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D E C I S I O N
of 17 February 2000

Case Number: T 0881/96 - 3.4.2

Application Number: 89911063.9

Publication Number: 0442898

IPC: G01D 5/24, G01R 27/26

Language of the proceedings: EN

Title of invention:
Method and apparatus for measurement of capacitance and for capacitive measurement of displacement

Patentee:
CARL MAHR HOLDING GMBH

Opponent:
ROSEMOUNT INC.

Headword:
-

Relevant legal provisions:
EPC Art. 100(b), 111(1)

Keyword:
"Main request: sufficiency of disclosure (yes)"
"Remittal for further prosecution of other grounds of opposition (yes)"

Decisions cited:
-

Catchword:

-

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Case Number: T 0881/96 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 17 February 2000

Appellant: (Proprietor of the patent)
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Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted 24 July 1996 revoking European patent No. 0 442 898 pursuant to Article 102(1) EPC.**

Composition of the Board:

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

Summary of Facts and Submissions

I. The appellant is proprietor of the European patent No. 0 442 898 which was granted with 22 claims on the basis of European patent application No. 89 911 063.9.

Claim 1 as granted reads as follows:

"1. A capacitive displacement measurement apparatus comprising primary and secondary electrode systems (18, 20) spaced transversely apart and mutually-opposed, one of said systems (18, 20) being displaceable relative to the other electrode system without changing the transverse spacing of the electrode systems (18, 20), wherein

(a) said primary electrode system (18) comprises a single primary electrode (18) of plate form, and said secondary electrode system (20) comprises two similar secondary electrodes (20) of plate form which (i) are closely spaced apart, and (ii) together span fully or substantially so the whole of the primary electrode (18), thereby on relative displacement of said electrode systems (18, 20) there occurs a progressive reduction in the overlap of the primary electrode (18) first with one of said secondary electrodes (20) and then with the second of said secondary electrodes (20);

(b) clock means (86) for providing a succession of clock pulses defining successive clock periods;

(c) electric charge pumping means (30, 55) arranged when operating in a first mode to supply to the primary electrode (18) via a first one of the secondary

electrodes (20) first predetermined packets of electrical charge during selected first clock periods so as to increase the electric charge on the primary electrode (18), and when operating in a second mode to withdraw from the primary electrode (18) via the second of the secondary electrodes (20) second predetermined packets of electrical charge during selected second clock periods so as to decrease the electric charge on the primary electrode (18);

(d) charge monitoring means (26, 46) for monitoring the level of electric charge present on the primary electrode (18), and for causing the charge pumping means (30, 55) to operate in the first mode whenever at the end of a said second clock period the charge present on the primary electrode (18) has fallen below a predetermined datum level, and to operate in the second mode whenever at the end of a said first clock period the charge present on the primary electrode (18) has risen above the said datum level;

(e) charge summating means (92, 94) for summating during each cycle during which a displacement measurement is made (i) the charge supplied to the primary electrode (18) via the first secondary electrode (20), and (ii) the charge withdrawn from the primary electrode (18) via the second secondary electrode (20), and for providing at the end of each measurement cycle electric signals N2 and N1 representing the respective summations of the charges supplied to and withdrawn from the primary electrode (18); and

(f) signal converting means (106, 44, 96-102) for

converting the signals N1 and N2 into a displacement signal which is directly indicative of the relative displacement of said primary and secondary electrode systems (18, 20)."

The independent claims 9, 15 and 17 concern a method of determining the displacement of an object, a capacitance ratio measurement apparatus for measuring the ratio of the capacitances of two capacitors, and a method of determining the ratio of the capacitances of two capacitors, respectively.

The claims 2 to 8, 10 to 14, 16 and 18 to 22 are dependent claims.

II. The respondent filed an opposition against the grant of the patent on the grounds

(i) that the subject-matter of the patent was not new and/or lacked an inventive step having regard to 4 cited prior art documents (Articles 100(a), 54 and 56 EPC), and

(ii) that the 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 (Article 100(b) EPC).

III. The patent was revoked

The reasons given by the Opposition Division were in substance as follows:

The question of sufficiency revolves around the

functioning of the charge pumping means (30, 55) and monitoring means (26, 46); as defined in claim 1, predetermined charge packets are supplied to the primary electrode via a first secondary electrode until the charge on the primary electrode exceeds a given level; then, predetermined charge packets are withdrawn from the primary electrode via a second secondary electrode until the charge on the primary electrode is below a given level. The charge on the primary electrode is monitored by the monitoring means to achieve that.

However, no means for applying a succession of charge packets is disclosed in the patent.

