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**Datasheet for the decision  
of 01 February 2011**

**Case Number:** T 1283/07 - 3.4.02

**Application Number:** 01129596.1

**Publication Number:** 1195602

**IPC:** G01N27/407, G01N27/406

**Language of the proceedings:** EN

**Title of invention:**

Oxygen sensor with the heater element contacting the inner surface of the closed end tubular solid electrolyte

**Applicant:**

DENSO Corporation

**Headword:**

**Relevant legal provisions:**

EPC 1973 Art. 56

**Keyword:**

**Catchword:**

Inventive step - main, first to fourth auxiliary requests (no)



Case Number: T 1283/07 - 3.4.02

**D E C I S I O N**  
**of the Technical Board of Appeal 3.4.02**  
**of 01 February 2011**

**Appellant:** DENSO Corporation, 1-1  
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**Representative:** TBK-Patent  
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**Decision under appeal:** **Decision of the Examining Division of the  
European Patent Office posted 07.03.07 refusing  
European patent application No. 01129596.1  
pursuant to Article 97(1) EPC 1973**

**Composition of the Board:**

**Chairman:** F. J. Narganes-Quijano  
**Members:** M. Rayner  
B. Müller

### Summary of Facts and Submissions

I. The present appeal is against the decision of the examining division refusing European patent application number 01129596.1 concerning an oxygen sensing element system.

II. In the examination and/or appeal proceedings, reference has been made to documents including the following:-

|     |                 |
|-----|-----------------|
| X1  | DE-A-19 702 096 |
| X2  | US-A-4 155 827  |
| X7  | DE-A-3 726 479  |
| DX9 | DE-A-2 206 216  |
| D10 | JP-A-57 166 556 |
| D15 | JP-A-8 271 474. |

III. In the decision under appeal, the examining division substantiated its refusal with lack of inventive step of the subject matter of the claims of the request before it. Arguments of the examining division pertinent to the appeal can be summarised as follows.

IV. The subject matter of claim 1 is obvious from a combination of documents X1 and X7. Document X1 discloses all features of the preamble of the claim. The subject matter of claim 1 differs from the disclosure of X1 by the features of its characterising part, namely that the sensing electrode is entirely located in a region extending from the distal end of the oxygen sensing element to a position spaced by a distance 0.8 L away from the distal end, and in that the external lead electrode has a circumferential width in the range from 0.1 mm to 5 mm, the circumferential width of the external lead electrode being smaller than that of the sensing electrode. Since the passages of

document X1 relating to electrodes contain no information about the shape of the sensing electrode, a skilled person wanting to realise the teaching therein disclosed, has first to design the shape of the sensing electrode. In order to do this, the skilled person would choose one of the usual shapes of sensing electrodes as depicted in many documents, for instance in Figure 1 of document X7. The sensing electrode shown discloses all the features defined in the characterising portion of claim 1 including the circumferential width in the range from 0.1mm to 5mm as for the skilled person it is apparent that said circumferential width lies in this range. In particular, the skilled person is familiar with the fact that the outer diameter of the cup-shaped electrolytic body is normally around 8 mm, so that Figure 1 of document X7 implies that the width of the external lead electrode lies in the range from 0.1 mm to 5 mm, although not explicitly specified in X7. In applying this shape to the sensing electrode of document X1 the skilled person is led to the subject matter of claim 1 without any inventive step. In the foregoing argumentation, document X7 could be replaced by document DX9. Any advantages of the shape of the sensing electrode, such as a homogenous temperature distribution on the sensing electrode or a short response time do not imply an inventive step because they are at best mere bonus effects of an electrode design, which is per se obvious simply due to the fact that this design is customary and popular irrespective of the provision of a heater as reflected for example by X7 and DX9 (see section 4 of the decision) or D10 (see section 6.1 of the decision). Moreover, there are other advantages of this electrode design as compared to the other popular electrode design in the form of an entirely covered outer surface, which are unrelated to

the provision of a heater, for instance the reduction of amount of expensive electrode material including noble metal as mentioned in the application in the first three lines on page 31. Furthermore, positive effects of the reduced area of the sensor electrode are paid for by a reduced signal level and associated reduced signal to noise ratio. The skilled person recognizes the predictable advantages and disadvantages of the two electrode designs and chooses one without any inventive step. The subject matter of dependent claim 4 {the board observes this concerns the sensing electrode being formed by chemical plating} is conventional (see for example page 10, lines 7-12 of document DX9 ("chemische Reduktion und galvanische Abscheidung")).

