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**Datasheet for the decision
of 10 March 2022**

Case Number: T 0947/17 - 3.2.06

Application Number: 09178852.1

Publication Number: 2204534

IPC: F01D5/14

Language of the proceedings: EN

Title of invention:
Turbine airfoil clocking

Patent Proprietor:
General Electric Company

Opponent:
Siemens Aktiengesellschaft

Headword:

Relevant legal provisions:

EPC Art. 83, 56
RPBA Art. 12(4)

Keyword:

Sufficiency of disclosure - (yes)

Inventive step - (yes)

Late-filed objection - should have been submitted in first-
instance proceedings (yes)

Decisions cited:

Catchword:



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Case Number: T 0947/17 - 3.2.06

D E C I S I O N
of Technical Board of Appeal 3.2.06
of 10 March 2022

Appellant: Siemens Aktiengesellschaft
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Decision under appeal: **Interlocutory decision of the Opposition
Division of the European Patent Office posted on
15 February 2017 concerning maintenance of the
European Patent No. 2204534 in amended form.**

Composition of the Board:

Chairman M. Harrison
Members: T. Rosenblatt
E. Kossonakou

Summary of Facts and Submissions

- I. The appellant (opponent) filed an appeal against the interlocutory decision of the opposition division in which it found that European patent No. 2 204 534 in an amended form met the requirements of the EPC.
- II. The appellant and the respondent (proprietor) were summoned to oral proceedings before the Board.
- III. In a communication pursuant to Article 15(1) of the Rules of Procedure of the Boards of Appeal (RPBA 2020), the parties were informed of the Board's preliminary opinion on the case.
- IV. Oral proceedings were held on 10 March 2022 by videoconference.
- V. The appellant requested that the decision under appeal be set aside and the European patent No. 2 204 534 be revoked.

The respondent requested that the appeal be dismissed.

- VI. The following documents were referred to by the appellant:
 - D1 : EP 1 182 339 A2
 - E1 : N. Billiard et al. "Impact of Clocking on the Aero-Thermodynamics of a Second Stator tested in a One and a Half Stage HP Turbine. Part 1: Aerodynamic Effects", July 2007
 - E3 : N.L. Key et al. "An investigation of the flow physics of vane clocking using unsteady flow measurements", Proceedings of ASME Turbo Expo 2008,

Power for Land, Sea and Air, GT 2008, June 9-13, 2008.

VII. Amended claim 1 underlying the impugned decision has the following wording (the feature numbering in square brackets being that assigned to each feature by the appellant on page 2 of its appeal grounds):

"[1] A method of decreasing the operational stresses acting on a target airfoil row (136) in a turbine engine (100);

[2] wherein the target airfoil row (136) is bordered on one side by a first upstream airfoil row (134), which comprises the first row of airfoils (130) in the upstream direction from the target airfoil row, and on the other side by a first downstream airfoil row (138), which comprises the first row of airfoils (130) the downstream direction from the target airfoil row (136);

[3] the first upstream airfoil row (134) and the first downstream airfoil row (138) having the same number of similar airfoils (130) and

[4] both comprising either a row of rotor blades (120), (126) or a row of stator blades (122), (128), and

[5] the target airfoil (130) row comprising the other;

[7] the first upstream airfoil row is bordered by a second upstream airfoil row, which comprises the second row of airfoils (130) in the upstream direction from the target airfoil row;

[8] the second upstream airfoil row is bordered by a third upstream airfoil row, which comprises the third row of airfoils (130) in the upstream direction from the target airfoil row;

[6] the method comprising the step of:

[6.1] configuring the circumferential position of the airfoils (130) of the first upstream airfoil row (134) and the airfoils (130) of first downstream airfoil row (138) such that at least 90% of the airfoils (130) of the first upstream airfoil row (134) and at least 90% of the airfoils (130) of the first downstream airfoil row (138) comprise

[6.2] a clocking relationship of between 25% and 75% pitch; and

[9.1] configuring the circumferential position of the airfoils (130) of the third upstream row and the airfoils (130) of first upstream airfoil row such that at least 90% of the airfoils (130) of the third upstream airfoil row and at least 90% of the airfoils (130) of the first upstream airfoil row comprise

[9.2] a clocking relationship of between 25% and 75% pitch;

[10] wherein the pitch comprises the circumferential distance between a point on an airfoil in an airfoil row and the same point on either of the neighboring airfoils in the same row; and

[11] the clocking relationship of between 25% and 75% pitch provides that the circumferential position of an airfoil in the first downstream airfoil row lags or leads the circumferential position of a corresponding airfoil in the first upstream airfoil row by an offset of between 25% and 75% of the measurement of the pitch."

