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D E C I S I O N
of 15 May 2003

Case Number: T 0075/99 - 3.4.1

Application Number: 88104077.8

Publication Number: 0282967

IPC: G01R 33/00

Language of the proceedings: EN

Title of invention:
Sensor for detecting variation in magnetic field

Patentee:
SUMITOMO ELECTRIC INDUSTRIES, LTD.

Opponent:
Mannesmann VDO AG

Headword:
-

Relevant legal provisions:
EPC Art. 52(1), 54, 56

Keyword:
"Inventive step (yes) - after amendment"

Decisions cited:
-

Catchword:
-

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Case Number: T 0075/99 **-** 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 15 May 2003

Appellant: (Opponent)
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Representative:
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Respondent: (Proprietor of the patent)
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Representative:
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Decision under appeal:
Decision of the Opposition Division of the European Patent Office posted 17 November 1998 rejecting the opposition filed against European patent No. 0282967 pursuant to Article 102(2) EPC.

Composition of the Board:

Chairman: G. Davies
Members: R. Q. Bekkering
G. Assi

Summary of Facts and Submissions

I. The appeal is directed against the decision of the opposition division dated 17 November 1998, rejecting the opposition against European patent 0 282 967.

II. Opposition had been filed against the patent as a whole, based on Article 100(a) EPC on the grounds of lack of novelty and inventive step (Articles 52(1), 54 and 56 EPC).

III. The notice of appeal of the opponent was received on 13 January 1999, the appeal fee being paid on the same day, and the statement of grounds of appeal was received on 17 March 1999.

IV. The appellant (opponent) requested in writing that the decision under appeal be set aside and the patent be revoked.

V. Oral proceedings were held on 15 May 2003.

The appellant did not attend the oral proceedings, as announced in a letter dated 6 March 2003.

VI. The respondent (patentee) requested that the appeal be dismissed and that the patent be maintained as granted (main request).

Alternatively, it was requested that the patent be maintained in amended form on the basis of the following documents:

First auxiliary request:

Claims: Claims 1 to 11 as filed during the oral proceedings on 15 May 2003;

Description: Columns 1 and 2 as filed during the oral proceedings on 15 May 2003;
Columns 3 to 12 as granted;

Drawings: Figures 1 to 13 as granted;

Second auxiliary request:

Claims: Claim 1 as filed with letter of 15 April 2003;
Claims 2 to 11 as granted;

Description and drawings as granted;

Third auxiliary request:

Claims: Claims 1 to 8 as filed with letter of 15 April 2003;

Description and drawings as granted;

Fourth auxiliary request:

Claims: Claim 1 as filed with letter of 15 April 2003;
Claims 2 to 11 as granted;

Description and drawings as granted.

VII. Reference was made in particular to the following documents:

D1: DE-B-21 54 847

D2: DE-A-35 30 288

D4: DE-B-21 11 499

D7: US-A-4 463 312

Furthermore, reference was made to D11, corresponding to an alleged prior art sensor, described in the application as filed and depicted in figure 1, for which no pre-published document was identified.

VIII. Claim 1 as granted (main request) reads as follows:

"1. A sensor for detecting variation in magnetic field, said sensor comprising:
a sensor element part (102,103,104; 122,123,124; 142; 202,203,204; 222; 302,303,304; 322,323,324; 342; 402,403,404; 422; 502,503,504; 522) having a terminal (106; 126; 156; 206; 226; 306; 326; 346; 406; 426; 506; 536) for detecting variation in magnetic field and generating a signal;
an output wire (107; 127; 147; 207; 227; 307; 327; 347; 407; 427; 507; 527) having an end connected to said terminal for outputting said signal from said sensor element part to the exterior;
a case (108; 128; 148; 208; 228; 308; 328; 348; 408; 428; 508; 528) having an opening (112; 132; 152; 212; 232; 312; 332; 352; 412; 432; 512; 532) on a side

towards said output wire, covering said sensor element part;
a first resin part (109a; 149a; 209a; 229a; 309a; 329a; 349a; 409a; 429a; 509a; 529a) filled in said case (108) for covering said sensor element part;
characterized by
a second resin part (109b; 149b; 209b; 229b; 309b; 329b; 349b; 409b; 429b; 509b; 529b) formed to seal a clearance between said case and said first resin part by covering the opening of said case, and wherein said first resin part is prepared by thermosetting resin and said second resin part is prepared by thermoplastic resin."

