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 398/91 - 3.4.2

Application No.: 84 200 240.4

Publication No.: 0 152 636

Title of invention: Electrode assembly for measuring the concentration of an electro-chemical active species

Classification: G01N 27/46

D E C I S I O N
of 26 June 1992

Proprietor of the patent: Yokogawa Europe B.V.

Opponent: Drägerwerk AG

Headword:

EPC Articles 54, 102(1)

Keyword: Novelty of main claim: no (alleged distinguishing feature neither explicitly nor directly and unambiguously implicitly disclosed)

Headnote

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number : T 398/91 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 26 June 1992

Appellant : (Proprietor of the patent)
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Representative :
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Respondent : (Opponent)
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Decision under appeal :
Decision of Opposition Division of the European Patent Office dated 6 February 1991, posted on 20 March 1991 revoking European patent No. 0 152 636 pursuant to Article 102(1) EPC.

Composition of the Board :

Chairman : E. Turrini
Members : M. Chomentowski
L. Mancini

Summary of Facts and Submissions

I. The Appellant is proprietor of European patent No. 0 152 636, which was granted on the basis of European patent application No. 84 200 240.4.

II. Claim 1 of the patent in suit reads as follows:

"1. An electrode assembly for measuring the concentration of an electro- chemical active species, such as oxygen, in a fluid; having:
first metallic electrode means (2, 15) permeable to said species and provided with a first surface exposable to said species and a second surface contacting an electrolytic medium (4, 14);
a barrier means (1, 11) for separating said electrolytic medium from said fluid; which barrier means is permeable to said species;
a second electrode means (5, 19) having a surface in contact with said electrolytic medium;
and electrical connections (7, 8, 16, 20) extending from said first and second electrode means for connection to a current measuring means and allowing a current to flow through said first electrode means for electro-chemically absorbing said species at said first electrode means and through said second electrode means without restoring said species in the electrolytic medium:
characterized in that said first electrode means (2, 15) contains a layer of sufficiently small thickness to be permeable to the said species, the said first surface of it is immediately mounted to said barrier means, which supports it and that the said second surface of the first electrode means is in free contact with the said electrolytic medium."

Claims 2 to 8 are dependent claims.

III. The Respondent (Opponent) filed an opposition against the European patent, in particular on the grounds that the subject-matter of the claims of the opposed patent lacked novelty or an inventive step having regard inter alia to the disclosure in

E1 = US-A-3 574 078.

The Respondent additionally argued that the patent did not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art.

IV. The Opposition division revoked the patent on the grounds that, although the patent was considered as sufficiently disclosing the invention and although the subject-matter of the claims of the opposed patent was considered as novel having regard to the prior art because none of the prior art documents disclosed an apparatus with a thin electrode layer in the sense of the opposed patent, said subject-matter however lacked an inventive step with respect to the disclosure in, inter alia, E1.

V. The Appellant filed an appeal against this decision. He requested that the decision under appeal be set aside and that the patent be maintained in the form as granted.

VI. The Respondent requested that the appeal be dismissed and that the patent be revoked.

VII. In a communication, the Board informed the parties that it was of the provisional opinion that the subject-matter of Claim 1 of the patent in suit lacked novelty having regard to the disclosure in E1 and that the dependent Claims 2 to 8 did not contain matter which could be considered as

implying an inventive step with regard inter alia to the same prior art document.

VIII. The Appellant submitted the following arguments in support of his request. Contrary to the metallic layer in the known assembly, which is porous, the metallic layer of Claim 1 in suit is continuous and not porous and is made thin enough so that the sample species (oxygen) can diffuse through it and thus immediately react when reaching the electrolyte which is maintained on the other side of the metallic layer. The prior art does not suggest the use of a metallic layer which is of a non-porous structure such that the oxygen flow therethrough is admittedly reduced but such that the electrolyte does not penetrate therein and thus is farther away from the diffusing oxygen. Thus, by replacing a known porous structure by an unsuggested non-porous thin layer and thereby overcoming the prejudice of the time lag due to reduced oxygen flow and to the lack of immediate contact between the membrane and the electrolyte, the electrode assembly of Claim 1 in suit is novel and implies an inventive step.

