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D E C I S I O N
of 16 December 1996

Case Number: T 0708/95 3.4.2

Application Number: 88830166.0

Publication Number: 0338180

IPC: G01L 1/18, G01L 9/06, G01B 7/18

Language of the proceedings: EN

Title of invention:
An electrical force and/or deformation sensor, particularly for use as a pressure sensor

Patentee:
MAGNETI MARELLI S.p.A.

Opponent:
VDO Adolf Schindling AG
Endress + Hauser GmbH + Co.

Headword:
-

Relevant legal provisions:
EPC Art. 106 to 108, 114(2), 54 and 56 EPC
EPC R. 64 and 65

Keyword:
"Fresh case - inadmissible (no)"
"Documents not submitted in due time - disregarded (no)"
"Main request - novelty (yes)"
"Inventive step - (yes)"

Decisions cited:
T 0611/90

Catchword:
-

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Case Number: T 0708/95 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 16 December 1996

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Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted 13 July 1995 rejecting the opposition filed against European patent No. 0 338 180 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. European patent No. 0 338 180, which was granted on the basis of European patent application No. 88 830 166.0 filed on 21 April 1988 and which is now the respondent's (proprietor's) main request, has a set of 7 claims, the only independent claim reading as follows:

"1. An electrical force and/or deformation sensor, particularly for use as a pressure sensor, comprising a support structure (1) including an element (2a) which is resiliently deformable by a force or pressure to be measured and on which at least one piezoresistive sensitive element (R) is deposited, the structure also carrying electrical conductor eans (C) connected to the at least one sensitive element (R) and adapted to enable its connection to supply and processing circuit means (3);

the support structure including a rigid plate (1) in one face (1a) of which is formed a recess (2) whose bottom wall (2a) is thin and is resiliently deformable under the action of a force or pressure to be measured, the at least one sensitive element (R) being provided on the other face (1b) of the plate (1) in correspondence with the bottom wall (2a) of the recess (2), the conductor means (C) also being provided on the other face (1b) of the plate (1);

characterised in that said rigid plate (1) is made of a ceramic material and in that said at least one piezoresistive sensitive element (R) is a thick-film resistor deposited by silk-screen printing on said plate (1) and the conductor means (C) comprise conductive strips also deposited by silk-screen printing on said other face (1b) of the plate (1)."

II. Two oppositions were filed against the granted patent on the grounds that its subject-matter lacked novelty having regard to C15 = EP-A-0333091 or an inventive step having regard to, inter alia, C4 = DE-A-3604418.

III. The oppositions were rejected.

The Opposition Division in particular took the view that no prior art document contained a sensor with all the features of the opposed claim 1 and that, taking into account some of the cited documents, there could be seen no logical chain of arguments why a person skilled in the art of semiconductor sensors would drop the semiconductor manufacturing technology and switch to the ceramics manufacturing technology which uses different techniques.

IV. The appellant (opponent 1) lodged an appeal against this decision. The argumentation in the statement of grounds of appeal was based on 3 new documents: C16 = Handbuch für Ingenieure, 2.Ausgabe, Sensoren, Meßaufnehmer; Expert Verlag, 1988; C17 = US-A-4 311 980; and C18 = Society of Automotive Engineers Inc. "Low Cost Thick-Film Pressure Sensor", Cattaneo, Dell'Acqua, Forlani, Pirozzi, 1980.

V. In the communication annexed to the summons to oral proceedings requested auxiliarily by i.a. the appellant, the Board of appeal expressed the following opinion: although as argued by the respondent the appeal was based on new documents and thus constituted a fresh case, it could however be admissible on the basis of the decision T 0611/90, OJ EPO, 1993, 050; however, it appeared that the subject-matter in dispute was new and involved an

inventive step having regard to these newly cited documents, whereby it seemed that the exact date at which C16 had been published could not be established.

VI. By letter dated 3 December 1996, the second opponent declared that it would not attend the oral proceedings.

VII. During the oral proceedings of 16 December 1996, the respondent filed a new text of claim 1 as an auxiliary request and requested that the appeal be rejected as inadmissible or dismissed as unallowable, and that the patent be maintained either in the granted form or in amended form according to the auxiliary request. The respondent submitted the following arguments in support of its requests.

The grounds of appeal do not substantiate the reasons why the decision rendered by the Opposition Division should be set aside, but only cites three new documents, C16, C17 and C18, thereby constituting a fresh case. Therefore, the appeal should be rejected as inadmissible.

