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D E C I S I O N
of 19 July 1996

Case Number: T 0660/93 - 3.4.2

Application Number: 87308883.5

Publication Number: 0263692

IPC: G01N 21/64, A61B 5/00

Language of the proceedings: EN

Title of invention:
Gas sensor

Applicant:
MINNESOTA MINING AND MANUFACTURING COMPANY

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56

Keyword:
"Novelty (main and third auxiliary request: no)"
"Inventive step (first and second auxiliary request: no)"

Decisions cited:
T 0026/85, T 0198/84, T 0017/85

Catchword:
-



Case Number: T 0660/93 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 19 July 1996

Appellant:

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Decision under appeal:

Decision of the Examining Division of the European
Patent Office posted 8 March 1993 refusing
European patent application No. 87 308 883.5
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: E. Turrini
Members: R. Zottmann
L. C. Mancini

Summary of Facts and Submissions

I. The Appellant (Applicant) lodged an appeal against the decision of the Examining Division to refuse European patent application No. 87 308 883.5 with the publication No. 0 263 692.

II. In a communication pursuant to Article 110(2) EPC and in an annex to the summons to attend oral proceedings according to Article 11(2) of the Rules of Procedure of the Boards of Appeal, the Board expressed its preliminary opinion that none of the sets of claims submitted as main request and first to third auxiliary requests met the provisions of the EPC since at least each claim 1 of said requests lacked novelty or did not involve an inventive step with respect to the prior art disclosed in

(2): IEEE TRANSACTIONS ON BIOMEDICAL ENGINEERING, vol. BME-33, no. 2, February 1986, pages 117 to 132,

(3): EP-A-0 105 870 and/or

(4): Römpps Chemielexikon, 8th ed., vol. 2, Stuttgart 1981, pages 1126 to 1130, catchwords "Emulsionen" and "Emulgatoren".

Thereafter, the Appellant withdrew its request for oral proceedings.

III. The Appellant requested that the decision under appeal be set aside and that the patent be granted on the basis of the main set of claims or, alternatively, on the basis of one of the three auxiliary sets of claims filed with the letter dated 4 January 1996.

IV. Claim 1 of the main request reads as follows:

"1. A gas sensor comprising a gas-permeable, light-permeable, ion-impermeable and substantially aqueous-impermeable matrix having a plurality of micro-compartments dispersed therein and an aqueous phase in and substantially filling the micro-compartments, the aqueous phase containing a buffer and a water-soluble dye,

characterised in that the micro-compartments are formed directly in the polymeric matrix and are smaller than 5 micrometers in size."

Claim 1 of the first auxiliary request differs from claim 1 of the main request only in that feature

", and the polymeric matrix is located on an optical face of an optical fiber"

is added at the end of the claim.

Claim 1 of the second auxiliary request differs from claim 1 of the main request only in that feature

", and the aqueous phase includes an emulsification enhancement agent"

is added at the end of the claim.

Claim 1 of the third auxiliary request differs from claim 1 of the main request only in that "smaller than 5 micrometers in size" at the end of the claim is replaced by "smaller than 2 micrometers in size" (underlining added).

V. The Appellant's arguing with respect to claim 1 of the four requests is summarized as follows:

The person skilled in the art would not seriously contemplate applying the gas sensor according to the first embodiment of (3) in the range of overlap of (3) and claim 1 (0.1 to 5 or 2 μm). There are considerable difficulties to realize, when starting from the first embodiment of (3) where no solid spacers are used, a gas sensor with micro-compartments smaller than 5 or 2 μm . The range of the diameters according to (3) comprises three orders of magnitude and is, therefore, such an extensive numerical range that it does not represent a disclosure.

This view is supported by decisions T 0198/84 cited by the Appellant and T 0017/85 cited by the Examining Division. The application-in-suit is a valid selection invention in accordance with the first decision. The second decision is not relevant since the difference between (3) and the application-in-suit is far greater than the difference between the claimed range and the prior art in the second decision. As to decision T 0026/85 cited by the Board, it is believed that the application-in-suit is novel over (3) in accordance with said decision. This follows in particular from the fact that (3) is dissuading the skilled person from practising the teaching of said first embodiment since this embodiment is totally silent as to the diameter of the droplets and does not even mention that droplets of indicator solution are incorporated in the polymer membrane.