IX. The Respondent submitted the following arguments in support of his request. The patent in suit does not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art. Moreover, the claimed device is not disclosed in such a way that it can be distinguished over the known structures, in particular those which are formed by using the same deposition methods as the disputed device. Therefore, the subject-matter of the claims lacks novelty or an inventive step.

Reasons for the Decision

1. The appeal is admissible.

2. Novelty

2.1 An electrode assembly for measuring the concentration of an electro-chemical active species, such as oxygen, in a fluid, is known from E1 (see column 2, lines 33 to 44; column 2, line 59 to column 3, line 25; column 4, lines 9 to 25; Figures 1, 2a and 2b; Figure 3; see also Claim 1); the known electrode assembly has first metallic electrode means (the electrode body (12a)) provided with a first surface exposable to said species and a second surface contacting an electrolytic medium (11); insofar as the electrode body is concerned generally, it can be any type of electrically conductive body capable of allowing diffusion or permeation of the particular species of interest through the diffusion medium (12), i.e. through the species permeable barrier layer (12c), through the species permeable carrier layer (12b) and through the first metallic electrode means (12a) embedded in said last layer; thus, the first metallic electrode means (12a) is permeable to the sample species in that sense that it allows diffusion of the sample species from the fluid to the electolytic medium (11);
as mentioned above, the diffusion medium (12) of the known electrode assembly comprises in particular the species permeable barrier layer (12c) and the species permeable carrier layer (12b), and is in a sealing position across the opening of the chamber of the electrochemical sensor, and thus separates the electrolyte medium (11) from the fluid comprising the species; since at least in the preferred known embodiment of Figures 1 to 3 the first metallic electrode means (12a) is apertured and thus does not separate the electrolytic medium from the fluid, it is

the composite layer (12b, 12c), comprising the superposed layers (12c) and (12b), which, in accordance with its mentioned functions, is a separating species permeable barrier means (12b, 12c); the known electrode assembly also has a second electrode means (15) which has a surface in contact with said electrolytic medium (11), and electrical connections (16, 17) which extend from said first and second electrode means for connection to a current measuring means and allow a current to flow through said first electrode means for electro-chemically absorbing said species at said first electrode means and through said second electrode means without restoring said species in the electrolytic medium.

As already mentioned above, the said first surface of said known electrically conductive body (12a) is embedded in the carrier part (12b) of said barrier means (12b, 12c) and is thus immediately mounted to said barrier means, which supports it, and
the electrical body is permeable to the sample species; moreover, the second surface of said electrically conductive body (12a) of E1 (see in particular column 4, lines 9 to 25) has contact sites with the electrolytic medium (11) and is thus in free contact with it.

2.2 The Appellant has submitted that the subject-matter of Claim 1 in suit is distinguished over the known device; in particular, contrary to the conductive layer of Claim 1 in suit, the grid of E1, in the form of a mesh, is not a layer; moreover, contrary to the conductive layer of Claim 1 in suit, which allows diffusion of the sample species, the electrode body (12a) of E1 has not said properties because, although it does not hinder diffusion through the diffusion medium, it is clearly the carrier layer (12b) and not the conductive metallic body (12a) which allows diffusion; permeability exists in the diffusion medium

