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D E C I S I O N
of 9 January 1998

Case Number: T 0781/96 - 3.4.2
Application Number: 89202571.9
Publication Number: 0364054
IPC: G01F 1/84

Language of the proceedings: EN

Title of invention:
High temperature coriolis mass flow rate meter

Patentee:
Micro Motion Incorporated

Opponent:
Endress + Hauser Flowtec AG
Krohne Messtechnik GmbH & Co. KG

Headword:
-

Relevant legal provisions:
EPC Art. 56, 100(a), (b), (c), 113(1)

Keyword:
"Subject-matter extended (no)"
"Sufficiency of disclosure (yes)"
"Novelty (yes)"
"Inventive step (yes)"
"Basis for decision (yes)"

Decisions cited:
T 0455/91

Catchword:
-



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Boards of Appeal

Chambres de recours

Case Number: T 0781/96 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 9 January 1998

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Decision under appeal:

Decision of the Opposition Division of the
European Patent Office posted 25 July 1996
rejecting the opposition filed against European
patent No. 0 364 054 pursuant to Article 102(2)
EPC.

Composition of the Board:

Chairman: E. Turrini
Members: M. Chomentowski
B. J. Schachenmann

Summary of Facts and Submissions

- I. The respondent is proprietor of European patent No. 0 364 054, which has been granted with 8 claims on the basis of European patent application No. 89 202 571.9 citing inter alia the prior art document D4: US-A-4 738 143. The only independent claim of the European patent reads as follows:

"1. A Coriolis mass flow meter (10), electrically connectable to processing means including means for providing a driver signal to said meter and to means for processing a deflection signal produced in said meter to provide an output representative of the mass flow rate of the fluid flow, said flow meter being capable of operating at relatively high temperatures, comprising
flow conduit means (11, 11') made of an alloy that is substantially insusceptible to carbide precipitation occurring at said relatively high temperatures for receiving fluid therethrough whose mass flow rate is to be measured,
a housing enclosing said flow conduit means,
means for mounting (15) said flow conduit means,
driver means (16), responsive to said driver signal, for vibrating said flow conduit means with respect to said mounting means,
sensor means (17) for sensing the deflection of said flow conduit means caused by fluid flow through said flow conduit means and for producing said deflection signal representative of said deflection, each of said driver and said sensor means comprising
magnet means (24),
coil means (22), and
terminal block means (64), having multiple conductors (66), mounted adjacent to said coil means and in a stationary relationship with respect to said housing,

flexure means (60, 62), having one or more uninsulated electrical conductors, for electrically interconnecting said coil means of said driver means and said sensor means with said adjacent terminal block means, said flexure means being dimensioned so as to form a U-shape when electrically interconnecting said coils with said conductors of said adjacent terminal block means, feed-through means (70) having multiple conductors (68, 69) therethrough for providing a passage for routing signals through said housing means, said signals including said driver signals and said deflection signals from said driver means and said sensor means,

multiple internal insulated wiring leads (68) for electrically interconnecting individual ones of said conductors of said terminal block means with corresponding internal ends of said individual conductors of said feed-through means, and multiple external insulated wiring leads (82) for providing at least a portion of the electrical interconnection between individual ones of said conductors of said external ends of said individual conductors of said feed-through means and said processing means,

characterized in that said relatively high temperatures are in a temperature range having a lower boundary in excess of 260 degrees C and an upper boundary of approximately 426 degrees C and said flow meter is capable of operating without malfunction in said range, said housing hermetically encloses said flow meter, an inert gas fills said hermetically closed housing, said feed-through means provides a hermetically sealed passage through said housing, said driver means, sensor means, magnet means, coil means and flexure means are all of a high temperature type suitable to operate

substantially without malfunction due to thermally caused fatigue within said temperature range, and said housing includes no cooling means utilising an externally supplied flowing cooling medium."

II. The appellant (opponent 1) has filed an opposition on the grounds that the subject-matter of the European patent extended beyond the content of the application as filed and that said subject-matter lacked an inventive step having regard to inter alia D4, D8: SWINGWIRL II, a brochure from Flowtec AG, Reinach BL 1, 02/87, and D9: "m-point mass flowmeter", a brochure from Flowtec AG, 08/88.

An opposition had also been filed by opponent 2, based on the grounds that, inter alia, the European patent did not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art.