An indication such as "expert-Verl. 1988" in C16 does not exclude a date of publication after the 21 April 1988, and a foreword of the editor with the date April 1988 does not exclude a publication date after April 1988. Thus, C16 is not a prior art document. C17 does not show a structure with only one recess and made of a ceramic material, i.e. "monolithic", as derivable from the indications in claim 1 and in the whole patent in suit. The same last objection applies to the sensor of C18, which comprises two parts of a ceramic material glued together by sealing glass. Moreover, the sensor in dispute is further distinguished from the sensor of

C18, the conductor means of which comprise conductive strips deposited on said other face of the plate by a thick-film technique, but which can be deposited by other methods than the claimed silk-screen printing, as can be seen from C15. The sensor of C4 is not relevant for a combination with C18 because, in particular, the sensing elements are embedded in the "monolithic" structure, and not on its surface. Transposing the monolithic technique of semiconductor sensors shown in other prior art documents into the structure of C18 is not obvious because of the largely different technologies used. Moreover, the long time period between the publication of C18 and the patent in suit shows that it was only apparently that a simplification such as substituting one single piece for the two glued pieces of C18 could be considered as being straightforward. Therefore, the subject-matter of claim 1 of the main request involves an inventive step.

IX. The appellant submitted the following arguments in support of its request that the decision under appeal be set aside and the patent be revoked:

Because of the surprising findings of the Opposition Division relating to the non obvious combination of documents relating to semiconductor force sensors and to ceramic force sensors, new documents concerning ceramic sensors, such as C16 to C18, were necessary. Therefore, the appeal is admissible.

Although C16 may have been published shortly after the filing date of the patent in suit, it is a handbook and represents permanent general knowledge of the person skilled in the art already for some time before its publication, and it should be accepted as such. The structure of the sensor in dispute is distinguished from the ceramic sensor of

C18 mainly in that the former is in one piece, and not in two pieces of ceramic material glued together, as in C18. This main distinguishing feature, i.e. the "monolithic" structure of the sensor in dispute, is not directly derivable from the text of the claim. Monolithic structures of sensor substrates are in any case known from other force sensors using other materials, for instance C4, which shows a structure of the sensor substrate in one piece with a recess therein, or the sensors made of semiconductor material and comprising said same features of the recess in a support body in a single piece of semiconductor material carrying the sensing elements and the interconnections. There is in particular no such person skilled only in the art of ceramic sensors or skilled only in the art of semiconductor sensors; indeed, as derivable for instance from C18 and C17, which also shows a ceramic sensor with recesses, both documents comprising indications about semiconductor sensors, the person skilled in the art of sensors in charge of developing ceramic sensors is aware of the technique of semiconductor sensors and can transpose developments of said technique in an obvious way to the ceramic sensors. Therefore, the subject-matter of claim 1 in dispute does not involve an inventive step.

Reasons for the Decision

1. *Admissibility of the appeal*

1.1 In the notice of appeal dated 9 August 1995, it is mentioned that an appeal is lodged against the decision of 21 June/13 July 1995 and that it is requested that said decision be set aside and that the patent be revoked.

In the statement of grounds of appeal dated 9 November 1995, it is mentioned that, with respect to the reasons of the appeal of 9 August 1995, three documents, C16, C17 and C18, which have been found, are to be added to the state of the art and that, having regard to these documents, the subject-matter of claim 1 in dispute lacks novelty or an inventive step.

1.2 Indeed, the statement of grounds of appeal does not criticize the decision rendered by the Opposition Division but rather cites new documents. The respondent has requested that the appeal be rejected as inadmissible because the grounds of appeal do not substantiate the reasons why the decision rendered by the Opposition Division should be set aside. This argument of the respondent cannot convince for the following reasons:

The appellant's argument can be accepted that, because of the findings of the Opposition Division relating to the non obvious combination of documents relating to semiconductor sensors and to ceramic sensors, new documents concerning said ceramic sensors were necessary. In any case, the respondent's observations contain no reference to any basis in the European Patent Convention or in the jurisprudence of the Boards of appeal for justifying such a rejection. Therefore, since the notice of appeal contains a statement indicating that cancellation of the decision of the Opposition Division is requested and the statement of grounds of appeal is at least based on the same opposition ground (see the decision T 0611/90, OJ EPO, 1993, 050, in particular the points 2 to 5 of the reasons), the requirements of Rule 64(b) and Article 106 to 108 EPC are satisfied and, accordingly, the appeal is admissible (cf. Article 106 to 108 and Rules 64 and 65 EPC).