IX. Claim 1 according to the first auxiliary request consists of the preamble of claim 1 of the main request, with amended reference numerals, and the following characterising portion:

"*a second resin part (109b; 129b; 149b; 209b; 229b; 309b; 329c; 349b; 409b; 429b; 509b; 529b) molded in the vicinity of the opening in order to seal a clearance between said case and said first resin part by covering the opening of said case, and wherein said first resin part is prepared by thermosetting resin and said second resin part is prepared by thermoplastic resin.*"

X. Claims 1 of the second, third and fourth auxiliary requests are based on claim 1 as granted and contain further limitations.

XI. The opposition division found in the appealed decision *inter alia* that for claim 1 as granted the only feature considered to be new in view of document D1 consisted of the second part, corresponding in D1 to the plug covering the opening of the case of the sensor, being prepared by thermoplastic resin. However, it was then held that in order to apply the thermoplastic resin this plug would have to be removed. Since the skilled person would have refrained from removing the plug and furthermore would not have considered the sealing provided by the plug as insufficient, the addition of a thermoplastic resin was not considered to be obvious.

Document D2 taught the man skilled in the art to cover the terminals of the sensor element part either by a thermosetting resin or by extrusion. D2 failed to teach a combined use of a thermosetting and a thermoplastic resin.

Document D4 did not suggest the application of a thermoplastic resin either, but rather disclosed an entirely different arrangement with a heat-shrinkable protective sleeve covering an output wire and a thermosetting resin part of the sensor.

Document D11 did not disclose the provision of a second resin part.

Accordingly, the subject-matter of claim 1 of the patent in suit was considered to involve an inventive step.

XII. The arguments submitted by the appellant (opponent) may be summarised as follows:

From document D1 a sensor was known comprising a sensor element with terminals embedded in a cast resin in a case. Over the cast resin filling, the case was closed by means of a plug. Irrespective of the type of plug used, the combination showed that the cast resin alone did not provide the required sealing and resistance against vibrations and shocks. For this reason the plug was provided. Similar situations occurred in the sensors disclosed in documents D2 and D4. Accordingly, the provision of a second resin part for sealing the sensor was already suggested in the prior art. It would have been obvious to apply this teaching to a structure as known from D11. Furthermore, the particular shape of the second resin part was already suggested in document D2, where in an alternative to the main embodiment a moulded thermoplastic second resin part was provided covering the interface between the cast first resin part and the case. In particular, there was nothing in D2 suggesting that the cast first resin part was omitted in this instance.

Accordingly, the subject-matter of claim 1 as granted was considered to lack an inventive step. Strictly speaking, the subject-matter of claim 1 in fact lacked novelty over document D2.

XIII. The patentee argued essentially as follows:

The sensor according to claim 1 as granted provided a simple arrangement, yet well protected against corrosion. The plug provided in the sensor of D1 merely

closed the case and could not be said to seal a clearance between the case and the first resin part as required by claim 1 as granted. The sealing function was in fact obtained in D1 by an additional gasket shown in the drawing. Furthermore, there was no indication in D1 or any of the remaining cited prior art of the particularly advantageous selection of materials for the first and second resin parts as defined in claim 1. Document D11 showed only a single resin part sealing the sensor.

The further cited documents D2, D4 and D7 showed completely different sensor structures, so that the man skilled in the art did not receive any suggestions from these documents leading to a sensor as claimed.

Accordingly, both novelty and the presence of an inventive step had to be recognised for the subject-matter of claim 1 as granted.

The auxiliary requests contained additional limitations further supporting the novelty and inventiveness of the subject-matter of claim 1.

Reasons for the Decision

1. The appeal complies with the requirements of Articles 106 to 108 and Rule 64 EPC and is therefore admissible.

2. Regarding D11, the respondent (patentee) stated (cf letter of 15 April 2003, item 2) that although the inventors of the patent in suit knew the sensor shown

in figure 1 as prior art, they were not aware of any publication which showed exactly such a sensor. Accordingly, in the absence of any evidence to the contrary, this prior art is considered to be in-house prior art of the patentee, not made available to the public and consequently discarded.