V. The appellant requested that the decision under appeal be set aside. Oral proceedings were requested on an auxiliary basis. The following requests were made on the substance of the case in the order given:-

a) Main Request

Grant of a patent based on claims 1 to 4  
filed with the letter dated 22 July 2005.

b) Remittal of the case to the first instance for examination of the first auxiliary request filed on 01 February 2011.

c) First Auxiliary Request

Grant of a patent based on claims 1 to 3  
filed on 01 February 2011.

d) Second Auxiliary Request

Grant of a patent based on claims 1 to 3  
filed on 01 February 2011.

e) Third Auxiliary Request

Grant of a patent based on claims 1 to 4  
filed on 01 February 2011.

f) Fourth Auxiliary Request

Grant of a patent based on claims 1 to 6  
filed on 01 February 2011.

VI. In support of its main request, the appellant argued as follows.

An oxygen sensing element of the kind recited in the preamble of claim 1 is known from document X1. In the oxygen sensing element according to the invention, the contact portion is disposed close to the distal end of the oxygen sensing element to render heat losses to a housing supporting the sensing element small. However, a temperature distribution is then generated in the electrolytic body. The inventors have found that by locating the sensing electrode entirely between the distal end of the oxygen sensing element and a position spaced by a distance  $0.8 L$  away from the distal end, the sensing electrode can be uniformly heated by the heater, can be rapidly heated and can maintain a high temperature during the operation of the sensing element. The effects of the invention are not additional bonus effects, but are the primary and essential effects of the features, by which the underlying object is achieved. Moreover, these effects are directly related to the fact that the oxygen sensing element according to the invention comprises a heater. While Figure 1 of document X7 shows features concerning extension of the sensing electrode and a smaller lead electrode width, these features are not mentioned in the text of document X7, and a

circumferential width from 0.1 mm to 5 mm of the external lead electrode is no more than vague unsupported conjecture. As the oxygen sensing element according to document X7 does not comprise a heater, it is not subject to problems associated with oxygen sensing elements having a heater for raising the temperature up to the predetermined activation temperature. Furthermore, document DX9 neither explicitly nor implicitly discloses that the external lead electrode 16 has a circumferential width in the range 0.1 mm to 5 mm. According to document DX9, the part-length extension of the sensing electrode is provided because the part-length extension is regarded as being advantageous for reducing the amount of material needed for forming the sensing electrode. Therefore, the teaching of document DX9 does not prompt the skilled person, faced with the technical problem to be solved by the invention, to modify the oxygen sensing element according to document X1 to reach the subject matter of claim 1.

VII. Consequent to the request of the appellant, oral proceedings were appointed by the board. In a communication attached to the summons, the board informed the appellant as follows.

The focus of the appeal was on inventive step. A certain commonality between document DX9 and the application existed in relation to economising on catalyst materials by covering only a portion of the surface of the solid electrolyte exposed to hot gases, in particular in covering only the exterior of the bottom portion. Reference could be made to page 31, first three lines of the application and page 6, lines 2 to 10 of document DX9, these being passages noted by the examining division and the appellant.

It did seem that saving precious metal was just as valid for a sensing element with a heater as for one without a heater. Moreover, as the examining division pointed out, covering or partially covering was in any case commonplace. Concentrating on temperature distribution would not seem to the board to be a convincing response to this argument. On the question of dimensions, the examining division gave its view as to what was obvious to the skilled person and why. Would the skilled person have assumed other values and if so why? It seemed obvious for the skilled person to have provided a sensing element as claimed.

The appellant should not be surprised should the board find it necessary to refer to any of the prior art documents in the file if any further arguments advanced or amendments made called for this for their proper treatment.

