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Datasheet for the decision of 2 March 2011

Case Number: T 2037/08 - 3402

Application Number: 01946250.6

Publication Number: 1295155

IPC: G02B6/32

Language of the proceeding: EN

Title of invention:
MICRO-OPTIC COUPLER INCORPORATING A TAPERED FIBER

Applicant:
Scientific-Atlanta Inc.

Relevant legal provisions:
EPC Art. 123(2)

Keyword:
Added subject-matter (no)

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T2037/08 - 3402

D E C I S I O N
of the Technical Board of Appeal 3402
of 2 March 2011

Appellant: Scientific-Atlanta Inc.
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 10 March 2008 refusing European application No. 01946250.6 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman: A. G. Klein
Members: F. J. Narganes-Quijano
B. Müller

Summary of Facts and Submissions

I. The appellant (applicant) lodged an appeal against the decision of the examining division refusing European patent application No. 01946250.6 based on the International application No. PCT/US01/18828 (published with the International publication No. WO 01/96920).

II. The decision to refuse the application was based on the grounds that the subject-matter of claim 1 amended according to the request then on file contravened the requirements of Article 123(2) EPC.

In addition, in a section of the decision having the heading "*Obiter dictum*", the examining division referred to documents

D1: WO-A-9954765 (published in Japanese) together with the English translation (document D1') published as EP-A-1076249 in accordance with Article 158(3) EPC 1973
D2: US-A-5555330
D3: US-A-5818630

and expressed the view that

- the subject-matter of independent claim 8 amended according to the request then on file contravened the requirements of Article 123(2) EPC and
- independent claims 1 and 8 then on file did not define patentable subject-matter with regard to the disclosure of documents D1, D2 and D3 (Article 52(1) EPC).

III. In response to the preliminary opinion expressed by the Board in a communication annexed to a summons to oral proceedings and in reply to a subsequent telephone

consultation with the rapporteur of the Board, the appellant submitted with its letter dated 14 January 2011 amended pages 1 to 4, 9 and 11 of the description and with its letter dated 28 January 2011 three sets of claims amended according to a main and first and second auxiliary requests and amended pages 3(a) and 7 of the description replacing the corresponding documents of the application as published.

The appellant requested that the decision under appeal be set aside and a patent be granted on the basis of the main or one of the first and second auxiliary requests.

After consideration of the amendments made to the application documents according to the main request of the appellant, the Board cancelled the oral proceedings.

IV. Independent claims 1 and 8 of the main request read as follows:

" 1. A method for reshaping and matching spatial properties of multimode optical inputs, the method comprising the steps of:
receiving, at a double-clad input fiber (501), multimode optical inputs from a further input fiber (500), the double-clad input fiber (501) having a tapered end;
coupling the multimode inputs to at least one output fiber (503) with a coupler (502);
modifying a spatial profile of the multimode inputs using the double-clad input fiber (501) having the tapered end; and
mounting the double-clad input fiber (501) in a glass capillary and polishing the glass capillary to expose

the tapered end of the double-clad input fiber (501), wherein the tapered end of the double-clad input fiber (501) has a core diameter that is smaller than a core diameter of an input end of the double-clad input fiber (501)."

" 8. A micro-optic coupler (301) for receiving a multimode beam and for providing a spatially modified multimode beam, the micro-optic coupler (301) comprising:
a double-clad input fiber (309), for receiving the multimode beam from a further input fiber (307), the double-clad input fiber (309) having a core diameter;
a multimode output fiber (303) having a core diameter; and
focusing elements (302) for coupling the multimode beam received by the double-clad input fiber (309) to the multimode output fiber (303);
wherein the double-clad input fiber (309) has a tapered end such that an input core diameter of an input end of the double-clad input fiber (309) is larger than an output core diameter of the tapered end of the double-clad input fiber (309); and
the core diameter of the multimode output fiber (303) is larger than the output core diameter of the tapered end of double-clad input fiber (309), whereby the spatial profile of the multimode beam is modified by the tapered end of the double-clad input fiber (309)."

The main request also includes dependent claims 2 to 7 and 9 to 11 referring back to claims 1 and 8, respectively.

The claims of the first and second auxiliary requests are not relevant for the present decision.

