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**Datasheet for the decision
of 26 February 2015**

Case Number: T 1275/11 - 3.4.02

Application Number: 06125403.3

Publication Number: 1795861

IPC: G01B7/14

Language of the proceedings: EN

Title of invention:

Multi-range clearance measurement system and method of operation

Applicant:

GENERAL ELECTRIC COMPANY

Relevant legal provisions:

EPC 1973 Art. 56, 54(1)

Keyword:

Novelty and inventive step (yes - amended claims)



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Case Number: T 1275/11 - 3.4.02

D E C I S I O N
of Technical Board of Appeal 3.4.02
of 26 February 2015

Appellant: GENERAL ELECTRIC COMPANY
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Decision under appeal: **Decision of the Examining Division of the
European Patent Office posted on 19 January 2011
refusing European patent application No.
06125403.3 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman F. Maaswinkel
Members: F. J. Narganes-Quijano
L. Bühler

Summary of Facts and Submissions

I. The appellant (applicant) lodged an appeal against the decision of the examining division refusing European patent application No. 06125403.3 (publication No. 1795861).

In its decision the examining division referred to documents

D1: US 2003/0215323 A1

D2: DE 4119244 A1

and held with regard to claim 1 then on file that the claimed subject-matter was not new (Article 54(1) EPC 1973) or at least did not involve an inventive step (Article 56 EPC 1973).

II. With the statement setting out the grounds of appeal the appellant filed an amended set of claims and amended pages 1 and 2 of the description, and requested that the decision under appeal be set aside and a patent be granted.

III. In reply to a telephone consultation with the rapporteur of the Board, the appellant filed with the letter dated 19 September 2014 an amended set of claims 1 to 4 and amended pages 6 to 8 and 11 of the description replacing the corresponding application documents on file.

IV. Independent claims 1 and 3 of the set of claims of the present request of the appellant read as follows:

"1. A system (12) for measuring clearance between a stationary object (44) and a rotating component (42), comprising:

at least one sensor (58) for measuring the clearance between the stationary object and the rotating component, the at least one sensor being configured to be disposed on the stationary object (44) and configured to measure a speed of rotation of the rotating component (42); and

a controller (64) coupled to the at least one sensor (58), wherein the controller (64) is configured to control an operating mode of the sensor (58) based upon the measured speed of rotation of the rotating component (42), wherein:

the sensor (58) comprises a capacitive probe having a plurality of conductive elements (114-118) and a plurality of switches (120-124) operable by said controller to selectively couple, in accordance with the operating mode of the sensor, each of the plurality of the conductive elements (114-118) to an output of the sensor (58)."

"3. A method of measuring clearance between a stationary part (44) and a rotating part (42) by means of a sensor (58) disposed on the stationary part (44), comprising:

measuring a speed of rotation of the rotating part (42) via the sensor (58); and

switching between a plurality of modes of operation of the sensor (58) based upon the measured speed of rotation; wherein:

the sensor (58) comprises a capacitive probe having a plurality of conductive elements (114-118) and a plurality of switches (120-124) operable to selectively couple, in accordance with the operating mode of the sensor, each of the plurality of the conductive elements (114-118) to an output of the sensor (58)."

The present set of claims further includes dependent claims 2 and 4 referring back to independent claims 1 and 3, respectively.

Reasons for the Decision

1. The appeal is admissible.

2. *Amendments*

The Board is satisfied that the application documents amended according to the present request of the appellant comply with the formal requirements of the EPC, and in particular with the requirements of Article 123(2) EPC. More particularly, claim 1 is based on claim 1 and dependent claims 3 to 5 as originally filed, dependent claim 2 is based on dependent claim 2 as originally filed, independent claim 3 is based on independent claim 8 and dependent claims 4 and 5 as originally filed, and dependent claim 4 is based on independent claim 10 as originally filed.

The description has been amended in order to comply with the requirements of the EPC, and in particular with those set forth in Article 84, second sentence and in Rule 27(1), paragraphs (b) and (c), and Rule 35(12) EPC 1973.

3. *Novelty and inventive step*

3.1 Present claim 1 is directed to a system for measuring the clearance between a stationary object and a rotating component by means of a sensor comprising a capacitive probe.

In its decision the examining division held that the system defined in claim 1 then on file was anticipated by the disclosure of document D1. This document discloses a gas turbine engine comprising a system of the type mentioned above (abstract and Figure 1). In the system disclosed in document D1 the capacitive probe of the sensor comprises a plurality of conductive elements (electrodes 32 and 33 in Figure 3) arranged in the shroud of the gas turbine housing for measuring the clearance between the shroud and a compressor wheel of the rotor shaft of the turbine engine (Figure 3 and paragraphs [0010] and [0041]).