VIII. The arguments of the appellant may be summarised as follows.

Article 83 EPC

In the written and oral proceedings before the opposition division it had been criticised that the feature "similar airfoils" could not be carried out. The patent did not contain any indication in regard to which property (such as material or shape) of an airfoil the term "similar" referred to, so that a skilled person was unable to provide similar or unsimilar airfoils. Since it was unclear what was covered by the claim, the scope of protection could not be determined. The question in regard to which property airfoils had to be similar was not even answered, neither by the respondent nor by the opposition division in the written decision, the latter consequently infringing the appellant's right to be heard. The right to be heard required that the opposition division should have considered this question, which they had failed to do by not answering it.

Further, neither feature 8 nor the remaining parts of claim 1 defined a number of airfoils of the third upstream row. Feature 8 could not be carried out with arbitrary airfoil numbers, the claim thus being too broad.

Article 56 EPC

The subject-matter of claim 1 was obvious in view of the method known from either E1 (or D1) and common general knowledge or the customary practice followed by the skilled person. Only features 7 to 9 were not known

from these documents which both related to a turbine with less stages or airfoil rows than required by claim 1. The teaching of E1 (or D1) would however simply be extended by the skilled person to any type of axial multi-stage machines as a matter of course, so as to repeat the known method on a neighbouring pair of airfoil rows in regard to a second (upstream) target airfoil row and the further reduction of operational stresses on the first target airfoil would thus be obtained as a side effect. This was further supported by E3, which could also be taken as the closest prior art to the subject-matter of claim 1 and which would lead to the same result, i.e. a lack of inventive step.

The same conclusion would also be arrived at when starting from D1 as the closest prior art. Again, only features 7 to 9 were not known from this document. However it was not clear that these features achieved the claimed effect of further reducing operational stresses by clocking an additional third upstream airfoil row, at least not over the entire breadth of the claim. It was not apparent that any effect at all would be achieved. Absent any technical effect, no problem was solved and the subject-matter could therefore not involve an inventive step.

IX. The arguments of the respondent, as far as relevant to the present decision, may be summarised as follows.

Article 56 EPC

E1 did not represent a suitable starting point for the assessment of inventive step as it concerned transonic turbines. The target row considered in E1 was different to that according to claim 1 of the patent, so that the effect sought was not shown for other rows. Feature 6.2

was also not disclosed in E1. Nothing in E1 or from common general knowledge would have lead the skilled person to extend the teaching to at least two airfoil rows upstream. Starting from D1 as the closest prior art, no different conclusion was possible. According to D1, third row airfoils were clocked circumferentially relative to first row airfoils for bathing the third row airfoils with relatively cool wakes discharged from the first row airfoils during the hottest running condition of the turbine engine. D1 did not disclose the specific clocking ratio according to feature 6.2 of claim 1, nor any reduction of operational stresses. D1 also did not disclose or suggest five consecutive rows being in a clocked arrangement. There was no suggestion that the clocking disclosed could be adapted for further airfoils so as to provide further operational advantages.

Reasons for the Decision

Article 83 EPC

1. The requirement of Article 83 EPC is met.

The arguments submitted by the appellant in writing and orally in the appeal procedure, as far as they are admitted into the proceedings (see below), do not throw any doubts on the question of whether the invention defined by the subject-matter of claim 1 is disclosed in the patent in suit in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art.

1.1 The appellant's objection as to the term "similar" may be considered to be based on a perceived lack of clarity. Although it may be difficult to draw a sharp line between "similar" and "unsimilar" airfoils, including the question which airfoil property (e.g. material or shape) might possibly be relevant here to determine similarity, these considerations merely impinge on the exact limits of the scope of protection of the claim, as was also recognised by the appellant when it argued that it was unclear which embodiments fell under the claim and which not. The appellant's own difficulty of determining the exact limits of the scope of protection does, however, not lead to a conclusion of there being insufficient disclosure. Despite the absence of an indication in the patent as to the pertinent properties of airfoils when considering their similarity, the mere question raised by the appellant does not demonstrate that the skilled person, taking into account common general knowledge, would be unable to provide rows of similar airfoils and thereby to carry out the invention defined by claim 1.