(12) by means of the carrier layer (12b) mostly at the locations where no metallic material is present, but the electrode itself is not permeable in the sense of the patent in suit. The Appellant has further argued that, although the patent in suit does not mention that the layer is continuous or non-porous, its whole content indicates unambiguously said features; in this respect, he has also submitted that, contrary to the metallic layer of Claim 1 in suit, which is continuous and not porous and is made thin enough so that the sample species (oxygen) can diffuse through it and thus immediately react when reaching the electrolyte which is maintained on the other side of the metallic layer, the metallic layer in the known electrode assemblies is either in the form of an apertured mesh or screen, as in E1, or is porous, as in other prior art documents; having regard to this property of the layer, the feature of Claim 1 in suit that the layer contained in the first electrode means is "of sufficiently small thickness to be permeable to the said species" is quite clear to the expert, and any other interpretation of the text of the patent, or of the text of the application as filed, would not make sense; in particular, a perforated foil is permeable with all thicknesses and to an extent which normally is far greater than is obtainable with a foil of the lowest thickness commensurate with a mechanically acceptable layer; in the application in suit, no perforations in the metal layer were meant because, with such perforations, a direct electrolyte leakage would have occurred towards the medium to be monitored.

2.3 However, these arguments are not considered as relevant for the following reasons. In E1 (see column 4, lines 9 to 25), the electrode body (12a) is mentioned as having the following two particular functions in the electrode assembly: it is a conductive body capable of allowing

diffusion or permeation of sample species through the diffusion medium (12) of which it is a part (function of species permeability); it provides contact sites with the electrolyte to allow the chemical reactions necessary for operation of the cell (electrical function).

2.3.1 Concerning the electrical function, it is to be noted that, in the preferred known embodiment illustrated by Figures 1 to 3 of E1 (see column 3, lines 2 to 8), the electrode body (12a) is exposed to electrolyte (11), in particular as shown in Figure 1, i.e. at least along the whole surface of the opening of the chamber (10), and is electrically contacted by an electrical lead (16); the statement that, with respect to the particularly preferred screen-like or mesh electrode, it is preferred that a fine mesh or screen of suitable metal be used, and that, the finer the mesh, the more desirable it is from an operational standpoint, is a clear indication that as many contact sites as possible along the surface of contact with the electrolyte is a desirable feature for the operation of the electrode assembly; indeed, in this respect, apertures of any kind in the surface of contact of the electrode body result in less contact sites, i.e. less sites where the chemical reactions necessary for operation of the cell take place. Thus, from the electrical point of view, it is derivable from E1 that a conductive body consisting of a layer of the type of the apertured layer (12a) of Figures 1 to 3, extending across the opening of the cell (10) and having a mesh as fine as possible, and even no mesh at all, i.e. a metallic layer without apertures, fulfills the electrical requirements of the electrode body.

2.3.2 From the point of view of the function of permeation, the same statement that, with respect to the particularly preferred screen-like or mesh electrode, it is preferred

that a fine mesh or screen of suitable metal be used, and that, the finer the mesh, the more desirable it is from an operational standpoint, is a clear indication that, by reducing the dimensions of the apertures in the apertured electrode body (12a), i.e. by providing less area free of electrode body at the interface with the electrolyte (11), the operation of the cell is not negatively influenced. Moreover, since E1 (see column 4, lines 17 to 25) also states that, insofar as the electrode body is concerned generally, it is not necessary that it be a mesh or screen since it can be any type of electrically conductive body capable of allowing diffusion or permeation of the particular species of interest, it is directly derivable that a conductive body without apertures and of a structure such that it allows diffusion or permeation of the species would fulfill the requirement of permeation of the electrode body. In this respect, it is to be noted that E1 (see column 2, lines 37 to 44) stresses that it is a part of the diffusion layer different from the electrode body which controls the diffusion of the species into the cell. Therefore, it is derivable from E1 that a conductive body consisting of a layer of the type of the apertured layer (12a) of Figures 1 to 3, extending across the opening of the cell (10) and having a mesh as fine as possible, and even no mesh at all, i.e. a layer without apertures and capable of allowing permeation of the species, fulfills the requirements of permeability of the permeable electrode body.

2.3.3 Therefore, the Board is of the opinion that first metallic electrode means consisting of a layer without apertures and capable of allowing permeation of the species, is disclosed in E1.

