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Datasheet for the decision of 12 April 2021

Case Number: T 2005/18 - 3.4.02

Application Number: 10742957.3

Publication Number: 2601487

IPC: G01F1/84

Language of the proceedings: EN

Title of invention:
METHOD AND APPARATUS FOR DETERMINING A TEMPERATURE OF A VIBRATING SENSOR COMPONENT OF A VIBRATING METER

Applicant:
Micro Motion, Inc.

Relevant legal provisions:
EPC Art. 54(1), 56

Keyword:
Novelty and inventive step (yes, amended claims)

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Case Number: T 2005/18 - 3.4.02

D E C I S I O N
of Technical Board of Appeal 3.4.02
of 12 April 2021

Appellant: (Applicant)	Micro Motion, Inc. 7070 Winchester Circle Boulder, CO 80301 (US)
Representative:	Vossius & Partner Patentanwälte Rechtsanwälte mbB P.O. Box 86 07 67 81634 München (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 22 March 2018 refusing European patent application No. 10742957.3 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	R. Bekkering
Members:	F. J. Narganes-Quijano
	G. Decker

Summary of Facts and Submissions

I. The appellant (applicant) lodged an appeal against the decision of the examining division refusing European patent application No. 10742957.3.

II. During the first-instance proceedings reference was made to the following documents:

D1: US 2005 0125167 A1
D2: US 2003 0235233 A1
D3: US 2006 0179895 A1
D4: US 6230104 B1.

In its decision the examining division held in respect of the claims of the sole request then on file that the subject-matter of each of independent claims 1 and 12 was not new over each of documents D1 and D2 (Article 54(1) EPC), and that the subject-matter of independent claim 8 did not involve an inventive step in view of document D3 as closest state of the art in combination with document D1, and also in view of document D1 as closest state of the art in combination with document D3 (Article 56 EPC).

III. With the statement setting out the grounds of appeal the appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of the claims of a main or an auxiliary request, together with pages 1 to 23 of the description and drawing sheets 1/7 to 7/7 of the application as published.

IV. In reply to a communication of the board annexed to the summons to oral proceedings, the appellant filed with the letter dated 25 February 2021 claims 1 to 15 according to auxiliary request 2, and amended pages 2, 5 to 9, 14, 16, 19 and 20 of the description.

V. In reply to a further communication of the board, and by letter dated 22 March 2021, the appellant stated that auxiliary request 2 was made the main request, and filed amended page 9 of the description replacing page 9 filed with the letter dated 25 February 2021, and amended pages 12 and 13 replacing the corresponding pages 12 and 13 of the application as published.

The present main request is thus based on the following application documents:

- claims: Nos. 1 to 15 filed as auxiliary request 2 with the letter dated 25 February 2021;
- description: pages 1, 3, 4, 10, 11, 13, 15, 17, 18, 21 and 22 of the application as published, pages 2, 5 to 8, 14, 16, 19 and 20 filed with the letter dated 25 February 2021, and pages 9, 12 and 23 filed with the letter dated 22 March 2021; and
- drawings: sheets 1/7 to 7/7 of the application as published.

VI. Subsequently, the oral proceedings were cancelled.

VII. Independent claims 1, 8 and 12 of the present main request read as follows:

"1. A method for determining a temperature of a vibrating sensor component (204A, 205A, 205'A) coupled to a conduit of a vibrating meter (200), comprising steps of:

supplying a temperature determination signal to the vibrating sensor component (204A, 205A, 205'A) coupled to the conduit (203A, 203B) of the vibrating meter (200);

measuring a resulting signal resulting from the temperature determination signal; and

determining a temperature of the sensor component (204A, 205A, 205'A) based on the temperature determination signal and the resulting signal;

wherein the sensor component (204A, 205A, 205'A) imposes vibrations on or receives vibrations from the conduit vibrating at a resonant frequency to measure a material in the conduit (203A, 203B) while receiving the temperature determination signal and providing a sensor signal resulting from the vibrations."

"8. A method for generating a correlation between a voltage-to-current ratio and temperature of a sensor component (204A, 205A, 205'A) coupled to a conduit (2O3A, 203B) of a vibrating meter (200), comprising steps of:

supplying a test signal to the sensor component (204A, 205A, 205'A) coupled to the conduit of the vibrating meter;

measuring a first resulting signal resulting from the test signal;

determining a first voltage-to-current ratio based on the test signal and the resulting signal;

measuring a first temperature of the sensor component (204A, 205A, 205'A); and

storing the first determined voltage-to-current ratio with the first measured temperature;

wherein the sensor component (204A, 205A, 205'A) imposes vibrations on or receives vibrations from the conduit (203A, 203B) vibrating at a resonant frequency to measure a material in the conduit while receiving

the test signal and providing a sensor signal resulting from the vibrations."