Since the requirement of Article 83 EPC is not concerned with the determination of the scope of protection, the appellant's question, in regard to which property the airfoils had to have in order to be similar, does not require an answer.

1.2 Concerning the appellant's arguments allegedly raised in the written procedure before the opposition division, referred to at the top of page 4 of the appeal grounds, the Board had stated in its preliminary opinion that the generality of that reference did not comply with the requirement to specify expressly, *inter alia*, all the facts, arguments and evidence relied on

(see Article 12(3) RPBA 2020, which in this respect corresponds to Article 12(2) RPBA 2007). It could not be ascertained, from this unspecific reference, where an objection was raised according to which the feature "similar airfoils" was insufficiently disclosed in such a way that the invention could not be carried out.

The appellant did not reply to this point of the preliminary opinion, so that no further arguments concerning this aspect of the objection pursuant to Article 83 EPC, besides the argument considered in item 1.1 above, require consideration.

- 1.3 In regard to the objection raised against "feature 8", the Board expressed its intention in the preliminary opinion to hold this objection inadmissible (Article 12(4) RPBA 2007) since no reason was apparent why this objection could not have been raised before the opposition division. The appellant also did not submit any further comment on this aspect. The Board thus has no reason to deviate from its intention and hereby confirms that it holds the objection raised against feature 8 inadmissible (Article 12(4) RPBA 2007).

2. The appellant's right to be heard was also not violated by the opposition division not answering the question raised in the oral proceedings as to whether the similarity of an airfoil referred to the material or the shape (item 3.1.1 of the minutes of the oral proceedings before the opposition division). There is no requirement for an opposition division to answer such a question from a party. The party is there to provide its arguments on a case and the opposition division is there to decide on the arguments, albeit in certain cases the opposition division may choose of its own motion to inform the parties how it understands

particular wording of a claim.

The Board can accept that a party's right to be heard requires a consideration of its arguments which should then be reflected in the written reasoning (Article 113(1) in conjunction with Rule 111(2) EPC).

The impugned decision and the minutes contain some inconsistencies on the issues raised by the appellant under Article 83 EPC against the then considered main request underlying the impugned decision. The impugned decision (item 3, the entire section on pages 2 and 3 headed "Art 100(b) in combination with Art 83 EPC.") indeed lacks any mention of the particular issue questioned by the appellant in the second paragraph of item 3.1.1 of the minutes ("similar airfoils" referring to material or shape?). The Board, as also mentioned above, nevertheless sees no reason why the opposition division was required to provide a concrete answer on the question recorded in the minutes. Assuming for the sake of argument that the contested terminology would have been considered unclear by the opposition division, the crucial question to be answered by the division under Article 83 EPC would then have been why the claimed invention could still be considered to be disclosed in a manner sufficiently clear and complete in the patent, rather than which property was relevant.

And in regard to such a crucial question it would indeed have been incumbent on the opposition division to take into account the appellant's arguments possibly substantiating why the skilled person was allegedly unable to provide "similar airfoils" and to at least briefly reply to such arguments in the written reasoning. However, the appellant made no arguments in this respect. At least the minutes do not record any

particular argument submitted by the appellant except for the mentioned question. Having regard to other details of the arguments submitted by the parties during the oral proceedings and recorded in the minutes it is not apparent that the minutes are incomplete in this regard, nor has it been argued by the appellant that this was the case; a request for correction of the minutes of the oral proceedings before the opposition division is also not on file. As regards arguments allegedly submitted in writing during the opposition procedure in this specific regard, the appellant did not reply to the Board's remark on the generality of the respective statement in the grounds of appeal (see also above 1.2).

In summary, the lack of a concrete answer to the appellant's question does not constitute a violation of its right to be heard (Article 113(1) EPC).

Article 56 EPC

3. The subject-matter of claim 1 involves an inventive step (Article 56 EPC).
4. E1 represents an appropriate starting point for the assessment of inventive step.
 - 4.1 In fact, E1 discloses different clocking relationships between two stator airfoil rows of a (high pressure) turbine stage and considers the effects of unsteady forces applied on a downstream stator's vane (see the top paragraph of the left column on page 4 and the final sentence of the abstract of E1). More particularly E1 discloses features 1 to 6, 6.1 and 6.2, 10 and 11 of claim 1. In particular in regard to feature 6.2, a clocking relationship of 25%, 50% and

75% of pitch in the three airfoil rows shown in Figure 3 of E1 are explicitly disclosed, as also argued by the appellant on page 5 of the appeal grounds. The Board thus follows the appellant's argument according to which only features 7, 8 and 9 (9.1 and 9.2) of claim 1 are not disclosed in E1.

