BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

Publication in the Official Journal ~~Yes~~ / No

File Number: T 782/89 - 3.4.2

Application No.: 84 104 732.7

Publication No.: 0 126 989

Title of invention: Fluid pressure transmitter

Classification: G01L 9/00; G01L 13/02

# D E C I S I O N
of 8 April 1991

Proprietor of the patent: Honeywell Inc.

Opponent: Siemens AG

Headword:

EPC Art. 84 and 56

Keyword: "Clarity (yes, after amendments)"
"Inventive step (yes)"

## Headnote

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number : T 782/89 - 3.4.2

# D E C I S I O N
## of the Technical Board of Appeal 3.4.2
## of 8 April 1991

Appellant : (Opponent)
Siemens Aktiengesellschaft
Berlin und München
Postfach 22 16 34
8000 München 22
(DE)

Respondent : (Proprietor of the patent)
Honeywell Inc.
Honeywell Plaza
Minneapolis
Minnesota 55408
(US)

Representative :
Rentzsch, Heinz
Honeywell Europe S.A. Holding KG
Patent- und Lizenzabteilung
Kaiserleistrasse 55
6050 Offenbach am Main
(DE)

Decision under appeal :
Decision of Opposition Division of the European Patent Office dated 25 July 1989, posted on 3 October 1989 rejecting the opposition filed against European patent No. 0 126 989 pursuant to Article 102(2) EPC.

Composition of the Board :

Chairman : E. Turrini
Members : W.W.G. Hofmann
C.V. Payraudeau

Summary of Facts and Submissions

I. European patent No. 0 126 989 was granted on the basis of European patent application No. 84 104 732.7 claiming priority from the application No. 491 613 filed in the United States of America on 4 May 1983.

II. The Appellant (Opponent) filed an opposition against the European patent, on the grounds that the subject-matter of claim 1 of the opposed patent was not novel having regard to the disclosure in EP-A-0 080 186 (Art. 54(3) and (4) EPC for the designated contracting states DE and GB) and that the subject-matter of the claims of the opposed patent did not involve an inventive step with reference to US-A-4 342 231.

III. The Opposition Division rejected the opposition.

IV. The Appellant lodged an appeal against this decision.

V. In the grounds for appeal, the Appellant referred to the following documents:

(D1) US-A-4 342 231,
(D2) EP-A-0 080 186,
(D3) Electronic engineering, Vol. 53, November 1981, London (GB), E. Bose, Fluid pressure transducers, page 169,
(D4) DE-A-2 718 931,
(D5) Schott Produktinformation Nr. 4830, Glas-durchführungen,
(D6) Kyocera, Ceramic substrates and lids, and (D7) US-A-4 400 682.

VI. Oral proceedings were held before the Board, at the end of which the Respondent (Proprietor of the patent) requested

that the decision under appeal be set aside and the patent maintained on the basis of the following documents filed during the oral proceedings and dated 8 April 1991:

- claims: 1 to 5,
- description: pages 1,2 and columns 1 to 3,
- drawings: single sheet.

The Appellant requested that the patent be revoked.

VII. Claim 1 reads as follows:

"1. A pressure transmitter comprising:

(a) a housing (2,6,10) for being filled with a fill fluid and having at least one pressure inlet port (4,16),

(b) pressure sensing means (24,26) mounted within said housing and including a pressure sensor in the form of a diaphragm (26) and a mounting tube (24) for said sensor (26),

(c) electrically conducting wires (38) held in a wall (10) of said housing (2,6,10) by hermetic seals (42) with one end of said wires extending out of said housing and the other end being electrically connected to said pressure sensor (26),

(d) a spacer (34) provided within the cavity (8) of said housing for minimizing the free volume therein,

(e)

the direction of said wires (38),

(f) said wires (38) extending freely through said bores (44) and being mechanically fixed to said spacer (34) at the end of

said bores remote from said wall (10), such that

(g) said spacer (34) is suspended as a free floating body within said housing (2,6,10) and is spaced from the interior walls of said housing and from said sensing means (24,26)".