As to claim 1 of the first auxiliary request the appellant's additional arguing can be summarized as follows: The very large micells/spacers contemplated for use by (3) would lead the person skilled in the art away

from using the compositions of (3) on the small optical face of a typical optical fiber. There is no reason why (2) and (3) should be combined. Since the amount of matrix placed on the face of an optical fiber is substantially smaller than a layer applied to a smooth surface, as according to (3), the micells in the matrix on the optical fiber would be more susceptible to the influence of external forces, particularly during manufacture. Therefore, solid spacers would be used in the micells.

As to claim 1 of the second auxiliary request the appellant's additional arguing is focused on the following point: Document (3) does not disclose or suggest the inclusion of an emulsification enhancement agent.

Reasons for the Decision

1. The appeal is admissible

2. The Board finds that none of the four versions of claim 1 introduces subject-matter not contained in the application as originally filed and thus none of them infringes Article 123(2) EPC.

3. *Main request and third auxiliary request*

- 3.1 It is undisputed that document (3) discloses the nearest prior art with respect to the subject-matter of claim 1 and describes a gas sensor with all features of the preamble of claim 1. Reference is made to page 5 lines 1 to 30, page 12 line 22 to page 13 line 6 and claim 1. Moreover, the micro-compartments (called "Mizellen", to

be translated as mi-cells) of the gas sensor of (3) are formed directly in the polymeric matrix; reference is made to page 5 lines 8 to 18 and the characterizing part of claim 1 of (3) disclosing that the aqueous indicator solution is incorporated in the polymer membrane in homogeneous dispersion in the form of droplets in order to obtain the micro-compartments.

Accordingly, the sole matter of interest is whether from (3) the last feature (micro-compartments are smaller than 5 or, respectively, 2 μm) can be taken.

- 3.2 In (3) said micro-compartments, in a first embodiment (according to page 5 second paragraph to page 8 line 5, the first example on page 12 line 33 to page 13 line 6), are obtained - as in the application-in-suit - by incorporating aqueous phase containing the solved indicator dye in a hydrophobic matrix in homogeneous dispersion in the form of droplets which represent the micro-compartments (see page 5 paragraph 3). Said first embodiment corresponds also to the device described in the abstract and in claim 1 of (3).

In a second embodiment of (3) (page 11 line 17 to page 12 line 10, claims 7 to 9 and the second and third examples on page 13 line 7 to page 14 line 14) the matrix contains place-holders ("Platzhalter") in the form of small spheres consisting of glass, polyacrylamid etc. carrying absorbed or adsorbed dye solution.

It is only the first embodiment which is relevant with respect to the application-in-suit.

3.3 According to document (3) (see page 5 paragraph 2 and claim 1) the diameters of the dispersed droplets have an order of magnitude of 0.1 to 100 μm . This does, however, not mean that said diameters or the mean diameter may vary arbitrarily between said limits. The magnitude of the diameter of the droplets is not mentioned in the first example. However, the place-holders have the same order of magnitude as the droplets (see page 11 paragraph 4). Therefore and since in both examples of said second embodiment, the place-holders have a mean diameter of 20 μm , the mean diameter of the droplets of said first embodiment is preferably of an order of magnitude of 20 μm , and, therefore, can vary from several micrometers to a few tens of micrometers.

3.4 Decision T 0026/85 (of 20 September 1988, published in OJ 1990, pages 22 to 29) arrives at the following conclusions which are drawn under consideration of the earlier case law, e. g. T 0198/84 (of 28 February 1985) and T 0017/85 (of 6 June 1986), and which are consistent with said case law: The realistic approach in assessing the novelty of the invention under examination over the prior art in a case where overlapping ranges of a certain parameter exist, would be to consider whether the person skilled in the art would, in the light of the technical facts, seriously contemplate applying the technical teachings of the prior art document in the range of overlap. If it can be fairly assumed that he would do so, it must be concluded that no novelty exists (see headnote and 8. to 10.).