"12. A meter electronics (220) for a vibrating meter (200) including one or more conduits (203A, 203B) and one or more sensor components (204A, 205A, 205'A) coupled to the one or more conduits (2O3A, 203B), and including a processing system (303) configured to:

supply a temperature determination signal to a sensor component (204A, 205A, 205'A) of the one or more sensor components (204A, 205A, 205'A) coupled to the one or more conduits (203A, 203B) of the vibrating meter (200);

measure a resulting signal; and

determine a temperature of the sensor component based on the temperature determination signal and the resulting signal resulting from the temperature determination signal;

wherein the sensor component imposes vibrations on or receives vibrations from the conduit vibrating at a resonant frequency to measure a material in the conduit while receiving the temperature determination signal and providing a sensor signal resulting from the vibrations."

The main request also includes dependent claims 2 to 7, 9 to 11, and 13 to 15, referring back to independent claims 1, 8 and 12, respectively.

Reasons for the Decision

1. The appeal is admissible.

2. *Amendments*

Independent claims 1, 8 and 12 of the present main request are respectively based on independent claims 1, 10 and 16 as originally filed, together with Fig. 4, 6 and 7 and the corresponding description in the application as filed (see, in particular, the passages on page 13, line 28, to page 14, line 4, and page 15, line 24, to page 16, line 11, together with the passages on page 11, lines 13 to 21, page 11, line 28, to page 12, line 1, and page 20, lines 11 to 31, of the description of the application as filed). Dependent claims 2 to 7, 9 to 11, and 13 to 15 correspond, respectively, to dependent claims 2 to 7, 11, 14, 15, and 17 to 19 as originally filed.

The amendments made to the description relate to the adaption of its content to the invention as defined in the present claims (Rule 42(1)(c) EPC), and to the acknowledgement of the pertinent state of the art (document D1) in the introductory part of the description (Rule 42(1)(b) EPC).

Therefore, the board is satisfied that the application documents of the present main request satisfy the requirements of Article 123(2) EPC.

3. *Independent claim 12 of the main request - Novelty*

3.1 Document D1 discloses a vibrating meter constituted by a Coriolis mass flowmeter (Fig. 1 and abstract) comprising a conduit ("Measuring Pipe" in Fig. 1, and paragraphs [0009] and [0010]) and having a meter electronics including a processing system (see "DSP / CPU" in Fig. 1). The vibrating meter includes a

vibrating sensor component coupled to the conduit (see each of sensors A, B and C in Fig. 1, and paragraph [0021]) and comprising an assembly of a coil and a magnetic core (paragraph [0008]) which can operate both as an actuator to impose vibrations on the conduit and as a sensor to receive vibrations from the conduit (paragraphs [0007] to [0011], [0037] and [0038]).

3.1.1 Document D1 also discloses the provision of temperature sensors in the conduit (sensors Tp1 and Tp2 in Fig. 1 and in the table in paragraph [0022]) for measuring the temperature of the conduit (paragraphs [0003], [0030] and [0034]). In addition, the document also discloses in paragraph [0013] the following: "The possibility of measuring the current and voltage of each sensor/ actuator makes it possible to determine the resistance of the coil. In this way, detection of a cable rupture or a temperature measurement is possible. (The resistance of the copper changes in dependence on the temperature)". In the board's view the person skilled in the technical field under consideration is familiar with the basic principles of electronics and would understand that the last sentence of the mentioned passage of document D1 refers to the well-known principle on which common temperature sensors are based (see, for instance, the resistance temperature detectors of the prior art referred to in the description of the present application, page 4, lines 9 to 30, and page 11, lines 3 to 5) and according to which the resistance of a coil as that of the sensor considered in document D1 depends on temperature, and that the first and second sentences of the mentioned passage disclose the measurement of the current and the voltage of the coil and the subsequent determination of the resistance of the coil for the purpose of correlating the determined value of the resistance to

temperature, thus determining the temperature of the coil. The skilled person would therefore understand the mentioned passage as the disclosure of an alternative to the determination of the temperature by means of the temperature sensors, the alternative consisting in first supplying - for instance, when the operation of the vibrating sensor component as an actuator and as a sensor is momentarily interrupted - a current (constituting "a temperature determination signal" as claimed) to the coil of the vibrating sensor component and then measuring the output (i.e. the "resulting signal" as claimed) of the coil, whereby a comparison of these two quantities would allow for the determination of the temperature of the coil and therefore of the vibrating sensor component by the corresponding electronics.