The principle behind the present invention is described starting from line 3, column 8 of the patent: if a voltage V is applied to the capacitor formed by the first secondary electrode and the primary electrode, it will charge up with a charge Q; if this charge is withdrawn from the capacitor formed by the second secondary electrode and the primary electrode, which are only partially overlapping and thus having a lower capacitance when the secondary electrodes have moved with parallel to the primary electrodes, then a voltage V will cause less than complete charge to be withdrawn; it is therefore necessary to withdraw more than one packet of charge; the ratio of the capacitances, and thus displacement can be calculated from the ratio of the number of charge packets supplied and withdrawn.

With reference to Figure 1, it is clear that the charging and discharging of the capacitors is controlled by the block (55) of the electric charge

pumping means (30, 55) which is described as being a flip-flop; however, the output of a flip-flop can take only two states of 0 and 1 which might correspond for example with 0 V and 5 V; in this case, when charging the first capacitor up, the supplying of the first charge packet would charge said capacitor up to 5 V; the monitoring means would then monitor a charge above the datum, and switch the output of the flip-flop to 0 V. When the first charge packet is withdrawn from the second capacitor, said capacitor would thus discharge to 0 V. However, there is then no way of applying other voltages to enable withdrawal of subsequent charge packets. Thus, this aspect of the invention is insufficiently disclosed.

As pointed out by the opponent, the circuits shown in Figures 1 and 4 function satisfactorily as they stand. It would be perfectly clear to the skilled person that no modification is necessary to them at all. The problem is not that they do not function, but rather that they do not operate in the manner claimed in claim 1 and 15. In any case, it is not apparent that simply dividing the output of the flip-flop into a series of pulses would enable the circuit to function as claimed. As already explained, it is the voltage levels which are critical to the method of functioning, not the number of pulses; however much pulse division is performed, there will be no other voltage levels available for charging or discharging.

Therefore, the patent was to be revoked because already said features were not disclosed sufficiently.

IV. The patent proprietor lodged an appeal against said

decision.

V. The statement of grounds of appeal, filed with letter of 29 November 1996, contained an annex in form of a statutory declaration of Mr A. T. Keefe (hereafter **Keefe (1)**), presented as a person skilled in the relevant art, about the issue of sufficiency.

VI. The respondent filed with letter dated 18 February 1997 an answer to the appeal *inter alia* comprising the remark that the claims of the granted patent as they were interpreted by the appellant (patent proprietor) read directly onto the cited prior art, and, moreover, an auxiliary request for oral proceedings.

VII. With letter dated 20 May 1998, the appellant also requested oral proceedings auxiliarily.

VIII. The appellant's observations dated 4 November 1998 contained further arguments supported by declarations of six technically skilled persons or experts,

Dr **G. C. M. Meijer**,
Mr **A. T. Keefe (2)**,
Mr **R. Banks**,
Mr **J. M. Robinson**,
Mr **A. D. Stevens**,

which were annexed to said observations,

the sixth declaration being that of

Mr **A. N. Dames**,

annexed to appellant's letter dated 23 November 1998.

IX. In preparation for the oral proceedings, the appellant filed with telefax of 17 January 2000 further technical information comprising a plurality of drawings provided by Mr Keefe and showing a modification of Figure 1 of the granted patent in successive steps of the method of operating the apparatus of the patent in suit, with technical explanations. The modified Figure 1 was presented as corresponding to a modification based on column 15, line 52 to column 16, line 3, of the granted patent which was considered by the appellant as the most relevant embodiment. A corresponding drawing showing voltages, charges on different parts of the apparatus during successive periods of the operation of the apparatus, was also filed.

Moreover, the appellant indicated that two experts, Mr Keefe and Mr Strack, would attend at the oral proceedings.

It was requested that, should the Board uphold the proprietor's appeal on the question of sufficiency of description, the case be remitted to the first instance for further prosecution on the basis of the patent as granted (main request) in order not to deprive the proprietor of consideration of the other grounds of appeal by two instances. Furthermore, the appellant filed a set of 4 auxiliary requests referring to various amendments in the description, the Figures and the claims.

X. Oral proceedings took place on 17 February 2000.

XI. The appellant essentially argued with respect to his main request of setting aside the decision under appeal and remitting the case to the first instance that, on the basis of the whole content of the patent in suit and of the common general knowledge, the features of the invention were either directly derivable or could be found without effort by the skilled person, who would interpret the terms of the patent and understand their meaning, even if said meaning was only "figurative" and not "literal" and needed adaptation of the necessary means. This was shown by the provided plurality of statutory declarations of skilled persons and illustrated technical explanations annexed thereto.

Therefore, the invention was sufficiently disclosed.

XII. The respondent (opponent) has, with respect to his request that the appeal be dismissed and the European patent be revoked accordingly, used the same reasoning as in the decision under appeal, i.e. that the invention defined by the claims could not be carried out by a skilled person because the information therein was insufficient and because the embodiments in the description and drawings did not work in the same way as defined in the claims.

