

**Internal distribution code:**

- (A) [ ] Publication in OJ  
(B) [ ] To Chairmen and Members  
(C) [X] To Chairmen  
(D) [ ] No distribution

**Datasheet for the decision  
of 15 May 2007**

**Case Number:** T 1063/05 - 3.4.02  
**Application Number:** 98960590.2  
**Publication Number:** 1036305  
**IPC:** G01F 1/84  
**Language of the proceedings:** EN

**Title of invention:**

An apparatus for measuring characteristics of a material flowing through the apparatus and a method for affixing a driver means to at least one conduit of an apparatus for measuring properties of a material flowing through said at least one conduit

**Patentee:**

MICRO MOTION INCORPORATED

**Opponent:**

Endress+Hauser (Deutschland) AG+Co. KG

**Headword:**

-

**Relevant legal provisions:**

EPC Art. 56

**Keyword:**

"Inventive step (yes)"

**Decisions cited:**

T 0531/03

**Catchword:**

-



Case Number: T 1063/05 - 3.4.02

**D E C I S I O N**  
**of the Technical Board of Appeal 3.4.02**  
**of 15 May 2007**

(Opponent) Endress+Hauser (Deutschland) AG+Co. KG  
Colmarer Strasse 6  
D-79576 Weil am Rhein (DE)

**Representative:** Andres, Angelika Maria  
Endress+Hauser (Deutschland) AG+Co. KG  
PatServe  
Colmarer Strasse 6  
D-79576 Weil am Rhein (DE)

**Respondent:** MICRO MOTION INCORPORATED  
(Patent Proprietor) 7070 Winchester Circle  
Boulder  
Colorado 80301 (US)

**Representative:** Bibby, William Mark  
Mathisen, Macara & Co.  
The Coach House  
6-8 Swakeleys Road  
Ickenham  
Uxbridge UB10 8BZ (GB)

**Decision under appeal:** **Interlocutory decision of the Opposition  
Division of the European Patent Office posted  
16 June 2005 concerning maintenance of European  
patent No. 1036305 in amended form.**

**Composition of the Board:**

**Chairman:** A. G. Klein  
**Members:** F. J. Narganes-Quijano  
M. J. Vogel

## Summary of Facts and Submissions

I. The appellant (opponent) has lodged an appeal against the interlocutory decision of the opposition division finding European patent No. 1036305 (based on European application No. 98960590.2 published as International publication No. WO 99/28708) as amended by the respondent (patent proprietor) during the first-instance proceedings to meet the requirements of the EPC.

The opposition filed by the appellant against the patent as a whole was based on the grounds of lack of novelty and of inventive step (Article 100(a) EPC) and on the grounds of insufficiency of disclosure (Article 100(b) EPC).

In the decision under appeal the opposition division referred, among others, to the following documents:

D2 : US-A-4823614

D6 : "Coriolis-Massendurchflußmesser mit einem einzigen geraden Meßrohr", W. Drahm, Fortschritt-Berichte VDI, series 8, No. 525, VDI-Verlag GmbH, Düsseldorf (DE), 1995; pages 14 to 17 and 26 to 33

D7 : "ANSYS user's manual for revision 5.0", Vol. I: Procedures, Swanson Analysis Systems Inc., Houston, PA, 1992; pages 3-13 to 3-20

and held that the subject-matter of claims 1 to 4 as amended during the opposition proceedings is novel and involves an inventive step (Articles 52(1), 54 and 56 EPC) with regard to the prior art considered during the proceedings.

II. With the statement setting out the grounds of appeal the appellant submitted the following documents:

D6' :D6 *supra*, pages 44 to 68

D10 : "Mass Flowmeters-Coriolis" C. Apple, Process Measurement and Analysis, Instrument Engineers' Handbook, 3rd ed., CRC Press (US), 1995; pages 121 to 134

D11 : "A finite element for the vibration analysis of a fluid-conveying Timoshenko beam" C. P. Stack *et al.*, Micro Motion Inc., American Institute of Aeronautics and Astronautics Inc., 1993; pages 2120 to 2129

D12 : "Dubbel - Taschenbuch für den Maschinenbau", W. Beitz *et al.*, 18th ed., Springer-Verlag, Berlin, 1995; pages 0 10 to 0 27,

contested the view of the opposition division that the claimed subject-matter involves an inventive step, and requested that the decision be set aside and the patent be revoked.

The respondent requested that the appeal be dismissed.

