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D E C I S I O N
of 11 March 1997

Case Number: T 0883/95 - 3.4.2

Application Number: 89312263.0

Publication Number: 0372773

IPC: G01L 9/00, G01L 9/12, G01L 9/14

Language of the proceedings: EN

Title of invention:
Pressure sensor with flexible printed circuit

Patentee:
TEXAS INSTRUMENTS INCORPORATED

Opponent:
Endress + Hause GmbH + Co.

Headword:
-

Relevant legal provisions:
EPC Art. 123(3), 123 (2), 82, 84, 54, 56, 112(1)(a)

Keyword:
Main request:
"Protection extended - (no)"
"Subject-matter extended - (no)"
"Unity of invention - (not required)"
"Clarity - (yes)"
"Novelty - (yes)"
"Inventive step - (yes)"
"Referral to the Enlarged Board of Appeal - (no)"

Decisions cited:
G 0001/91, OJ 1992, 253

Catchword:
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Summary of Facts and Submissions

- I. The respondent is proprietor of European patent No. 0 372 773 which was granted on the basis of European patent application No. 89 312 263.0 citing D5 = US-A-4716492 as starting point for the invention.
- II. An opposition was filed by the appellant (opponent) on the grounds that the subject-matter of the patent lacked an inventive step having regard to D5 and, i.a., D7 = US-A-4227788.
- III. The opposition was rejected.
- IV. The appellant (opponent) lodged an appeal against this decision.
- V. During the oral proceedings of 11 March 1997 which had been requested auxiliarily by the respondent, a new, amended set of claims 1 to 12 was filed, the only two independent claims thereof reading as follows:

"1. A pressure sensor comprising a disc shaped capacitive pressure transducer (12) having a surface (12.1) to be exposed to an applied pressure to provide a capacitance which varies with the applied pressure and having transducer terminals (24, 26, 34) disposed at an opposite surface, a cup-shaped connector body (36) of electrical insulating material having a bottom, side walls and a rim, and having the connector terminals extending through the body, the connector body being disposed with the rim thereof facing said opposite transducer surface (read "surface,") a housing (46) securing the connector body to the transducer in overlying relation to said opposite transducer surface for forming a chamber (38) therebetween, and an electrical circuit disposed in the chamber electrically

connected to the transducer and connector terminals for providing an electrical signal corresponding to the applied pressure, the electrical circuit including a flexible substrate (52) having one end portion (52.1) disposed in overlying relation to said opposite transducer surface mounting electrical circuit components electrically connected to the transducer terminals and having an opposite end portion (52.2) folded over said one end portion and mounting circuit paths thereon electrically connected to the connector terminals; wherein the electrical circuit is arranged to be calibrated relative to the capacitive pressure transducer after mounting on the housing, the connector body has an integral tubular portion thereof opening at one end outside the sensor and extending into the chamber to dispose its opposite end in closely spaced relation to the electrical circuit for permitting access to a calibration portion of the electrical circuit for calibration thereof and an encapsulant fills the tubular portion of the connector body for sealing the chamber, the tubular portion of the housing restricting said encapsulant to the calibration portion of the electrical circuit."

"7. A pressure sensor comprising a disc shaped capacitive pressure transducer (12) having a surface (12.1) to be exposed to an applied pressure to provide a capacitance which varies with the applied pressure and having transducer terminals (24, 26, 34) disposed at an opposite surface, a cup-shaped connector body (36) of electrical insulating material having a bottom, side walls and a rim, and having the connector terminals extending through the body, the connector body being disposed with the rim thereof facing said opposite transducer surface (read "surface,") a metal housing (46) securing the connector body to the transducer in overlying relation to said opposite transducer surface for forming a chamber (38)

therebetween, and an electrical circuit disposed in the chamber electrically connected to the transducer and connector terminals for providing an electrical signal corresponding to the applied pressure, the electrical circuit including a flexible substrate (52) having one end portion (52.1) disposed in overlying relation to said opposite transducer surface mounting electrical circuit components electrically connected to the transducer terminals and having an opposite end portion (52.2) folded over said one end portion and mounting circuit paths thereon electrically connected to the connector terminals; wherein the electrical circuit has circuit paths forming electrical ground connections for the electrical circuit, the flexible substrate has a tab extending therefrom and has a circuit pad formed on the tab, a capacitor is mounted on the flexible circuit substrate electrically connected between a ground connection circuit path of the electrical circuit and said circuit pad, and the tab extends from the chamber between the connector body and the transducer to electrically connect the circuit pad to the metal housing to capacitively couple the ground connection circuit path to the metal housing for providing the sensor with electromagnetic compatibility."

