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**Datasheet for the decision
of 17 September 2008**

Case Number: T 0006/08 - 3.2.06

Application Number: 02752254.9

Publication Number: 1409847

IPC: F01D 5/14

Language of the proceedings: EN

Title of invention:

First-stage high pressure turbine bucket airfoil

Applicant:

GENERAL ELECTRIC COMPANY

Opponent:

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Headword:

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Relevant legal provisions:

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Relevant legal provisions (EPC 1973):

EPC Art. 84, 56

Keyword:

"Claims - support by the description (no)"
"Inventive step (no)"

Decisions cited:

-

Catchword:

-



Case Number: T 0006/08 - 3.2.06

D E C I S I O N
of the Technical Board of Appeal 3.2.06
of 17 September 2008

Appellant: GENERAL ELECTRIC COMPANY
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Representative: Bedford, Grant Richard
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 13 July 2007
refusing European application No. 02752254.9
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: K. Garnett
Members: G. Pricolo
M. Harrison

Summary of Facts and Submissions

I. With the decision posted on 13 July 2007 the European patent application 02 752 254.9 was refused.

II. The examining division found that claims 1 and 2 did not comply with the requirements of Article 84 EPC, because they were not clear and not concise. In additional grounds and not forming part of the actual decision, the examining division stated that the subject-matter of claims 1 and 2 lacked an inventive step having regard to the disclosure of document

D1 : EP-A-0 887 513.

III. Against this decision the appellant (applicant) filed an appeal which was received at the European Patent Office on 13 September 2007. The corresponding fee was paid on the same date. A statement setting out the grounds of appeal was received at the European Patent Office on 23 November 2007.

IV. In accordance with its request, the appellant was summoned to oral proceedings.

V. In the annex to the summons to oral proceedings the board of appeal informed the appellant of its preliminary opinion according to which it appeared questionable whether the subject-matter of the claims was supported by the description (Article 84 EPC 1973). The board further questioned whether the subject-matter of claims 1 and 2 involved an inventive step having regard to the prior art turbine bucket known from D1.

VI. In reply to this preliminary opinion, the appellant withdrew its request for oral proceedings. Instead it requested that a written decision be issued taking into account the submitted figures and comments.

The oral proceedings were duly cancelled.

VII. The appellant requested that the decision of the examining division be set aside and that a patent be granted on the basis of the claims submitted together with the statement setting out the grounds of appeal.

VIII. The independent claim reads as follows:

"1. A turbine bucket (17) for the first stage of a gas turbine, said turbine bucket (17) having an uncoated nominal airfoil profile (10) substantially in accordance with Cartesian coordinates values of X, Y and Z set forth in Table I carried only to three decimal places wherein Z is a perpendicular distance from a plane normal to a radius of the turbine centerline and containing the X and Y values with the Z value commencing at zero in the X, Y plane at the radially innermost aerodynamic section of the airfoil and X and Y are coordinates defining the airfoil profile at each distance Z, the profiles at the Z distances being joined smoothly with one another to form a complete airfoil shape; the X, Y and Z values being scaled as a function of the same constant or number to provide a scaled-up or scaled-down bucket airfoil."

Table I referred to in the claim is contained in the description of the application and lists the Cartesian

coordinates of roughly 1600 points constituting the airfoil profile in the unit of inches.

- IX. The arguments submitted by the appellant in its reply did not contain any comments on the board's objection raised under Article 84 EPC 1973. The appellant only submitted arguments and two figures relating to technical improvements that the claimed invention provided with respect to conventional airfoil design profiles. The appellant concluded that the claims presently on file were novel and involved an inventive step with respect to conventional known airfoil profiles.

Reasons for the Decision

1. The appeal is admissible.
2. The claims do not meet the requirements of Article 84 EPC 1973 since they are not supported by the description.
 - 2.1 According to claim 1, the shape of the bucket's airfoil profile is defined independently of its absolute size (i.e. it can be scaled by a constant). Although within certain limits linear scaling appears to have no impact on the aerodynamic efficiency of a gas turbine, this is not the case with respect to extreme down-scaling (e.g. the case of a micro gas turbine), where increasing Reynolds-number effects are not negligible. Due to the decreasing distance between the hub and tip sections, the airfoil vortexing will also change drastically. Similarly, with extreme up-scaling, vibrations or

centrifugal forces have an increasing impact on mechanical loading.