3. *Main request*

3.1 Novelty (Articles 100(a), 52(1) and 54(1),(2) EPC)

3.1.1 Novelty was only disputed with respect to document D2. This document discloses in accordance with a first embodiment (cf figure 1 and corresponding description) a sensor having a sensor element part (13-18) with terminals (19), an output wire (30-33), a case (26), a first resin part (36) cast in a cavity (22) of a coil bobbin (14,18) of the sensor element part and a second part (37) forming a cover over the cavity.

There are however a number of differences between the subject-matter of claim 1 as granted and this sensor of D2. In particular, in D2 the first resin part is made of cast resin, which thus could be either a thermosetting resin or a thermoplastic resin. The second part forming a cover is attached by ultrasound welding to the bobbin made of injection moulded resin. The material of the second part is not further specified. Moreover, the first resin part is not filled in the case and the second part does not to seal any clearance between the case and the first resin part.

Furthermore, according to a further embodiment of D2 the cover is omitted and an extension part of the bobbin with the output wire and the terminals are injection moulded with a resin in a mould, whereby the cavity should be suitably shaped for injection moulding. As argued in the first instance decision, in this case the cast resin, which in the first embodiment fills the cavity, is omitted, thereby rendering the particular shape of the cavity necessary. Accordingly, in this second embodiment only a single resin part is provided, formed by the injection moulded resin.

Thus, the subject-matter of claim 1 as granted is novel over document D2.

3.1.2 From document D1, which is in fact considered to provide the closest prior art, a sensor according to the preamble of claim 1 is known. In particular, document D1 discloses, in accordance with the wording of claim 1 as granted, a sensor for detecting variation in magnetic field, the sensor comprising:

(a) a sensor element part (1, 2, 2a, 2b, 3, 4, 7) having a terminal (ends of coil 1 (cf column 3, lines 15 to 25 and figure)) for detecting variation in magnetic field and generating a signal;

(b) a conductor (5) having an end connected to said terminal for outputting said signal from said sensor element part to the exterior;

(c) a case (9) having an opening on a side towards said output wire, covering said sensor element part;

(d) a first resin part (11) filled in said case for covering said sensor element part;

and

(e) a second part (12) formed to close the opening of said case.

In particular, regarding feature (b), it is noted that the conductor (5) of the sensor of D1 meets the definition of a "wire" serving to "output" the electrical signal of the sensor as provided by claim 1. Furthermore, in the sensor of D1 the second part consists of a plug of insulating material with moulded plug pins. The opening of the case is closed by means of the plug which is fixed by deforming the border of the case inwardly. Irrespective of whether a seal ring is provided between the plug and the case, by plugging the opening of the case the interior of the case is to a large extent sealed from the external environment. As a matter of course the plug also seals any clearance between the first resin part and the case from the external environment, as required by claim 1.

According to document D1 the first resin part is formed by casting a resin in vacuum at a temperature of 160°C. Generally both thermosetting and thermoplastic resins can be cast and document D1 does not further specify the type of resin used.

Regarding the second part, document D1 merely discloses that it is made of an insulating material.

Thus, the sensor according to claim 1 as granted differs from the sensor known from D1 in that:

- the first resin part is prepared by thermosetting resin; and

- the second part is prepared by thermoplastic resin.

Accordingly, the subject-matter of claim 1 is novel over document D1.

Novelty is also provided over the remaining, more remote cited prior art according to documents D4 and D7.

3.2 Inventive step (Articles 100(a), 52(1) and 56 EPC)

As discussed above, the difference between the subject-matter of claim 1 as granted and the closest prior art provided by document D1 consists in the selection of the materials used for the first resin part and the second part.

The selection of specifically a thermosetting resin for the first resin part is considered to be a design option falling within the competence of the skilled person, especially as thermosetting resins are commonly used (see eg document D7) in the field of magnetic sensors at issue and clearly suitable in the present case.

