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**Datasheet for the decision
of 14 December 2011**

Case Number: T 1336/09 - 3.4.02

Application Number: 99904082.7

Publication Number: 1051597

IPC: G01F1/84

Language of the proceedings: EN

Title of invention:

SYSTEM FOR VALIDATING CALIBRATION OF A CORIOLIS FLOWMETER

Applicant:

MICRO MOTION INCORPORATED

Headword:

Relevant legal provisions:

EPC Art. 54, 56, 115

EPC Rule 50(3), 86, 114

Keyword:

Novelty and inventive step (yes)
third party observations - filed late and anonymously
(admitted into the procedure)

Decisions cited:

G 1/03, G 2/03, T 0735/04, T 0258/05, T 0146/07

Catchword:

See point 2



Case Number: T1336/09 - 3.4.02

D E C I S I O N
of the Technical Board of Appeal 3.4.02
of 14 December 2011

Appellant: MICRO MOTION INCORPORATED
(Applicant) 7070 Winchester Circle
Boulder
Colorado 80301 (ETATS-UNIS D'AMERIQUE)

Representative: Pugsley, Victoria Antonietta
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Decision under appeal: **Decision of the Examining Division of the
European Patent Office posted 27 November 2008
refusing European patent application No.
99904082.7 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman: A. Klein
Members: F. Maaswinkel
D. Rogers

Summary of Facts and Submissions

- I. This is an appeal against the decision of the examining division refusing European patent application No. 99904082.7 (published as WO-A-99/39164) on the grounds that the patent application did not meet the requirements of Art. 123(2) EPC and Art. 84 EPC because independent claims 1 and 8 then on file contained added subject-matter and lacked clarity. In addition the examining division remarked that it appeared that the subject-matter of claim 8 lacked novelty over the disclosure in document D1 (WO-A-88/02853).
- II. Against this decision the applicant (appellant) lodged an appeal. With the statement setting out the grounds of appeal the appellant filed new claims according to a main and first to third auxiliary requests. The appellant requested that the decision under appeal be set aside and the patent application be granted in the form as originally filed or with the claims according to one of the first to third auxiliary requests. With a subsequent letter of 3 July 2009 replacement sets of claims according to a main and first to third auxiliary requests were filed.
- III. In a communication pursuant to Article 15(1) RPBA dated 2 August 2011 and accompanying the summons to oral proceedings on 23 November 2011, the board observed that it appeared that the claims lacked essential features (Art. 84 EPC). It was also noted that the appellant had not taken a position concerning the passages in document D1 referred to in the decision. In this communication, for illustrating that the concept of self-validation in the field of Coriolis flowmeters was known before, the board of its own motion (Art.

111(1) and 114(1) EPC) made reference to the following document:

D4: Manus Henry "Self-Validation Improves Coriolis Flowmeter", Control Engineering, Vol. 42, May 1995, pages 81, 82, 84 and 86.

- IV. In a letter dated 22 August 2011 the appellant requested to change the scheduled date for the oral proceedings. In reply the board set a new date on 14 December 2011.
- V. In a subsequent letter of 14 November 2011 the appellant filed a further set of claims according to a fourth auxiliary request.
- VI. On 8 December 2011 observations under Art. 115 EPC were filed online and anonymously by a third party. In these submissions the following documents were cited under the header "Novelty, Article 54 EPC":

D5: EP-A-0 816 807

D6: WO-A-96/05484.

On 9 December 2011, in view of the imminence of the oral proceedings, the rapporteur of the board informed the appellant's representative by the phone of the filing of the third party observations, offering to postpone the oral proceedings. The representative did not accept this offer.

- VII. At the start of the oral proceedings on 14 December 2011 the appellant filed a new main request replacing all previous requests and requested that a patent be granted on the basis of this request.

VIII. The wording of independent claim 1 of this request reads as follows:

" A system (400) for validating a mass flow calibration factor of a Coriolis flowmeter (5) having:

flow tube means (103A-B);

driver means for oscillating said flow tube means as a material (501) flows therethrough, the material having a known density or density constant;

sensor means (105-105') for detecting oscillation of said flow tube means (103A-B);

a memory (230) for storing said known density or density constant; and

processor means arranged to:

determine a measured period of oscillation of said flow tube means (103A-B) from signals received from the sensor means (105-105'); and

at least one of:

compare the measured period of oscillation with an expected period of oscillation, the expected period of oscillation being determined from said known density of said material; or

determine a measured density or density constant of the material (501) from the measured period of oscillation and compare the measured density or density constant with the known density or density constant; and

signal that a possible error condition in mass flow calibration factor exists in dependence on the comparison, the mass flow calibration factor being the ratio of:

the mass flow rate of the material along the tube; and

the oscillation phase difference at two different points along the tube ".