VIII. During the oral proceedings, the appellant filed claims according to the first to fourth auxiliary requests and argued as follows.

In the present case, there is a large amount of prior art, of which document X1 shows a contact portion yet is silent about electrodes. One should bear in mind that document DX9 is from 1972, when heating was not so fast. Figures 8 and 9 of the application show the quick heating of the invention. Modern sensors are thus quicker and more precise and, before the invention, the teaching was that, for them, the heater should be completely covered to provide a strong signal from a larger area. Departing from this teaching is not straightforward, as is shown, for example by the teaching of document D15 which moves away from the



invention by failing even to teach heater contact in Figure 6 thereof. Moreover, in developing the sensor of document X1 economic use of material need not be a key issue, as can be seen from document X2, column 5, lines 51 et seq., where expensive material is wasted in forming grooves. The appellant agreed, however, with a comment from the board that the heater was involved at this reference. The appellant went to submit, moreover, that the "technical" problem addressed by the invention relates to heating the sensor and not to saving expensive material because the latter is not a technical problem, the sensor, in fact, being cheaper when the heater is left out as in document X7, DX9 or D10.

The chairman observed that as remarked by the examining division in its decision, document D10 can be taken in place of document X7 in its analysis. Furthermore, the issue of how to modify the structure technically so that it requires less expensive material was indeed a technical problem.

On the substance of its auxiliary requests, the appellant argued that the first auxiliary request relating to chemical plating of the sensing electrode was a selection of a way of making the sensor which had the additional benefits set out on page 6 of the application. The sensor was made more reactive and more sensitive thereby. The chairman pointed to the second and third lines on page 6 of the decision under appeal reciting that the subject matter of claim 4 was conventional, referring for example to lines 7 to 12 on page 10 of document DX9. The appellant explained that, although the claim was not detailed on this point, it had been realised that aspects in relation to chemical plating at the very high operating temperature of the

sensor are very important. This had not been thoroughly examined before the first instance and this was why the case should be remitted for such examination, rather than the matter being decided by the board.

With respect to the second auxiliary request, the appellant explained that the sensor was easier to manufacture if the reference electrode and external lead electrode are manufactured using chemical plating. The third and fourth auxiliary requests show advantageous ring or bell and bend shaped configurations for the sensing electrode, and, moreover, the terminology was clarified and consistent with the description.

In relation to the newly filed third and fourth auxiliary requests, the chairman referred to the disclosure of Figures 2 to 5 of document D10 and to that of Figure 6 of document D15 previously referred to by the appellant. The appellant explained that document D10 discloses no heater and neither can the temperature be reduced by the lead electrode as it is not smaller than the sensor as in the fourth auxiliary request. With reference to the third and fourth auxiliary requests, the appellant remarked that they showed amendments in US format so that underlined portions of the claims should be read as part of the claim, whereas struck out portions should be read as cancelled.

- IX. The independent claims of the main and auxiliary requests are worded as follows. The third and fourth auxiliary requests are reproduced without strike throughs and underlining for simplification and so as to be read as indicated by the appellant (the claims as filed are attached to the minutes of the oral proceedings before the board).

Main Request

"1. An oxygen sensing element, comprising:  
a cup-shaped solid electrolytic body (10) with one end closed and an inside space serving as a reference gas chamber (18),  
a sensing electrode (11) for generating a sensing signal provided on an outer surface (101) of said solid electrolytic body (10) so as to be exposed to a measuring gas,  
an external lead electrode (111) which extends on said outer surface (101) of said solid electrolytic body (10) to transmit the sensing signal from said sensing electrode (11) to the outside,  
a reference electrode (12) provided on an inner surface (102) of said solid electrolytic body (10), and  
a heater (19) disposed in said reference gas chamber (18),  
wherein a gas receiving surface region (13), exposed to the measuring gas when said oxygen sensing element is operated, is provided on said outer surface (101) of said oxygen sensing element so as to extend from a distal end (14) of said oxygen sensing element to a position spaced by a distance L away from said distal end (14),  
wherein said oxygen sensing element comprises a contact portion (100) having a region (Pi) where said heater (19) is brought into contact with said inner surface (102) of said solid electrolytic body (10) and an opposing region (Po) on said outer surface (101) of said solid electrolytic body (10), at least part of said contact portion (100) being located in a region extending from said distal end (14) of said oxygen sensing element to a position spaced by a distance 0.4 L away from said distal end (14), and