2. *Main request*

2.1 State of the art

2.1.1 It is first to be noted that, whereas the date of filing of the European patent application No.88 830 166.0 having formed the basis for the patent in suit is 21 April 1988, C16 carries only, on the second page of the submitted document, the indication "expert-Verl. 1988 (Das Handbuch für Ingenieure; Ausg. 2) ISBN 3-8169-0278-2", and, on the third page thereof, as foreword of the editor, a presentation text with the date April 1988. Indeed, as argued by the appellant, C16 is a handbook and represents permanent general knowledge of the person skilled in the art. However, this general knowledge is that at the time the handbook was published but, in the present case, the exact date at which C16 has been published could not be established. Thus, as credibly argued by the respondent, an indication such as "expert-Verl. 1988" does not exclude a date of publication after 21 April 1988, and a presentation text showing April 1988 does not exclude a publication date after 21 April 1988; moreover, if the teaching of C16 were already "present general knowledge" before 21 April 1988, it should be easy for the appellant, made aware of this objection in particular by the respondent's observations, to find evidence for establishing his assertion, for instance by another document published before that date. Therefore, as convincingly objected by the respondent, as long as there is no indication that C16 has been made available to the public before 21 April 1988, C16 is no prior art document in the sense of Article 54(2) EPC, even for establishing general knowledge before that date.

2.1.2 An electrical force and/or deformation sensor, particularly for use as a pressure sensor, is known from C18 (see page 52, left-hand column, last paragraph to right-hand column, first paragraph; see also the abstract on the first page, and Figure 4 and 7 to 9); the sensor comprises a support structure including an element which is resiliently deformable by a force or pressure to be measured and on which at least one piezoresistive sensitive element is deposited; the structure also carries electrical conductor means connected to the at least one sensitive element and adapted to enable its connection to supply and processing circuit means;

the support structure includes a rigid plate in one face of which is formed a recess whose bottom wall is thin and is resiliently deformable under the action of a force or pressure to be measured, the at least one sensitive element being provided on the other face of the plate in correspondence with the bottom wall of the recess, the conductor means also being provided on the other face of the plate;

said rigid plate comprises a ceramic material; said at least one piezoresistive sensitive element is a thick-film resistor deposited by silk-screen printing on said plate; and the conductor means comprise conductive strips also deposited on said other face of the plate.

2.1.2.1 However, contrary to the sensor in dispute, the rigid plate of theknown sensor is not made of a ceramic material, i.e. is not made of a single piece of ceramic material, but is made of two pieces of ceramic material which are joined together by a ring of sealing glass. In this respect, it is to be noted that it is directly and unambiguously derivable from the expressions "the support structure including a

rigid plate (1) in one face (1a) of which is formed a recess (2) whose bottom wall (2a) is thin and is resiliently deformable under the action of a force or pressure to be measured," and "said rigid plate (1) is made of a ceramic material" that the structure of the sensor wherein the recess is formed comprises only one piece, i.e. is reduced to a single ceramic piece or, using the expression adopted by the respondent in its argumentation, is "monolithic". Incidentally, it is to be noted that this interpretation corresponds to the teaching in the patent in suit (see column 1, lines 52 to 55; see also column 3, lines 27 to 31; Figure 2 and 3) of a single piece of ceramic material made for instance by moulding or sintering.

Moreover, the conductor means of the known device comprise conductive strips deposited on said other face of the plate by a thick-film technique, but, contrary to the sensor in dispute, they are not specified as being deposited by silk-screen printing. In this respect, it is to be noted that, as convincingly argued by the respondent with reference to column 3, lines 17 to 22 of C15, silk-screen printing is not the only method of depositing thick-film elements.

2.1.3 A first embodiment in C17 concerns a sensor which is illustrated by Figure 1 and which includes a ceramic body (1) with piezoresistive sensitive elements (R1 to R4) which are formed in the thick-film technology by screen printing. However, contrary to the sensor in suit, this known sensor in particular does not comprise any recess and, moreover, the piezoresistive sensitive elements are not on one face of the sensor, but on opposed faces thereof. Incidentally, it is to be noted that the further sensors shown in C17 (see Figure 2, 3 and 5; see also claims 1, 4 and 5) use

substrates comprised of a diaphragm with a clamped edge portion, wherein said substrate is of a ceramic material; these substrates do not comprise one recess, but two recesses in opposed faces of said sensor; the arguments of the appellant that sensors with two recesses were not excluded by claim 1 in dispute are not found convincing having regard to the expressions "a recess" and "the recess" in claim 1 and to the whole teaching of the patent in suit (see for instance column 1, line 55 to column 2, line 2; the Figures), according to which the silk-screen printing is done on a single surface, that is, on the face of the rigid plate opposite that in which the recess is formed.

2.1.4 C17 and C18 have been filed after the nine months period mentioned in Article 99(1) EPC and thus have not been submitted in due time. However, since they both show pressure sensors including support parts comprising ceramic material, with sensing elements and also with at least one recess on surfaces thereof, they are relevant and, therefore, they are not disregarded (Article 114(2) EPC).