II. The oppositions were rejected.

The Opposition Division took the following view:

There were enough examples of e.g. materials in the description to carry out the invention. There was also sufficient disclosure in the original application, e.g. of the materials used, all indicating the need to avoid failure in the high temperature range, and e.g. the list of objects of the invention, whereby high operating temperatures and the exclusion of cooling means using a cooling purge were stressed, to support all the features of the patent. The novelty of the subject-matter of the patent had not been disputed. Starting from D4, which showed a Coriolis flow meter which does not comprise the features of the characterising portion of claim 1, the skilled person would not take D8 into account because this other flow

meter was not a Coriolis flow meter and it was not provided with a hermetic enclosure surrounding most of the apparatus; he would not take D9 into account either, because this further flow meter, which was indeed a Coriolis flow meter, was for a lower range of operating temperatures and comprised a vacuum enclosure, i.e. no inert gas filling. Therefore, the subject-matter of claim 1 involved an inventive step.

IV. Opponent 1 (the appellant) lodged an appeal against this decision.

He requested that the decision under appeal be set aside and that the patent in suit be revoked and argued in substance as follows in support of his request:

The feature in claim 1 that the housing of the flow meter includes no cooling means utilising an externally supplied flowing cooling medium had no basis in the original application, which specified that an object of the invention was a Coriolis flow meter that did not utilize a cooling purge. There was no basis either for the feature that the Coriolis mass flow meter was capable of operating in a temperature range from about 260°C to about 426°C without malfunction, and that, in particular, the driver means, sensor means, magnet means, coil means and flexure means necessary for the flow meter were all of a high temperature type suitable to operate substantially without malfunction due to thermally caused fatigue within said temperature range; in particular, "fatigue" of a material was derivable from the original application only with respect to the ceramic insulation of the wires used in the flow meter. By using functional features in place of the original features in the examples, the subject-matter had been extended.

Starting from D4, the skilled person would be prompted, according to the findings of decision T 455/91, OJ EPO, 1995, 684, to investigate, for convenient solutions of his problem of avoiding cooling purge means in the flow meter, in the neighbouring field of flow meters based on different principles, and thus to transfer from D8 a protected enclosure to his high temperature apparatus, the further constructive features of claim 1 in dispute providing no inventive contribution. Therefore, the subject-matter of claim 1 in dispute lacked an inventive step.

- V. As main request, the respondent (patent proprietor) requested that the appeal be dismissed and, as auxiliary request, that oral proceedings be held. The following arguments were submitted in support of the main request:

It was derivable from the original application that the Coriolis flow meter was capable of reliable operation at relatively high temperatures, so that its means, for instance the materials, were adapted to this purpose; in particular, it was understandable that the ceramic insulation of the wirings and also the copper utilised, which were mentioned as being eventually plagued by thermally caused fatigue, were however such that the flow meter could be operated without malfunction even at these high temperatures. The original application also specified that an object of the invention was a Coriolis flow meter that did not utilize a cooling purge, so that there was a basis for the last feature of claim 1 of the patent.

The skilled person starting from the flow meter of D4 and intending to operate it at higher temperatures while avoiding the use of a cooling gas, would not take into account D8, for the following reasons: this other flow meter, which used a vortex created around a

sensor, belonged to a different technical field because it was not a Coriolis flow meter; following the remarks of the above-mentioned decision T 455/91, that a transfer of convenient solutions from a neighbouring technical field to the own field was to be done "if this transfer of technical knowledge involves nothing out of the ordinary", and taking into account the numerous differences in the constructive features of a Coriolis flow meter and a vortex flow meter, the skilled person would not turn to the vastly different metering technology for insights how to solve the problem referred to above, so that the subject-matter of claim 1 in dispute involved an inventive step.

VI. Opponent 2 has not filed any comment during the appeal procedure.

Reasons for the Decision

1. The appeal is admissible.

2. *Allowability of the amendments*

2.1 According to claim 1 in dispute (see the characterising portion), the Coriolis mass flow meter is capable of operating at relatively high temperatures which are in a temperature range having a lower boundary in excess of 260° C and an upper boundary of approximately 426°C and said flow meter is capable of operating without malfunction in said range; the housing enclosing the flow conduit means receiving fluid therethrough whose mass flow rate is to be measured encloses hermetically said flow meter; an inert gas fills said hermetically closed housing; the feed-through means providing a passage for routing signals through said housing means provides a hermetically sealed passage through said

housing; the driver means, sensor means, magnet means, coil means and flexure means necessary for the flow meter are all of a high temperature type suitable to operate substantially without malfunction due to thermally caused fatigue within said temperature range; moreover, said housing includes no cooling means utilising an externally supplied flowing cooling medium.

