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D E C I S I O N
of 29 November 1994

Case Number: T 0756/92 - 3.4.2

Application Number: 88307754.7

Publication Number: 0306193

IPC: G01F 1/86

Language of the proceedings: EN

Title of invention:

Fluid meter

Applicant:

SCHLUMBERGER INDUSTRIES LIMITED

Opponent:

Headword:

Relevant legal provisions:

EPC Art. 123(2), 111(1), 54, 56

Keyword:

"Main request: amendments - deletion of feature (not allowed)"
"Auxiliary request: inventive step - (yes) after amendment"

Decisions cited:

Catchword:

Case Number: T 0756/92 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 29 November 1994

Appellant: SCHLUMBERGER INDUSTRIES LIMITED
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Decision under appeal: Decision of the Examining Division of the European Patent Office dated 24 March 1992 refusing European patent application No. 88 307 754.7 pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: E. Turrini
Members: W. W. G. Hofmann
J-C. Saisset

Summary of Facts and Submissions

- I. The Appellant (applicant) lodged an appeal against the decision of the Examining Division on the refusal of the application No. 88 307 754.7 (publication No. 0 306 193).

The Examining Division had held that the application did not meet the requirements of Article 123(2) EPC since the amended Claim 1 lacked two features presented as essential in the original claims and description, that is the provision of three sensing means and the production of an error signal by combining the outputs of the three sensing means.

- II. Oral proceedings were held at the end of which the Appellant requested that the decision under appeal be set aside and a patent granted

as a main request: on the basis of Claims 1 to 4 and the adapted description filed during the oral proceedings, and the drawings as originally filed,

or, as an auxiliary request: on the basis of Claims 1 and 2 and the adapted description filed during the oral proceedings, and the drawings as originally filed.

- III. Claim 1 according to the main request reads as follows:

"1. A fluid flow meter for use in domestic gas metering, the meter comprising at least two sensing devices, one of said sensing devices being able to monitor lower flow rates and comprising a micro-engineered semi-conductor flow sensor (15) for

providing an output signal indicative of the flow rate of said fluid and being characterised in that the other device comprises a fluidic oscillator flowmeter (16) for providing a digital output signal indicative of the velocity of said fluid at flow rates above a predetermined level, calibration means (17, 18, 19, 20) operative at flow rates above said predetermined level for comparing the respective output signals of the semi-conductor flow sensor (15) and the fluidic oscillator flowmeter (16) from time to time and for producing and storing an error signal dependent upon the difference between said output signals, and means (RECALIBRATE, Figure 4) for correcting the output signal of the semi-conductor flow sensor (15) in dependence upon the stored error signal."

Claims 2 to 4 are dependent on Claim 1.

Claim 1 according to the auxiliary request reads as follows:

"1. A fluid flowmeter for use in domestic gas metering, the meter including flow sensing means, the flow sensing means comprising density sensing means (14) and a micro-engineered cantilevered beam flow sensor or a hot beam flow sensor for providing signals indicative of the density and flow rate of said fluid, the flowmeter being characterised by a fluidic oscillator flowmeter (16) for providing a digital output signal indicative of the velocity of said fluid at flow rates above a predetermined level, calibration means (17, 18, 19, 20) operative at flow rates above said predetermined level for comparing respective signals derived from the flow sensing means and the fluidic

oscillator flowmeter (16) from time to time and for producing and storing an error signal dependent upon the difference between said compared signals, and means (RECALIBRATE) for correcting the output signal derived from the flow sensing means in dependence upon the stored error signal."

Claim 2 is dependent on Claim 1.

IV. The Appellant essentially argued as follows:

Although it is acknowledged that the original claims of the application specified three sensing means, one of which was implicitly or explicitly a density transducer, a person skilled in the art of domestic gas metering would, for the following reasons, have readily appreciated that this was an error.

To date, domestic gas metering has always been performed on a volumetric basis, without density correction, so that it was clear that volumetric measurement was intended in the present application. This is corroborated by the second paragraph of page 8 of the original description, where it is indicated that although the specific embodiment is directed at providing a measurement of mass flow rate, it is possible to monitor other fluid characteristics, which can only mean volumetric flow rate. If, however, only volumetric flow rate is measured, neither the device as a whole nor the calibration means requires a density sensor. This is again corroborated by the second paragraph of the original page 8 which refers to "at least two metering or sensing devices". Moreover, the description also mentions a hot beam sensor which, like

the fluidic oscillator flow meter, is a volumetric flow sensor and does not require a density measurement.