wherein said sensing electrode (11) is placed at least at a part of said contact portion (100) so as to be heated by said heater (19),  
characterized  
in that said sensing electrode (11) is entirely located in a region extending from said distal end (14) of said oxygen sensing element to a position spaced by a distance 0.8 L away from said distal end (14), and in that said external lead electrode (111) has a circumferential width in the range from 0.1 mm to 5 mm, the circumferential width of said external lead electrode (111) being smaller than that of said sensing electrode (11)."

#### First Auxiliary Request

Claim 1 of this request differs from that of the main request only in that the word "and" is deleted between the characterising features and the following added at the end

", and in that said sensing electrode (11) is formed by chemical plating."

#### Second Auxiliary Request

Claim 1 of this request differs from that of the main request only in that the word "and" is deleted between the characterising features and the following added at the end

", and in that said reference electrode (12), said sensing electrode (11) and said external lead electrode (111) are formed by chemical plating."

#### Third Auxiliary Request

"1. An oxygen sensing element, comprising:

a cup-shaped solid electrolytic body (10) having an outer surface (101), a {sic} one end closed so as to form a cup shape in a longitudinal direction of the solid electrolytic body, and an inside space sectioned therein by an inner surface (102) so as to extend in the longitudinal direction, the inside space serving as a reference gas chamber (18), the outer surface of the closed one end providing an element tip (14) of the solid electrolytic body,

a sensing electrode (11) for sensing a gas to be measured to output a sensing signal, the sensing electrode being provided on the outer surface (101) of said solid electrolytic body (10) and exposed to the gas when being measured,

an external lead electrode (111) disposed on the outer surface (101) to extend on said solid electrolytic body (10) to transmit the sensing signal from said sensing electrode (11) to an outside of the oxygen sensing element,

a reference electrode (12) provided on the inner surface (102) of said solid electrolytic body (10), and a heater (19) disposed in said reference gas chamber (18),

wherein the oxygen sensing element is configured to have a gas receiving surface region (13) which is exposed to the gas provided on said outer surface (101) so as to extend from the element tip (14) to a position of the solid electrolytic body spaced by a distance L away from said element tip (14) in the longitudinal direction,

wherein said oxygen sensing element comprises a contact portion (100) having a region (Pi) where said heater (19) is brought into contact with said inner surface (102) and an opposing region (Po) located on said outer surface (101) so as to be opposed to the region,

at least part of said contact portion (100) being located in a desired region of the solid electrolytic body in the longitudinal direction, the desired region extending from said element tip (14) to a position of the solid electrolytic body spaced by a distance  $0.4L$  away from said element tip (14) in the longitudinal direction, and

wherein said sensing electrode (11) is located to reach, at least, a part of said contact portion (100) in the longitudinal direction, characterized

in that said sensing electrode (11) is located in the longitudinal direction only in the range extending from a position of the solid electrolyte body spaced by a distance  $0.2L$  away from the element tip to a further position of the solid electrolyte body spaced by a distance  $0.44L$  apart from the element tip, and in that said external lead electrodes (111) has a circumferential width in a circumferential direction of the solid electrolyte body in the range from 0.1 mm to 5 mm, the circumferential width of said external lead electrode (111) being smaller than that the circumferential width of said sensing electrode (11)."