Both parties requested oral proceedings on an auxiliary basis.

III. Oral proceedings before the Board were held on 15.05.2007. The parties maintained their respective requests. At the end of the oral proceedings the Board gave its decision.

IV. Claim 1 upon which the interlocutory decision under appeal was based reads as follows:

"A method for affixing a driver means (104) to at least one conduit (103A-103B) of an apparatus (5) for measuring properties of a material flowing through said at least one conduit (103A-103B), the method including the steps of:

selecting a position (N109) for said drive means (104) that substantially maximises the amplitude of oscillations of said at least one conduit (103A-103B) in at least one desired mode, and

placing said driver means (104) at said position (N109),

the method being characterised by the steps of:

extracting eigenvector coefficients at a plurality of nodes along said at least one conduit (103A-103B) from a finite element model of said apparatus for said at least one desired mode and at least one undesired mode; and

selecting said position (N109) that substantially maximises said amplitude of oscillations in said at least one desired mode and that substantially minimizes the amplitude of oscillations in said at least one undesired mode from said eigenvector coefficients at said plurality of nodes."

Dependent claims 2 to 4 all refer back to claim 1.

V. The arguments of the appellant in support of its requests are essentially the following:

As shown in document D10, the problem considered in the patent, and in particular the problem of maximising the

amplitude of the driver or suppressing external vibrations and undesirable modes of vibrations of the system, reflects the normal tasks of the skilled person working in this field at the filing date of the patent and cannot contribute to inventive step. In addition, it also belonged to the normal tasks of a skilled person to consider in the analysis of the vibrations of the system the use of simulation methods, and in particular the use of computer modelling as referred to in documents D6 (page 29) and D2 (column 14, line 24 *et seq.* and column 15, line 13 *et seq.*). More particularly, document D6 (chapter 2.2 on page 45 and pages 64 to 68) points at the use of FEM programs, in particular of ANSYS, instead of MATHCAD in the determination of the oscillation characteristics of a Coriolis flowmeter.

It was also common at the filing date of the patent to describe the systems at issue not only by modal analytical means but also by computer simulation (document D7, pages 3 to 13, document D11, and document D12, pages 10 to 29). In this context, the use of FEM methods cannot support the presence of an inventive step.

The extraction of eigenvector coefficients at a plurality of nodes along the conduit, either alone or in combination with a finite element model of the apparatus, constitutes an aim of ANSYS and in fact the essential purpose of the use of an ANSYS-based finite element model in the modal analysis of the apparatus (document D7, pages 3-17 and 3-19). The extraction of eigenvector coefficients in the sense of the invention (see paragraphs [0026] and [0027] of the patent specification) is also implemented in documents D2, D6

and D7. The patent specification itself acknowledges in page 6, lines 2 and 3 that the analysis of the vibration characteristics of complex mechanical systems and the use of finite element models belonged to the common general knowledge at the filing date of the patent.

It follows from these considerations that the analysis of the oscillations modes according to the claimed method cannot involve an inventive step.

The same applies to the selection of the position of the driver according to the claimed method. As taught in document D6 (page 14, Figure 1.9), the positioning of the driver at the centre of the measuring structure should be carried out carefully in order to preserve the symmetry of the mechanical structure, the central position of the structure satisfying inherently the claimed criteria with regard to the symmetrical and the asymmetrical modes which correspond to the desired and the undesired modes, respectively. In addition, document D2 already teaches positioning the driver at a position of maximal amplitude of the desired oscillation mode (column 14, line 10 *et seq.* and column 12, line 64 to column 13, line 1), this position corresponding according to Figures 3A to 3E to a position in which other oscillation modes are inherently minimised.

Furthermore, the steps of determination and of selection of the driver position according to the claimed method involve mental activities and mathematical methods which lack the required technical character and, according to decision T 531/03, these

features cannot be considered to contribute to inventive step.

VI. The arguments of the respondent can be summarised as follows:

The patent addresses the problem of optimally locating driver elements on the vibration tubes so that unwanted modes are minimised. The driver has been usually located at the centre of the structure for reasons of symmetry and not to minimise an unwanted mode. Document D2 mentions techniques such as trial and error and computer modelling in the determination of the driver's position, the latter being determined on the basis of one single condition, namely the maximisation of the amplitude of one single mode. There is no teaching in document D2 to simultaneously consider the characteristics of a second mode.

