a low pressure turbine (22); the low pressure compressor (14) and the high pressure compressor (16) comprising a plurality of adjacent ~~rotor~~ compressor stages circumferentially disposed about an engine centerline axis (A); each compression stage including a row of stator vanes (24) followed by a row of rotor blades (26); the low pressure compressor (14) and the high pressure compressor (16) also including multiple disks (28) which rotate about engine centerline axis (A) to rotate the rotor blades (26), each disk (28) including a disk rim (30) and each disk rim (28) supporting a plurality of rotor blades (26);

an engine casing (40);

an airfoil (25) ~~having~~ extending between a radial outward end (34) and a radial inward end (36) directly opposite of the radial outward end (34), said airfoil (25) being a cantilevered compressor stator vane; ~~and~~

the cantilevered compressor stator vane fixed to the engine casing (40) at its radial outward end (34), the engine casing (40) surrounding the compressor section, the combustor section and the turbine section; and

a seal member (32) adjacent to said radial inward end (36) of said airfoil (25), wherein said seal member (32) is coated with an abrasive material (46) and

said seal member (32) includes a rotor seal land extending from each disk rim 30 between ~~adjacent rotor stages~~adjacent disk rims 30 of adjacent rows of rotor blades 26, characterized in that

a tip (38) of said radial inward end (36) of said airfoil (25) is coated with an abradable material (42) and

said abradable material (42) includes zirconium oxide comprising yttria stabilized zirconia.