2.2 A first objection of the appellant is that the feature that the housing of the flow meter includes no cooling means utilising an externally supplied flowing cooling medium has no basis in the original application. However, as pointed out by the respondent, the original application (see page 8, lines 12 and 13) specifies that an object of the invention is a Coriolis flow meter that does not utilize a cooling purge. Moreover, the original application (see page 5, line 33 to page 6, line 17, more in particular page 6, lines 10 to 14) specifies that an active gas cooling purge line, typically using nitrogen gas flowing at a sufficient flow rate, is incorporated into the meter of the acknowledged D4 in order to maintain the velocity sensors and drive assembly at a relatively low temperature; further considerations about drawbacks of a system including such purge lines using a cooling purge gas, in particular with an active source of gas being connected to the purge line of the meter, are mentioned in the original application (see page 6, line 19 to page 7, line 15 and page 7, lines 30 to 35). Therefore, the cooling means (to be avoided) is not restricted to those utilising flowing nitrogen gas and, as convincingly argued by the respondent, there is a basis in the original application for a meter wherein the housing of the flow meter includes no cooling means utilising an externally supplied flowing cooling

medium. Incidentally, it is to be noted that, for the same reasons, a possible amendment consisting in substituting "cooling purge" for "cooling means", proposed by the respondent in this respect, is not considered as useful and thus is not relevant.

- 2.3 A second objection of the appellant is that there is no basis in the original application for the feature that the Coriolis mass flow meter is capable of operating in a temperature range from approximately 260°C to approximately 427°C without malfunction, and that, in particular, the driver means, sensor means, magnet means, coil means and flexure means necessary for the flow meter are all of a high temperature type suitable to operate substantially without malfunction due to thermally caused fatigue within said temperature range. In particular, the appellant has stressed that "fatigue" of a material is derivable from the original application only with respect to the ceramic insulation of the wires used in the flow meter.

However, the respondent has convincingly argued as follows in this respect:

Indeed, the original application (see page 4, line 25 to page 5, line 3) mentions drawbacks of prior art meters using eventually fatiguing ceramic insulation of the wires. Yet, the original application (see page 5, lines 22 to 24) stresses that not only the ceramic wiring insulation of known flow meters can result in drawbacks, but also the copper wires: "Copper wires could not be used inasmuch as it exhibits grain growth at temperatures above 400°F which would cause creepage and eventual fatigue". Moreover, it is explicitly mentioned in the original application (see page 8, lines 5 to 10) that an object of the invention is "to provide apparatus for a Coriolis mass flow meter that is capable of reliably operating at relatively high

temperatures, such as in excess of 500°F (approximately 260°C) and preferably as high as 800°F (approximately 427°C)". Therefore, in the context of the original application, the objected features are directly and unambiguously derivable.

2.4 It is to be noted that the appellant has also provided arguments concerning the content of the previous application for claiming priority for the patent in suit, or concerning the scope of protection conferred by said previous application for claiming priority or by the application as originally filed. However, since these objections do not relate to the grounds of opposition comprised in the exhaustive and restricted list in Article 100 EPC and in particular to those of Article 100(c) EPC, they are disregarded.

2.5 Therefore, the Board is satisfied that the subject-matter of the patent in suit does not extend beyond the content of the application as filed (Article 100(c) EPC).

3. *Sufficiency of disclosure*

Only opponent 2, who has not appealed against the impugned decision and who has not provided any comment during the appeal procedure, had based his opposition *inter alia* on the ground that the invention was not sufficiently disclosed in the European patent. Therefore, since the reasoning in the impugned decision with respect to sufficiency is convincing and since opponent 1, the sole appellant, has not provided any argument in this respect, the Board is satisfied that the European patent discloses the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art (Article 83 and 100(b) EPC).

4. *Novelty*

It has not been disputed that D4 represents the closest prior art and that the device known from this document does not comprise all the features of claim 1 in dispute. Therefore, the subject-matter of claim 1 in dispute is new in the sense of Article 54 EPC.

5. *Inventive step*

5.1 It has not been disputed either that the Coriolis mass flow meter (10) known from D4 (see the abstract; column 3, line 21 to column 5, line 31; column 5, line 60 to column 9, line 3; Figure 1 to 7), i.e. the closest prior art, comprises all the features of the first part of claim 1 in dispute which is shown here above.

5.2 However, the Coriolis flow meter known from D4 is indicated as operating at temperatures as high as only 400°F (approximately 204°C), and this is contrary to the relatively high operating temperatures for the Coriolis flow meter in dispute, which are in a temperature range having a lower boundary in excess of 260°C and an upper boundary of approximately 426°C, with said flow meter being capable of operating without malfunction in said range.

Moreover, the Coriolis flow meter known from D4 (see column 8, lines 31 to column 9, line 3; Figure 1. to 3) is indicated as utilising an externally supplied flowing cooling medium for cooling said means, said cooling medium being flowed by a tubing (56) with vents (58) and being withdrawn from the housing (26) through a vent (60). In contrast, in the Coriolis flow meter in dispute, the housing hermetically encloses said flow meter, an inert gas fills said hermetically closed

housing, said feed-through means provides a hermetically sealed passage through said housing, said driver means, sensor means, magnet means, coil means and flexure means are all of a high temperature type suitable to operate substantially without malfunction due to thermally caused fatigue within said temperature range, and said housing includes no cooling means utilising an externally supplied flowing cooling medium.