The wording of claim 9 of this request reads as follows:

" A method for validating a mass flow calibration factor of a Coriolis flowmeter (5) having a flow tube means (103A-B), a means for oscillating said flow tube means as a material (501) having a known density or density constant flows therethrough, and sensor means (105-105') for detecting oscillation of said flow tube means, said method comprising:

 flowing said material having a known density or density constant through said flow tube means;

 oscillating said flow tube means as said material flows therethrough;

 determining a measured period of oscillation of said flow tube means from signals received from the sensor means;

 at least one of:

 comparing the measured period of oscillation with a known or expected period of oscillation; or

 determining a measured density or density constant of the material from the measured period of oscillation and comparing the measured density or density constant with the known density or density constant; and

 signalling that a possible error condition in the mass flow calibration factor exists in dependence on the comparison, the mass flow calibration factor being the ratio of:

 the mass flow rate of the material; and

 the oscillation phase difference at two different points along the tube ".

Claims 2 to 8 and 10 to 17 are dependent claims.

IX. In support of its request the appellant submitted the following arguments:

The amendments in independent claim 1 have their basis in original claims 1, 2, 6, 13 and 14, and in the following passages of the published description: page 3, lines 22 and 23; page 9, lines 25 and 26; Fig. 3, step 312; Fig. 11, step 1103; page 1, line 28 - page 2, line 6. Similarly independent claim 9 is based on original claims 16, 17 and 21; on page 3, lines 22 and 23; on the embodiment of Fig. 9; and on page 1, line 28 - page 2, line 6 of the published description. The dependent claims find their support in the original dependent claims. Furthermore, by including the features regarded as essential for the invention in the independent claims, the objections under Art. 84 EPC should have been overcome. Finally the description has been adapted to acknowledge the prior art document D6. Therefore the amendments should also not be objectionable under Art. 123(2) EPC.

The present invention relates to a method and system for validating a calibration factor of a Coriolis flowmeter. In such flowmeters, the measured phase difference is multiplied by a flow calibration factor (FCF) in order to obtain mass flow rate. The FCF is generally unique to each Coriolis flowmeter, being dependent, at least in part, upon the mechanical properties of the flowmeter. Thus, prior to installation of the flowmeter, a calibration process is carried out to establish the FCF for the specific meter in question. Such calibration processes are well known in the art (for example as described in prior art document D1) and generally involve flowing a material through the meter at a known flow rate and dividing the flow rate by the measured phase difference in the tube

oscillations to give the FCF for the meter. Furthermore, since the volume of the fluid contained in the flow tubes at any given point in time remains constant, the only way the mass of the contained fluid can change is if its density changes. Thus, the instantaneous mass of the full flow tubes indicates the density of the flow material. Since the stiffness of the flow tubes remains essentially constant, the mass (and, by inference, the density) of the fluid contained in the fixed volume of the flow tubes is the only variable affecting the natural frequency of the flow tubes. Thus, flowmeters measure density by subjecting the measured tube period (the reciprocal of tube natural frequency) to a predetermined density calibration factor. While Coriolis flowmeters are advantageous in that accuracy of the measured mass flow rate is substantially unaffected by wear of moving components (the mass flow rate being calculated only from the phase difference of the sensors measuring the oscillation at separate points on the meter), the appellants have recognised that the mechanical properties of the flowmeter may change throughout the operational life of the flowmeter which can render the mass flow measurements of the meter inaccurate (page 2, lines 22 and 23) and have identified a particularly simple and effective solution to this problem. Specifically, they have recognized that there is a mathematical relationship between the FCF of a Coriolis flowmeter and the period of oscillation. More precisely, for any given material flowing through the flowmeter and for any given FCF, the period of oscillation of the flow tubes is constant. That is to say, if the properties of the material flowing through the flowmeter are known, a correctly calibrated flowmeter will have a predictable and fixed period of oscillation. Thus, any deviation in the period of

oscillation from that expected must indicate a change in the FCF. The solution for validating the FCF, defined in claims 1 and 9, is not known nor rendered obvious by the prior art.