It may be that the Appellant's conclusion is true that there are considerable differences between the case of decision T 0017/85 cited by the Examining Division and the case to be decided here and thus the arguments against novelty of claim 1 may not be well-founded.

Anyway, the inverse conclusion, namely that said differences indicate that claim 1 is novel, is inadmissible. It seems that the only conclusion may be that said decision is not very helpful when judging novelty of claim 1.

Similar considerations apply to decision T 0198/84. The claimed range does not be an overlapping range but a very low section (ca. 0.18%) of the range of the prior art (ca. 0.18%) not comprising the limits of the range of the prior art, whereas in the present case there is an overlapping range which is moreover a much higher part (ca. 5% and, respectively, 2%) of the range of the prior art. Last but not least, the claimed range of said decision leads to an unexpected effect (less catalyst concentration provides a higher yield).

The case of decision T 0026/85 comes much closer to the present case. The overlapping range (the thickness $\bar{U}A$ of the recording layer is 0.1 to less than 0.3 μm) comprises several percent (6,9%) of the range of the prior art (0.1 to 3 μm) - in the present case ca. 5% and, respectively, 2% - , the preferred example ($\bar{U}A$ is 1 μm) is far removed from the nearest limit of the overlapping range ($<0.3 \mu\text{m}$) and thus by a factor of >3.3 greater than said limit - in the present case is the factor in the order of 4 and, respectively, 10, see section 3.3 above. As well in said decision as in the present case, the suitable range of the prior art is limited on both ends whereas the lower limit of the claimed range is zero. Moreover, it is stated in the prior art that, if the recording layer has the same thickness as in the overlapping range, those embodiments would not yield the best results. Nevertheless, the Board, in said decision, concluded that no novelty exists in the overlapping range. The only difference between said decision and the present case is that the

range of the prior art of said decision covers one and a half order of magnitude whereas the range in the present case covers three such orders. In view of the similarities of the present case and the case of decision T 0026/85 and the differences of the cases of each of decisions T 0198/84 and T 0017/85 on the one hand and the present case on the other hand, said difference between T 0026/85 and the present case is considered as being of minor importance.

Therefore, the Board, in the present case, follows the principle set up in decision T 0026/85.

- 3.5 Document (3) suggests that a certain mean diameter should be selected and that the mean diameter may vary between several micrometers and a few tens of micrometers (see 3.3 above), but in (3) nowhere is stated that a certain range is particularly preferred or should be excluded.

The skilled person knows that the smaller the droplets are the higher is their specific surface (that is the surface of the droplets per volume) and thus the more effective is the gas exchange of the droplets with the surrounding gas-permeable polymer matrix. Consequently, the sensitivity of the gas sensor increases with decreasing diameter of the droplets. Therefore, it is self-evident that in certain generally known commercial applications of gas sensors where high sensitivity for the gas components to be detected and/or where very small sensor sizes are requested or desirable, e. g. for in vivo gas sensors with optical fibres, the lower part of the range of 0.1 to 100 μm of (3) will be preferred. The effect that reduction of the diameter leads to a faster and more effective gas exchange into the aqueous phase is not unexpected.

In contrast to the arguing of the Appellant, the Board sees no difficulties to realize, starting from said first embodiment of (3), a gas sensor with all the features of claim 1, that is with dispersed droplets with diameters smaller than 5 or, respectively, 2 μm . To obtain such an emulsion, the skilled person would extend the time of homogenisation and/or increase the intensity of homogenisation and/or use emulsifiers.

On the one hand the Appellant argues that the range of the diameters according to (3) (comprising three orders of magnitude) is such an extensive numerical range that it does not represent a disclosure, on the other hand the ranges claimed in claims 1 of the application-in-suit cover in practice more than three orders of magnitude since emulsions with droplet diameters down to much less than 0.1 μm are usual in the art. Moreover, since the droplets in such emulsions can have diameters down to much less than 0.1 μm , said range of (3) does represent a restriction with respect to the obtainable diameters. Furthermore, the overlapping range covers more than one order of magnitude of the three orders of magnitude of (3). Similar considerations apply when the volumes are compared instead of the diameters.