VI. The respondent requested that the patent be maintained on the basis of, in particular, a main request consisting of the claims 1 to 12 filed during the oral proceedings of 11 March 1997, the description to be adapted and the sheets of drawings 1/4 to 4/4 (Figure 1 to 7) as granted. The respondent argued as follows in support of its main request:

Each of the two independent claims of the main request consists of a combination of features of granted claims which had a dependency relation, and there is a basis in the original patent application and the granted patent for the chosen wording, so that there is no

extended protection or subject-matter resulting from these amendments. Although there might be defined, with respect to claims 1 and 7 of the main request, a group of inventions which are not so linked as to form a single general inventive concept, this however is irrelevant in the present case since, following the decision of the Enlarged Board of appeal G 1/91, OJ 1992, 253, unity of invention does not come under the requirements that a European patent and the invention to which it relates must meet under Article 102(3) EPC when the patent is maintained in amended form.

Starting from the pressure sensor of D5, the person skilled in the art would not consider the solution of flexible electrical circuits of for instance D7 for replacing the set of lead wires, because D7 relates to cameras and the like, and not to pressure sensors. Moreover, the advantageous properties of the flexible circuits used in D7 are different from those utilised in the patent in suit. In any case, the further features of claims 1 and 7 of the main request are not directly derivable from D7. The flexibility of the electrical circuits, together with the further features for calibrating and sealing, on the one hand (for claim 1) and for forming electrical ground connections for the electrical circuit, on the other hand (for claim 7) solve at least the problems mentioned in the patent in suit, i.e. that it is somewhat difficult to assemble the sensor in an economical manner and to properly calibrate the sensor and seal it after calibration, and to assure that the sensor is compatible with use in automotive environments and the like where there is substantial electromagnetic interference. Therefore, the subject-matter of claims 1 and 7 of the main request involves an inventive step.

VII. The appellant requested that the decision under appeal be set aside and the patent be revoked. Moreover, the appellant requested auxiliarily that the following question be referred to the Enlarged Board of appeal: "Is it possible during opposition or appeal after opposition, if the only main claim as granted no longer stands, to present a request with a plurality of independent claims?"

The appellant submitted the following arguments in support of both requests:

Claim 1 of the main request consists of a combination of features of granted claim 1 and granted claim 2, which was dependent from claim 1, and of most of the features of granted claim 8, which was dependent from claim 2. However, the feature of granted claim 8 that it is "after said calibrating" that an encapsulant fills the tubular portion of the connector body for sealing the chamber, has been deleted from the part of granted claim 8 introduced for drafting claim 1 of the main request. The deletion of these words can result in an extension of the scope or of the subject-matter of the patent. The same objection arises with respect to new claim 12, dependent from claim 7, for the same reason.

Starting from the pressure sensor of D5, the person skilled in the art knowing the technique in neighbouring technical fields and taking into account the directly apparent advantages of flexible electrical circuits of for instance D7, would use in an obvious way such flexible circuits in the device of D5 in place of the set of lead wires therein, because both documents are related to the problem of electrical interconnections in restricted spaces. Indeed, the further features of claim 1 of the main request are all known in isolation, even if not shown in the documents

in the file, and the person skilled in the art could, if necessary, take them into account for solving in an obvious way some of the generally known problems listed in the patent in suit, such as the difficulty to assemble the sensor in an economical manner, to properly calibrate the sensor and seal it after calibration, and to assure that the sensor is compatible with use in automotive environments and the like where there is substantial electromagnetic interference. Therefore, the claims of the main request lack an inventive step.

