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D E C I S I O N
of 27 February 1996

Case Number: T 0760/93 - 3.4.2

Application Number: 86300491.7

Publication Number: 0196150

IPC: G01F 1/80

Language of the proceedings: EN

Title of invention:
Fluid flow measurement

Patentee:
INTERNATIONAL CONTROL AUTOMATION FINANCE S.A.

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step - no"

Decisions cited:
-

Catchword:
"Submissions regarding a problem to be solved based on unsubstantiated advantages cannot be considered in assessing inventive step. The remaining very general problem (creation of a redundant signal - redundancy being a property often desired in many technical fields) solved with obvious means."



Case Number: T 0760/93 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 27 February 1996

Appellant: INTERNATIONAL CONTROL AUTOMATION FINANCE S.A.
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Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 1 July 1993 revoking
European patent No. 0 196 150 pursuant to
Article 102(1) EPC.

Composition of the Board:

Chairman: E. Turrini
Members: W. W. G. Hofmann
B. J. Schachenmann

Summary of Facts and Submissions

I. The Appellants (Proprietors of the patent) lodged an appeal against the decision of the Opposition Division on the revocation of the patent No. 0 196 150.

Oppositions had been filed against the patent as a whole by Respondents I and II (Opponents I and II) and based on Article 100(a) EPC.

The Opposition Division had held that the grounds for opposition mentioned in Article 100(a) EPC prejudiced the maintenance of the patent, having regard in particular to the documents

(D1) EP-A-0 109 218

(D2) EP-A-0 119 638

(D3) JP-A-57 137 818 (English translation).

II. Oral proceedings were held. The Respondents I, although duly summoned, did not participate.

At the end of the oral proceedings, the Appellants requested that the decision under appeal be set aside and that the patent be maintained in amended form on the basis of Claims 1 and 6 filed as main request (also present main request) on 11 November 1993 or on the basis of Claims 1 and 6 presented on 6 May 1993 as "Request 2" (present auxiliary request), Claims 2 to 5 and 7, 8 as granted for both requests.

The Respondents II requested that the appeal be dismissed. The Respondents I requested in writing that the appeal be dismissed.

III. The wording of the independent Claims 1 and 6 on file at the date of the present decision reads as follows:

Main request:

"1. Apparatus for measuring the mass flow rate of a fluid flow, the apparatus comprising:

a pair of straight parallel flexible conduits (36, 37) each having opposite ends (34, 35, 42, 43), an axis and a mid-point between the opposite ends (34, 35, 42, 43); support means (32, 40) connected to the conduits (36, 37) for holding the opposite ends (34, 35, 42, 43) only of the conduits at substantially fixed positions; connector means (30) connected to the support means (32, 40) for supplying a fluid flow whose mass flow rate is to be measured to the pair of straight parallel conduits (36, 37) such that each conduit receives approximately one half of the fluid flow at one end of the conduits and the fluid flow is recombined at the other end of the conduits;

drive means (48) associated with the pair of conduits (36, 37) and responsive to a drive signal for oscillating the pair of conduits towards and away from each other at a selected frequency in a direction transverse to their respective axes and substantially at the mid-points of the conduits (36, 37); at least one sensor (56) for sensing motion of the conduits (36, 37) at a sensing point (a, b) spaced from each mid-point and from the opposite ends (34, 35, 42, 43) to enable detection of the phase difference in the related frequency resulting from fluid flow; and phase measuring means (80) connected to the sensor (56) and to the drive means (48) and responsive to the sensed motion and to the drive signal to measure the phase

difference between motion at the mid-point and motion at the sensing point (a, b), the phase difference corresponding to a measurement of the mass flow rate of the fluid flow."