Furthermore according to claim 1, the orientation of the X- and Y-axis is left undetermined, so that an airfoil having a profile as defined by the coordinates of claim 1 may have different orientations of the leading or trailing edges with respect to the turbine axis. The orientation of the profiles directly affects the velocity triangles and, as a consequence, the aerodynamic and thermodynamic efficiency and the overall performance of the turbine stage.

- 2.2 The description, in contrast, is restricted to a turbine bucket in which the X-axis is oriented parallel to the rotor or turbine axis (figure 2). An improved turbine performance is only described in connection with this specific configuration. There is no indication that the X- and Y-axes may have different orientations than those disclosed in figure 2 and that the intended effect of optimised aerodynamic efficiency, as well as improved aerodynamic and mechanical bucket loading, is also obtainable for turbine buckets covered by claim 1 and having such different orientations of the X- and Y-axes.

Similarly, although the description comprises a statement to the effect that the coordinate values set forth in Table I may be scaled upwardly or downwardly by a constant number (page 42, paragraph following Table I), there is no indication that the aforementioned intended effect is obtainable for turbine buckets covered by claim 1 when scaled up or

down by extreme factors, resulting for example in micro turbines.

The claim is thus not supported by the description.

2.3 The appellant has neither limited the claim nor refuted the board's viewpoint on this issue given in the annex to the summons to oral proceedings.

2.4 For this reason alone the application has to be refused (Article 97(1) EPC), so that the appeal cannot succeed.

3. Although the examining division mentioned that lack of inventive step (Article 56 EPC) was an "additional ground not forming part of the decision", it provided a complete reasoning in that respect. The Board agrees with the conclusion reached by the examining division.

3.1 D1 discloses a prior art turbine bucket from which the turbine bucket according to claim 1 is distinguished by the airfoil profile defined by the Cartesian coordinates in Table I and by the feature that these coordinates may be scaled by a constant. Hence the difference lies in the particular three-dimensional, size-independent shape.

3.2 The application mentions as technical problems the optimisation of the aerodynamic efficiency as well as aerodynamic and mechanical bucket loading (page 1, third paragraph). These are common problems faced by the skilled person in the design of a turbine stage of a gas turbine. For example, the profile disclosed in D1 improves turbine performance by avoiding the formation of shock waves at the leading edge of the airfoil as

well as boundary separation along the pressure and suction sides of the airfoil (D1, passage bridging columns 1 and 2). Similarly, the interaction between the stages of the high pressure turbine (page 1, third paragraph) will always be considered by the skilled person during the design of an airfoil profile. The buckets according to the present claim may therefore only be regarded as alternative solutions to the common turbine performance optimisation problem.

Consequently, starting from D1, the problem to be solved is to provide an alternative airfoil profile for first stage turbine buckets of a gas turbine for obtaining improved turbine performance.

3.3 The Board does not dispute that the particular airfoil shape defined by the coordinates given in Table I of the application presents a higher aerodynamic efficiency and improved aerodynamic and mechanical loading properties compared to the conventional airfoil design profile mentioned by the appellant in its reply to the Board's preliminary opinion. It is to be noted, however, that the applicant did not explain whether the data presented were actually gathered on real profiles or were only the result of estimations or simulations (sub-title to figure 1: "*FB airfoil design, ..., predicted to have higher efficiency capability...*" ; sub-title to figure 2: "*Desired design space more constrained than typical last stage design => requires different design philosophy*"; emphasis added).

3.4 Anyway, these data, which are based on a comparison with an unspecified "conventional" airfoil shape, merely confirm the uncontested fact that the technical

problems as mentioned in the description (optimisation of the aerodynamic efficiency as well as aerodynamic and mechanical bucket loading) are effectively solved, but do not support the presence of an inventive step. As has been mentioned before, the optimisation of the airfoil profiles for gas turbines is a common problem. CAD together with CFD simulations and finally testing in wind tunnels may be employed for this purpose, using a major amount of trial and error on the basis of arbitrary modification of existing profiles. In the absence of any indication of surprising or unexpected technical effects, or of any statement as to specific profile features being causal to the intended improvement, the airfoil profile of the turbine bucket according to claim 1 can only be regarded as the result of a normal design procedure, which does not involve an inventive step.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

M. Patin

K. Garnett