Moreover, he has pointed out deficiencies in the disclosure derivable from the patent specification concerning particular features or means of the illustrated circuits, whereby the skilled person would have had difficulties in determining from his general knowledge and from the state of the art which means are to be implemented for the invention to be carried out.

Therefore, the disclosure was insufficient.

Reasons for the Decision

1. The appeal is admissible.

2. *Main request*

2.1 Sufficiency of disclosure

2.1.1 A capacitive displacement measurement apparatus is defined in **claim 1 in dispute**.
(see item I here above).

2.1.2 The **principle** behind the present invention is described in the description of the patent in suit and has been correctly analysed in the decision under appeal (cf. item III above).

2.1.3 **Embodiments** of the invention are disclosed in the patent in suit.

The patent in suit contains in particular information about a first circuit for operating the apparatus, illustrated by Figure 1, whereby modifications of said circuit are also mentioned in the description, some of them being illustrated by Figure 3 and Figure 4, others, for instance the one of column 15, line 52 to column 16, line 3 which was indicated by the appellant in his last telefax, corresponding to no Figure of the patent as granted.

An important part of the circuit illustrated in these Figures concern the feature (c) of claim 1, i.e. the electric charge pumping means (30, 55) (cf. item I here above).

In the description of the patent in suit (see in particular column 9, lines 55 to 58; column 10, lines 25 to 32; column 12, lines 41 to 45; column 13, lines 36 to 48, more in particular lines 42 to 48; see also column 15, line 52 to column 13, line 3), part (55) is mentioned as being a "delayed flip-flop" which, in accordance with the sign of the potential appearing at its input at the end of a clock period, said sign depending from a comparator (54) in the charge producing circuit (30), will determine the output of said delayed flip-flop (55) in the next clock period and hence the particular secondary electrode (20) (left or right) of the selected pair of electrodes (18, 20) that will be energised in that next clock period.

As in particular shown in Figure 1, the output of the delayed flip-flop (55) is delivered to the primary electrode, to left-right changeover means (46) of the selector means (40) acting on the electrode switching means (28) controlling the individual switches (32, 34,...) for connecting each of the secondary electrodes (20), and, via the counters (92, 94) and the control logic circuit (106), to the up-down counter (44) controlling the selector means.

The individual switches (32, 34, ...) for connecting each of the secondary electrodes (20) are connected, for energising said second electrodes, to a sensor energising terminal (58) connected to an input of the

operational amplifier (48) at the input of the charge pumping/producing means (30) (see also column 12, lines 1 to 16).

The circuit further provides a charge accumulating capacitor (66) wherein charge is accumulated in accordance with the charge on the in-use secondary electrode (20) (see column 12, lines 17 to 32) and can be withdrawn under the control of a switch control means (90) connected to receive clock pulses from the clock-pulse generator (86) used for the whole circuit of the apparatus (see column 10, lines 42 to 56).

The charge producing means (30) also comprises a charge modulator comprising switches (70, 72, 74, 76) controlled by said switch control means (90) (see column 10, lines 42 to 56 and column 12, lines 33 to 40), and the above-mentioned comparator (54) which determines the charge so far gathered compared to a virtual zero and which energises the delayed flip-flop (55) accordingly so that said flip-flop (55) supplies as its output and thus at the output of the charge producing means (30) a voltage of one or the other polarity.

In the particular **modification** disclosed in column 15, line 52 to column 16, line 3 of the description and which has been taken into account by the appellant to draw a modified Figure 1 for explaining in his last telefax the operation of the apparatus, the output of the delayed flip-flop (55) and thus of the charge producing means (30) is only connected to the means controlling and energising the secondary electrodes (20), while the primary electrode is connected to the

sensor energising terminal (58) connected to the input of the charge pumping/producing means (30).

2.1.4 As set forth here above (cf. item I), the independent claims 9, 15 and 17 concern a method of determining the displacement of an object, a capacitance ratio measurement apparatus for measuring the ratio of the capacitances of two capacitors, and a method of determining the ratio of the capacitances of two capacitors, respectively, the claims 2 to 8, 10 to 14, 16 and 18 to 22 being dependent claims relating to particular embodiments.

These further claims define different aspects and/or particular embodiments of the same invention as claim 1 in dispute, and since this has not been disputed, it is not necessary to analyse in detail the technical teaching of these further claims.

2.2 The objections raised against the patent in suit are that a plurality of aspects or features of the invention in dispute as defined in particular in claim 1 are not sufficiently disclosed.

According to the decision under appeal (cf. item III here above), although the circuits shown in Figures 1 and 4 are considered as functioning satisfactorily as they stand and although it would be perfectly clear to the skilled person that no modification is necessary to them at all, said circuits do not operate in the manner claimed in claim 1.