Document D6 teaches the use of a MATHCAD program in the determination of eigenfrequencies and eigenforms of vibration modes of a flowmeter having a driver at a central location, i.e. the document is not concerned with the determination of the location of the driver or with the selection of this position on the basis of the analysis disclosed in the document. The document only refers to the driver being positioned centrally in order to preserve the symmetry of the mechanical structure.

Document D10 gives a general description of Coriolis flowmeters and recommends to ensure, for instance by the provision of rigid clamps, that the pipeline vibration frequency is not the same as the flowmeter



operating frequency. The document also teaches that the driver is typically placed at the centre of the tube (page 122, second column, lines 15 and 16). Thus, the document does not address the problem of the invention and does not suggest the claimed method.

In document D11 the driver is positioned to maximise a bending or a twisting mode (Figures 6 and 8), and documents D7 and D12 merely describe modal analysis of vibrating structures.

### **Reasons for the Decision**

1. The appeal is admissible.

2. *Amendments*

The amendments to the patent concern the deletion of claims 1 to 13 as granted and the renumbering of claims 14 to 17 as granted as claims 1 to 4. In addition, the description has been amended to give account of the deletion of claims 1 to 13 as granted. It has been undisputed during the proceedings that the amendments satisfy the formal requirements of the EPC, and in particular those set forth in Articles 123 (2) and (3) EPC.

3. *Grounds for opposition under Article 100 (b) EPC*

During the appeal proceedings the appellant did not refer any longer to the grounds for opposition of insufficiency of disclosure (Article 100 (b) EPC). In addition, these grounds for opposition were invoked and

substantiated during the first-instance proceedings only in respect of the invention defined in claim 1 as granted; claim 1 as granted, however, has been deleted (see point 2 above) and the patent as presently amended is not directed any longer to the invention defined in claim 1 as granted. Accordingly, the grounds for opposition under Article 100 (b) EPC initially invoked by the appellant are not relevant for the patent as presently amended.

4. *Grounds for opposition under Article 100 (a) EPC*

4.1 *Novelty*

It has been undisputed during the present appeal proceedings that the claims of the amended patent upon which the interlocutory decision under appeal was based define novel subject-matter over the prior art considered during the proceedings (Articles 52(1) and 54 EPC). In particular, document D2 discloses a Coriolis-type mass flowmeter (Figure 1 and the corresponding description) and a method of affixing a driver to the flow conduit of the mass flowmeter and including the steps of determining the location of the conduit at which the amplitude envelope for the second oscillation mode of the conduit is at a maximum (column 14, lines 9 to 31), and positioning the driver at that location. According to the document, the driver's location is found by trial and error, by computer modelling or experimentally (column 14, lines 24 to 28 and column 15, lines 13 and 14), and there is no disclosure of selecting the position of the driver following the procedure defined in the characterizing portion of claim 1.

## 4.2 *Inventive step*

4.2.1 The appellant's contention that the claimed invention does not involve an inventive step relies on document D2 as the closest state of the art. As already concluded in point 4.1 above, the subject-matter of claim 1 differs from the method disclosed in document D2 in the features defined in the characterizing portion of the claim. In essence, according to these features, eigenvector coefficients at a plurality of nodes along the conduit are extracted from a finite element model of the apparatus for at least a desired mode and an undesired mode, and then the position of the driver is selected on the basis of the eigenvector coefficients so that the amplitude of oscillations in the desired and in the undesired modes is maximised and minimised, respectively, at the location of the driver.

4.2.2 According to the patent specification, the distinguishing features identified above result in a procedure of selection of an optimal location of the driver such that not only the desired mode is maximised, but unwanted modes of the flow conduit are minimised, thus improving the performances of the flowmeter (page 2, line 41 to page 3, line 8 and page 3, lines 26 to 29). The objective problem solved by the claimed subject-matter over the method disclosed in document D2 can therefore be seen in improving the procedure of selection of the driver's location in the flow conduit in view of the performances of the flowmeter.

4.2.3 Document D2 teaches using trial and error, computer modelling or experimental considerations in the

determination of the position of the driver at which the amplitude of oscillations at one of the oscillation modes is maximised (column 14, lines 24 to 28 and column 15, lines 13 and 14) and is silent as to the characteristics of any other mode at that specific position. The appellant's contention that the driver's position disclosed in document D2 would also inherently minimise other modes of the conduit as can be inferred from the conduit's natural vibration modes represented in Figures 3A to 3E (column 13, line 34 to column 14, line 2) might well lead to the conclusion that document D2 implicitly discloses flowmeters inherently satisfying the conditions expressed in the claimed method; however, in the absence in document D2 of any explicit disclosure or specific teaching relating to the characteristics, and in particular to the minimisation, of other vibration modes at the position of the driver, the appellant's submissions do not allow the conclusion that the skilled person would have considered in the determination of the driver's position the further step of minimising at that position some of the modes in addition to maximising one of the modes as a solution to the problem formulated above.