- 5.3 According to the patent in suit (see column 5, line 37 to column 7, line 21), the Coriolis flow meter of D4 has disadvantages in particular as a result of the provided cooling purge gas means, and an object of the present invention is to provide such a meter operating at temperatures as high as about 426°C and which do not utilize a cooling purge.
- 5.4 Another flow meter is known from D8 (see in particular the first page, the seven first lines; the second page, the two first paragraphs), which is also a high temperature flow meter because it has an operating range from - 200°C to about 400°C. This flow meter was commercialized and is thus derivable as being capable of operating without malfunction at least up to about 400°C and as comprising technical means also adapted to this range of temperature; in particular, the sensor of said flow meter is in contact with the flowing medium which can have a temperature in the above-mentioned temperature range, said sensor being well protected therefrom. The appellant has argued that the teaching of D8, and in particular the feature that the sensor is protected from the flowing medium to be measured, would lead the skilled person towards the flow meter in dispute. In this respect, he has referred to inter alia the above-mentioned decision T 455/91.

However, the following is to be noted in this respect:

Firstly, among the decisions cited by the appellant, the above-mentioned decision T 455/91 is the only one which, in the statement of grounds of appeal, is commented in detail with respect to the combined consideration of D4 and D8 and, in any case, the other cited decisions are not more relevant in this context.

Moreover, the respondent has convincingly argued as follows:

The flow meter of D8 is not a Coriolis flow meter, but a flow meter based on another principle, wherein a "DSC-SENSOR", i.e. a "differential switched capacitor" is surrounded by the flowing medium to be measured, more in particular in a vortex of said flowing medium; contrary to a Coriolis flow meter, this other known flow meter has no vibrating flow tubes, no magnetic drivers and no magnetic velocity sensors, and is thus not faced with problems associated with such parts. Thus, although Coriolis flow meters and flow meters using a "DSC-SENSOR" both allow the measurements of fluid flows, they belong to different technical fields. Indeed, as mentioned in particular in the above-mentioned decision T 455/91 (cf. the Headnote and points 5.1.3 to 5.1.3.3 of the reasons) indicated by the appellant, the skilled person working in one field would regard a means conveniently adopted in a neighbouring field as being readily usable also in that field. However, according to the end of said paragraph 5.1.3.3 of said decision, he would do so only "if this transfer of technical knowledge involves nothing out of the ordinary". Taking into account the above-mentioned numerous differences in component features between a

Coriolis flow meter with cooling by means of an active cooling purge and a flow meter with a protected DSC-sensor, such transfer is to be considered as being "out of the ordinary" and, thus, it would be only the result of hindsight.

5.5 Indeed, a Coriolis flow meter with a housing enclosing the flow conduit means is also known from D9 (see the first page of text, the first column and the first paragraph of the second column; second page, second paragraph of the part "Measuring system" and first paragraph of the part "Principle of operation"; fifth page, the part "Construction"), whereby said housing hermetically encloses said flow meter and said housing includes no cooling means utilising an externally supplied flowing cooling medium. However, the indicated operating temperature range is only up to 150°C, and not about 426°C and, more in particular, no inert gas fills said hermetically closed housing, which is under vacuum, this last feature being indicated as preventing ingress of moisture, i.e. in relation with another purpose.

Incidentally, it is to be noted that the appellant has not provided any argument relating to D9.

5.6 Therefore, since having regard to the state of the art the subject-matter of claim 1 in dispute is not obvious to a person skilled in the art, it involves an inventive step in the sense of Article 56 EPC and it is patentable in accordance with Article 52(1) EPC.

6. Consequently, the grounds for opposition do not prejudice the maintenance of the European patent unamended (Article 102(2) EPC).

7. Therefore, since the Board has considered all the arguments of the appellant filed in writing and since oral proceedings had been requested auxiliarily only by the respondent, it was not necessary to summon the parties to oral proceedings. Moreover, as mentioned here above, opponent 2, a party as of right in accordance with Article 107 EPC, has remained silent during the appeal procedure. Thus, since the parties have had sufficient opportunity to present their comments on the above-mentioned grounds and evidence, a decision may be issued (Article 113(1) EPC).

Order

For these reasons it is decided that:

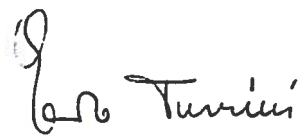
The appeal is dismissed.

The Registrar:



P. Martorana

The Chairman:



E. Turrini

YCA

B.Sch.