#### Fourth Auxiliary Request

"1. An oxygen sensing element, comprising:  
a cup-shaped solid electrolytic body (10) having an outer surface (101), a {sic} one end closed so as to form a cup shape in a longitudinal direction of the solid electrolytic body, and an inside space sectioned therein by an inner surface (102) so as to extend in the longitudinal direction, the inside space serving as a reference gas chamber (18), the outer surface of the

closed one end providing an element tip (14) of the solid electrolytic body,  
a sensing electrode (11) for sensing a gas to be measured to output a sensing signal, the sensing electrode being provided on the outer surface (101) of said solid electrolytic body (10) and exposed to the gas when being measured,  
an external lead electrode (111) disposed on the outer surface (101) to extend on said solid electrolytic body (10) to transmit the sensing signal from said sensing electrode (11) to an outside of the oxygen sensing element,  
a reference electrode (12) provided on the inner surface (102) of said solid electrolytic body (10), and  
a heater (19) disposed in said reference gas chamber (18),  
wherein the oxygen sensing element is configured to have a gas receiving surface region (13) which is exposed to the gas provided on said outer surface (101) so as to extend from the element tip (14) to a position of the solid electrolytic body spaced by a distance L away from said element tip (14) in the longitudinal direction,  
wherein said oxygen sensing element comprises a contact portion (100) having a region (Pi) where said heater (19) is brought into contact with said inner surface (102) and an opposing region (Po) located on said outer surface (101) so as to be opposed to the region in a radial direction of the solid electrolytic body (10),  
at least part of said contact portion (100) being located in a desired region of the solid electrolytic body in the longitudinal direction, the desired region extending from said element tip (14) to a position of the solid electrolytic body spaced by a distance 0.4L

away from said element tip (14) in the longitudinal direction, and  
wherein said sensing electrode (11) is located to reach, at least, a part of said contact portion (100) in the longitudinal direction, characterized  
in that said sensing electrode (11) is located i) in the longitudinal direction only in the range extending from the element tip to a position of the solid electrolyte body spaced by a distance  $0.56L$  apart from the element tip and ii) partly in a circumferential direction of the solid electrolyte body, and  
in that said external lead electrodes (111) has a circumferential width in the circumferential direction in the range from 0.1 mm to 5 mm, the circumferential width of said external lead electrode (111) being smaller than the circumferential width of said sensing electrode (11)."

- X. At the end of the oral proceedings, the board gave its decision.

### **Reasons for the Decision**

1. The appeal is admissible.
2. Main request
  - 2.1 Novelty

Claim 1 up for decision before the board is the same as that before the examining division. The novelty analysis made by the examining division in relation to claims 1 compared with the disclosure of document X1 was not disputed by the appellant and the board itself sees no reason further to investigate this analysis.



This analysis leads to novelty over the disclosure of document X1 being understood to be given by virtue of features claimed in the characterising part of the claim pertaining to the location and extension of the sensing electrode and width of the lead electrode.

2.2 Problem addressed by the novel subject matter

2.2.1 The novel features of the claim can be considered to solve both (a) the problem of efficient heating and (b) the problem of efficient use of expensive material.

2.2.2 The board has no doubt that the skilled person was well aware of the very well known problem (b) and an example underlining the importance of economising on catalyst materials is given in document DX9, page 6, lines 3 to 9 as follows: "In order to economise on catalyst materials, primarily when these materials comprise platinum or predominantly platinum metals, it is advantageous if only a portion of the surface of the solid electrolyte exposed to the exhaust gas is covered by the layer. Thus, when the solid electrolyte is in the form of a tube, it is sufficient to cover only the exterior of the bottom portion with the layer,..." [translation by the board]. Reference can also be had to the Abstract of document D10, as follows: "Capacity as an oxygen detector is displayed sufficiently by making the area of this electrode 1/10 whole area of the leg of the element. Hereby, use of precious noble metal is decreased in quantity and price is lowered." Moreover, while not explicitly recited, a saving of material self evidently takes place in the Figure 1 configuration of document X7. Therefore, in taking the technical step of designing a sensor electrode efficiently to use expensive material, the skilled person meets the requirement of the sensing

electrode being entirely located in a region extending from the distal end of the oxygen sensing element to a position spaced by a distance of 0.8 times the length of the gas receiving surface region.

