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**Datasheet for the decision  
of 8 February 2008**

**Case Number:** T 0162/06 - 3.4.02

**Application Number:** 99308548.9

**Publication Number:** 1094346

**IPC:** G02B 6/255

**Language of the proceedings:** EN

**Title of invention:**  
Fusion spliced optical fibers

**Applicant:**  
Viveen Limited

**Opponent:**  
-

**Headword:**  
-

**Relevant legal provisions:**  
EPC Art. 56

**Relevant legal provisions (EPC 1973):**  
-

**Keyword:**  
"Main request: inventive step - no"  
"Remittal to first instance for granting a patent on the basis  
of the auxiliary request"

**Decisions cited:**  
-

**Catchword:**  
-



Case Number: T 0162/06 - 3.4.02

**D E C I S I O N**  
of the Technical Board of Appeal 3.4.02  
of 8 February 2008

**Appellant:**

Viveen Limited  
Holland Road  
National Technological Park  
Co. Limerick (IE)

**Representative:**

Read, Matthew Charles  
Venner Shipley LLP  
20 Little Britain  
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**Decision under appeal:**

Decision of the Examining Division of the  
European Patent Office posted 14 September 2005  
refusing European application No. 99308548.9  
pursuant to Article 97(1) EPC.

**Composition of the Board:**

**Chairman:** A. Klein  
**Members:** M. Stock  
C. Rennie-Smith

## Summary of Facts and Submissions

I. The applicant and appellant has appealed against the decision of the examining division refusing European patent application 99 308 548.9 (publication EP 1 094 346 A1) under Article 97(1) EPC in connection with Articles 52(1) and 56 EPC. The examining division noted also that claims restricted to a combination of dispersion-compensating fiber and standard single mode fiber would meet the requirements of Article 52(1) EPC. The following documents were cited:

D1: US 5 074 633 A

D2: J.T. Krause et al, "Splice Loss of Single-Mode Fiber As Related to Fusion Time, Temperature, and Index Profile Alteration", IEEE Journal of Lightwave Technology, vol. LT-4, no. 7, pages 837-840

II. The appellant has requested that a patent be granted on the basis of claims according to a main request or an auxiliary request filed with the statement of the grounds of appeal. The auxiliary request corresponds to the restricted combination considered as allowable by the examining division. In addition to D1 and D2 the appellant has made reference to the following documents mentioned in the European search report:

D3: EP 0 890 853 A1

D4: EP 0 340 042 A1

Appellant's arguments can be summarised as follows:

In contrast to the opinion of the examining division, D1 did not disclose that the fusion splice is a longitudinal diffused region comprising a length of both fibers. Figure 2 of D1 depicts a fiber joint 60 in which the core 30 of the first fiber 10 has been diffused to form a taper region, so that the diameter of that core 30 increases as the splice is approached along the first fiber 10. However, Figure 2 does not show any variation in the diameter of the core 60 of the second fiber 40 and does not indicate any diffusion thereof. D1 discloses that portions of both fibers are subject to heat treatment and gives an approximate temperature distribution along a length of both fibers. However, it does not clearly and unambiguously disclose the diffusion of the core 60 of the second fiber 40.

Moreover, while two of the three heat treatment procedures discussed in D1 involve applying heat to a portion of the second fiber 40, this does not imply that the core 60 of the second fiber 40 undergoes any significant degree of diffusion. The first and second fibers 10, 40 have different refractive index profiles, as required by present claim 1. It thus follows that, if portions of both fibers 10, 40 are subjected to identical heat treatments, their core dopants will diffuse at different rates. Such a differential diffusion rate is referred to in D3. Meanwhile, D4 refers to differential migration rates in standard and high numerical aperture fibers.

A skilled person considering the disclosure of D1 would be aware that the diffusion rates of the cores 30, 60

of the first and second fibers 10, 40 would differ from one another and that the application of identical heat treatments to portions of the first and second fibers 10, 40 would not result in equal amounts of diffusion.

