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D E C I S I O N
of 10 November 1993

Case Number: T 0794/91 - 3.4.2

Application Number: 84115975.9

Publication Number: 0154026

IPC: G02B 6/16, G03G 13/04, G03B 37/025

Language of the proceedings: EN

Title of invention:
A monomode optical fibre and a method of manufacture

Patentee:
British Telecommunications public limited company

Opponent:
Alcatel SEL Aktiengesellschaft

Headword:
-

Relevant legal norms:
EPC Art. 56

Keyword:
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0794/91 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 10 November 1993

Appellant: (Opponent)
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Decision under appeal: **Decision of the Opposition Division of the European Patent Office dated 18 June 1991 and posted on 9 August 1991 rejecting the opposition filed against European patent No. 0 154 026 pursuant to Article 102(2) EPC.**

Composition of the Board:

Chairman: E. Turrini
Members: W.W.G. Hofmann
M.V.E. Lewenton

Summary of Facts and Submissions

I. European patent No. 0 154 026 was granted on the basis of European patent application No. 84 115 975.9.

II. The Appellant (Opponent) lodged an appeal against the decision of the Opposition Division to reject the opposition against the patent. The Opposition Division had expressed the view that the grounds for opposition mentioned in Article 100 EPC did not prejudice the maintenance of the patent unamended, having regard to the documents:

(D1) EP-A-0 041 864,
(D2) DE-B-2 804 467, and
(D3) DE-A-2 434 717.

III. During oral proceedings, the following further document, mentioned in the description of the patent, was considered:

(D4) "Electronics Letters" 5 July 1979, Vol. 15, No. 14, pages 411 to 413.

IV. The Appellant requested that the decision under appeal be set aside and the patent revoked.

The Respondent (Patentee) requested that the appeal be dismissed and the patent maintained as granted.

V. The wording of Claims 1 and 8 on file at the time of the decision reads as follows:

"1. A monomode optical fibre having a core and a cladding, wherein the core comprises silica doped with a refractive-index-increasing substance, and the cladding

has an outer region comprising substantially undoped silica, with the remainder of the cladding including regions of silica doped with both refractive-index-increasing and refractive-index-decreasing substances, characterised in that the concentration of said dopants in said remainder of the cladding is less towards the core of the fibre so that there exists at least an intermediate region of the cladding where the concentration of said dopants is greater than in the remaining inner region of the cladding, and in that said remaining inner region of the cladding has an outer radius in the range from 1.5 to 2 times the radius of the core.

8. A method of manufacturing a monomode optical fibre as claimed in any one of claims 1 to 7 which comprises the steps of depositing successive layers of silica or doped silica on the inner surface of a tubular silica substrate by thermal oxidation of a vapour including a silicon compound, and, as necessary, dopant materials, and subsequently heating the tube to cause it to collapse into a preform of the fibre, wherein the composition of the vapour is controlled such that said successively deposited layers correspond to said remainder of the cladding and to said core as specified in claim 1."

Claims 2 to 7 are dependent on Claim 1.

VI. The Appellant essentially argued as follows:

D2 is not restricted to multimode fibres. The problem to be solved is stated in D2 without reference to any specific type of fibre, and in fact, regarding the problem of avoiding the diffusion of light absorbing impurities into the core or cladding, there is no basic difference between monomode and multimode fibres. The

person skilled in the art would therefore read D2 as referring to monomode fibres just as well as to multimode fibres. As a barrier layer against the diffusion of impurities, D2 discloses an intermediate deposited layer of silica doped with both refractive-index-increasing and refractive-index-decreasing substances. Furthermore, D3 describes a monomode optical fibre having an intermediate layer of pure silica. D3 does not mention a barrier effect of this layer, but states that this material near the core serves to obtain a high degree of transmission for the light which - to a substantial percentage - is transmitted in the cladding.

Since for the purpose of stopping diffusion a layer doped with both index-increasing and decreasing substances is known, and for the separate purpose of low-loss guiding of light a pure silica layer, the person skilled in the art would simply combine these two layers for achieving the two purposes. The silica layer could then be positioned where the B_2O_3 doped layer is in Figure 3a of D2.

The dimensioning of the "remaining inner region of the cladding" according to Claim 1 is not inventive since the energy distribution of the light outside the core is known, and, moreover, the most suitable thickness could easily be found by a series of tests.

VII. The Respondent's arguments may be summarised as follows:

There is no indication in D2 that its teaching could also be applied to monomode fibres. On the contrary, all of its content, and in particular Figures 3a and 3b, point to the fact that D2 relates to multimode fibres.