Regarding the fact that the only independent (device) claim of the granted patent should be replaced by two new independent device claims, there can be a problem of legal certainty for the competitors of a patentee, which could be faced, after opposition or appeal following an opposition, to a plurality of new independent claims possibly leading in different directions and covering matter which apparently was not important at the time the patent was granted with only one independent claim. Therefore, it is requested auxiliarily to refer the above mentioned question to the Enlarged Board of Appeal.

Reasons for the Decision

1. The appeal is admissible.
2. *Allowability of the amendments*

Claim 7 of the main request consists in substance of a combination of the features of granted claim 1 and granted claim 2, which was dependent from claim 1, and

of the features of granted claim 5, which was dependent from claim 2, and there has been no objection concerning these amendments.

Claim 1 of the main request consists in substance of a combination of the features of granted claim 1 and granted claim 2, which was dependent from claim 1, and of most of the features of granted claim 8, which was dependent from claim 2. The feature of granted claim 8 that the electrical circuit is calibrated relative to the capacitive transducer after mounting on the housing, has been replaced, for providing only device features in the claim which is a device claim, by the feature that the electrical circuit is arranged to be calibrated relative to the capacitive transducer after mounting on the housing, and there has been no objection against this amendment. The further feature of granted claim 8, that it is "after said calibrating" that an encapsulant fills the tubular portion of the connector body for sealing the chamber, has been deleted from the part of granted claim 8 introduced for drafting claim 1 in dispute. The appellant has objected to the deletion of these words, which in his view can introduce an extension of the subject-matter of the patent. However, the respondent has pointed out the passage of the description as granted (see column 3, lines 18 to 31), which does not differ from the corresponding passage of the original description (see page 4, last paragraph to page 5, first paragraph), where it is stated that the electrical circuit is adapted to be calibrated after mounting on the housing, the connector body having an integral tubular portion open at one end outside the housing and extending into the chamber to dispose its opposite end adjacent a calibrating portion of the electrical circuit on the flexible substrate for permitting access to that calibrating portion of the circuit for calibrating the sensor, and that an encapsulant is introduced into the

tubular portion of the connector body for sealing the chamber, the tubular body restricting the encapsulant to the tubular body of the circuit for assuring proper operation of other portions of the circuit. As convincingly argued by the respondent, this is in substance the same as the text of claim 1 of the main request.

The same objection of the appellant, concerning new claim 12, dependent from claim 7, is not convincing for the same reasons. The further amendments in the claims are, as convincingly argued by the respondent, for adapting the text of the dependent claims to the new independent claims. Therefore, the claims of the European patent have not been amended in such a way as to extend the protection conferred and the European patent has not been amended in such a way that it contains subject-matter which extends beyond the content of the application as filed (Article 123(3) and (2) EPC).

3. *Unity of invention*

The Board agrees with the respondent that, although there might be defined, with respect to claims 1 and 7 of the main request, a group of inventions which are not so linked as to form a single general inventive concept, this is however irrelevant in the present case. Following the above-mentioned decision of the Enlarged Board of appeal G 1/91 (see the Headnote), unity of invention (Article 82 EPC) does not come under the requirements that a European patent and the invention to which it relates must meet under Article 102(3) EPC when the patent is maintained in amended form.

4. *Clarity*

The Board is satisfied that, since in particular terms relating to a process have been amended using the expression "arranged to be calibrated ... after" or have been deleted for arriving at the claims of the main request, which are device claims, these claims are clear within the meaning of Article 84 EPC.

5. *Novelty*

It has not been contested that the closest prior art is represented by the pressure sensor known from D5. It has also been admitted that, contrary to the devices of claims 1 and 7 in dispute, in particular the electrical circuit of D5, which is also disposed in a chamber of a pressure sensor and is electrically connected to a transducer and connector terminals for providing an electrical signal corresponding to the applied pressure, however does not include a flexible substrate. Thus, the subject-matter of any of the main claims 1 and 7 of the main request is novel in the sense of Article 54 EPC.

