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Aktenzeichen / Case Number / N° du recours : T 170/85 - 3.3.1

Anmeldenummer / Filing No / N° de la demande : 78 300 096.1

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Bezeichnung der Erfindung: Improvements in or relating to optical fibres and  
Title of invention: glasses  
Titre de l'invention :

Klassifikation / Classification / Classement : C03C 3/08

**ENTSCHEIDUNG / DECISION**

vom / of / du 27 September 1988.

Anmelder / Applicant / Demandeur :

Patentinhaber / Proprietor of the patent /  
Titulaire du brevet : The Post Office

Einsprechender / Opponent / Opposant : Schott Glaswerke

Stichwort / Headword / Référence : Optical fibres/Post Office

EPÜ / EPC / CBE Articles 54 and 56

Schlagwort / Keyword / Mot clé : "Novelty (confirmed)"  
"Inventive step (confirmed)"  
"No objection to claims by Appellants  
(Opponent)"

**Leitsatz / Headnote / Sommaire**

Europäisches  
Patentamt

European Patent  
Office

Office européen  
des brevets

Beschwerdekammern

Boards of Appeal

Chambres de recours

Case Number : T 170/85 - 3.3.1



**D E C I S I O N**  
of the Technical Board of Appeal 3.3.1  
of 27 September 1988

**Appellant:**  
(Opponent)

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**Decision under appeal:** Decision of the Opposition Division of the European Patent Office dated 23 April 1985 rejecting the opposition filed against European patent No. 0 000 282 pursuant to Article 102(2) EPC

**Composition of the Board:**

**Chairman:** K.J.A. Jahn

**Member:** R.W. Andrews

C.V. Payraudeau

### Summary of facts and submissions

- I. The mention of the grant of the patent No. 0 000 282 in respect of European patent application No. 78 300 096.1, filed 28 June 1978 and claiming priority of 28 June 1977 from a prior application in the United Kingdom, was announced on 26 August 1981 (cf. Bulletin 81/34) on the basis of nine claims relating to glasses suitable for the manufacture of optical fibres and graded index optical fibres having total insertion losses of less than 20 dB/km.
- II. On 11 May 1982 a notice of opposition was filed requesting the revocation of the patent on the ground that its subject-matter lacked novelty. The opposition was supported, inter alia, by the following documents :
- (1) US-A-3 607 322
  - (3) DE-B-2 454 293
  - (4) DE-B-2 311 823
  - (7) JP-A-76 112 819 and
  - (8) GB-A-1 097 716
- III. By a decision dated 23 April 1985, the Opposition Division rejected the opposition on the basis that the subject-matter of the patent in suit was novel and involved an inventive step. The Opposition Division concluded that the claimed glass compositions were novel since none of the cited documents explicitly disclosed glass compositions falling within the claimed area. Furthermore, the Opposition Division examined whether the subject-matter involved an inventive step of its own motion and concluded that the proposed solution to the problem of providing soda-boro-silicate glass compositions and optical fibres having an unexpectedly low insertion loss of less than 20 dB/km combined with a good thermal expansion match between the

core and cladding and a reasonably high numerical aperture was not obvious in the light of the cited documents.

- IV. An appeal, requesting the revocation of the disputed patent, was lodged on 14 June 1985 with the payment of the prescribed fee. A statement of grounds for appeal was filed on 16 August 1985.
- V. In response to various objections from the Appellant and the Board, the Respondent filed an amended set of claims on 19 September 1988 by a duly confirmed telefax. Independent Claims 1, 2 (after correction of a clerical error) and 5 of this set of claims read as follows :

"1. A graded index optical fibre drawn from a double crucible having a total insertion loss of less than 20 dB/km and having a core and cladding, the said optical fibre being characterised in that the core is formed from a melt of a first glass containing between 50 and 70 mole per cent of silica, and 13 to 33 mole per cent of sodium oxide and up to 5 mole per cent of one or more other compatible oxides, and boric oxide, its composition being calculated by taking a particular notional sodium oxide-boric oxide-silica composition lying within the range defined by Region A of Figure 1 of the accompanying drawings, and at least partially replacing sodium oxide or sodium oxide and silica by alkaline earth metal oxide in such a proportion that the total content of alkaline earth metal oxide in the glass melt is less than 20 mole per cent and in that the cladding is formed from a melt of a second glass having a refractive index lower than that of the first glass and having a sodium oxide-boric oxide-silica composition lying within the range defined by Region A of Figure 1, and containing up to 5 mole per cent of one or more other compatible oxides, the compositions of the first and second glasses being selected to exclude compositions which undergo phase separation or

devitrification during production in the double crucible and the gradation of refractive index resulting from a composition gradient caused by thermal diffusion in the double crucible of alkaline earth metal oxide from higher concentrations in the core to lower but finite concentrations in the cladding.