2.2.3 So far as the width of the leads is concerned, although it is true that a specific width value is not given in the prior art documents, the board is persuaded by the position of the examining division that the outer diameter of the cup-shaped electrolytic body is normally around 8 mm, so that Figure 1 of document X7 implies that the width of the external lead electrode lies in the range from 0.1 mm to 5 mm. The same consideration applies, for example to document D10. No argument was offered as to why the skilled person would expect any other width. Accordingly, the board does not accept that only mere speculation leads to the dimensions claimed, but considers rather more, that they are obvious.

2.2.4 The board therefore reached the view that the subject matter of claim 1 is obvious to the skilled person so that no inventive step can be considered to be involved therein.

2.2.5 The position of the appellant that the problem addressed by the novel features of the claim was problem (a) rather than problem (b), as mentioned in section 2.2.1 above, and that therefore problem (b) should be left aside does not convince the board. This is because the arguments submitted are not convincing as, for example, a skilled person starting from document X1 to design the electrodes has no reason to dispense with contact between the heater and electrolytic body whatever document D15 shows in this respect, as the designing concerns the electrodes, not

the heater. Designing an electrode by not covering the entire sensing element is a technical matter and not just a financial cost cutting exercise. Moreover, the contention that partial covering applies in the prior art only to sensors without a heater is not persuasive. For instance, document DX9 shows a covered unheated sensor element in Figure 1 and a partially covered unheated element in Figure 3, the latter meeting problem (b), the former not doing so. Moreover, heating by the gas to be measured occurs in all cases, whether a heater is provided or not. The onward march of technology between the dates of the prior documents does not affect the efficient use of expensive material whatever the calendar timepoint concerned. The submission that the skilled person would have reduced costs by leaving the heater out from the sensing element shown in document X1 is not convincing because the improvement concerned relates to the electrode covering and not to other items in the sensing element. Furthermore, the allegation that the teaching of document X2 shows that saving expensive material is not very important did not persuade the board because the passage cited refers not to any noble metal coating as sensing electrode but to removing glass and palladium to form a spiral glass and palladium wiring of the heater element and the lead to the inner electrode.

3. Remittal to the First Instance for examination of the "First Auxiliary Request"
- 3.1 The board does not share the view of the appellant that subject matter relating to plating had not been thoroughly examined before the first instance. This is because the subject matter concerned was claimed in the then dependent claim 4 about which the division stated in the decision under appeal that it was conventional,

as shown for example on page 10, lines 5 to 11 of document DX9 ("chemische Reduktion und galvanische Abscheidung"). As a matter of interest, a corresponding objection had also already been made in an official communication of 24 March 2005 during the examining procedure.

- 3.2 The board therefore concluded that the subject matter concerned had been examined by the first instance and that therefore there was no reason to remit the case on this basis for examination of the "First Auxiliary Request".

4. First Auxiliary Request

This request adds to the main request in substance the forming of the sensing electrode by chemical plating. The board agrees with the appellant that this is a selection of a known method. For instance, page 6, lines 28 to 29 of the application recite "In general, chemical plating, conductive paste printing, sputtering or evaporation is preferably used in the formation of various electrodes." The appellant's position is also confirmed by, for example, document X7, column 7, lines 42-44, "Application of the electrodes can take place in thick film technology, for example dipping, printing or spraying" [translation by the board].

- 4.1 The board has also no reason to dispute that chemical plating results in the sensor being more reactive and sensitive. For example, page 7, lines 2 to 5 of the application recite that "Furthermore, compared with the electrode formed by sputtering or evaporation, the electrode formed by the chemical plating has numerous fine pores which contribute the diffusion of oxygen and therefore improve the response." The board sees this

confirmed in relation to micro-pores, for instance in the paragraph bridging pages 5 and 6 of document DX9, "The pore density must be such that at least 0.01% of the surface of the catalysing layer comprises micro-pores or micro-cracks." [translation by the board]

4.2 However, while agreeing with the appellant's points, the board does not consider this situation to amount to an inventive step because the skilled person would have tried all the standard methods and selected one by weighing its known advantages and disadvantages in a routine way against those of the others. In other words the simple choice of any of the known methods in the circumstances of the present case is not inventive. In the present case, there are, as the appellant observed, no details pertaining to the chemical plating present in the claim, nor indeed is there anything in the description going further. The board therefore agrees with the examining division about chemical plating being a standard procedure and was not able to see any subject matter going beyond this which might confer an inventive step.