6. *Inventive step*

6.1 A pressure sensor is known from D5 (see column 1, line 5 to column 3, line 6; column 3, line 37 to column 6, line 17; Figures 1 and 2); said sensor comprises a disc shaped capacitive pressure transducer (12) having a surface (42) to be exposed to an applied pressure to provide a capacitance which varies with the applied pressure and having transducer terminals, i.e. the conductive parts (48, 50) disposed at an opposite surface and connected to the plates (32, 38) of the capacitance via the conductors (52, 54), a cup-shaped connector body of electrical insulating material having a bottom, side walls and a rim; the connector terminals

(22) of the connector body extend through the body, the connector body (18) being disposed with the rim thereof facing said opposite transducer surface; the pressure sensor comprises also a housing (20) securing the connector body (18) to the transducer (12) in overlying relation to said opposite transducer surface for forming a chamber (24) therebetween.

The known pressure sensor further comprises an electrical circuit disposed in the chamber (24), said electrical circuit comprising in particular an electronic means such as an integrated circuit unit (44), and other discrete components such as a capacitor (46) and a variable resistor (47); these components are electrically connected to the transducer and connector terminals for providing an electrical signal corresponding to the applied pressure. The electrical circuit includes a first circuit conductor means comprising circuit path means (48, 50) for electrical connection disposed in overlying relation to said opposite transducer surface mounting electrical circuit components electrically connected to the transducer terminals; the electrical circuit is also electrically connected to the connector terminals (22) by a second circuit conductor means (56).

- 6.2 However, contrary to the pressure sensor of claim 1 of the main request, in the known sensor, the first circuit conductor means (48, 50) does not include a flexible substrate; moreover, the second circuit path means is not another end of the first circuit conductor means (48, 50) folded over said first circuit conductor means and mounting circuit paths thereon, but is a set of lead wires (56) connected to the circuit.

Additionally, contrary to the pressure sensor of claim 1 of the main request, the electrical circuit of the known sensor is not arranged to be calibrated relative to the capacitive pressure transducer after mounting on the housing, the connector body has not an integral tubular portion thereof opening at one end outside the sensor and extending into the chamber to dispose its opposite end in closely spaced relation to the electrical circuit for permitting access to a calibration portion of the electrical circuit for calibration thereof, and an encapsulant does not fill any tubular portion of the connector body for sealing the chamber so that the tubular portion of the housing restrict said encapsulant to the calibration portion of the electrical circuit.

6.3 According to the patent in suit (see column 1, line 40 to column 2, line 3), it is somewhat difficult to assemble the sensor known from D5 in an economical manner, to properly calibrate the sensor and seal it after calibration, and to assure that the sensor is compatible with use in automotive environments and the like where there is substantial electromagnetic interference.

6.4 Indeed, the "flexible" properties of a substrate of an electrical circuit of a device are used for instance in D7 (see column 1, line 54 to column 2, line 5; column 2, lines 25 to 39) wherein connecting lead wires in very restricted spaces are replaced by such a flexible circuit which can be bent in various shapes in accordance with the particular geometry of the device to receive the required interconnections. The appellant has argued that the person skilled in the field of D5

would know the technique in neighbouring technical fields and, taking into account the directly apparent advantages of flexible electrical circuits of for instance D7, would use in an obvious way such flexible circuits in the device of D5 because both documents are related to the problem of electrical interconnections in restricted spaces.

However, in addition to this feature of the flexible substrate, there are further features distinguishing the pressure sensor of claim 1 of the main request from the sensor known from D5, in particular the feature that in the pressure sensor in dispute the electrical circuit is arranged to be calibrated relative to the capacitive pressure transducer after mounting on the housing, the connector body having an integral tubular portion thereof opening at one end outside the sensor and extending into the chamber to dispose its opposite end in closely spaced relation to the electrical circuit for permitting access to a calibration portion of the electrical circuit for calibration thereof and an encapsulant filling said tubular portion of the connector body for sealing the chamber, the tubular portion of the housing restricting said encapsulant to the calibration portion of the electrical circuit.