The facts of the present case seem even more favourable to the Appellant than the facts of decision T 187/91 since in the present case the possibility of using two sensors instead of three is explicitly disclosed.

Reasons for the Decision

1. The appeal is admissible.
2. *Main request*
 - 2.1 Claim 1 according to the main request relates to a fluid flow meter comprising "at least two" sensing devices. One of these sensing devices is expressed as comprising a micro-engineered semi-conductor flow sensor and the other device is expressed as comprising a fluidic oscillator flow meter. According to the claim, the error signal which is used for correcting the output signal of the semi-conductor flow sensor is produced in dependence on the output signals of the semi-conductor and the fluidic oscillator flow sensors.

This means that in contrast to the subject-matter of the original independent Claims 1 and 9, the claimed subject-matter now also relates to a fluid flow meter which has no third sensing means, i.e. no density transducer, and in which no contribution from the output of a density transducer is used to derive the error signal.

Since there is no basis for this modification in the original claims, it has to be checked whether the drawings and the description provide an original disclosure for a flow meter having no third sensing means, i.e. no density transducer.

2.2 Those drawings which relate to the overall construction, i.e. Figures 4 and 7, both show a density transducer ((14) and (37)). Throughout the original description, wherever the construction of the flow meter is mentioned, a density transducer forming part of the flow meter is mentioned as well.

The Appellant relies on the text of page 8, lines 5 to 12, for showing that the original application discloses the measurement of purely volumetric flow rate (which would then not necessarily require the measurement of density) and the calibration of the flow meter by means of only two sensing devices.

However, the unspecific statement that "other fluid characteristics" (in addition to the measurement of mass flow rate) could be monitored, might mean quite a number of different fluid properties. In the view of the Board, the vague wording "other fluid characteristics" following the mention of "mass flowrate" leaves much room for uncertain interpretation, but in any case does not point to one single alternative, i.e. the volumetric flow rate. The further statement that the invention is generally directed at calibration of a meter "by comparing measurements from at least two metering or sensing devices" also does not unambiguously point to the possibility of omitting the density transducer. It is

clear that the principle of calibration consists in the comparison of the output signals of one metering device with those of a second ("standard") metering device, in the present case the comparison of the signals of the microbeam sensor (which may comprise one or more microbeams) and of the fluidic oscillator flow meter. This basic principle expressed in the cited paragraph of the original description does not contradict the fact that it may be desirable or necessary, before combining the obtained output signals in order to perform the comparison, to transform one or both of these signals in such a way that they are comparable, using for this transformation data obtained from a further sensor, e.g. a density transducer.

The text cited by the Appellant, therefore, does not provide the alleged disclosure.

2.3 The presence of a density transducer also appears reasonable to the reader of the application, in view of the problem to be solved. On page 1, lines 13 to 21 it is stated that, over the long period of use desired for the flow meter, the effects not only of contamination and drift due to the analogue nature of the device, but also of changes in fluid composition should be alleviated. Corrections for changes in fluid composition, however, require the knowledge of the actual fluid densities.

2.4 The Appellant argued that domestic gas metering, which is e.g. mentioned on the original page 1, line 2 (the passage reading: "... a meter suitable for use in domestic gas metering"), implied purely volumetric flow measurement which as such would not require a

measurement of density. Even assuming that uncorrected volumetric flow measurement is the usual practice in domestic gas metering, the Board is nevertheless of the opinion that mass flow measurement as well is certainly suitable for use in domestic gas metering, so that the above-cited statement cannot provide the basis for the disclosure of a fluid meter not requiring (and even less of a fluid meter implicitly definitely lacking) a density transducer.

The Appellant also argued that according to page 5, lines 18 and 19, of the original description "a hot beam sensor may be used to measure characteristics of fluid which is flowing", that a hot beam sensor measured volumetric flow and that for determining volumetric flow no density transducer was required.

However, the document "A.T.J. Hayward: Flowmeters, 1979", pages 11, 12, 81, 94 and 95, filed by the Appellant in order to show that hot beam sensors are volumetric flow sensors, indicates on page 95, lines 5 and 6, that the calibration of hot resistor probes is to some extent dependent upon the density and the thermal properties of the gas, so that the measurement of this type of sensors is not purely volumetric. Moreover, even the presence of a volumetric flow sensor (instead of the cantilevered microbeam flow sensor) in the fluid meter according to the present application would not necessarily imply that the parameter to be determined by the device as a whole is also purely volumetric flow without any correction for density.