More specifically, document D1 discloses the use of a common Coriolis meter assembly for measuring the density of an unknown fluid. The calculated density of the fluid being passed through the assembly is displayed, in order to allow any changes in e.g. the composition or properties of the fluid to be monitored. This document further suggests that during the calibration of the system, the displayed density value of a known fluid may be visually compared against its known density value, to serve as a useful check on meter operation (see page 48, lines 24 to 30). This visual check does not correspond to the requirement of claim 1 for a processor means arranged to detect a possible error condition in the mass flow calibration factor in dependence on a comparison of the measured period of oscillation and an expected period of oscillation, or of a comparison of the measured density or density constant determined from the measured period of oscillation with the known values, and to signal that a possible error condition in the mass flow calibration factor exists. Therefore, the present application is novel over D1. In fact, the teaching of D1 on this point is in contrast to the requirements of the present invention in that D1 directs the skilled person to carry out this single visual check in person and only in the context of calibration of the meter. D1 does not teach or suggest a system that is configured to monitor continuously a mass flow calibration factor and to signal automatically when an error condition arises in this calibration factor. Therefore, the

disclosure of document D1 neither anticipates nor suggests the present invention.

Document D4 discloses a Coriolis flowmeter to which self-validation technology has been applied. D4 is entirely directed to the detection and mitigation of faults within the sensors used to monitor the system (see the Figure on page 81 and page 82, columns 2 and 3). In the specific example described from page 84 onwards, D4 describes the effects on the system of a fault arising in relation to the temperature sensor. In this example, the result of the loss of temperature input indicates to the diagnostic software that something has gone wrong with the system. Consequently, the diagnostic software detects that the raw temperature data is not credible and estimates the temperature from historical data. As a result of this validation process, the validated density and mass flow outputs remain unaffected by the loss of the temperature input (see the Figure on page 86, right-hand column). Nowhere in D4 is a processor means disclosed that detects a possible error condition in response to the measured period of oscillation, as required by the independent claims. Instead, the only error condition detected is a loss of temperature input. Therefore, the present application is novel over D4. Furthermore, the validated density data shown on page 86 of D4 does not reveal any significant change following the loss of the temperature input, indicating that the density constant of the flow tube has not been affected. Therefore, the disclosure of document D4 neither anticipates nor suggests the present invention.

As to the further documents, document D5 may be considered to disclose the closest prior art, since it is concerned with detecting a possible error condition

in a Coriolis flowmeter. However, in order to predict and detect a flowmeter failure a complex solution including the comparison of the resonant frequencies and/or drive power is disclosed, which is a different solution than the one in the invention in which the flow calibration factor is validated. Document D6 discloses a complex system that receives information from an operating Coriolis mass flowmeter and compares the information to threshold signatures representing various fault conditions. Also this document does not address the flow calibration factor or its validation.

Therefore, in view of the prior art, the subject-matter of the independent claims is novel and involves an inventive step.

Reasons for the Decision

1. The appeal is admissible.
2. *Late and anonymous third party observations under Article 115 EPC*
 - 2.1 The third party observations referred to under point VI above were filed four working days only before the scheduled oral proceedings, citing two new documents which were obviously highly relevant against several of the requests then on file.

The appellant though having been informed of the filing of the observations in advance of the oral proceedings neither requested that these be excluded from the procedure, nor that the oral proceedings be postponed. At the start of the oral proceedings, it filed an

amended request in which due account had been taken of the new citations.

In these circumstances the board considered that the lateness of the observations should not per se be a bar to their admission into the procedure.

- 2.2 In respect of the anonymous character of the observations under Article 115 EPC, the Board notes that a Decision of the President of the EPO and a Notice from the EPO, both dated 10 May 2011 and concerning the filing of third party observations under Article 115 EPC by means of an online form made available on the website of the EPO, have been published in OJ EP0 2011, pages 418 and 420 respectively. The Decision in particular allows for third party observations being filed without signature (see Article 2 of the Decision), the Notice states that "Observations may be filed anonymously" (see the 4th paragraph under point "Formal requirements")

Indeed, the boards of appeal of the EPO are bound only by the EPC, but the above dispositions in relation to anonymous third party observations are in line with earlier decisions of the boards, which did admit such observations both in ex-parte and in inter partes appeal proceedings, without apparent misgivings in relation to their anonymous character (see T 0258/05, point 3.3 in combination with point V, and T 0735/04, point 2).

Since the observations in the present case have been made under Article 115 EPC in an ex parte appeal before a technical board of appeal and are limited to the citation of pieces of prior art and the indication of the correspondences between their content and certain

claimed features, which essentially are statements of facts, the present situation is also quite different from that in the decisions G 1/03 and G 2/03 (OJ EPO 2004; 413 and 448) in which the Enlarged Board of Appeal without further explanations did not take into account an anonymously filed statement made within the frame of the referral of a point of law in relation to the allowability of disclaimers.