Therefore, document D1 discloses as an alternative a vibrating meter comprising - as held by the examining division in its decision - meter electronics configured to supply a temperature determination signal to the sensor component, to measure a resulting signal, and to determine a temperature of the sensor component based on the temperature determination signal and the signal resulting from the temperature determination signal as required by independent claim 12.

3.1.2 However, present independent claim 12 has been amended to further require that "the sensor component imposes vibrations on or receives vibrations from the conduit vibrating at a resonant frequency to measure a material in the conduit while receiving the temperature determination signal and providing a sensor signal resulting from the vibrations", and there is no disclosure in document D1 of meter electronics comprising a processing system configured to operate in

this way, i.e. to supply the temperature determination signal to the sensor component and to determine the temperature of the sensor component on the basis of the resulting signal while the sensor component imposes vibrations on or receives vibrations from the conduit vibrating at a resonant frequency to measure the material in the conduit and provides a sensor signal resulting from the vibrations. More particularly, there is no indication in document D1 - in particular, not in paragraph [0013] - of supplying simultaneously a temperature determination signal and a driving current to the coil, and/or of processing the output of the coil of the vibrating sensor component as a signal indicative of both temperature and vibrations, and/or of determining the temperature of the coil while the sensor component is being driven.

3.1.3 Therefore, the meter electronics defined in independent claim 12 is new over the disclosure of document D1.

3.2 Document D2 discloses a microcomputer arranged to determine the temperature of a vibrating sensor component on the basis of a temperature determination signal supplied to the component and the resulting signal (abstract, together with Fig. 5 and the corresponding description, and in particular paragraph [0048]; see also paragraphs [0057] and [0058]). However, the vibrating sensor component of document D2 is a vibration-type level sensor within a pipe (pipe 1 in Fig. 5) for detecting the presence of powder deposited on the pipe (paragraphs [0046] and [0047]), and not a sensor component coupled to a conduit of a vibrating meter; it follows that the microcomputer of document D2 does not constitute meter electronics as required by independent claim 12 because, as submitted by the appellant, the microcomputer is only configured

to determine the presence or the absence of powder on the pipe (abstract, and paragraph [0038], last two sentences; see also paragraphs [0049], and [0055] and [0056]). In addition, the operation of determination of the temperature and the operation of detection of the presence of powder are carried out at different times (see Fig. 6 and 7, together with paragraph [0053]).

3.3 The remaining documents on file are less pertinent for the issue of novelty of the subject-matter of independent claim 12. In particular, document D3 is directed to a system for the determination of the temperature of a rotating electromagnetic machine such as an electric motor or generator (see abstract), and the document is silent as to the provision of meter electronics of the claimed type; and document D4 discloses a Coriolis flowmeter comprising a combined pickoff and oscillatory driver and the corresponding meter electronics (Fig. 4 and 7 to 9, together with the corresponding description), but the document is silent as to the determination of the temperature of the driver or of any other component of the flowmeter.

3.4 Therefore, the meter electronics defined in independent claim 12 of the main request, and therefore also that defined in dependent claims 13 to 15, is new over the prior art on file (Article 54(1) EPC).

4. *Independent claim 12 of the main request - Inventive step*

4.1 The meter electronics of document D1 represents in the board's view the closest state of the art in respect of the meter electronics defined in independent claim 12. The distinguishing features of the claimed meter

electronics over the meter electronics disclosed in document D1 (see point 3.1.2 above) have the effect of eliminating the need for operating the meter electronics and the sensor component in two different modes, i.e. in a temperature determination mode and in a vibration metering mode, thus simplifying and improving the operation of determining the temperature and measuring the material in the conduit. Accordingly, the objective problem can be seen in simplifying and improving in the meter electronics disclosed in document D1 the operation of determining the temperature and measuring the material in the conduit.

None of the documents on file discloses or suggests solving the objective problem by modifying the operation of the meter electronics of document D1 as claimed. In particular,

- document D2 does not disclose meter electronics for use with a vibrating meter, but only electronics arranged to determine the presence or the absence of powder deposited on a pipe by means of a vibration-type level sensor within the pipe (see point 3.2 above) and, in any case, the determination of temperature is not carried out while the level sensor is being driven for detecting the presence of powder, but only carried out during cycles intercalated between the powder detection cycles (Fig. 6 and 7, together with the corresponding description, in particular paragraph [0053]);
- document D3 is silent as to the provision of meter electronics of the claimed type and also silent as to the determination of the temperature of a sensor component as claimed (see point 3.3 above); and
- document D4 discloses meter electronics for use with a Coriolis vibrating meter, but is silent as to the determination temperature (see point 3.3 above).