"6. A method of measuring the mass flow rate of a fluid flow, the method comprising:

transversely oscillating mid-points of a pair of straight parallel flexible conduits (36, 37) towards and away from each other by means of a drive signal at a selected frequency while holding opposite ends (34, 35, 42, 43) only of the conduits (36, 37) substantially fixed;

passing approximately one half of a fluid flow whose mass flow rate is to be measured through each of the conduits (36, 37);

sensing motion of each conduit (36, 37) at a sensing location (a, b) spaced from the mid-points of the conduits (36, 37) and from the opposite ends (34, 35, 42, 43) of the conduits (36, 37); and

measuring the phase difference between motion at the mid-points and motion at the sensing location (a, b) in response to the sensed motion and to the drive signal, which measurement corresponds to the mass flow rate of the fluid flow."

Claims 2 to 5 and 7, 8 are respectively dependent on Claims 1 and 6.

Auxiliary request:

The text of Claim 1 is identical to that of the main request, except for the paragraph concerning the sensor(s). This paragraph reads as follows:

"1. ... one or more sensors (56) for sensing motion of the conduits (36, 37) at a sensing point (a) or respective sensing points (a, b) each spaced by a predetermined distance from each mid-point and spaced from the opposite ends (34, 35, 42, 43) to enable detection of a phase difference in the related frequency resulting from fluid flow; and ...".

Up to the passage: "... through each of the conduits (36, 37);", Claim 6 according to the auxiliary request is identical to that of the main request. From there it reads as follows:

"6. ... sensing motion of each conduit (36, 37) at one or more sensing locations (a, b) each spaced by a predetermined distance from the mid-points of the conduits (36, 37) and spaced from the opposite ends (34, 35, 42, 43) of the conduits (36, 37); and measuring a phase difference induced by the fluid flow between the drive signal and the measured motion at the or each sensing location (a, b), which measurement corresponds to the mass flow rate of the fluid flow."

Claims 2 to 5 and 7, 8 are respectively dependent on Claims 1 and 6.

IV. The Appellants essentially argued as follows:

It is not disputed that D2 discloses many of the features of present Claim 1. However, D2 does not disclose sensing the motion at mid-point and deriving the phase difference from the drive signal and the sensed motion at least one sensing point. Thus, one mass flow rate measurement is obtained for each sensor. The main point of the invention is not the use of the mid-point for reference, but the use of the drive signal. This drive signal provides phase reference

without requiring a sensor and thus either saves one sensor which means a simplification of the apparatus, or improves accuracy in the sense of reliability. The solution according to Claim 1 is not obvious since it requires leaving the usual tracks followed by the prior art, where the driving signal was never used as a reference. There may have been a prejudice because the phase relationship between the driving signal and the motion at mid-point was not trusted. Actually there is no phase lag between the driving signal and the motion, and even if there were one, it would cancel out for the case of two sensors combined with the drive signal. Figures 4 and 5 of D3 only show theoretical considerations regarding the phase shift at different points along the tubes and thus do not suggest the practical use of a signal at midpoint. The flow meter described in D3 does not use a signal at mid-point, but only the phase difference from one sensor to the other.

V. The Respondents I only argued in writing. In the appeal proceedings, they cited two further documents ("Digest of the 6th International Conference on Medical Electronics and Biological Engineering", Tokyo, 1965, pages 48/49; and "Mass Flow Meter Remote Electronics Instruction Manual" of Micro Motion Inc., Boulder, Co., 1/83) and mainly based their argumentation on these documents. (These documents are not relevant to the present decision.)

VI. The arguments of Respondents II may be summarised as follows:

D2 discloses all the features of Claim 1 except the use of the motion at the mid-point and of the corresponding drive signal for measuring the phase difference. In Figures 4 and 5 of D3 it is shown that phase differences exist and therefore might be used between any two points

along the tube. It is further shown (Fig.6) that an electrical signal corresponding to the vibration frequency is anyway present at the mid-point position G. In order to obtain a further signal, it would be evident for a person skilled in the art to use this signal, which is already present, for phase shift measurement since nothing else but a phase reference signal is required. No surprising effect is achieved by providing this feature. In fact, as far as the alternative, allowed in Claim 1, relating to two sensors in addition to the drive signal is concerned, any advantageous effect is denied since the larger phase difference achieved according to D2 between the points at 25% and 75% of the length of the tubes is fully equivalent to the combination of the two smaller phase differences according to present Claim 1. Simplifying the known apparatus, on which problem the alternative according to Claim 1 relating to one sensor might be based, is a usual aim for any skilled person, and thus cannot contribute to inventive step.

