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**Datasheet for the decision  
of 11 February 2010**

**Case Number:** T 2343/08 - 3.2.06

**Application Number:** 00311244.8

**Publication Number:** 1111190

**IPC:** F01D 5/18

**Language of the proceedings:** EN

**Title of invention:**

Cooled turbine blade with slanted and chevron shaped  
turbulators

**Patentee:**

GENERAL ELECTRIC COMPANY

**Opponent:**

Alstom Technology Ltd

**Headword:**

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**Relevant legal provisions:**

RPBA Art. 13(1)

**Relevant legal provisions (EPC 1973):**

EPC Art. 54(2)

**Keyword:**

"Novelty (no) - main request"

"Auxiliary request - late filed - not admitted"

**Decisions cited:**

T 0501/92, T 0946/06

**Catchword:**

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Case Number: T 2343/08 - 3.2.06

**D E C I S I O N**  
of the Technical Board of Appeal 3.2.06  
of 11 February 2010

**Appellant:** Alstom Technologies Ltd  
Brown Boveri Strasse 7  
CH-5400 Baden (CH)

**Representative:** -

**Respondent:** GENERAL ELECTRIC COMPANY  
(Patent Proprietor) 1 River Road  
Schenectady, NY 12345 (US)

**Representative:** Goode, Ian Roy  
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**Decision under appeal:** Decision of the Opposition Division of the  
European Patent Office posted 30 October 2008  
rejecting the opposition filed against European  
patent No. 1111190 pursuant to Article 102(2)  
EPC.

**Composition of the Board:**

**Chairman:** P. Alting Van Geusau  
**Members:** G. Pricolo  
K. Garnett

## Summary of Facts and Submissions

I. The appeal is from the decision of the Opposition Division posted on 30 October 2008 to reject the opposition filed against European patent No. 1 111 190 granted in respect of European patent application No. 00 311 244.8.

II. Claim 1 as granted reads as follows:

"1. A turbine rotor blade (10) comprising: pressure and suction sidewalls (16,18) extending longitudinally in span from root (22) to tip (24), and extending in chord between leading and trailing edges (26, 28); said sidewalls being spaced laterally apart between said leading and trailing edges, and joined together by chordally spaced apart partitions (30) extending longitudinally between said root and tip to define a flow channel (32) for channeling a coolant (34) therethrough; characterised by: said blade having twist to position said pressure sidewall at said channel in most part closer to said leading edge than said opposite suction sidewall at said channel to offset laterally said channel (32a,b,h,k) from said leading edge (26) toward said trailing edge (28), and said channel having a row of slant turbulators (38) spaced apart longitudinally and all inclined inward toward said root (22) and trailing edge (28) and continuous between said partitions (30) for directing said coolant along said turbulators co-directionally with Coriolis flow inside said channel."

III. In coming to its decision the Opposition Division held, *inter alia*, that the subject-matter of claim 1 was

novel over the disclosure of document:

D1: Ian K. Jennions et al.: "The GT24/26 low pressure turbine" International Gas Turbine & Aeroengine Congress & Exhibition, Stockholm, June 2 to 5, 1998.

The Opposition Division argued that the skilled person, although aware that most of the modern turbine blades were twisted, could not infer any degree of twist for the blade shown in Figs. 7a and 7b of D1. The Opposition Division further considered that even if the skilled person would recognize a twist in the blade shown in Figs. 7a and 7b of D1, a precise offset of any inner channel with respect to a leading edge could not be inferred.

- IV. Against this decision, the opponent lodged an appeal, received at the EPO on 22 December 2008, and simultaneously paid the appeal fee. The statement setting out the grounds of appeal was received at the EPO on 1 March 2009.
  
- V. Oral proceedings, at the end of which the decision of the Board was announced, took place on 11 February 2010.

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

The respondent (patentee) requested that the appeal be dismissed, alternatively that the patent be maintained on the basis of the auxiliary request filed during the oral proceedings.

VI. Claim 1 according to the auxiliary request reads as follows:

"1. A turbine rotor blade (10) comprising: pressure and suction sidewalls (16,18) extending longitudinally in span from root (22) to tip (24), and extending in chord between leading and trailing edges (26, 28); said sidewalls being spaced laterally apart between said leading and trailing edges, and joined together by chordally spaced apart partitions (30) extending longitudinally between said root and tip to define a flow channel (32) for channeling a coolant (34) therethrough; said blade having twist to position said pressure sidewall at said channel in most part closer to said leading edge than said opposite suction sidewall at said channel to offset laterally said channel (32a,b,h,k) from said leading edge (26) toward said trailing edge (28), and said channel having a row of slant turbulators (38) extending straight between said partitions, being spaced apart longitudinally and all being inclined inward toward said root (22) and trailing edge (28) and continuous between said partitions (30) for directing said coolant along said turbulators co-directionally with Coriolis flow inside said channel; and said turbulators being disposed inside said channel along both said pressure and suction sidewalls; characterized by another flow channel (32,c,d,e,g) disposed forward of said offset channel and aligned with said leading edge; and respective rows of turbulator chevrons (44) disposed inside said aligned channel along said pressure and suction sidewalls with said pressure-side chevrons pointing outward toward said tip, and said suction-side

chevrons pointing inward toward said root."