2.3.4 Concerning the technical content of the patent in suit, it is to be noted that, as admitted by the Appellant, said

patent does not explicitly disclose that the claimed first metallic electrode means is a non-porous or continuous layer and no such explicit teaching is disclosed in the corresponding patent application as filed either. In this respect, there is no explicit teaching in the patent in suit (see column 2, lines 41 to 48 and column 4, lines 18 to 20) that the sample species passes through the metallic layer by diffusion; it is to be noted that, for any non-apertured layer of porous material, i.e. whereby the pores do not form apertures between both faces of the layer, and for any non-porous layer, the permeability is increased when the thickness of said layer is made smaller, because the distance which the species has to pass to transit from one face of the layer to the opposite surface thereof, is smaller for thinner layers. Therefore, the mentioned structural feature that the metallic layer is of sufficiently small thickness does not result in a direct and unambiguous way in the alleged distinguishing structural feature that said layer is non-porous and continuous.

Indeed, a continuous and non-porous layer is less permeable for electrolyte than an apertured layer. However, there is no direct technical relation between the porousness of a layer and the permeability for an electrolyte, because the pores may not form apertures between the faces of the layer and because, for pores of small dimensions, there may be no transit of the electrolyte due to the nature of said electrolyte. Therefore, even if there are indications in the patent in suit and in the corresponding application as filed that the layer should be impervious to said electrolyte and should forbid that it passes onto the first surface of the layer, there is no direct relation between said functional feature and a non-porous and continuous structural feature of said layer, at least as long as for instance the

dimensions of the included voids or pores are not specified.

As credibly argued by the Respondent, neither the patent in suit nor the corresponding patent application as filed disclose the electrode assembly in dispute, and in particular the specific features of the process for its fabrication, so that the alleged non-porous and continuous layer be obtained; thus, by amending the patent in suit to include the alleged structural features so that they would correspond to the interpretation provided by the Appellant, it would be necessary to include additional subject-matter, for instance specific technical features of the fabrication process, and this would not be allowable (Article 123(2) EPC). Therefore, the alleged continuous and non-porous property of the metallic layer of the device in dispute is not included in the patent in suit and is thus not a distinguishing feature.

2.4 Therefore, since all the features of the subject-matter of Claim 1 in suit are known from E1, said subject-matter is not novel in the sense of Article 54 EPC.

3. The Appellant has suggested that a new main claim, consisting of the combination of Claim 1 and dependent Claims 2 and 3 of the patent in suit, could be allowable, but has not requested formally any amendment. In relation with the dependent Claims 2 and 3, the following is to be noted.

A device obtained by a vacuum deposition method for producing a metal foil is mentioned in E1 (see column 1, line 69 to column 2, line 12) with the resulting advantage that the cathode inescapably moves with the membrane and that the problem of distance variation disappears. Although in other respects disadvantages of this

deposition method, in particular a lack of adherence to the membrane, are also mentioned in E1, this method is disclosed and can be used by the skilled person in accordance with the accepted limitations of the produced sensor. Thus, the vacuum deposition and the further sputtering and chemical deposition techniques, which are cited in Claim 2 in suit to obtain the claimed device and which are generally known equivalent deposition techniques, could be used in an obvious way for producing the metallic electrode layer of E1, and therefore, the Board is of the opinion that the features of Claim 2 as granted would not provide any inventive contribution to the disputed device. Moreover, a thickness range of 0.1 to 20 μm encompasses the thickness values mentioned in E1 (see column 3, lines 51 to 57); noble metals are also mentioned in E1 (see column 4, lines 13 to 16). Therefore, the Board is of the opinion that Claim 3 as granted cannot be considered as contributing to an inventive step of the disputed device.

These considerations were already stressed in the communication of the Board.

4. Therefore, the Board is of the opinion that the patent in suit is not allowable in the sense of Article 52(1) EPC and thus, since the grounds for opposition mentioned in Article 100(a) EPC are considered as prejudicing the maintenance of the patent, it has to be revoked (Article 102(1) EPC).

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

P. Martorana E. Turrini

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