The only requirements imposed on third party observations by Rule 114(1) EPC are that they be filed in writing in an official language of the EPO and state the grounds on which they are based. The written form of the observation and the use of an official language indeed constitute the minimal conditions for allowing them to be communicated to the applicant or proprietor and to be commented upon by the latter, as provided for in Rule 114(2) EPC.

Rule 50(3) EPC and by analogy Rule 86 EPC, which establish the requirement that documents filed in the examining or opposition procedure be signed, do not in the board's opinion directly apply to third party observations. As a matter of fact, the reference in Rule 50(3) EPC, in relation to the case of a missing signature, to "the party concerned" indicates that the rule addresses the filing of documents by parties to the procedure, which a person who files third party observations clearly is not, as is expressly stated in Article 115 EPC (see the last sentence)

The board is aware of decision T 0146/07, dated the day before the date of the present decision and made public later, in which the deciding board disregarded third party observations because of their anonymous character, on the basis inter alia of a different

appreciation of the relevance to this issue of Rule 50(3) EPC and of decisions G1/03 and G2/03 (see points 3 to 6).

Contrary to the present instance, decision T 0146/07 concerned an inter partes appeal, and it emphasised that "Identification is particularly important in the context of opposition proceedings in order to allow the competent organ of the EPO to verify whether the observations are indeed filed by a third party rather than by a party to the proceedings. Otherwise, a party might be tempted to submit late observations and/or documents by means of anonymous third party observations in order to avoid negative procedural consequences such as apportionment of costs."

In ex parte proceedings however the appellant is the sole party and it can at any time raise new issues or submit new prior art - and so can the board of its own motion by virtue of Article 114(1) EPC. Accordingly the risk of anonymous third party observations providing a cover for procedural abuse can be largely excluded in ex parte proceedings.

For these reasons the board considered that in the present circumstances the anonymous character of the third party observations did not bar them from being admitted into the procedure.

3. *Amendments*

- 3.1 In its decision the examining division had raised objections under Article 84 and 123(2) EPC against certain expressions in the former claims. The present claims have been amended in this respect and are, in the opinion of the board, not objectionable under

Article 84 EPC. Furthermore the board is satisfied that the detailed basis of the claims in the originally filed application documents as explained by the appellant meets the requirements of Article 123(2) EPC. The further amendments include the adaptation of the wording of the dependent claims to the independent claims and an acknowledgement of the prior art in the description, as to which the board has no reservations. Therefore the present request meets the formal requirements of the EPC.

4. *Patentability*

4.1 *Novelty*

4.1.1 *Document D1*

In an "Additional remark - Article 52(1) and (2) EPC" annexed to the decision under appeal, the examining division had pointed to the second paragraph on page 48 of document D1. According to page 42, lines 33 to 35 of this document, a period of oscillation is measured. From this period of oscillation a density of the material is calculated (page 48, lines 25 to 27) which is visually compared with a known density (page 48, line 28) and which serves "as a useful check on meter operation". The board understands from this passage that this visual comparison is a consequence of a full calibration of the system, which requires additional steps (namely: the measurement of the periods of oscillation by running the system with two fluids of known density, see equation (17) on page 42 of D1) compared to the validating method defined in claim 9 of the present request. Furthermore, document D1 does not address the mass flow calibration factor or its validation.

4.1.2 Document D4 had been referred to in the board's communication for illustrating that the concept of self-validation in the field of Coriolis flowmeters was known. On page 84, left column, last paragraph, this document discloses that to perform validation on the instrument, several signals providing measurement and diagnostic information are picked up from the transmitter boards and pass through a signal-conditioning unit into a PC. One of these signals is the frequency of oscillation, which is used to calculate the density of the process fluid, a further signal being the phase difference between the two arms of the flowtube, which is directly proportional to mass flow (same column, penultimate paragraph). Document D4 does not address the mass flow calibration factor or its validation which is the subject of the present independent claims.

4.1.3 Document D5 discloses a Coriolis flowmeter comprising two drivers 46a and 46b and two sensors 48a and 48b which are used to monitor and predict flowmeter failure modes due to mechanical deterioration during meter operation. By driving the flowmeter in a symmetrical and antisymmetrical mode of oscillation the ratio of the resonant frequencies the meter factor (the equivalent of the mass flow calibration factor), can be compensated, see col. 3, l. 35 to 37; col. 8, l. 35 to 56; and col. 9, l. 41 to col. 10, l. 27. Such a change in the ratio of frequencies is also indicative of corrosion or erosion of the tubes with a resultant loss of mass (col. 10, l. 54 to l. 56). Therefore in the flowmeter disclosed in this document not only is the meter factor validated in the sense that the correctness of prior settings or entered values of the meter is confirmed, but also the meter factor is corrected as a result of the ratio of resonant

frequencies. The system and the method defined in the present independent claims differ from the solution offered in document D5 in that the validation is based on running a flow of a material of known density or density constant through the flow tube and measuring the period of oscillation, which is used for further comparison.