At the priority date of the patent in suit, it was known that the necessary ratio of the outer diameter of the

core to that of the intermediate layer of a monomode fibre is about 1:5, in order to achieve optimum transmission properties of the fibre. D3, according to which this intermediate layer appears to be thinner than would be required by the said ratio, had to pay for the easier fabrication of the pure silica layer by higher energy losses. No strict distinction can be made between intermediate layer materials functioning as diffusion barriers and such functioning as low-loss light guides; regarding pure silica, its function as a diffusion barrier is mentioned in D2, column 2, lines 13 to 16 (the Respondent referred to the corresponding document D2 - Offenlegungsschrift, page 4, lines 15 to 18). D3 would not be the best prior art to start from at the priority date of the patent, but if the person skilled in the art did so, and if he further took D2 into consideration despite the fact that D2 relates to a multimode fibre, he would have replaced the silica layer by a thicker layer doped with index-increasing and index-decreasing substances, and not added one to the other.

The dimensioning of the remaining inner region of the cladding as defined in Claim 1 is not described in any of the cited documents. This dimensioning also involves an inventive step. There is no reason why the skilled person would have performed experiments varying the dimensions of this region of the cladding.

Reasons for the Decision

1. The appeal is admissible.

2. *Novelty*

2.1 The objection that the subject-matter of Claim 1 lacks novelty having regard to D1 (prior art in the sense of Article 54(3) EPC), raised in the grounds of opposition, is no longer maintained by the Appellant. The Board finds that this document does not destroy the novelty of the subject-matter of Claim 1 or Claim 8 since it does not disclose the ratio of 1.5 to 2 between the outer radius of the remaining inner region of the cladding and that of the core.

2.2 The teaching of D2 (cf. in particular Claim 1; Figures 2 and 3a; column 3, lines 22 to 25; column 4, lines 48 to 55; column 6, lines 35 to 55) insofar corresponds to present Claim 1 as it discloses an optical fibre having a core and a cladding, wherein the core comprises silica doped with a refractive-index-increasing substance, and the cladding has an outer region comprising substantially undoped silica, with the remainder of the cladding including regions of silica doped with both refractive-index-increasing and refractive-index-decreasing substances.

D2 does not disclose that this fibre is a monomode fibre (the Appellant does not deny this fact as far as only the question of novelty is concerned).

Moreover, the subject-matter of Claim 1 is distinguished from the known fibre in that the concentration of the said (index-increasing and index-decreasing) dopants in the said remainder of the cladding is less towards the

core of the fibre (even if, for the case of a W-fibre in D2, one considers the "Mantelschicht" as forming part of the "remainder of the cladding" in the sense of present Claim 1, there would still be lacking the characteristic that the amount of dopant in this "Mantelschicht" (B_2O_3) is less than in the region including the index-increasing (GeO_2) and index-decreasing (B_2O_3) dopants). Since D2 does not disclose such a region of reduced doping, it necessarily also lacks a disclosure regarding an outer radius thereof (1.5 to 2 times the radius of the core).

2.3 The fibre described in D4 corresponds to the step index embodiment of D2, except for the fact that the fibre is monomode. Thus, D4 corresponds to the preamble portion of Claim 1.

2.4 D3 relates to monomode fibres (cf. page 5, lines 11 to 13 and page 4, line 13) having a core and a cladding, wherein the core comprises silica doped with a refractive index increasing substance, and the cladding has an outer region comprising substantially undoped silica (cf. in particular page 5, lines 17 to 20; page 6, lines 1 to 12; page 8, line 18; Figure 2). The remainder of the cladding includes a deposited layer of undoped silica (cf. page 4, lines 25 to 30; page 8, lines 17 and 18).

A region of silica doped with both refractive index increasing and decreasing substances, and a range of 1.5 to 2 times the radius of the core for the outer radius of the deposited layer of undoped silica, are not mentioned in D3.

2.5 The subject-matter of Claim 1 is therefore new in the sense of Article 54 EPC. The same is true for the manufacturing method according to Claim 8 since this

method is also determined by the specific layers which are provided in accordance with Claim 1.

3. *Inventive step*

3.1 The patent in suit is concerned with monomode optical fibres and aims at further reducing absorption losses in the transmission spectrum (cf. column 2, lines 35 to 37, and column 1, lines 42 to 46) without having to face the disadvantageous effects of high deposition and sintering temperatures (cf. column 1, lines 50 to 54). Obtaining such good transmission involves using nonabsorbing components in the deposited layers as well as avoiding the diffusion of absorbing components into the inner regions of the fibre (cf. column 2, lines 37 to 39 and column 4, line 60).

Different parts of this object are already dealt with in the documents D2 to D4: D2 concerns the function of the intermediate layer as a barrier against diffusion, D3 and D4 mention the importance of the deposited material for achieving low attenuation in the fibre, D2 and D4 deal with avoiding high deposition and sintering temperatures. The patent in suit aims at a fibre which is satisfactory in all of these aspects.

The decisive question is whether the documents D2 to D4 lead in an obvious way to the solution as claimed in the patent.

3.2 In the view of the Board, the skilled person, when intending to develop a new monomode fibre, would only start from teachings concerning monomode fibres since the basic constructional features of an optical fibre depend on the intended light propagation mode.