2. A graded index optical fibre drawn from a double crucible having a total insertion loss of less than 20 dB/km and having a core and cladding, the said optical fibre being characterised in that the core and cladding are formed respectively from melts of first and second glasses each containing between 50 and 70 mole per cent of silica, and 13 to 33 mole per cent of sodium oxide and up to 5 mole per cent of one or more other compatible oxides, and boric oxide, their compositions being calculated by taking a particular notional sodium oxide-boric oxide-silica composition lying within the range defined by Region A of Figure 1 of the accompanying drawings, and at least partially replacing sodium oxide or sodium oxide and silica by alkaline earth metal oxide in such a proportion that the total content of alkaline earth metal oxide in the glass melt is less than 20 mole per cent and in that the second glass has a refractive index lower than that of the first glass, the compositions of the first and second glasses being selected to exclude compositions which undergo phase separation or devitrification during production in the double crucible and the gradation of refractive index resulting from a composition gradient caused by thermal diffusion in the double crucible of alkaline earth metal oxide from higher concentrations in the core to lower but finite concentrations in the cladding.

5. A graded index optical fibre drawn from a double crucible having a total insertion loss of less than 20 dB/km and

having a core and cladding characterised in that the core is formed from a melt of a first glass consisting of:

- a) 50-70 mole per cent of silica
- b) Boric oxide
- c) 13-33 mole per cent of one or more alkali metal oxides selected from sodium oxide and potassium oxide and
- d) up to 20 mole per cent of one or more alkaline earth metal oxides selected from calcium oxide, strontium oxide and barium oxide, and, optionally,
- e) up to 5 mole per cent of one or more other compatible oxides

and in that the cladding is formed from a melt of a second glass having a refractive index less than that of the first glass and consisting of:

- a) Silica
- b) Boric oxide
- c) one or more alkali metal oxides selected from sodium oxide and potassium oxide, and, optionally,
- d) one or more alkaline earth metal oxides selected from calcium oxide, strontium oxide and barium oxide, and also optionally,
- e) up to 5 mole per cent of one or more other compatible oxides, the first and second glass compositions being selected to exclude compositions which undergo phase separation or devitrification during production in the

double crucible and the gradation of refractive index resulting from a composition gradient caused by thermal diffusion in the double crucible of alkaline earth metal oxide from higher concentrations in the core to lower but finite concentrations in the cladding."

- VI. In a duly confirmed telecopy filed on 21 September 1988, the Appellant stated that he had no objections to these claims and that he would probably not attend the oral proceedings due to take place on 27 September 1988. The Board construes this statement as meaning that the Appellant has no substantive objections to the presently claimed subject-matter.
- VII. At these oral proceedings only the Respondent was present and he argued that the subject-matter of the claims filed on 19 September 1988 involves an inventive step in the light of the only really relevant prior art as represented by document (3). According to the Respondent the basis for the invention lay in the unexpected discovery that alkaline earth metal oxides were able to diffuse at fibre-drawing temperatures. This discovery made an improvement possible in the graded optical fibres manufactured from glass compositions obtained by modifying the soda-boro-silicate glass compositions disclosed in document (3) using the double crucible technique.
- VIII. The Respondent requested that the patent be maintained in amended form on the basis of Claims 1 to 5 filed on 19 September 1988.