2.5 Contrary to the argument of the Appellant, the facts in the present case are not more but less favourable to

the applicant than those in decision T 187/91 (OJ 1994, 572) since, as shown above, the number of sensors now claimed in the present application is also not explicitly disclosed and, contrary to the cited case, there is no implicit disclosure pointing to the modified subject-matter.

2.6 For these reasons, Claim 1 according to the main request contravenes Article 123(2) EPC. The main request is therefore not allowable.

3. *Auxiliary request*

3.1 Claim 1 according to the auxiliary request is based on the original Claim 9. The wording is modified insofar as "flow sensing means" are mentioned, which flow sensing means are defined as comprising density sensing means and a micro-engineered cantilevered beam or hot beam flow sensor (for these more precise definitions of the flow sensors see original page 1, lines 13 and 14, and page 5, line 18). Since for producing the error signal, the signals from the flow sensing means and from the fluidic oscillator flow meter (for the latter flow meter and its signals see the original Claims 7 and 10, and page 6, lines 34 and 35) are compared, the density sensing means are - as according to the original Claim 9 - included in the determination of the error signal.

Moreover, "domestic gas metering" is mentioned on page 1, line 2, and page 8, lines 21 to 26, the "storing" of the signals and the comparison "from time to time" results from page 7, lines 3 to 8, the "difference" (which should clearly not be taken in the

strict mathematical sense, but rather in the sense of a ratio) between the compared signals is mentioned on page 7, line 29.

The disclosure of Claim 2 is based on the original description page 2, line 31 to page 3, line 1.

Thus, the claims according to the auxiliary request meet the requirements of Article 123(2) EPC.

3.2 Taking into consideration the content of the file the Board decides under Article 111(1) EPC to examine novelty and inventive step.

3.3 The document AU-A-66 889/86 (which was indicated in the European search report to be a prepublished family member of EP-A-0 239 703) describes a fluid flow meter comprising a micro-engineered cantilevered beam flow sensor or a hot beam sensor.

However, this document neither mentions a fluidic oscillator flow meter, nor density sensing means, nor calibration of the flow sensing means by comparing its signals with those of the fluidic oscillator flow meter.

Also, none of the further documents discussed below discloses a flow meter comprising two flow sensors of different type and calibration means for calibrating one flow sensor by means of the other flow sensor.

In particular, GB-A-1 554 408 describes a fluidic oscillator flowmeter combined with a pressure transducer for measuring mass flow, GB-A-2 085 597

describes a density sensor combined with a volumetric flow sensor, CH-A-615 506 describes a density sensor combined with a fluidic oscillator flow sensor, and GB-A-2 146 781 describes an adjustable flow bypass for extending the range of flow rates of a flow meter.

Therefore, the subject-matter of Claim 1 is novel in the sense of Article 54 EPC.

- 3.4 AU-A-66 889/86 is considered to represent the closest prior art since it relates to a flow meter comprising a micro-engineered cantilevered beam flow sensor, i.e. the type of sensor on which the present invention bases the intended continuous measurements of fluid flow for the full attainable range of flow rates.

Starting from this prior art, the present invention aims at rendering long term measurements possible (for periods of about 20 years), without undue impairment of the accuracy caused by contamination, changes in fluid composition and drift due to the analogue nature of the device (cf. page 1, lines 14 to 24 of the present description).

Regarding the solution of this problem according to Claim 1, i.e. the idea of combining the microbeam flow sensor with a fluidic oscillator flow meter, density sensing means and calibration means for calibrating from time to time the microbeam flow sensor by means of the data from the other sensors, AU-A-66 889/86 does not contribute any disclosure or suggestion.

Moreover, the idea of combining two flow sensors of different type (one of which is more stable but does

not cover the whole desired range of flow rates) and occasionally calibrating the one by means of the other, is also nowhere mentioned or suggested in any one of the other cited documents.

For these reasons, the subject-matter of Claim 1 is not obvious to a person skilled in the art and, consequently, involves an inventive step in the sense of Article 56 EPC.

- 3.4 Claim 1 according to the auxiliary request is therefore allowable (Article 52(1) EPC).

Claim 2 is allowable by virtue of its dependence on Claim 1.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to grant a patent on the basis of

Claims 1 and 2 according to the auxiliary request and the corresponding adapted description (pages 1, 2 + insert sheet for page 2, 2a, 3 to 12) both filed during the oral proceedings, and
Figures 1 to 7 of the drawings as originally filed.

The Registrar:

The Chairman:

P. Martorana

E. Turrini