The respondent's arguments disputing the above summarised feature analysis are not convincing. For the purposes of this decision a detailed reasoning on these aspects is however not required, since the Board anyway decided in favour of the respondent.

- 4.2 In the context of its objection starting from E1 as the closest prior art, the appellant did not dispute that the technical effect mentioned in paragraphs 38 to 40 of the patent's description indeed occurred as a consequence of the identified distinguishing features, i.e. a further reduction of the operational stress on a particular target airfoil row (see however also point 5.3 below).

The objective technical problem can therefore be seen as being the provision of a method of further reducing operational stresses on a given target airfoil row.

- 4.3 It is undisputed that neither E1 nor D1 discloses the distinguishing features 7, 8 and 9. It has also not been shown that these features and the effect achieved by them would belong to common general knowledge of a skilled person. Therefore the Board finds no hint in E1, D1 or common general knowledge, except by impermissible use of hindsight, pointing the skilled person to solve the objective technical problem by airfoil clocking of the third and first upstream rows

according to features 9.1 and 9.2 of claim 1.

4.4 The appellant's central argument, based essentially on a repeated application of a proven successful technique, is not convincing.

4.4.1 It is first to be noted, as also argued by the respondent in the oral proceedings before the Board, that the target airfoil row on which the effects of clocking are investigated in E1 is a different row than that of claim 1. According to feature 2 of claim 1 the target airfoil row is an intermediate airfoil row between a first upstream and a first downstream airfoil row, where the first upstream and first downstream airfoil rows are of the same type, either being both a rotor or a stator airfoil row (feature 4 of claim 1), and the target airfoil row in-between is then necessarily of the other type (feature 5 of claim 1). In the 1 ½-stage turbine test rig used in E1 and composed of a first upstream stator row, an intermediate (downstream) rotor row and a second downstream stator row, aerodynamic effects are investigated on the second downstream stator row (see for example title, abstract or "Conclusions" of E1).

Whilst the nature of the target airfoil row (stator or rotor) is not decisive in regard to the present question of obviousness, the position of the target airfoil row relative to the clocked airfoil rows does however matter in this respect, and this position is different in E1 compared to claim 1.

4.4.2 Since there are no structural differences identifiable between the airfoil rows according to claim 1 and those of the 1 ½ stage test rig of E1, the effect of clocking the first upstream and downstream rows on the

intermediate row as defined in the claim, i.e. decreasing operational stresses on such intermediate target row, nevertheless must necessarily be assumed to have occurred under the disclosed clocking ratios also in the test rig used in E1, even though this effect on the intermediate row was not investigated or even mentioned therein. However, since this effect on the intermediate target row between first upstream and first downstream airfoil rows is not disclosed in E1, the skilled person could not get any incentive from E1 of how to further reduce operational stress on that very (intermediate) target row. Only with the knowledge of the invention, and thus by hindsight, could the skilled person have concluded that clocking according to E1 would, in addition to the effects on the downstream stator airfoil row, also reduce operational stresses on the intermediate rotor airfoil row.

4.4.3 Even though turbine arrangements with more stages than the disclosed 1 ½ stage test rig are well known in the art, and even though the skilled person would indeed always strive to improve such known arrangements by techniques proven successful in similar circumstances, the skilled person - faced with the above objective problem concerning the intermediate airfoil row between two neighbouring clocked airfoils rows - cannot simply extend or repeat a teaching to such bigger turbines when they are not even aware of the existence of the claimed effect (reduction of the operational stress on an intermediate airfoil row). Moreover, neither E1 nor D1 consider turbine arrangements with more than four airfoil rows or the extension of the respective teaching to such arrangements. Under these circumstances there can be no reasonable expectation of success which could have motivated the skilled person to further reduce operational stresses on a target

airfoil row arranged between clocked first upstream and first downstream airfoil rows by clocking also a third upstream airfoil row with the first upstream airfoil row.

5. D1 can also be taken as a starting point when using the problem-solution-approach to examine whether the subject-matter of claim 1 involves an inventive step. However the result is not different to that when starting from E1 as the closest prior art.