VIII. The Appellant submitted, in particular, that the subject-matter of claim 1 lacked inventive step with regard to documents D1, D4 or D3, because the idea of a free floating spacer within the housing of a pressure transmitter was already known in the prior art. Specifically:

- a free floating spacer was known from document D1 (see ceramic substrate 109 in Fig. 2a and 2b), relating to a differential pressure transmitter. The substrate 109 was soldered to electrically conducting wires 113 held in a wall of a sealing member 103, so that during the cooling phase after the soldering process a space, even though very small, was created between the ceramic substrate 109 and the sealing member 103. A retainer pin 112 was used only for securing a protecting cover 110, but not the ceramic substrate 109,

- document D4 showed a pressure transmitter (see Figs. 1, 3, 4) comprising a shield 108 within a housing, the shield being supported as a free floating body and spaced from the interior walls of the housing and from the pressure sensing means; this shield could be regarded as a spacer within the meaning of the patent in suit,

- document D3 referred to a fluid pressure transducer (see Fig. 1) comprising a ceramic thickfilm circuit,

which floated together with a sensor assembly between two resilient O-ring seals. The thickfilm circuit was spaced from the interior walls of the housing of the transducer and from the pressure sensing means. It could be regarded as the free floating spacer of claim 1.

Document D2, already cited and discussed in opposition pro-ceedings, should destroy the novelty of the subject-matter of claim 1, pursuant to Art. 54(3) and (4) EPC for the designated contracting states DE and GB.

IX. The Respondent contested the arguments of the Appellant. In particular, he submitted that neither the drawings, nor the specification of D1 showed or even gave a hint at any space between sealing member 103 and ceramic substrate 109. The provision of the retainer pin 112 projecting through the ceramic substrate 109 clearly taught that this substrate was not free floating with respect to the member 103.

The shield 108 of document D4 was not a spacer, but an ion migration shield, and could not be regarded as a free floating body.

With reference to D3, the thickfilm circuit was not free floating, because a compressive force was applied to the housing of the transducer in order to seal it.

## Reasons for the Decision

1. The appeal is admissible.

2. **Allowability of the amendments**

2.1 The features which, according to the valid claim 1, have been introduced into the original claim 1, are disclosed in the application as originally filed:

- the feature that the housing is filled with a fill fluid (see 1(a)) is mentioned on page 4, lines 6 to 11,
- a pressure sensor in the form of a diaphragm arranged on a mounting tube (see 1(b)) is disclosed on page 2, lines 15 to 18,
- feature 1(c) is disclosed in the original claim 2,
- the statement "for minimizing the free volume therein" in feature 1(d) is disclosed on page 4, lines 3 to 6,
- feature 1(e) is disclosed on page 3, lines 7 to 11,
- features 1(f) are disclosed in the original claim 7 (see (f) and (h)),
- the fact that the spacer is suspended and spaced from the interior walls of the housing and from the pressure sensing means (see 1(g)) is disclosed on page 3, lines 22 to 27.

2.2 As regards the dependent claims, claims 2, 3, 4 and 5 substantially correspond to the original claims 3, 4, 6 and 7, respectively. In valid claim 3 the feature that the wires 30 are flexible is disclosed in the original claim 5. Valid claim 5 corresponds to the original claim 7 in which features (f), (g) and (h) have been deleted; these features are now mentioned in valid claims 1 and 3.

2.3 Since all the amendments of the claims are in the form of a further definition of features already existing in the claims as granted and no deletion of any feature in the granted version of the claims has been made, the scope of the protection conferred has been restricted.

2.4 The Board is, therefore, satisfied that the amended version of the patent, on the basis of which the Respondent requests that the patent be maintained, does not contravene the requirements of Art. 123(2) and (3) EPC, since neither does this version include subject-matter extending beyond the content of the application as filed, nor do the amendments to the claims have the effect of extending the scope of the protection conferred.

3. Clarity

3.1 As the Board pointed out in the communication dated 6 February 1991, claim 1 contains two terms, the meaning of which needs to be discussed. In particular, these terms are:

- "spacer" (see feature 1(d)), and
- "free floating" (see feature 1(g)).

Both terms have a normal meaning in the relevant art, i.e. "spacer" means a piece of metal or other material for making a space, interval or division, whereas "free floating" means buoyed on or in a fluid without any attachment or fixation. Since in the present case these terms have a special meaning, this meaning must be clearly indicated in the wording of claim 1. The amended valid claim 1 satisfies this requirement. Indeed, the term "spacer" is defined by the statement of purpose "for minimizing the free volume therein"; it should be noted that this statement, and in particular the use of the verb "to minimize", clearly indicates that a body is intentionally provided within the housing of the pressure transmitter with the function of reducing the free volume therein as much as possible. The shape of this body is not essential, provided it fulfils this function and satisfies the further conditions men-tioned in claim 1, in particular the fact that the spacer is suspended so as to be a "free

floating" body. This term refers to the fixation of the body within the housing and the valid claim 1 now clearly defines how this fixation is realised; namely, the body (spacer) is suspended from the electrically conducting wires 38 at the end of the bores remote from wall 10 (see features 1(f) and 1(g)) and otherwise avoids all contact, i.e. it is spaced from the interior walls of the housing and from the sensing means (see feature 1(g)).