#### Reasons for the Decision

1. The appeal complies with Articles 106 to 108 and Rule 64 EPC and is, therefore, allowable.

2. There are no formal objections under Article 123 EPC to present Claims 1 to 5 since they are supported by the original disclosure and do not extend the protection conferred. Thus, the present Claims 1 to 5 are based on the granted Claims 5 to 9 respectively. The references to the graded index optical fibres being drawn from a double crucible and the glass of the core and cladding being in the form of a melt in Claims 1, 2 and 5 are based on the original text page 3, lines 3 to 5 and 8 to 13 and 18 to 23 (cf. also column 2, lines 1 to 13 and 19 to 25 of the published patent specification) and all the Examples.
  - 2.1 The indication that the gradation of refractive index results from a composition gradient caused by thermal diffusion in the double crucible of alkaline earth metal oxide from higher concentrations in the core to lower but finite concentrations in the cladding (cf. claims 1, 2 and 5) finds support on page 4, lines 6 to 14 in combination with page 7, lines 12 to 14, page 10, lines 9/10 and 19 to 22 and Figures 2, 6, 7 and 8 of the published patent application (cf. column 2, lines 36 to 44 in combination with column 4, lines 22 to 26 and 62 to 64 and column 5, lines 47/48 and 60 to 63 and Figures 2, 6, 7 and 8 of the printed patent specification).
  - 2.2 The additional requirement that the compositions of the core and cladding glasses are selected to exclude compositions which undergo phase separation or devitrification during production in Claim 2 represents an essential feature since a graded index optical fibre made from glasses not fulfilling this requirement would not possess a total insertion loss of less than 20 dB/km. Therefore, this amendment represents an allowable restriction.

- 2.3 The insertion of the word "other" between "more" and "compatible" in Claims 1 and 2 represents an admissible clarification and is supported by the paragraph bridging pages 10 to 11 of the original text (cf. also the paragraph bridging columns 5 and 6 of the published patent specification).
3. The patent in suit relates to graded index optical fibres drawn from a double crucible having a total insertion loss of less than 20 dB/km. The core and cladding glasses are formed from glasses with low softening points. Document (3), which in the Board's opinion represents the closest prior art, discloses glasses with low softening points suitable for the production of optical fibres using the double crucible technique (cf. Claims 1 to 9 and 19 and column 3, lines 10 to 25). However, it was found that when these prior art glasses were used to manufacture graded index optical fibres by means of the double crucible technique the numerical aperture values of the resulting optical fibres were too low. Low numerical aperture values result in the collecting power of the optical fibres being too low and, therefore, the possible transmission distances not being large enough.

In the light of this closest prior art the technical problem underlying the disputed patent may be seen in providing graded index optical fibres drawn from a double crucible with improved numerical aperture values having total insertion losses and pulse broadenings similar to those manufactured from these prior art glasses.

According to the patent in suit this technical problem is essentially solved by drawing the glass fibre from a double crucible in which at least the core glass contains up to 20 mole % of an alkaline earth metal oxide in addition to sodium and/or potassium oxide, boric oxide and silica and,

optionally, up to 5 mole % of one or more other compatible oxides, the core and cladding glasses being selected to exclude composition which undergo phase separation or devitrification during production.

In view of the results obtained in the Comparative Example and the Examples of the disputed patent the Board is satisfied that the technical problem as defined above is plausibly solved.

4. After examination of the cited documents the Board has reached the conclusion that this technical teaching is not disclosed in any of them and the claimed subject-matter is, therefore, novel.
- 4.1 Document (1), which is only relevant insofar as the subject-matter of Claim 5 is concerned, discloses a light transmitting glass fibre comprising, in terms of percentages by weight, a core glass consisting essentially of 23 to 41% silica, 7-10% alumina, 2.5 to 11% boric oxide, up to 10% potassium oxide and 34 to 59% barium oxide and a cladding glass consisting essentially of 61 to 65% silica, 4 to 6% alumina, up to 3% calcium oxide, 0.90 to 4% magnesium oxide, 12 to 16% boric oxide, 7 to 12% sodium oxide, up to 4% lithium oxide and up to 3% fluorine (cf. Claim 13). The glass fibres are produced using conventional techniques (cf. column 2, lines 45 to 47).

Although it is possible to accurately convert in a single defined system a specific mole percentage to a weight percentage and vice versa, this is not possible in the case of ranges. A detailed examination of the Examples of document (1) has revealed that none of the glass compositions disclosed therein anticipate those compositions defined in Claim 5 from which the claimed graded index optical fibres are prepared.

These prior art glass fibres are also distinguished from those claimed in Claim 5 of the disputed patent in that, due to their much higher numerical apertures, these fibres are only intended to transmit the maximum luminous intensity from a source over a limited distance to a desired location, viz. to function as a light pipe to transmit incoherent light over the relatively short distances required for monitoring and lighting devices for cars and aircraft and for medical applications (cf. column 7, lines 39 to 44 and column 1, lines 18 to 20). Moreover, in the absence of any indication to the contrary, it can be reasonably assumed that the prior art fibres are stepped index fibres. Therefore, the subject-matter of Claim 5 is novel with respect to the disclosure of this document.

