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**Datasheet for the decision
of 19 September 2008**

Case Number: T 1978/07 - 3.2.06

Application Number: 02752324.0

Publication Number: 1409848

IPC: F01D 5/14

Language of the proceedings: EN

Title of invention:
Third-stage turbine nozzle airfoil

Applicant:
GENERAL ELECTRIC COMPANY

Opponent:
-

Headword:
-

Relevant legal provisions:
-

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 1978/07 - 3.2.06

D E C I S I O N
of the Technical Board of Appeal 3.2.06
of 19 September 2008

Appellant:
(Applicant)

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Representative:

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Decision under appeal:

Decision of the Examining Division of the
European Patent Office posted 16 July 2007
refusing European application No. 02752324.0
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 16 July 2007 the European patent application 02 752 324.0 was refused.
- II. The examining division held 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 not forming part of the actual decision, the examining division held that the subject-matter of claims 1 and 2 lacked an inventive step.
- III. Against this decision the appellant (applicant) filed an appeal which was received at the European Patent Office on 21 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.
- 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 claims read as follows:

"1. A turbine nozzle for forming part of a third stage nozzle (12) of a gas turbine having a nozzle vane (14) in the shape of an airfoil having an uncoated nominal airfoil profile characterised substantially in accordance with Cartesian coordinate values of X, Y and Z set forth in inches in Table I 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 a radially innermost aerodynamic section of the airfoil and X and Y are coordinate values defining the airfoil profile at each distance Z, the profiles at the Z distances being joined smoothly with one another to form the complete airfoil profile; 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 nozzle airfoil.

2. A turbine comprising a turbine nozzle having a plurality of vanes for forming a third stage (12) of a gas turbine having a plurality of vanes, each of the vanes being in the shape of an airfoil having an uncoated nominal airfoil profile characterised substantially in accordance with Cartesian coordinate

values of X, Y and Z set forth in inches in Table I 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 coordinate values defining the airfoil profile at each distance Z, the profiles at the Z distances being joined smoothly with one another to form the 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 nozzle airfoil."

Table I referred to in the claims is contained in the description of the application and lists the Cartesian coordinates of roughly 1500 points constituting the airfoil profile.

- 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 nozzle'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 have an increasing impact on mechanical loading.

Furthermore according to claim 1, the orientation of the X- and Y-axes 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 nozzle in which the X-axis is oriented parallel to the nozzle or turbine axis (cf. page 5, line 5 of the WO-publication of the application). 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 and that the intended effect of optimised aerodynamic efficiency, as well as improved aerodynamic and mechanical loading, is also obtainable for turbine nozzles 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 86, paragraph following Table I), there is no indication that the aforementioned intended effect is obtainable for turbine nozzles covered by claim 1 when scaled up or down by extreme factors, resulting for example in micro turbines.

Claim 1 is thus not supported by the description. Since claim 2 includes the same features as claim 1 in this respect, claim 2 is also not supported by the description.

- 2.3 The appellant has neither limited the claims 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 Gas turbines comprising three or more turbine stages comprising a nozzle were generally known at the priority date of the present application. The nozzle according to claim 1 is distinguishable over a known third stage nozzle, referred to as being the closest prior art in the second paragraph on page 1 of the description, in view of the particular airfoil profile defined by the Cartesian coordinates in Table I and by the fact that these coordinates may be scaled by a constant. Hence the difference lies in the particular three-dimensional, size-independent shape.

3.2 Since the same difference exists between the aforementioned prior art turbine and the turbine according to claim 2, the following assessment of inventive step applies to both claims 1 and 2.

3.3 Optimisation of the aerodynamic efficiency is a common problem faced by the skilled person in the design of a turbine stage of a gas turbine. The nozzle and turbine according to the present claims may therefore only be considered as alternative solutions to this common optimisation problem.

Consequently, the problem to be solved may be formulated as providing an alternative airfoil profile for third stage turbine nozzles of a gas turbine for obtaining improved turbine performance.

3.4 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).

- 3.5 Anyway, these data, which are based on a comparison with an unspecified "conventional" airfoil shape, merely confirm the uncontested fact that the technical problem as mentioned (optimisation of the aerodynamic efficiency as well as aerodynamic and mechanical 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, and of any statement as to specific profile features being causal to the intended improvement, the airfoil profile of the turbine nozzle 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