Consequently, the skilled person would in the light of the technical facts seriously contemplate applying the technical teachings of (3) in the range of overlap.

- 3.6 Thus in the present case all conditions of the general principle set up in decision T 0026/85 are met which leads to the conclusion that no novelty exists in the range of overlap and therefore claim 1 of the main request and claim 1 of the third auxiliary request are not novel and not allowable under Articles 52(1) and (2) and 54 EPC.

4. *First auxiliary request*

Claim 1 of the first auxiliary request differs from claim 1 of the main request only in that the feature "the polymeric matrix is located on an optical face of an optical fiber" is added.

Incorporation of the matrix on an optical face of an optical fibre is usual in the art of gas sensors, particularly when such sensors are to be used in vivo. Moreover, such a measure is suggested by document (2), where the matrix of a gas sensor of an intravascular blood gas probe is located on an optical face of an optical fiber (see there particularly Figures 2 and 3 and the corresponding description).

The embodiment of (3) using spacers is not preferred, since the use of spacers would require an extra step when manufacturing the sensor and extra costs. Moreover, it has to be taken into account that the solution (according to claim 1 and page 5 first half) of (3) consists in a sensor where aqueous droplets are dispersed in a hydrophobic matrix but not in a sensor with spacers. The sensor comprising spacers is not the subject-matter of an independent claim but of a dependent claim (claim 7; see also page 11 line 17: "In Weiterbildung der Erfindung sind ... Platzhalter ... ") and is thus of minor importance. Therefore, the skilled person would primarily test a sensor according to said solution and then, if a sensor without spacers were unsatisfying, the subordinate embodiment according to claim 7 of document (3).

Furthermore, apparently no differences of importance between the external forces acting on the matrix and on the droplets during and after applying the matrix when manufacturing and using a sensor according to claim 1 of

the first auxiliary request on the one hand and according to (3) on the other hand exist which would hinder the skilled person to try to apply a sensor material according to (3) without spacers on an optical fibre, making, e. g., use of the teachings of (2). Application of a drop on the fibre end and use of the sensor, e. g. to measure gas components in a liquid, would not entail considerably more, if at all more, external forces than spreading of the membrane according to (3) on a carrier (see e. g. the para bridging pages 7 and 8) and, respectively, the external forces acting on a thin membrane (which is not necessarily applied on a stiff carrier - it is only just in claim 6 that the membrane is applied on a carrier) during use of the sensor. The skilled person would form the drop, e. g. by a sleeve (see reference numeral 24 of the application-in-suit) or by gravity or surface forces, before the polymerisation step takes place, to obtain the desired shape, usually a hemisphere-like shape. An overcoat applied after polymerization will protect the matrix against external forces during use of the sensor - according to (3) the application-in-suit, too.

Claim 1 of the first auxiliary request, therefore, does not involve an inventive step vis-à-vis prior art (3) or, respectively, (3) and (2), and is not allowable under Article 56 EPC.

5. *Second auxiliary request*

Claim 1 of the second auxiliary request differs from claim 1 of the main request only in that the feature "the aqueous phase includes an emulsification enhancement agent" is added.

Use of emulsification enhancement agents is almost indispensable when emulsions with small particles of the dispersed phase are to be formed and maintained. The skilled person is well aware of that, this being illustrated by general chemical handbooks, see e. g. (4), particularly page 1128 left-hand column at the bottom to right-hand column. Use of such an agent is moreover suggested by (3), see e. g. page 6 second paragraph: " ... eine für die Dauer der Herstellung stabile Emulsion ... zu erzeugen ... " (underlining added).

Thus, claim 1 of the second auxiliary request does not involve an inventive step with respect to prior art (3) or, respectively, to prior art (3) and (4) and is not allowable under Article 56 EPC.

6. Since at least claim 1 of each of the requests is not allowable, none of the requests can be accepted.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

P. Martorana

E. Turrini