Therefore, the subject-matter of the claim 1 satisfies the requirement of Art. 84 EPC regarding clarity.

4. **Novelty**

4.1 Document D1 discloses a differential pressure transmitter comprising:

(a) a housing 102,103,115 for being filled with a fill fluid and having at least one pressure inlet port 105,106 (see Fig. 1, 2a),

(b) pressure sensing means mounted within said housing and including a pressure sensor in the form of a diaphragm 108 and a mounting tube 107 for said sensor (see Fig. 2a),

(c) electrically conducting wires 113 held in a wall of said housing by hermetic seals 114 with one end of said wires extending out of said housing and the other end being electrically connected to said pressure sensor (see Fig. 2a, 2b and col. 4, lines 58-68),

(d) a ceramic substrate 109 provided within the cavity of said housing (see Fig. 2a),

(e) bores extending through said ceramic substrate 109 in the direction of said wires 113 (see Fig. 2a),

(f) said wires extending through said bores and being mechanically fixed (soldered) to said ceramic substrate 109 (see Fig. 2a).

The ceramic substrate 109 can be considered as a spacer reducing the free volume within the housing, because the property of filling some space is typical of any body, no matter what the reason for providing it had originally been. Moreover, said ceramic substrate (or spacer) 109 is spaced from said pressure sensing means (see Fig. 2a, 2b; an annular gap between the diaphragm 108 and the ceramic substrate 109 is clearly visible).

4.1.1 The subject-matter of the valid claim 1 differs from the differential pressure transmitter according to D1 in that:

(d') the spacer minimizes the free volume within the cavity of the housing,

(f) the electrically conducting wires extend freely through said bores and are mechanically fixed at the end of the bores remote from said wall,

(g) the spacer is suspended as a free floating body within said housing and is spaced from the interior walls of said housing.

4.1.2 With regard to D1, the Appellant has argued that a small gap is formed between the ceramic substrate 109 and the sealing member 103 during the manufacturing process of the differential pressure transmitter and, therefore, this gap forms part of the implicit disclosure of D1. This submission, which is not substantiated by any evidence, is purely argumentative and cannot therefore be admitted by the Board.

4.2 Document D4 discloses a differential pressure transmitter comprising:

(a) a housing 14 for being filled with a fill fluid and having at least one pressure inlet port 16,18 (see Fig. 1,3),

(b) pressure sensing means mounted within said housing and including a pressure sensor in the form of a diaphragm 102 and a mounting tube 95 for said sensor (see Fig. 3 and page 13, third to fifth paragraphs); the Board regards the tube 95 as a mounting tube, because it has the function of supporting the diaphragm 102, besides that of providing the low-pressure fluid,

(c) electrically conducting wires 20 held in a wall of said housing by hermetic seals 124 with one end of said wires extending out of said housing and the other end being electrically connected to said pressure sensor (see Figs. 3, 4),

(d) an ion migration shield 108 provided within the cavity of said housing, held by parts 110, electrically connected to the pressure sensor and spaced from the interior walls of said housing and from said pressure sensing means (see Fig. 3).

The ion migration shield 108 can be considered as constituting a spacer reducing the free volume within the housing for the same reasons mentioned in section 4.1 above (see last paragraph) with regard to the ceramic substrate 109.

4.2.1 The subject-matter of the valid claim 1 differs from the differential pressure transmitter according to D4 in that:

(d') the spacer minimises the free volume within the cavity of the housing,

(e) bores extend through said spacer in the direction of said electrically connecting wires,

(f) said wires extend freely through said bores and are mechanically fixed to said spacer at the end of said bores remote from said wall,

(g') the spacer is suspended as a free floating body within said housing.

4.3 Document D3 discloses a fluid pressure transducer comprising:

(a) a housing for being filled with a fill fluid and having at least one pressure inlet port (see Fig. 1),

(b) pressure sensing means mounted within said housing and including a pressure sensor in the form of a diaphragm and a mounting tube for said sensor (see Fig. 1),

(d) a ceramic thickfilm circuit (see Fig. 1).