- 4.2 Document (8) discloses a process for the production of light conducting optical filaments and optical filament systems by depositing on a core formed from a single transparent glass filament solid particles of a glass which has a lower refractive index than the glass of the filament and then fusing the particles to form the cladding (cf. Claim 1). The only core glass composition disclosed in this document consists of, presumably in terms of percentages by weight, 35% silica, 15% boric oxide, 42% barium oxide, 1,5% alumina, 3% sodium oxide and 3,5% zirconium oxide. The equivalent composition, expressed in terms of mole percentages, consists of 50,9% silica, 18,51% boric acide, 23,54% barium oxide, 1,27% alumina, 4,18% sodium oxide and 2,44% zirconium oxide.

Thus, the fact alone that the amount of barium oxide present in this prior art core glass is greater than the maximum amount of alkaline earth metal oxide initially present in the core glass from which the claimed graded

index optical fibres are prepared, is sufficient to render the claimed subject-matter novel with respect to the disclosure of this document.

5. It still remains to be examined whether the requirement of inventive step is met by the claimed subject matter.

Document (4) discloses an optical glass body whose decrease in refractive index from its central axis to its peripheral surface is caused by a decrease in the concentration of thallium ions from the central axis of the glass body to its peripheral surface (cf. Claim 1). In addition to silica, boric acid, thallium oxide and alkali metal oxide the optical glass body may contain at its central axis up to 15 mole % of magnesium oxide, calcium oxide, barium oxide, zinc oxide, lead oxide, alumina, tin oxide or titanium oxide or mixtures thereof (cf. Claim 4). This document also teaches that the glass body may be prepared by means of a double crucible in which the melt in the inner crucible contains thallium oxide and that in the outer crucible alkali metal oxide (cf. column 13, lines 12 to 20). The mutual thermal diffusion of the thallium and alkali metal ions is effected during the spinning of the glass fibre from the double crucible (cf. column 13, lines 20 to 26).

Although this document teaches that a gradation in refractive index in a glass fibre can be effected by thermal diffusion of thallium ions during its production by means of a double crucible, there is no disclosure in this document which would allow the skilled person to conclude that alkaline earth metal oxides would be capable of diffusion at fibre drawing temperatures to cause a gradation of refractive index. Thus, from the teaching of this document the skilled person could not deduce that the solution to the problem underlying the patent in suit as defined above lay in the modification of the glasses disclosed in document (3)

by the addition of alkaline earth metal oxide and the application of their ability to diffuse during production of the optical fibres by means of a double crucible.

- 5.2 The English translation of document (7), the accuracy of which was not questioned by the Respondent, discloses that a glass rod for use as the starting material for the manufacture an optical glass fibre is produced by pulling it from the molten glass ingredients present in the central area of a container. In order to prevent contamination of the glass rod by materials eluted from the container, the glass ingredients in contact with the walls of the container are in the form of a powder (cf. pages 2 and 3 of the translation). A glass composition suitable for use in this process consists of 70% by weight (71,44 mole %) silica, 15% by weight (13,20 mole %) boric oxide, 10% by weight (9,89 mole %) sodium oxide and 5,0% by weight (5,47 mole %) calcium oxide (cf. the Example on page 5 of the translation). Thus, this glass composition is similar to the initial glass compositions used to prepared the presently claimed optical fibres. However, this document is completely silent on how the initially obtained glass rod is further processed to produce an optical glass fibre. Therefore, the teaching of this document would not provide the skilled person with any indication which would have led him to the proposed solution to the problem underlying the patent in suit.
6. In the Board's judgement none of the cited documents would have permitted the skilled person to predict that alkaline earth metal oxides would be capable of thermal diffusion at fibre-drawing temperatures. Since this forms the basis of the present invention, the proposed solution to the technical problem underlying the patent in suit is to be regarded as inventive. Therefore, the subject-matter of the

independent Claims 1, 2 and 5 involve an inventive step. Dependent Claims 3 and 4, which relate to preferred embodiments of Claim 2, derive their patentability from this claim.

### Order

For these reasons, it is decided that :

1. The decision under appeal is set aside.
2. The case is remitted to the Opposition Division with the order to maintain the patent in amended form on the basis of Claims 1 to 5 filed on 19 September 1988, subject to the correction of a clerical error in Claim 2, lines 9/10 ("its composition" amended to "their compositions") with a description to be brought into agreement with these claims.

The Registrar



The Chairman