6.5 Thus, it is credible that, as argued by the respondent, the combination of features of the pressure sensor of claim 1 in dispute solves at least two of the problems mentioned in the patent in suit, i.e. that it was somewhat difficult to assemble the sensor in an economical manner and to properly calibrate the sensor and seal it after calibration. Therefore, since this particular combination of features of claim 1 in dispute is not obvious to the person skilled in the art of D5 having regard to the state of the art, it involves an inventive step in the sense of Article 56 EPC.

6.6 As also mentioned here above with respect to claim 1, contrary to the pressure sensor of claim 7 of the main request, in the known sensor, the first circuit conductor means (48, 50) does not include a flexible substrate; moreover, the second circuit path means is not another end of the first circuit conductor means (48, 50) folded over said first circuit conductor means and mounting circuit paths thereon, but is a set of lead wires (56) connected to the circuit.

Additionally, contrary to the pressure sensor of claim 7 of the main request, the known sensor does not show the features that the electrical circuit has circuit paths forming electrical ground connections for the electrical circuit, the flexible substrate has a tab extending therefrom and has a circuit pad formed on the tab, a capacitor is mounted on the flexible circuit substrate electrically connected between a ground connection circuit path of the electrical circuit and said circuit pad, and the tab extends from the chamber between the connector body and the transducer to electrically connect the circuit pad to the metal housing to capacitively couple the ground connection circuit path to the metal housing for providing the sensor with electromagnetic compatibility.

Thus, it is credible that, as argued by the respondent, the combination of features of the pressure sensor of claim 7 of the main request solves at least two aspects of the problem mentioned in the patent in suit, i.e. that it is somewhat difficult to assemble the sensor in an economical manner and that it is difficult to assure that the sensor is compatible with use in automotive

environments and the like where there is substantial electromagnetic interference. Therefore, since this particular combination of features of claim 7 of the main request is not obvious to the person skilled in the art of D5 having regard to the state of the art, it also involves an inventive step in the sense of Article 56 EPC.

6.7 Thus, the patent may be maintained on the basis of the claims of respondent's main request (Article 56, 52(1) and 102(3) EPC).

7. Therefore, it is not necessary to take into consideration respondent's auxiliary request.

8. Appellant's request for referral of a question to the Enlarged Board of appeal

8.1 As mentioned here above, the appellant requested auxiliarily that the following question be referred to the Enlarged Board of appeal: "Is it possible during opposition or appeal after opposition, if the only main claim as granted no longer stands, to present a request with a plurality of independent claims?"

The appellant has argued in this respect on the basis of the legal certainty for the competitors of the patentee, which could be faced, after opposition or appeal following an opposition, to a plurality of independent claims possibly leading in different directions and covering matter which apparently was not important at the time the patent was granted with only one independent claim.

8.2 According to Article 112(1)(a) EPC, first sentence, in order to ensure uniform application of the law, or if an important point of law arises, the Board of appeal shall, during proceedings on a case and either of its own motion or following a request from a party to the appeal, refer any question to the Enlarged Board of Appeal if it considers that a decision is required for the above purposes.

However, it is to be noted that the requirements concerning the effect of amendments resulting in the patent in suit have been treated with respect to Article 123(3) and (2) EPC. Moreover, to the knowledge of the Board, there is no provision in the EPC forbidding, during opposition or appeal following an opposition, the introduction of a plurality of independent claims in place of only one independent claim in the granted patent. An important point of law in this respect is thus not apparent. Moreover, the appellant has not cited any decision showing that there could be any non uniform application of the law with respect to the issue referred to above. Therefore, in accordance with the text of Article 112(1)(a), first sentence, mentioned here above, the appellant's request is rejected.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the Opposition Division with the order to maintain the patent in amended form on the basis of the following documents:

the claims 1 to 12 filed during the oral proceedings of 11 March 1997,

the description to be adapted, and

the sheets of drawings 1/4 to 4/4 (Figure 1 to 7) as granted.

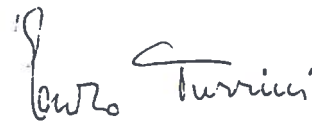
3. The appellant's auxiliary request to refer a question to the Enlarged Board of Appeal is rejected.

The Registrar:



P. Martorana

The Chairman:



E. Turrini

MCA
B.Sch.