4.3 The board therefore reached the view that the subject matter of claim 1 of the first auxiliary request is obvious to the skilled person so that no inventive step can be considered to be involved therein.

## 5. Second Auxiliary Request

5.1 This request adds to the first auxiliary request that the reference electrode and external lead electrode are formed by chemical plating. Here the argument advanced in support of inventive step is that manufacture is simplified when several items are formed in the same way by chemical plating, which is self

evident. The skilled person would again have chosen the methods by weighing advantages and disadvantages in a routine way. Accepting a known advantage of a unitary manufacturing process in this way, even for items where, say, pore density is not so significant, would be set against disadvantages. This amounts to no more than a routine procedure and therefore the board does not see any inventive step in the subject matter concerned.

5.2 The board therefore reached the view that the subject matter of claim 1 of the second auxiliary request is obvious to the skilled person so that no inventive step can be considered to be involved therein.

## 6. Third Auxiliary Request

6.1 The terminology of the claim has been generally adapted to that of the description. Thus "cup shape" and "inner surface" are more precisely defined by the term "tip" in place of "distal end". However, these amendments concern the pre-characterising part of the claim and are thus acknowledged as prior art, so not affecting the negative view of the board on inventive step.

6.2 A substantive difference in the characterising part of the claim is that the sensing element is located only in the regions extending from 0.2L to 0.4L from the tip, i.e. the ring or bell shape referred to by the appellant in the oral proceedings. The amendment offered amounts in comparison with claim 1 of the main request to a further restriction of use of expensive material. For this reason the amendment continues to be directed to solving problem (b) mentioned in point 2.2.1 above. Document D10, for example, discloses a cup shaped electrode range of 0.1 to 2/3 of the surface

area of the exposed leg, in other words, including the claimed range. The third auxiliary request relates particularly to use of a ring shaped element of the sort shown in Figures 15 and 30 of the application. A ring shaped element amounts to no more than an obvious design modification, which, as such, is disclosed in Figure 6 of document D15 as referred to during the oral proceedings. Therefore, in pursuing the objective of efficient use of noble metal, the board considers it obvious that points in the claimed range such as the midpoint of the range would be tried as obvious further alternatives to the Figure 2 and 3 type configurations of document D10, thus meeting the claim so that the amendment made cannot be considered to introduce any inventive step into its subject matter.

6.3 The board therefore reached the view that the subject matter of claim 1 of the third auxiliary request is obvious to the skilled person so that no inventive step can be considered to be involved therein.

#### 7. Fourth Auxiliary Request

7.1 The terminology of the claim has been generally adapted to that of the description. The substantive difference is that that the location is up to  $0.56L$  and the electrode is located partly in a circumferential direction, i.e. the bend (or band) shape referred to by the appellant in the oral proceedings. The bend (or band) again solves the problem of efficient use of expensive material. Document D10, for example, discloses a bend electrode in Figure 4 thereof. It is true that the lead electrodes are not of smaller circumferential width unlike other Figures in document D10. This situation does not, however, detract from the disclosure of partial circumferential coverage as such.

It is no more than an obvious design choice for the skilled person to reduce circumferential coverage as appropriate to balance routine design desiderata, whether the down to the lead width or not, the former naturally being easier to manufacture. The amendment therefore amounts to no more than another obvious modification to the electrode.

7.2 The board therefore reached the view that the subject matter of claim 1 of the fourth auxiliary request is obvious to the skilled person so that no inventive step can be considered to be involved therein.

8. In the light of the foregoing, the board was not convinced by the appeal that the decision of the examining division was incorrect.

### **Order**

### **For these reasons it is decided that:**

The appeal is dismissed.

The Registrar:

The Chairman:

M. Kiehl

F.J. Narganes-Quijano