VII. The arguments of the appellant can be summarized as follows:

Fig. 7a of D1, which is representative of the internal passages of a blade of a low pressure stage of a gas turbine, shows a cooling channel close to the trailing edge that is provided with a row of turbulators spaced apart longitudinally and inclined inward toward the root and the trailing edge of the blade. As generally known, and as shown in Fig. 11 of D1, the blade of a gas turbine is provided with a substantial degree of twist. In the context of the patent in suit, the term "twist" means that the blade is bent with respect to the rotor axis, i.e. that the blade when viewed from above is not parallel but lies obliquely with respect to the rotor axis. As a matter of fact, in Fig. 2 of the patent in suit the blade twist is represented by a twist angle A between the suction sidewall and the rotary axis. Therefore, the blade shown in Fig. 7a of D1 has a twist and, as a result, the cooling channel close to the trailing edge is offset laterally from the leading edge toward the trailing edge. Coolant flow through the channel experiences a Coriolis force because the blade rotates during operation about the rotary axis of the turbine. Accordingly, the turbulators in the cooling channel close to the trailing edge of the blade of Fig. 7a direct the coolant co-directionally with the Coriolis flow inside the channel. As a consequence, the subject-matter of claim 1 is not novel over D1.

The respondent's auxiliary request was filed at a very late stage of the oral proceedings, namely following the debate, the deliberation, and the announcement by the Board that the subject-matter of claim 1 as granted was considered to lack novelty over D1. Since no new elements had been introduced during the oral proceedings, the filing of the auxiliary request at such late stage was not justified. Furthermore, if the auxiliary request was admitted, then the case should be remitted to the department of first instance to consider the fresh issues raised by the amendments.

VIII. The respondent's reply can be summarized as follows:

The Opposition Division correctly stated that the skilled person could not infer any degree of twist from document D1. Blade twist in accordance with the patent in suit is a continuous twist of the blade along its longitudinal axis and not an inclination of the blade, when viewed from above, with respect to the turbine rotary axis. As a result of blade twist, the blade is helically shaped. D1 does not disclose that the blade has twist. Furthermore, although Fig. 7a shows a channel with a row of slant turbulators, it cannot not be inferred from the drawing whether the channel is offset laterally from the leading edge toward the trailing edge. Therefore, D1 does not disclose a twisted channel offset laterally from the leading edge toward the trailing edge as required by claim 1.

The auxiliary request filed at the oral proceedings before the Board had already been submitted during the proceedings before the Opposition Division. Therefore, it could not come as a surprise to the appellant.

## Reasons for the Decision

1. The appeal is admissible.
2. *Main request*
  - 2.1 Document D1 undisputedly discloses a turbine rotor blade in accordance with the preamble of claim 1, comprising (see in particular Figs. 7a, 7b and 11) pressure and suction sidewalls extending longitudinally in span from root to tip, and extending in chord between leading and trailing edges; said sidewalls being spaced laterally apart between said leading and trailing edges, and joined together by chordally-spaced apart partitions extending longitudinally between said root and tip to define a flow channel for channeling a coolant therethrough.
  - 2.2 A matter of dispute between the parties was the interpretation of the term "twist" and whether the blade shown in Fig. 7a of D1 has a twist.

Generally speaking, both interpretations of the term "twist" offered by the parties are possible. A blade can be regarded as having a twist because, when viewed from the top, it is inclined with respect to the rotary axis of the turbine. In this case the blade is "bent" as submitted by the appellant. A blade can also be regarded as having a twist when the degree of inclination varies along the length of the blade. In this case the blade is "helically twisted" as submitted by the respondent.



According to the description of the patent in suit (see par. [0025] and Figs. 2, 3), the blade twist is represented by a twist angle A between the suction sidewall and the rotary axis when viewed from above. Since the rotary axis is taken as a reference line, the twist of the blade is to be understood as an inclination, or bend, of the blade cross-section with respect to the rotary axis. This is corroborated by the further disclosure in the patent in suit (see par. [0026]) that one effect of blade twist is that one or more of the flow channels is offset circumferentially or laterally from the leading edge toward the trailing edge. This effect depends on the degree of inclination of the blade with respect to the rotary axis and not necessarily on the degree of helical twist. In fact, a helical twist may result in a flow channel being offset only over a portion of its length, if the twist angle A is low at the root and increases along the blade's length (in a conventional manner).

Therefore, the term "twist" in claim 1 may be interpreted in the light of the description as requiring that the blade lies obliquely to the rotary axis of the turbine. Claim 1 however does not exclude that the blade might, additionally, be helically twisted.

D1, in Fig. 11, clearly and unambiguously shows that the turbine blades of all four stages are inclined with respect to the rotary axis of the turbine. Since the blade shown in cross-section in Fig. 7a belongs to this turbine (see page 5, last two paragraphs), it is also

inclined, i.e. it has a twist in the sense of the patent in suit.