4.2 The board concludes that the meter electronics defined in independent claim 12, and therefore also that defined in dependent claims 13 to 15, involves an inventive step over the documents of the prior art on file (Article 56 EPC).

5. *Independent claim 1 of the main request - Novelty and inventive step*

Independent claim 1 is directed to a method for determining a temperature of a vibrating sensor component coupled to a conduit of a vibrating meter, and the steps of the method are substantially in one-to-one relationship with the structural and functional features of the meter electronics defined in independent claim 12. Therefore, the method of independent claim 1 of the main request and also that defined in dependent claims 2 to 7 is also new and involves an inventive step for reasons analogous to those set forth in points 3 and 4 above in respect of the meter electronics of independent claim 12 (Articles 54(1) and 56 EPC).

6. *Independent claim 8 of the main request - Novelty and inventive step*

6.1 The determination of the temperature of the coil of the vibrating sensor component of the Coriolis mass flowmeter of document D1 (cf. point 3.1 above) is carried out in terms of a comparison between the current supplied to the coil and the measurement of the output of the coil (see point 3.1.1 above), and this determination presupposes that a correlation between, on the one hand, the temperature of the coil and, on

the other hand, the relation between the current supplied to the coil and the output of the coil is already known. However, document D1 does not disclose how this correlation is obtained. In particular, document D1 does not disclose generating a correlation between a voltage-to-current ratio and temperature of the sensor component by first determining a voltage-to-current ratio based on a test signal supplied to the sensor component and the resulting sensor signal, and then storing the value of the voltage-to-current ratio and the measurement of the temperature of the sensor component, let alone carrying out the mentioned determination while "the sensor component (204A, 205A, 205'A) imposes vibrations on or receives vibrations from the conduit (103A, 103B) vibrating at a resonant frequency to measure a material in the conduit while receiving the test signal and providing a sensor signal resulting from the vibrations".

The determination of the temperature of the vibrating sensor component of document D2 (see point 3.2 above) is based on the detection of the change in phase of an alternate current at a frequency which is swept over a frequency range centred at the resonance frequency of the vibrating plate and supplied to the sensor component (abstract, and paragraphs [0013], [0018], [0043], [0057] and [0058]), and this document does not disclose or suggest the generation of a correlation between a voltage-to-current ratio and temperature of the sensor component, let alone of a sensor component coupled to a conduit of a vibrating meter (see point 3.2 above).

In document D3 (cf. point 3.3 above) the temperature of the rotating machine is determined as a function of the measured resistance of an energisable winding of the

machine and a temperature calibration parameter, this calibration parameter having previously been determined by a comparison of a measured value of the resistance of the winding and the temperature of an object situated near the machine (claim 1), in particular after the machine or motor has been idle for a predetermined time period (abstract, and paragraphs [0008] and [0026]).

Document D4 is silent as to temperature considerations of the components of the Coriolis flowmeter (see point 3.3 above).

Therefore, the method defined in independent claim 8, and therefore also that defined in dependent claims 9 to 11, is new over the documents of the prior art on file.

6.2 The closest state of the art in respect of the method of independent claim 8 is represented by document D1. The distinguishing features of the claimed method over document D1 (see point 6.1 above, first paragraph) allow for the determination of an appropriate correlation between the voltage-to-current ratio and the temperature of a sensor component of the type considered in the meter electronics defined in independent claim 12 and in the method of independent claim 1 for the purpose of carrying out the determination of the temperature of the sensor component with the meter electronics defined in independent claim 12 and with the method of independent claim 1. In addition, none of the documents on file (see point 6.1 above) disclose or suggest determining the mentioned correlation as claimed, and in particular by determining a correlation between a voltage-to-current ratio and temperature while the sensor

component imposes vibrations on or receives vibrations from the conduit vibrating at a resonant frequency to measure a material in the conduit while receiving the test signal and providing a sensor signal resulting from the vibrations.

The board concludes that the method defined in independent claim 8, and therefore also that defined in dependent claims 9 to 11, involves an inventive step over the documents of the prior art on file (Article 56 EPC).

7. In view of the above considerations, the board concludes that the application documents amended according to the present main request meet the requirements of the EPC.

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 in the following version:

- claims: Nos. 1 to 15 filed as auxiliary request 2 with the letter dated 25 February 2021;

- description: pages 1, 3, 4, 10, 11, 13, 15, 17, 18, 21 and 22 of the application as published, pages 2, 5 to 8, 14, 16, 19 and 20 filed with the letter dated

25 February 2021, and pages 9, 12 and 23 filed with the letter dated 22 March 2021; and

- drawings: sheets 1/7 to 7/7 of the application as published.

The Registrar: The Chairman:

L. Gabor R. Bekkering

Decision electronically authenticated