Moreover, according again to the decision under appeal, particular means such as the "delayed flip-flop (55)"

are not sufficiently described in the patent in suit and additional means which they need in view of the function they are given in the apparatus in dispute are not sufficiently described either.

2.3 In this respect, the appellant has argued inter alia that features of the invention or of the embodiments in the description, for instance "an alternating potential reaching the primary electrode", are evident, or for instance "other clock circuit connections", are implied which are not explicitly disclosed; that expressions or terms of the patent in suit which have been objected to in particular in the decision under appeal are to be understood "figuratively" and not "literally"; that the examples of the description should be interpreted as being examples of the invention or coextensive thereto.

Moreover, as stated for instance in the declaration by Mr A. N. Dames (see paragraph 26) with respect to feature (d), electric charge as such cannot be monitored directly, but only indirectly, for instance by measuring potential; similar conclusions can be derived from the declaration by Mr A. T. Keefe(2) (see paragraphs 24 to 26).

2.4 The Board is of the opinion that, with respect to the issue of sufficiency as it stands in view of the above-mentioned objections, on the one hand, and of the available technical information in the patent in suit together with the appellant's arguments and submitted supplementary technical information in form of a plurality of statutory declarations and illustrated technical explanations, on the other hand, the

following two questions are relevant (see paragraphs 2.4.1 and 2.4.2, below).

2.4.1 As pointed out by the Board during the oral proceedings, there may be **inconsistencies** between the claims, on the one hand, and the description and drawings on the other hand, which may result in an incorrect or defective definition of the matter for which protection is sought, i.e. in a lack of clarity in the sense of Article 84 EPC.

However, since lack of clarity of the claims is not one of the grounds of the limitative enumeration of grounds on which pursuant to Article 100 EPC an opposition can be based, and since the appellant's main request is based on the patent as granted without modification, an objection referring to such a deficiency cannot be used for opposing the patent.

In any case, lack of clarity of the claims does not result automatically in the invention not being disclosed in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art since sufficiency of disclosure must be assessed on the basis of the patent as a whole (see e.g. T 14/83, OJ EPO 1984, 105).

2.4.2 Thus, insofar as it has been admitted in the argumentation of the respondent (opponent) and in the decision under appeal that examples or circuits in the description work very well as they are, the deficiency being that they do not work according to the invention defined in the claim, it is to be considered whether the invention as defined by the claim can be carried

out.

As mentioned above, the appellant has admitted that there could be difficulties when taking expressions or indications in the patent in suit "**literally**", and that **some effort of interpretation** of the technical information therein is necessary.

The important point in this respect is whether at the priority date of the patent in suit said effort, comprising in particular determining the components necessary for completing the circuit and/or substituting particular parts thereof according to the invention as claimed was to be considered as necessitating a non obvious contribution by the skilled person, i.e. as constituting **undue burden** for him.

The respondent, asked by the Board during the oral proceedings about the difficulty which in his opinion the skilled person would have for determining the means to be used for the invention as claimed in the patent in suit, declared that he was not directly aware of the specific electronic parts necessary for the circuits as claimed, and that the skilled person would certainly have at least considerable difficulty in determining them.

However, this opinion of the respondent was not supported by any evidence and is also not convincing for the following reason:

The patent in suit has also been opposed as lacking novelty and/or inventive step having regard to cited prior art documents. In the respondent's answer dated

18 February 1997 (cf. item VI above), it was noted that the claims of the granted patent as they were interpreted by the appellant (patent proprietor) read directly onto the cited prior art. This has indeed to be interpreted as meaning that, taking into account the prior art and/or the general knowledge in the relevant technical field, the apparatus of claim 1 in suit with the means it comprises is either known or can be considered as being obvious to the skilled person.

Thus, the opponent has not established to the satisfaction of the Board that the deficiencies in the patent in suit as they have been objected to are such that at the priority date the skilled person could not correct and complete them on the basis of the original disclosure and his technical knowledge, or could do it only with undue burden.

2.5 Consequently, the patent in suit discloses the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art (Article 100(b) EPC).

3. Therefore, it is not necessary to take into consideration the appellant's auxiliary requests.

4. The appellant has requested that the case be remitted to the opposition division to examine the relevance of the further opposition grounds, i.e. those of Articles 54, 56 and 100(a) EPC, for which there is no decision, until now.

Since both the appellant and the respondent should not be deprived of consideration of these issues by two

instances, this request is justified and the case is remitted to the department of first instance (Article 111(1) EPC).

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 for further prosecution on the basis of the patent as granted (main request).

The Registrar: The Chairman:

P. Martorana E. Turrini