Reasons for the Decision

- 1. The appeal is admissible.
- 2. *Appellants' main request*
 - 2.1 Novelty
 - 2.1.1 Claim 1

In correspondence with the subject-matter of Claim 1, D2 (see in particular the "abstract"; page 2, line 26 to page 3, line 3; page 3, line 18; page 4, lines 9 to 25; page 5, lines 7 to 9, 24, 25; and Claims 1 and 6)

discloses an apparatus for measuring the mass flow rate of a fluid flow. This apparatus comprises a pair of straight parallel flexible conduits (see in particular page 5, lines 7 to 9, 24, 25; and Claim 6; the conduits are necessarily flexible since they are able to vibrate), support means connected to the conduits for holding the opposite ends thereof at substantially fixed positions, connector means for supplying to each conduit approximately one half of the fluid flow and for recombining the fluid flow, drive means responsive to a drive signal for oscillating the pair of conduits towards and away from each other ("antiphase") in a direction transverse to their respective axes and substantially at the mid-points of the conduits, two sensors for sensing the motion of the conduits at a sensing point spaced from each mid-point and from the opposite ends to enable detection of the phase difference in the related frequency resulting from fluid flow, and phase measuring means connected to the sensors and responsive to the sensed motion to measure the phase difference between the motion at the two sensing points, the phase difference corresponding to a measurement of the mass flow rate of the fluid flow.

The subject-matter of Claim 1 is distinguished from this known apparatus by the fact that the phase difference is determined by using - together with the sensed motion at the first sensing point - the motion at the mid-point by means of the drive signal, either instead of, or in addition to the sensed motion at the second one of the two sensing points (or at further sensing points).

Since the other cited documents do not come closer to the claimed subject-matter, the subject-matter of Claim 1 is novel in the sense of Article 54 EPC.

2.1.2 Claim 6

The features of method Claim 6 fully correspond to those of Claim 1, except for the fact that instead of the explicit definition "at least one sensor", the method only comprises the step of "sensing motion of each conduit at a sensing location ...". However, this is only a difference in wording since in Claim 6 the use of more than one sensor is not actually excluded and is - in fact - fully envisaged since Claim 7, which is dependent on Claim 6, explicitly relates to two sensing locations spaced from the mid-points.

Thus, the method according to Claim 6 is distinguished from the teaching of D2 by the same features and is novel for the same reasons as indicated above with respect to Claim 1.

2.2 Inventive step

According to both D2 and the present Claim 1, the two parallel conduits carrying the fluid flow are oscillated by drive means (necessarily responsive to a drive signal) acting upon the mid-points of the conduits, and the phase difference between the oscillation at different points along the conduits, caused by the fluid flow, is measured.

2.2.1 In determining the objective technical problem to be solved in progressing from the prior art according to D2 to the subject-matter of Claim 1, a distinction has to be made between the different alternatives expressed in the claim relating to the number of motion sensors used for determining the phase difference of oscillation along the conduits.

For the case of two sensors arranged on both sides of the mid-point (corresponding to D2), the measurement of two separate phase differences between each of the sensors and the drive signal has - due to the fact that the phase shift caused by the fluid flow continuously progresses from one side to the other - the character of splitting up the total phase difference existing between the locations of the two sensors into two (smaller, additive) portions by introducing, in between, some reference signal of the same frequency. The primary consequence is that a more complex measuring circuit is required.