The thickfilm circuit can be considered as a spacer reducing the free volume within the housing for the reasons already mentioned in section 4.1 or 4.2 above (see last paragraphs). Moreover, said thickfilm circuit (or spacer) is spaced from the interior walls of said housing and from said pressure sensing means (see Fig. 1). Indeed, the thickfilm circuit is placed against the upper side of a flange provided at one end of the mounting tube for the pressure sensor, but is so positioned within the housing by means of O-rings, that a gap is left between it and the pressure sen-sor and its mounting tube on one side, and the walls of the housing on the other side.

4.3.1 The subject-matter of the valid claim 1 differs from the fluid pressure transmitter according to D3 in that:

(c) electrically conducting wires are held in a wall of said housing by hermetic seals with one end of said wires extending out of said housing and the other end being electrically connected to said pressure sensor;

(d') the spacer minimises the free volume within the cavity of the housing,

(e) bores extend through said spacer in the direction of said electrically connecting wires,

(f) said wires extend freely through said bores and are mechanically fixed to said spacer at the end of said bores remote from said wall,

(g') the spacer is suspended as a free floating body within said housing.

4.4 European application D2 has a priority date prior to, but a publication date later than the priority date of the patent in suit; it refers to a semiconductor pressure transducer (see Fig. 1, 2) corresponding to that disclosed in document D1 (see Fig. 1, 2a). The subject-matter of claim 1 therefore differs from the disclosure of document D2 (see section 4.1 above). Since the priority of the patent in suit is correctly claimed, D2 is to be considered only in relation to novelty (Art. 54(3) and (4) EPC).

4.5 Documents D5 and D6 are irrelevant, because their publication date is not known.
Document D7 is also irrelevant, because it was published after the priority date of the patent in suit.
The further documents cited in the Search Report are less relevant than D1, D4 or D3.

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

5. **Inventive step**

5.1 The Board considers document D1 to be closest to the subject-matter of the present claim 1 since the transmitter described therein also comprises a body 109, which may be considered as a spacer, which has bores extending in the direction of wires providing a sealed

lead-through of the electrical connections of the sensor through the wall of the housing, and which is mechanically fixed to these wires.

Starting from this document, the object of the patent in suit is seen to be to provide a fluid pressure transmitter, in which the seals of the electrical connections of the sensor to the outside of the housing are relieved from mechanical stress caused by changes in temperature of the fluid and the parts inside the housing, and in which the volume of the fluid fill in the housing is minimized (see column 1, lines 23 to 31 of the patent specification). This problem is not mentioned in any of the documents D1, D3 or D4. It seems however to be clear for the skilled person - although none of the parties made any comment on this point - that quite generally too large volumes of fluid within the sensor housing have an adverse effect regarding thermal stress caused at various places in the housing (fluids have a particularly high coefficient of thermal expansion and the fluid system of the transmitter is usually a closed system separated by diaphragms from the main fluid system) and should therefore be avoided.

It is furthermore clear that fluid-tight seals of electrical lead-throughs are particularly critical regarding thermal stress (see document D4, page 8, paragraph 4 and page 9, paragraph 1).

Therefore, the Board cannot see an inventive merit in the fact alone of finding the above-mentioned problem.

5.1.1 According to claim 1, the solution to this problem relates to the construction of the spacer and to the way that it is fixed and arranged within the housing.

As it has been mentioned above, documents D1, D4 and D3 show bodies contained within the housing, which could be regarded as spacers for reducing the free volume therein. None of said documents, however, teaches or even suggests that a body should intentionally be placed within the hous-ing and be shaped so as to minimise the free volume, as a solution to the problem of thermally induced mechanical stress. The bodies referred to in said documents have, as a matter of fact, a different function; namely:

- in D1 the ceramic substrate 109 is necessary for the wiring of a resistance pattern formed on the semiconductor pressure sensor 108. The connection between the pressure sensor 108 and the ceramic substrate 109 is achieved by a wire-bonded lead wire 111. Lead wires 113 for transmitting the electric signals from the ceramic substrate 109 to the outside are soldered to said ceramic substrate 109 (see from col. 4, line 58 to col. 5, line 8). Although the ceramic substrate does reduce the free volume within the housing, nothing in this document suggests to transform this substrate into a filling body,