- 3.1.1 In its decision the examining division referred to the disclosure of document D1 in paragraphs [0012] and [0045] and held that these passages of the document disclosed or at least rendered obvious the provision of a controller configured to control an operating mode of the sensor. The Board does not find the examining division's view persuasive for the following reasons:

According to paragraph [0012] of document D1 the capacitance of the sensor arrangement is inversely proportional to the size of the clearance, and a high sensitivity can be achieved where the clearance is small, and according to paragraph [0045] a controller commands an actuator to adjust the current clearance to an ideal clearance corresponding to the current mode of operation of the engine (start-up, ignition, acceleration, steady-state, deceleration, cooling or shut-down) determined on the basis of the rotational speed and the temperature previously measured. It follows from these passages that the sensor measures the current clearance, that the sensitivity of the sensor depends on the clearance, and that the clearance is adjusted by an actuator according to the current mode of

operation of the engine. However, although the modification of the clearance according to the mode of operation of the engine would affect the measuring sensitivity of the sensor, the way the sensor operates is not altered by a modification of the clearance; thus, contrary to the examining division's finding, there is no disclosure in document D1 that would allow the conclusion that the operating mode of the sensor itself is controlled or modified, let alone within the meaning of the invention defined in claim 1 as presently amended which further requires a plurality of switches in the sensor operable by a controller to selectively couple the conductive elements of the sensor to an output of the sensor in accordance with the operating mode of the sensor.

3.1.2 In view of the above and of the additional features introduced in present claim 1 by way of amendment, the Board concludes that the system defined in present claim 1 is new over the disclosure of document D1 in that the claimed system further requires that

- the sensor is also configured to measure the speed of rotation of the rotating component,

- the system includes a controller configured to control the operating mode of the sensor based upon the measured speed of rotation of the rotating component, and

- the sensor comprises a plurality of switches operable by the controller to selectively couple, in accordance with the operating mode of the sensor, the conductive elements of the sensor to the output of the sensor.

3.1.3 None of the documents presently on file discloses or suggests the claimed combination of features. In particular, as already concluded in point 3.1.1 above,

document D1 is silent as to the modification of the operation of the sensor itself according to some operation parameter of the system, let alone according to the speed of rotation of the rotating component.

As regards document D2, this document discloses a sensor arranged in a tool for measuring the distance between the tool and a workpiece (abstract and column 1, lines 9 to 14), the sensor comprising a probe of the capacitive type including a plurality of electrodes (electrodes 2 in Figure 1) and a plurality of switchers (switchers 4) operable to selectively couple the electrodes to the output of the sensor (column 6, lines 12 to 31), and therefore operable to change the operation mode of the sensor. The operation mode of the sensor is changed by means of the switchers in order to control the measuring resolution of the probe (column 6, lines 41 to 60 and column 7, lines 39 to 48) and/or to select the appropriate electrodes that fit the specific operating conditions (column 4, lines 15 to 28, and column 8, lines 18 to 67). Thus, document D2 discloses measuring the distance between two component parts by means of a capacitive probe comprising means for switching between different modes of operation of the sensor as claimed, but the document does not disclose or suggest changing the operation mode of the probe according to the state of operation of the component parts, let alone according to the relative speed of rotation of the two parts.

It follows from the above analysis that document D2 pertains to a different technical field and that, in any case, a combination of documents D1 and D2 would not suggest the claimed system, nor the technical improvements achieved therewith, i.e. adjusting the configuration - and therefore the accuracy - of the sensor probe to the range of expected clearances between

the two component parts according to the state of operation of the parts as determined by the speed of rotation of the same (see page 7 third paragraph, and page 8, last paragraph of the description of the application).

Therefore, the subject-matter of claim 1 as amended according to the present request of the appellant involves an inventive step with regard to the available prior art (Article 56 EPC 1973).

- 3.2 Independent claim 3 is directed to a method of measuring the clearance between a stationary part and a rotating part and the steps of the claimed method are essentially in one-to-one relationship with the functional and structural features of the different means of the system defined in claim 1. It follows that the method defined in independent claim 3 is new and involves an inventive step for reasons analogous to those given in point 3.1 above with regard to claim 1.
- 3.3 The Board concludes that the subject-matter of independent claims 1 and 3 as well as that of dependent claims 2 and 4 is new and involves an inventive step over the prior art on file (Article 52(1) EPC).
4. The Board is also satisfied that the application documents amended according to the present request and the invention to which they relate meet the requirements of the EPC within the meaning of Article 97(1) EPC. The Board therefore concludes that the decision under appeal is to be set aside and a patent be granted on the basis of the application documents amended according to the present request of the appellant.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the department of first instance with the order to grant a patent on the basis of the following application documents:
 - claims: claim 1 to 4 filed with the letter dated 19 September 2014,
 - description: pages 3 to 5, 9, 10 and 12 as originally filed, pages 1 and 2 filed with the letter dated 25 May 2011, and pages 6 to 8 and 11 filed with the letter dated 19 September 2014, and
 - drawings: sheets 1/7 to 7/7 as originally filed.

The Registrar:

The Chairman:



M. Kiehl

F. Maaswinkel

Decision electronically authenticated