The examining division considered that the feature "wherein the amount of diffusion increases as the splice is approached along each fiber" was disclosed in D1. This is not the case because D1 does not clearly and unambiguously disclose the existence of a diffused region in the second fiber 40. In particular, Figure 2 depicts only an increase in the diameter of the core 30 of the first fiber 10. There is nothing in Figure 2 that suggests any significant diffusion of the core 60 of the second fiber 40. In addition, D1 refers only to the amount of diffusion increasing as the joint 60 is approached along the first fibre 10.

Furthermore, as noted above, the first and second fibers 10, 40 in D1 have different refractive index profiles and so the core dopants of the first and second fibers 10, 40 would diffuse at different rates. Thus, the application of a symmetrical heat distribution centred on the joint would not produce a symmetrical diffusion region. A skilled reader would be aware of the differential in diffusion rates and thus would not derive a symmetrical diffusion region from D1. Thus, D1 cannot be said to imply that the diffusion region is symmetrical in the manner asserted by the examining division.

As to the feature that the length of the diffused region in each fiber be 3 mm or more, it has been found that, if the length of the diffused region is greater

than 3 mm, a smooth transition between the fibres is produced, with a significant reduction in splice loss. The value of 3 mm is not an arbitrary limitation. On the contrary, this feature is required in order to obtain a joint having a splice loss in the range specified in claim 1. Therefore, even if the length of the diffused region were only 20% greater than that disclosed in D1, such a difference could not be simply dismissed as insignificant.

According to the last feature in claim 1 the fusion splice has a total splice loss, over the range of signal wavelengths, of less than 0.2 dB.

D1 refers only to a total splice loss of less than 0.3 dB and, in the detailed example, a joint having a splice loss of 0.12 dB at a specified wavelength of 1.31  $\mu\text{m}$ . There is no clear and unambiguous disclosure of a joint having a total splice loss of less than 0.2 dB over a predetermined range of wavelengths.

The joint of present claim 1 is distinguished from that of D1 by the extended diffusion region specified in the features discussed above, which provides a smooth transition between the two fibers. The provision of such a region thus results in an optical fiber joint having a relatively low loss.

The objectively determined technical problem is the provision of an alternative low loss annealed optical fiber joint.

At the priority date of the present application, those skilled in the art would have known, from inter alia any one of D1 to D4, that a joint between two optical

fibers could be formed through the application of heat and would be aware that extended heat treatment could cause tapering of the smaller core through diffusion. However, none of the prior art documents of record suggests diffusion of the larger core. D1 does not include any suggestion that any diffusion of the core 60 of the second fiber 40 is desirable. In view of this and the teaching of D2 regarding the adverse effects of extended heat treatment, the provision of a diffusion region extending at least 3 mm into the second fiber 40 would not be an obvious modification.

For these reasons, it is maintained that the prior art available at the priority date of the application is such that a skilled person would not have contemplated significantly increasing the extent of a diffusion region in the manner required by present claim 1 or claim 10.

III. In an annex to the summons to the oral proceedings requested by the appellant the Board has made the following comments:

Figure 2 of D1 shows an ideal joint in which "the diameter of the smaller-core fiber increases within a taper region as the splice is approached along the smaller-core fiber". The skilled person is aware that such a smooth transition from one core to the other cannot be achieved by the method of fusion-splicing employed. More realistic is that both cores are widened during fusion-splicing. This interpretation is supported by document D3 (introduced by the appellant) showing in Figure 2 a fiber joint of two fibers having a different core size and different refractive index profiles, associated with the fusion splice being a

longitudinal diffused region comprising a length of both fibers wherein the amount of diffusion increases as the splice is approached along each fiber. The splice loss in D1 is 0.1 dB, evidently for the signal wavelength, falling within the claimed range. The upper limit of the range of the heated region in each fiber in D1 is only 20% of the lower limit of the range defined in present claim 1. Presumably there is no particular effect connected with this slight shift, justifying an inventive step.

Therefore it appeared that the appeal would be dismissed as far as the main request is concerned. However, the Board had no reason to question the positive comments of the examining division with respect to subject-matter now forming the basis of the auxiliary request.

IV. In its letter dated 21 January 2008 the applicant requested reconsideration of the main request or, if the Board was minded to reject the main request, reconsideration of the first auxiliary request, and the Board was asked to note that the applicant would not attend, or be represented at, the oral proceedings.