In the grounds of appeal, the Appellants indicated that by this measure the accuracy in the sense of reliability is improved. However, upon the doubts expressed by the Board in its communication and in the oral proceedings, the Appellants could not present any argumentation or explanation for substantiating this alleged improvement. (Besides, improving accuracy beyond that achieved with two sensors alone is nowhere mentioned in the patent specification.) It is, in fact, implausible that the accuracy or reliability might be improved by merely splitting up the measured phase difference. The normal procedure of treating multiple measurement data relating to the same quantity to be measured would be to form the average, which averaging procedure, in the present case, would lead to cancellation of the phase value derived from the drive signal. The patent does not teach any other calculations; in fact, it contains no information at all about the treatment of the measured phase data.

Thus, lacking any specific information, the only problem which could possibly be seen as solved by the subject-matter of Claim 1 concerns the creation of a redundant signal quite in general, without having a specific purpose in view. Redundancy is certainly a property often desired in many fields of technology.

- 2.2.2 It is obvious that for obtaining a redundant signal any signal of the same frequency can be used since, in the absence of a specific application, its phase does not matter, and in the calculation of the fluid flow the phase value anyway cancels out. For this purpose, using the drive signal presented itself to the skilled person since this signal has the same frequency as the oscillation of the conduits and is directly accessible.

That a prejudice existed, as suggested by the Appellants, against using the drive signal because of its uncertain phase relationship with the mid-point motion of the conduits, is not plausible since - as already mentioned above - the exact phase value does not matter. The fact that none of the cited documents discloses the use of the drive signal as reference may well be due to the indeed questionable balance of advantages thereby achieved.

Therefore, connecting the phase measuring means not only to the two sensors, but also to the drive means, does not involve an inventive step.

- 2.2.3 Since one of the alternatives covered by Claim 1 (ie the case of two sensors included in the term "at least one sensor") has been shown to lack an inventive step, the same is true for the claimed subject-matter as a whole. It may be mentioned, however, that the alternative relating to only one sensor in addition to the drive signal is also not inventive since - as compared with

the apparatus according to D2 - the phase difference obtained for a certain mass flow of the fluid becomes smaller and thus the simplification by saving one sensor is traded for lower accuracy. If, for some reason, the simplification is sufficiently important and accuracy is unimportant, it is evident for a skilled person to use the drive signal instead of one sensor since the exciting signal itself is the natural reference for determining phase shifts.

2.2.4 For the above reasons, the subject-matter of Claim 1 does not involve an inventive step in the sense of Article 56 EPC. Claim 1 is therefore not allowable (Article 52(1) EPC).

2.2.5 As already mentioned in paragraph 2.1.2 above, method Claim 6 (although not specifically mentioning "at least one sensor") contains essentially the same features as Claim 1. For the same reasons as given above for Claim 1, Claim 6 is therefore also not allowable.

2.2.6 Consequently, the Appellants' main request is not allowable.

3. *Appellants' auxiliary request*

Apart from changing the expression "at least one sensor" into the synonymous "one or more sensors", Claim 1 according to the auxiliary request differs from Claim 1 according to the main request only insofar as it explicitly mentions the fact that as an alternative to having "a sensing point" there also may be "respective sensing points" each spaced by a predetermined distance from each mid-point and from the opposite ends. However, this corresponds exactly to the sense in which Claim 1 had to be understood in the version according to the main request as well.

For the same reasons as given above with respect to the main request, the subject-matter of Claim 1 according to the auxiliary request does not involve an inventive step and Claim 1 is consequently not allowable.

Claim 6 according to the auxiliary request also differs from Claim 6 according to the main request only by more explicitly distinguishing between the alternatives "one or more sensing locations". This modification of the wording does not influence the sense of the text.

For the same reasons as given in paragraph 2.2.5, Claim 6 according to the auxiliary request is not allowable.

The Appellants' auxiliary request is therefore also not allowable.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

P. Martorana

E. Turrini