- 2.3 The blade shown in the cross-sectional view of Fig. 7a of D1 comprises a flow channel adjacent the trailing edge (TE) that has a row of slant turbulators spaced apart longitudinally and all inclined inward toward said root and trailing edge (TE) and continuous between said partitions.

The respondent submitted that the flow channel on the left-hand side of Fig. 7a was only apparently adjacent the trailing edge; whether this was really the case depended on the location of the cross-sectional plane. However, since Fig. 7a indicates the trailing and leading edges (TE and LE), it clearly is a conventional cross-sectional view analogous to that of Fig. 1 of the patent in suit showing the complete internal configuration of the blade (i.e. it is not a cross-section taken along a plane but along a curved surface passing inside the blade). The flow channel on the left-hand side of Fig. 7a is therefore adjacent the trailing edge.

Since, as shown in Fig. 11, the blades are substantially inclined over the rotary axis, the flow channel adjacent the trailing edge (TE) of the blade according to Fig. 7a is necessarily offset laterally from the leading edge toward the trailing edge.

Accordingly, D1 discloses the features of the characterising portion of claim 1 according to which the blade has twist to position said pressure sidewall at said channel in most part closer to said leading

edge than said opposite suction sidewall at said channel to offset laterally said channel from said leading edge toward said trailing edge, and said channel having a row of slant turbulators spaced apart longitudinally and all inclined inward toward said root and trailing edge and continuous between said partitions.

- 2.4 The effect of the Coriolis force is to produce secondary flow fields in the flow channel in the form of a pair of counterrotating vortices as illustrated in Fig. 2 of the patent in suit. In the laterally offset channel of the blade shown in Fig. 7a of D1, the counterrotating vortices will engage the slant turbulators in a manner analogous to that shown in Fig. 3 of the patent in suit, i.e. in a flow orientation corresponding to the orientation of the slant turbulators. Accordingly, D1 also discloses the feature of claim 1 that the coolant is directed along the turbulators co-directionally with Coriolis flow inside the channel.
- 2.5 Therefore, D1 discloses all the features of claim 1 as granted. As a consequence, its subject-matter is not new within the meaning of Article 54(1) and (2) EPC.

### 3. *Auxiliary request*

- 3.1 At the oral proceedings, following the debate on the main request and an adjournment for deliberation, the Board expressed the opinion that the subject-matter of claim 1 lacked novelty over D1. The respondent then filed an auxiliary request for maintenance of the patent in amended form.

3.2 The filing of the auxiliary request represented an amendment to the respondent's case as set out in its reply to the grounds of appeal. In this respect it is irrelevant that the auxiliary request had already been filed during the proceedings before the Opposition Division because, in accordance with established case law of the boards of appeal, a procedural request made by a party in first instance proceedings before the EPO is not effective or applicable within subsequent appeal proceedings (see e.g. T 501/92, OJ 1996). Accordingly, the auxiliary request may be admitted and considered only at the Board's discretion pursuant to Article 13(1) of the Rules of Procedure of the Boards of Appeal (RPBA). This Article makes clear that in exercising that discretion, the Board must consider a range of factors including *inter alia* the complexity of the new subject matter submitted, the current state of the proceedings and the need for procedural economy.

3.3 In the appeal proceedings the respondent deliberately chose not to submit any auxiliary request as fallback position during the written phase of the proceedings, contrary to what it did in the proceedings before the Opposition Division. It filed the auxiliary request only when the Board, during the oral proceedings and after deliberation, expressed a negative opinion on the sole request on file. The respondent, however, could not have reasonably expected that it would, as a matter of certainty, prevail in the appeal proceedings with its main request. A patent proprietor must normally be prepared for the situation that its main requests will not be upheld, even if this may not immediately appear probable on the basis of the written proceedings

leading up to the oral proceedings. The fact that an opposition is rejected at first instance is absolutely no guarantee for a patent proprietor that this finding will be upheld on appeal. Thus it is clear that the patent proprietor must be prepared for this situation, and he must decide whether or not he is prepared to amend his main request in case of a successful attack by the opponent. However, this decision cannot be postponed to a very late stage, and this decision can also not be made dependent of the course of the oral proceedings. The patent proprietor himself must be able to identify and define such restricted subject-matter as may still be of interest to him in case the subject-matter of his main request should fail. It is understandably very tempting to delay action until an informed guess can be made as to how the board will decide as regards a main request. However, such tactical postponement of the filing of requests cannot be accepted. It would be clearly inequitable as regards the other party, and also contrary to the underlying principle of Article 13(3) RPBA, namely that the complete case of the parties must be set out by the time oral proceedings are appointed, and a fortiori by the time the oral proceedings are held. The purpose of oral proceedings is the exercise of the right of a party to present its case orally, and not a procedural occasion for testing the opinion of the board in order to prepare further requests (see in this respect T 946/06, point 9 of the reasons). Furthermore, the amendments made to claim 1 focus on the presence of turbulator chevrons in a flow channel disposed forward of the offset channel, which is an aspect apparently unrelated to the previous discussions during these proceedings. Under these circumstances, the Board

exercised its discretion under Article 13(1) RPBA not to admit the auxiliary requests into the proceedings for reasons of procedural economy.

**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:

M. Patin

P. Alting van Geusau