4.1.4 Document D6 discloses a Coriolis flowmeter in which the drive power and the resonant frequency of the flow tube are measured for detecting abnormal operating conditions of the flowmeter, and in particular the presence of a crack in the tubes. To this aim the values, the slopes and the curvatures of the measured values are simultaneously compared which are indicative for the occurrence of a crack (Fig. 3) and allow the detection and correction of a change in flow rate (Fig. 4, Fig. 8), in fluid density (Fig. 5), in void fraction (Fig. 6) and in mass fraction (Fig. 7). This solution is different than the one defined in the independent claims, which involves a comparison of measured values when a known material is flowed through the device with known or expected values.

4.1.5 The subject-matter of claims 1 and 9 is therefore novel over the prior art (Art. 52(1) and 54 EPC).

4.2 *Inventive step*

4.2.1 *Closest prior art*

In the opinion of the board, from the documents addressed supra, either documents D4, D5 or D6 could be considered as disclosing the closest prior art. As to document D1, it appears that its main purpose to carry out a complete calibration of the device, for which additional steps with a plurality of known fluids have

to be made. Obviously, if immediately after such a complete calibration the displayed result (density) on the meter differs from the expected result, a conclusion to the occurrence of a possible system fault can be drawn. This is, however, not comparable with a "validation" process as proposed in the present patent application and defined in the independent claims.

4.2.2 Document D4 discusses the concept of (self)-validation or the diagnosis of a possible fault within a flowmeter and its partial correction by the system with the example of a fault in a temperature sensor. A fault of the device influencing the mass flow calibration factor is not addressed, nor a related effect on the oscillation frequency (apart from the general statement in the left hand column on page 84, that the frequency of oscillation is used to calculate the density of the process fluid, which is a standard calculation in these flowmeters). Therefore document D4 does not provide any hint towards the solution defined in the independent claims.

4.2.3 The appellant has considered document D5 as the closest prior art. Indeed this document addresses monitoring, predicting and detecting possible error conditions in a Coriolis flowmeter. However, the solution offered in document D5 requires the presence of two drivers (and two sensors) in order to operate the particular flowmeter in the symmetrical and antisymmetrical oscillation modes. Therefore this is a very particular solution which, for instance, would not work on a Coriolis flowmeter of the type having only a single driver (as, e.g. shown in Fig. 1 of document D1; in Fig. 1 of document D6; or Fig. 1 of the patent application). It does not appear obvious why the skilled person, if starting from the particular

flowmeter shown in Fig. 1 of document D5, would consider validating the mass flow calibration factor in the way as defined as in the independent claims, because this would effectively imply completely abandoning the teaching of document D5.

4.2.4 As set out in point 4.1.4 supra, the fault detection instrumentation disclosed in document D6 uses a plurality of measured signals (resonant frequency, drive power, temperature of the flow tubes, and computed mass flow; see page 10, lines 25 to 29), together with the first and second derivatives of these parameters (page 11, lines 8 to 27), which are compared with the "signatures" for each fault condition (page 11, lines 28 to 29). In order to unambiguously distinguish a typical fault condition (e.g. a crack of the flow tube, see Fig. 3) from other operational conditions (Figures 4 to 7) both the values of the frequency as well as the drive power (and, in addition, the slopes and curvatures of these parameters) are compared with pre-stored threshold values. Thus the fault detection instrumentation disclosed in this document is based on a plurality of input variables, to be collected simultaneously. Therefore it would appear that the skilled person, starting from this disclosure, would not have an incentive to only measure the resonance frequency, because document D6 teaches that the frequency should be measured together with the drive power (and other parameters) in order to predict and detect a fault in a flowmeter.

4.2.5 Therefore the subject-matter of claims 1 and 9 of the present request involves an inventive step (Art. 52(1) and 56 EPC).

4.2.6 This similarly applies to the subject-matter of the dependent claims by virtue of their dependence on claim 1 or 9.

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:

Description:

pages 1, 4 - 17 of the published version of WO99/39164, and pages 2, 2a, 3 and 18 filed at the oral proceedings before the board on 14 December 2011;

Claims:

1 - 17 of the Main Request filed at the oral proceedings before the board on 14 December 2011;

Drawings:

Sheets 1/10 - 10/10 of WO99/39164 as published.

The Registrar:

The Chairman:



M. Kiehl

A. G. Klein

Decision electronically authenticated