D2 does not contain teachings regarding monomode fibres. The Appellant certainly argued that the reader of D2 would immediately think of monomode fibres in addition to multimode fibres since D2 deals quite generally with optical fibres of "any" structure and monomode fibres are not explicitly excluded. The Board, however, agrees with the Respondent's argument that the embodiments and figures of D2 (in particular Figures 3a, 3b) exclusively point to multimode fibres, and that the remainder of the document does not contain anything to the contrary, so that the skilled reader had no reason to associate these teachings with monomode fibres. The Board interprets the statement in D2, column 6, lines 35 to 41, that the invention could be used for W-fibres, step-index or graded-index fibres, as rather pointing to multimode fibres since only a multimode fibre can have all of these structures, and the only meaning that can be attributed to the statement in column 6, lines 60 to 62 (that the invention can be applied to optical fibres of any structure), is that this statement again relates to these W-, step-index- and graded-index- structures.

Thus, D2 could not have been the starting point for the development of the present optical fibre. Nevertheless, the Board accepts the Appellant's argument that a skilled person would learn from D2 that a layer of silica doped with both refractive-index-increasing and refractive-index-decreasing substances required only a relatively low deposition temperature and was suited as a barrier layer against diffusion of impurities.

3.3 When developing a new monomode fibre, the skilled person may start from D3. This document teaches the use of a pure silica intermediate layer (page 8, lines 17, 18; page 4, lines 25 to 30). It mentions that the intermediate layer serves the purpose of good optical transmission (page 4, lines 14 to 16 and 19 to 21).

D2, on the other hand, describes an intermediate layer of silica doped with both index-increasing and index-decreasing substances serving the purpose of a barrier against diffusion of impurities.

The Appellant argues that the skilled person would have regarded each of the intermediate layers according to D3 and D2 exclusively as an answer to the specific problem mentioned in the corresponding document and would, for solving both problems, employ both solutions, one in addition to the other. The Board does not share this view: The skilled person would look at these documents with his general knowledge and experience **at the priority date of the patent in suit**, and he would see the sum of the teachings of the documents available to him. At this date, he would see that an intermediate layer serves - and is able to serve - two purposes, low-loss transmission of light and stopping diffusion; the same type of layer (doped with both index-increasing and index-decreasing dopants) is mentioned in D2 for the one and in D4 for the other purpose, and pure silica is mentioned not only in context with good transmission (cf. D3 and also D4 (page 411, right-hand column, lines 11 to 4 from below)), but also in context with stopping diffusion (D2, column 2, lines 13 to 16, and Figure 3b). Knowing this, the skilled person would not try to split up this intermediate layer into two regions and add different types of layer to each other, but - if he was not satisfied with the known layers - would try to find one layer having an improved combination of properties. (The two layers (doped respectively with B_2O_3 and GeO_2+B_2O_3) provided according to the embodiment of D2 shown in Figure 3a, cannot stimulate the idea of using a compound layer as an intermediate layer in a monomode fibre since the inner one of the two layers (which - contrary to the present case - is not less doped than the outer one, and which has a refractive index lower

than both of its neighbour layers) is typical for W-structured multimode fibres and would simply be left out in monomode fibres).

3.4 For these reasons, combining features from D2 with those of D3 in such a way that they lead to the compound structure of the intermediate layer as claimed in Claim 1 of the present patent, is not considered obvious.

That the same is true for the possibility of combining D3 and D4 (no matter from which of the two documents the skilled person may start), is still more directly apparent since D4 only mentions the same purpose of the intermediate layer as D3 (good transmission), and the argument of complementary purposes applies here even less.

3.5 In the above considerations, no account has yet been taken of the fact that according to Claim 1 the remaining inner region of the cladding has an outer radius in the range from 1.5 to 2 times the radius of the core. This dimension of the reduced dopant region is not disclosed in any of the cited documents; it is essential for defining the character of the inner one of the two layers as being mainly responsible for low-loss guiding of the light. The Appellant has not brought forward a convincing reason why the skilled person - without using hindsight derived from knowledge of the present invention - would have chosen this dimension. The Appellant's argument that the skilled person could have made a series of tests to find it, is not convincing since making such tests would first require the idea of splitting up the intermediate layer into two regions and looking specifically for the thickness of the inner layer, which idea, as shown above, cannot be derived from the prior art.

3.6 For these reasons, the Board comes to the conclusion that the subject-matter of Claim 1 involves an inventive step in the sense of Article 56 EPC.

The same is true for the method according to Claim 8 for manufacturing an optical fibre as claimed in Claim 1 since the manufacturing method depends on the structure of the fibre to be produced.

Thus, Claims 1 and 8 are allowable (Article 52(1) EPC).

Claims 2 to 7 are allowable because of their dependence on Claim 1.

3.7 Therefore, the grounds for opposition do not prejudice the maintenance of the patent unamended.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

P. Martorana E. Turrini