5.1 D1 discloses specifically a two stage high pressure turbine, composed of four consecutive airfoil rows (22, 24, 26, 28, see Figures 2 and 4), where the first and third rows (22, 26) are stator rows and the second and fourth rows (24, 28) constitute rotors. D1 also discloses a method for reducing operational (thermal) stresses on a target airfoil row according to which the third row airfoils (26) are clocked circumferentially relative to the first row airfoils (22) for bathing the third row airfoils (26) with relatively cool wakes discharged from the first row airfoils during the hottest running condition of the turbine engine, as also argued by the respondent and confirmed by the description of D1, for example in paragraph 43.

The Board notes, in analogy to its considerations in item 4.4.1 above, that the target airfoil row on which (thermal) stresses are to be reduced by clocking of two (i.e. the first and third) airfoil rows is again the downstream clocked (third) row and not the row between the two clocked rows.

Although, again, the respondent contested the disclosure of any particular clocking ratio in D1, it can be assumed in favour of the appellant that the

subject-matter of claim 1 is distinguished from the method disclosed in D1 by only features 7 to 9.

- 5.2 The Board considers that, based on the fact that the distinguishing features of claim 1 are the same in regard to D1 as in regard to E1, the objective technical problem is the same and that for analogue reasons as given above in points 4.3 and 4.4.2., the conclusion on inventive step cannot be different.
- 5.3 During the oral proceedings before the Board the appellant raised, for the first time in the appeal proceedings, general doubts in regard to the achievement of any technical effect at all by the distinguishing features 7 to 9. Leaving aside any considerations as to the timeliness of the submission, just as for the objection on sufficiency of disclosure, where the appellant limited its argument essentially to pointing to a perceived lack of clarity and to merely asking a question on the scope of protection, the concerns raised by the appellant in regard to the contribution to or achievement of a technical effect by the distinguishing features are again of a totally general nature, bare of any substantiated, let alone convincing explanation as to why the effect could possibly not be achieved over the entire scope of the claim. Whether the respondent's counter arguments to this mere allegation submitted by the appellant for the first time in the oral proceedings were convincing or not is here not decisive. The appellant failed to present substantiated and comprehensible arguments on the basis of which the Board could have reached a well-founded conclusion that the claimed effect could indeed not be considered to be achieved over part or the entire scope of the claim. Simply alleging that the stated effect might not occur, as the appellant did, is

in itself not convincing, let alone a credible line of attack to which the respondent should be expected to supply comprehensive or structured counter-arguments.

6. The appellant's arguments concerning "selection inventions" presented in the written procedure (last two paragraphs of page 7 of the grounds of appeal), were found preliminarily unconvincing by the Board (see point 3.10 of the Board's communication pursuant to Article 15(1) RPBA 2020, in which it was stated that the appellant's arguments in relation to selection inventions were not convincing because the claimed method was not distinguished over E1 or D1 by values of a parameter selected from or overlapping with a known broader range of values). During the oral proceedings, it was repeated that the Board did not consider the invention to be a selection invention as already indicated in its preliminary opinion. The appellant did not respond in writing to that preliminary view of the Board, and in the oral proceedings simply made no use of its possibility to comment, stating instead that, in view of the Board's opinion, it had nothing further to add on this part of its objections. The Board thus confirms its reasons given in the preliminary opinion as to why the invention does not relate to a selection invention.

7. Similarly, the Board had also stated in its communication pursuant to Article 15(1) RPBA 2020 that it intended not to consider the objections based on E3, raised for the first time in the appeal procedure (Article 12(4) RPBA 2007). Such objections were not considered in the impugned decision and also the minutes of the oral proceedings did not contain any indication that a corresponding objection had been raised by the appellant. The notice of opposition, to

which the appellant had also referred in its written submission (see grounds of appeal, page 7, line 3), comprises in turn a single line on page 8 referring to E3, without any analysis of its content. No reason was given or readily apparent to the Board why objections based on E3 could not have been submitted before the opposition division. Again, the appellant did not comment on these aspects in reply to the Board's preliminary opinion. The Board therefore has no reason to deviate from the preliminary opinion and hereby confirms that the objections based on E3 are not to be considered in the appeal proceedings (Article 12(4) RPBA 2007).

8. Absent any objection prejudicial to the maintenance of the patent in the amended form considered to meet the requirements of the EPC by the opposition division, the appeal has to be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed

The Registrar:

The Chairman:



D. Grundner

M. Harrison

Decision electronically authenticated