Documents D6 and D6' disclose the basics of Coriolis mass flowmeters (page 14 and Figure 1.9) and the analysis of the eigenfrequencies and the eigenmodes of the conduit of the flowmeter (section 2.1.3 on pages 27 to 30 and Figures 2.4 and 2.5). According to the submissions of the appellant, the computation of the eigenvalues resulting from the aforementioned analysis and represented in equation 2.27 would involve extracting eigenvector coefficients in the sense of the

claimed invention and, in addition, this procedure can be carried out using finite element modelling as disclosed in the document (page 45, two last paragraphs). Nonetheless, the disclosure referred to by the appellant would at the most suggest the mathematical techniques specified in the characterizing portion of claim 1, not however the application of these techniques in the selection of any specific position for the flowmeter's driver. The aforementioned disclosure is in fact silent as to the technical characteristics of the driver's position and does not suggest the claimed solution. In particular, Figure 1.9 of document D6 only shows that a driving force is applied at the middle of the conduit, and the document is silent as to the specific technical characteristics of this position of the driver. Similar considerations apply to document D10 which relates to mass flowmeters of the Coriolis type and only specifies positioning the driver at the centre of the flow conduit (page 122, second column, lines 16 to 18 and Figure 2.10a).

Document D11 discloses the use of finite element analysis in the vibration analysis of fluid-conveying pipes, and in particular of Coriolis mass flowmeters driven at a predetermined mode (abstract and page 2123, last paragraph) by means of drivers located at specific positions (page 2124, last paragraph and Figures 6 to 8). However, also this document is silent as to any selection criteria or specific technical properties to be satisfied by the driver's position.

Document D7 is a standard reference on ANSYS in the modal analysis of mechanical structures for the determination of the oscillation characteristics of the

structures (page 3-13, first paragraph, and page 3-19); the document discloses, in addition, mode extraction (page 3-13, central paragraph, and page 3-17, section "Expand the modes") and finite element modelling (page 3-16, lines 6 to 8). Document D12 is a reference manual on mathematical analysis of vibrations and oscillations in structures and shows, among others, the basics on modal analysis and finite element modelling. However, none of documents D7 and D12 relate to flow conduits or to the technical characteristics of the application of a driving force to a flow conduit.

- 4.2.4 It follows that none of the documents considered during the appeal proceedings discloses or suggests solving the problem formulated in point 4.2.2 above by a sequence of steps involving the determination of the characteristics of a first predetermined oscillation mode and of a second predetermined oscillation mode at nodes along the flow conduit and positioning the driver at a location of the conduit that maximises the first oscillation mode and minimises the second oscillation mode. For these reasons, the Board is of the opinion that the subject-matter of claim 1 and that of dependent claims 2 to 4 involve an inventive step within the meaning of Article 56 EPC.

This conclusion relies exclusively on technical aspects of the claimed invention and, more particularly, on the technical contribution of the combination of features defined in claim 1 to the selection of the driver's position having predetermined technical characteristics. Thus, the conclusion above does not rely on aspects of the claimed invention such as the specific mathematical techniques mentioned in the claimed method or the way

the selection procedure of the driver's position is carried out and which may involve a mental act, but on the technical effect resulting from the interaction of these aspects with the technical elements of the claim and providing a solution to the technical problem formulated in point 4.2.2 above. Consequently, the conclusion reached above that the claimed invention involves an inventive step is not at variance with the appellant's contention that according to established case law, and in particular according to decision T 531/03, non-technical aspects of a claimed invention cannot be considered to contribute to inventive step within the meaning of Article 56 EPC.

5. In view of the above considerations and conclusions, the Board concluded during the oral proceedings that none of the submissions of the appellant prejudices the maintenance of the patent as amended according to the interlocutory decision under appeal and that consequently the appeal was to be dismissed.

## **Order**

### **For these reasons it is decided that:**

The appeal is dismissed.

The Registrar:

The Chairman:

M. Kiehl

A. G. Klein