- in D4 the ion migration shield 108 is used to provide a plane with a fixed potential with reference to the face of the silicon sensor 102 (see Respondent's letter of 9 August 1990, page 2, first paragraph); its function is to avoid that stray ions, which may be present in the fill liquid, influence the operation of the sensor. Minimising the volume of fill liquid within the pressure transmitter by means of this ion migration shield is nei-ther taught by this document, nor deducible from its teachings,

- in D3 the ceramic thickfilm circuit has the same function as the ceramic substrate of document D1. Again, the same conclusion valid for D1 and D4, as regards minimizing the free volume within the housing of the pressure transmit-ter by means of this ceramic thickfilm circuit, can be drawn for D3.

5.1.2 The feature that the spacer is suspended in a free floating way according to the definition given in the valid claim 1, is also neither disclosed, nor suggested by any of the cited documents.

The ceramic substrate 109 in D1 is soldered to the lead wires 113 and held to the wall 103. It is not evident, why it should and how it could be made free floating. Moreover, the lead wires 113 do not extend freely through bores of the ceramic substrate 109.

With regard to this document D1, the Appellant has argued in the grounds for appeal (see page 3, first paragraph), that the man skilled in the art knows that two parts must be heated up in order to be soldered together, that ceramic has a lower coefficient of thermal expansion than the materials used for the hermetic seals 114 (see documents D5 and D6 which, however, the Board considers as irrelevant, because they do not show any publication date), and that it is, therefore, obvious to the skilled man that, during the cooling phase from the soldering temperature to the normal temperature, a gap, even though very small, is formed between the ceramic substrate 109 and the sealing member 103. It is also obvious, in the opinion of the Appellant, that the ceramic substrate 109 should not be connected with the wires 113 in such a way as to generate a tension in the seals 114, in order to avoid the formation of cracks in the material of the seals, impairing the quality of the seals.

The Board cannot follow this argumentation, which as indicated above in point 4.1.2 is not supported by any evidence. As a matter of fact, it would rather appear that, owing to the different coefficients of thermal expansion of materials like metal, glass and ceramic, the ceramic substrate 109 could be pressed against the sealing member 103 during the cooling phase after the soldering process. During the oral proceedings the Appellant has been invited to better motivate his conclusion but he failed to do this; he only stated that a gap is present between the ceramic substrate 109 and the pressure sensor 108, which fact is not contested by the Board (see section 4.1, last paragraph).

In D4 the ion migration shield 108 is secured by a plurality of very solid bars 110 (see Fig. 3) instead of electrically conducting wires which freely extend through bores of the shield. Thus, this construction cannot suggest in any way free floating of the shield.

As regards D3, the Appellant argued that the sensor assembly (and, therefore, the ceramic thickfilm circuit too) floats between two resilient O-ring seals (see column in the middle, second paragraph). However, in the Respondent's opinion, which is shared by the Board, this is true only before the various parts of the pressure transducer are de-finitively assembled together; in fact, the transducer is sealed by applying a compressive force and by employing two fasteners, so as to fix together the sensor cover and the metal housing. In this assembled condition no free floating suspension of the thickfilm circuit is any longer possible.

Although the intention of avoiding thermal stress caused by the spacer might in itself be considered obvious, the

specific way that this is achieved according to claim 1, in particular the fact of keeping the spacer optimally movable by avoiding any contact with the wall 10 and by even avoiding any contact with the wires 38 except at the end of the bores remote from wall 10, goes decisively beyond pure routine work.

5.2 The Board then comes to the conclusion that the man skilled in the art, starting from a known pressure transmitter and having to solve the problem of mechanical stress caused by changes in temperature of the fill liquid and the parts within the housing, would not have any reason or find any hint in documents D1, D4 or D3 to modify the structure of the known transmitters according to the valid claim 1, without the exercise of an inventive activity, so as to solve the given problem.

5.3 For the above reasons the Board finds that the subject-matter of claim 1 involves an inventive step as defined in Article 56 EPC, and consequently claim 1 is allowable (Art. 52(1) EPC).

5.4 Claims 2 to 5, by virtue of their dependence on allowable claim 1, are also considered allowable under Article 52(1) EPC.

5.5 The description is correctly adapted to the valid set of claims.

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 maintain the patent on the basis of the documents filed by the Respondent during the oral proceedings dated 8 April 1991.

The Registrar: The Chairman:

P. Martorana E. Turrini