In the sensor of document D1 the second part consists of a preformed plug of insulating material with moulded plug pins. In view of its widespread use in industry, its well-known good properties in terms of electrical insulation as well as strength and durability, and its clear suitability in the present case, it would readily occur to the skilled person to use a thermoplastic resin as the insulating material for forming the plug of D1.

Accordingly, the subject-matter of claim 1 does not involve an inventive step.

3.3 The main request is therefore not allowable.

4. *First auxiliary request*

4.1 Amendments (Article 123(2),(3) EPC)

Claim 1 of the first auxiliary request has been amended by specifying that the second resin part is moulded in the vicinity of the opening. The amendment is derivable from the application as originally filed (see eg description, column 6, lines 26 to 30 of the application as published) and thus in conformity with the requirements of Article 123(2) EPC.

The above-mentioned limitation in amended claim 1 does not give rise to any objection under Article 123(3) EPC either.

4.2 Novelty, inventive step (Articles 52(1), 54(1),(2) and 56 EPC)

4.2.1 The sensor according to claim 1 of the first auxiliary request differs from the sensor known from D1 in that:

- the first resin part is prepared by thermosetting resin; and

- the second part is moulded in the vicinity of the opening and prepared by thermoplastic resin.

Accordingly, also the subject-matter of claim 1 of the first auxiliary request is novel over D1. The same conclusion applies with regard to the further cited prior art.

4.2.2 The above differences provide an overall improvement in sealing of the sensor element in the case from the external environment.

As such the problem of improving the sealing is commonly addressed in the technical field at issue, since these sensors are typically used as rotation sensors in gear boxes, in ABS systems in the wheel housing of cars and the like and thus subject to corrosive environments, heat and vibrations (see in particular D1, column 2, lines 22 to 27).

In the sensor of document D1 the second part consists of a preformed plug of insulating material with embedded contact pins which is mounted in the opening of the case by inward deformation of the edge of the case. From the drawing it would furthermore appear that a gasket is provided between the plug and the case in order to improve the sealing of the sensor.

In contrast thereto, according to claim 1 the second part is formed by moulding a thermoplastic resin in the vicinity of the opening of the case in order to seal a clearance between the case and the first resin part by covering the opening of the case. This provides, as argued by the respondent, a simple and at the same time effective sealing of the sensor.

As discussed above, in document D2 a magnetic sensor is sealed by casting a first resin in a cavity of a coil bobbin of a sensor element with protruding terminals, followed by placing a cap on the sensor by ultrasound-welding it to the extension of the bobbin. Alternatively, the end of the output wire, after connection to the terminals, and the extension of the bobbin are covered with resin using a mould, whereby the cavity is suitably formed for injection moulding. In this case the cap is omitted. According to this alternative, a single moulded resin part is used to seal the sensor. There is no suggestion of combining a resin cast in the cavity and a covering moulded resin.

In document D7 a sensor is disclosed in which the terminal of the sensor and the output wire are secured together to the case of the sensor by means of an epoxy resin packed in a boot member provided around the output wire and over the opening of the case. The boot member apparently is a preformed part in which the thermosetting epoxy resin is packed. There is no suggestion of moulding a resin over a cast resin.

Finally, document D4 shows a sensor with preformed connection and sensor bodies. Sealing is obtained with o-ring seals. There are no parts cast or moulded in or over the case.

Thus, the claimed solution is not rendered obvious by the cited prior art.

Accordingly, the subject-matter of claim 1 involves an inventive step.

4.2.3 The remaining claims 2 to 11 are dependent on claim 1 and provide further developments of the subject-matter of claim 1. Therefore, the subject-matter of these claims also involves an inventive step.

4.3 Accordingly, the respondent's first auxiliary request is allowable.

5. Under these circumstances there is no need to consider the second to fourth auxiliary requests.

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 as amended in accordance with the respondent's first auxiliary request:

Claims: Claims 1 to 11 as filed during the oral proceedings on 15 May 2003;

Description: Columns 1 and 2 as filed during the oral proceedings on 15 May 2003;
Columns 3 to 12 as granted;

Drawings: Figures 1 to 13 as granted;

The Registrar: The Chairman:

R. Schumacher G. Davies