2.2 *Novelty*

C15 is a European patent application which has been filed prior to the filing date of the patent in suit. The decision under appeal has not been criticized having respect to its findings concerning a feature distinguishing the sensor in dispute from the device of C15. Moreover, it has not been disputed that, among the documents concerning sensors of the same type as the sensor in dispute, i.e. comprising parts

of ceramic material, C18 represented the closest prior art, but did not show all the features of claim 1 in dispute. Therefore, the subject-matter of claim 1 of the main request is new in the sense of Article 54 EPC.

2.3 *Inventive step*

2.3.1 Since C15 is a document within the sense of Article 54(3) EPC, it is not considered in deciding whether there has been an inventive step (Article 56 EPC, second sentence).

As mentioned here above, the sensor of C18 is the most adequate starting point among the sensors with a substrate comprising ceramic material. According to the patent in suit (see column 1, lines 16 to 30 and 44 to 55; see also column 3, lines 25 to 31), a problem of such prior art sensors can be seen in the difficulties related to mounting and gluing a plurality of pieces, and an object of the invention in dispute can be seen in providing a sensor with a very simple structure, this object being solved in accordance with the invention in dispute by the first distinguishing feature, that the support structure of the sensor is reduced to a single ceramic piece.

2.3.2 There is no indication in C17 (see the text locations relating to Figure 2, 3 and 5) about a substrate made of a single piece of ceramic material and comprising only one recess in only one surface thereof.

2.3.3 The appellant has also argued that the person skilled in the art of C18 would be aware of other known sensor structures made of a single plate of material and including a recess in one of the main surfaces thereof.

2.3.3.1 Thus, there are sensor structures made of a semiconductor material and including a recess in one of their main surfaces, for instance the ones referred to in the patent in suit (see column 1, lines 7 to 15). The appellant has argued that the person developing ceramic sensors will take into account semiconductor sensors when considering specific comparable features; in this respect, the appellant has referred to C17 (see column 2, lines 1 to 30) and C18 (see page 54, left hand column, second paragraph, six last lines), which, although directed principally to ceramic sensors, also mention features of semiconductor sensors. However, as convincingly argued by the respondent, the person skilled in the art of ceramic sensors is indeed aware of the semiconductor sensors because these are the concurrent devices, the performances or cost of manufacturing of which are important, but this does not mean that a transposition of particular features from one technology to the other is directly practicable. In any case, as stressed by the Board during the oral proceedings, the person developing sensors by starting from C18 would find in this document (see the above-mentioned text location) the indication that, when comparing the manufacturing operations of semiconductor strain gauges to those used in C18, the bonding of the diaphragm to the thick ring is less costly in the present approach because it avoids the apparent strain due to the thermal mismatch of the materials. Said person would thus be refrained to transpose the single piece technique of the semiconductor sensors. The arguments of the appellant directed to technological developments afterwards did not convince the Board that such transposing was obvious because these developments were not specified.

2.3.3.2 Incidentally, it is to be noted that, as convincingly set forth in the decision under appeal, there can be seen no logical chain of arguments why a person skilled in the art of semiconductor sensors would drop the semiconductor manufacturing technology and switch to the ceramics manufacturing technology which uses different techniques. For this reason, semiconductor sensors are indeed not adequate starting points for the invention in dispute.

2.3.3.3 As indicated by the appellant, in the device of C4 (see claim 2), a support structure of a force sensor is manufactured by moulding ("ist eingegossen"). However, as convincingly argued by the respondent, in the devices of C4 (see claim 3; see also column 3, lines 16 to 20), the sensing elements are not on the surface of the structure, but in the interior thereof. Therefore, a combination with C18 is not obvious.

2.3.4 It is also to be noted that, asked by the Board during the oral proceedings whether the skilled person would not have been inclined to simplify the structure of the support of C18, made of two glued parts, by making it in a single part, the respondent convincingly argued that C18 was a document of 1980 and, in a very active field such as the field of sensors, it was only after 8 years that this inventive feature was proposed. Therefore, this simplification was only apparently "straightforward" for the person skilled in the art of C18.

2.3.5 Therefore, since already the first distinguishing feature, i.e. that the substrate of the sensor is made of a ceramic material, i.e. of a single piece of ceramic material, is not found to be obvious to a

person skilled in the art, the subject-matter of claim 1 of the main request involves an inventive step in the sense of Article 56 EPC and, thus, it is patentable (Article 52(1) EPC).

2.4 Since the main request is allowable pursuant to Article 102(2) EPC, the patent as granted can be maintained and it is not necessary to consider the auxiliary request.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

P. Martorana E. Turrini