V. The independent claims according to the main and auxiliary requests read as follows:

*Main request:*

1. An annealed optical fiber joint comprising first and second doped optical fibers (10,40) fusion spliced to one another for operation in a predetermined wavelength range, the second fiber having a different core size



and different refractive index profile from the first fiber, characterised in that associated with the fusion splice (90) is a longitudinal diffused region (75) comprising a length of both fibers wherein the amount of diffusion increases as the splice is approached along each fiber, the length of the diffused region in each fiber being 3 mm or more; and the fusion splice has a total splice loss, over the range of signal wavelengths, of less than 0.2 dB.

10. A method of annealing an optical fiber joint between first and second optical fibers (10,40) fusion spliced to one another for operation in a predetermined wavelength range, the second fiber having a different core size and different refractive index profile from the first fiber, characterised by heating the fibers in the region of the fusion splice to produce diffusion of dopants therein to form a longitudinal diffused region (75) comprising a length of both fibers wherein the amount of diffusion increases as the splice is approached along each fiber, the length of the diffused region in each fiber being 3 mm or more; and the fusion splice has total splice loss, over the range of signal wavelengths, of less than 0.2dB.

20. An annealed optical fiber joint produced by a method as claimed in any one of claims 10 to 19.

*Auxiliary request:*

1. An annealed optical fiber joint comprising first and second doped optical fibers (10,40) fusion spliced to one another for operation in a predetermined wavelength range, the second fiber having a different core size

and different refractive index profile from the first fiber, characterised in that:  
the first doped optical fiber (40) comprises a standard telecommunications single mode fiber;  
the second doped optical fiber (10) comprises a dispersion-compensating fiber;  
associated with the fusion splice (90) is a longitudinal diffused region (75) comprising a length of both fibers wherein the amount of diffusion increases as the splice is approached along each fiber, the length of the diffused region in each fiber being 3 mm or more; and  
the fusion splice has a total splice loss, over the range of signal wavelengths, of less than 0.2 dB.

6. A method of annealing an optical fiber joint between first and second optical fibers (10,40) fusion spliced to one another for operation in a predetermined wavelength range, the second fiber having a different core size and different refractive index profile from the first fiber, characterised by heating the fibers in the region of the fusion splice to produce diffusion of dopants therein to form a longitudinal diffused region (75) comprising a length of both fibers wherein the amount of diffusion increases as the splice is approached along each fiber, the first fiber (40) being a standard telecommunications single mode fiber, the second fiber (10) being a dispersion-compensating fiber, the length of the diffused region in each fiber being 3 mm or more; and the fusion splice having a total splice loss, over the range of signal wavelengths, of less than 0.2dB.

14. An annealed optical fiber joint produced by a method as claimed in any one of claims 6 to 13.

### **Reasons for the Decision**

1. After due reconsideration of the present case the Board maintained its opinion that the subject-matter of claim 1 according to the main request does not involve an inventive step, as was reasoned in the annex to the summons to oral proceedings, see point III above. This opinion was not disputed by the applicant in its last letter. The main request is therefore not allowable.
2. The auxiliary request is based on subject-matter found allowable by the examining division. The Board has no reason to question this finding of the examining division.
3. The description needs adaptation to the amended claims in order to satisfy Rules 43(1)(c) and 50(1) EPC 2000. Furthermore Document D3 should be acknowledged in the description in accordance with Rule 43(1)(b) EPC 2000.
4. The announcement of the applicant that it would not be represented at the oral proceedings is normally treated as equivalent to a withdrawal of the request for oral proceedings, see Case Law, 5th edition 2006, VI.C.2, chapter 2.2 at page 336. Since there was no reason for deviating from this practice, the Board cancelled the oral proceedings.

**Order**

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

1. The decision under appeal is set aside.
  
2. The case is remitted to the first instance to grant a patent with the following claims, the Figures 1a, 1b, 2, 3 and 4 as published and a description to be adapted:

Claims: 1 to 15 filed with letter of 13.01.2006 in accordance with the auxiliary request.

The Registrar:

The Chairman:

M. Kiehl

A. G. Klein