V. The arguments submitted by the appellant in support of its requests are essentially the following:

The embodiment of Figure 8 corresponds to that of Figure 1 (page 9, line 31), and the pump or input fibre 603 and the double-clad fibre 604 in Figure 8 correspond respectively to the pump fibre 110 and the output fibre 109 in Figure 1, these two fibres being double-clad fibres (page 7, line 8). According to the description, the tapered double-clad fibre 501 of Figure 7 can be used for fibre 110. It is therefore clear for the skilled person that Figures 7 and 8 do not relate to distinct or exclusive embodiments. The mounting, polishing and exposing steps are essential (paragraph bridging pages 9 and 10), and the skilled person knows that such operations can be carried out on any number of double-clad fibres mounted in the glass capillary and that there is no logical or physical reason for limiting the mounting, polishing and exposing steps to only one (Figure 7) or to two fibres (Figure 8).

Document D2 discloses fibres having their ends tapered by repeated dipping in HF solution, i.e. by etching (column 5, lines 44 to 48), and this method will merely result in the outer diameter being reduced and not in changes of the core diameter. In addition, neither document D1 nor document D2 teaches using a double-clad input fibre having a tapered end as claimed for improving the spatial modification of a light beam. Therefore, a skilled person would not have found it obvious to combine the teaching of documents D1 and D2 to arrive at the subject-matter of claim 1. In document D3 the mode-filter output fibre is not a multimode output fibre as required by claim 8, but a single-mode fibre (column 6, lines 8 to 33), and the problem

addressed in document D3, i.e. coupling a multimode input fibre to a single-mode output fibre, is different to that solved by the claimed invention.

Reasons for the Decision

1. The appeal is admissible.

2. *Article 123(2) EPC*

2.1 In the following, the relevant portions of the application documents as originally filed will be identified by reference to the documents of the application as published under the PCT (WO 01/96920).

2.2 Claim 1 amended according to the present main request results from the combination of the method defined in independent claim 30 and the features of dependent claim 35 as originally filed, the claim further incorporating features and clarifications based on the disclosure of the description of the application relating to Figures 7 and 8, and more particularly on the disclosure on page 8, lines 27 to 32 and page 10, lines 2 to 4.

The method defined in claim 1 specifies the step of "mounting the double-clad input fiber in a glass capillary and polishing the glass capillary to expose the tapered end of the double-clad input fiber". This feature was also present in claim 1 underlying the decision under appeal, and the reasons given by the examining division for the refusal of the application were that this feature did not meet the requirements of Article 123(2) EPC. According to the view expressed by the examining division in its decision, while the

objected claimed feature encompasses mounting a single tapered double-clad input fibre into the glass capillary and polishing the fibre to expose its tapered end, the disclosure of the application relating to Figures 8 to 14 would only support carrying out the mounting, polishing and exposing steps with two double-clad fibres inserted into the glass capillary, and the fact that the mounting, polishing and exposing steps defined in dependent claim 35 as originally filed involve "the tapered input fiber" would be insufficient to support carrying out the claimed steps with one single double-clad fibre because claim 35 only refers to independent claim 30 and none of these two claims refers to input fibres of the double-clad type.

As noted by the examining division, dependent claim 35 as originally filed defines the steps of mounting the tapered input fibre previously defined in claim 30 in a glass capillary and polishing the fibre to expose a tapered end of the fibre, and this dependent claim refers back only to independent claim 30 - and not to dependent claim 32 and/or 34 as originally filed requiring the use of fibres of the double-clad type - and none of claims 30 and 35 specifies that the tapered input fibre is of the double-clad type. However, the method of reshaping and matching spatial properties of multimode optical inputs defined in independent claim 30 as originally filed is directed to the embodiment disclosed in the description with reference to Figure 7 in which the tapered input fibre is of the double-clad type (page 8, lines 27 to 32) and, in addition, the mounting, polishing and exposing steps in a glass capillary are disclosed in the description of the application in connection with the mechanical tolerances of the tapering process of the double-clad input fibre (see in particular page 9, line 1 together

with line 29 *et seq*.). In view of this, the skilled person understands that the steps of mounting the tapered input fibre in a glass capillary and polishing and exposing its end as defined in dependent claim 35 as originally filed involve, in the specific embodiment disclosed with reference to Figure 7 and to which amended claim 1 is directed, carrying out the mounting, polishing and exposing steps with a tapered input fibre of the double-clad type as required by the amended feature objected to by the examining division.

In addition, contrary to the opinion expressed by the examining division in its decision, the objected feature is not at variance, in the context of the whole content of the application, with the fact that the sole example of the mounting, polishing and exposing steps described in the description with reference to Figures 8 to 14 involves two fibres mounted in parallel within the glass capillary. On the contrary, this disclosure (page 9, line 29 *et seq*.) illustrates the mounting, polishing and exposing steps in connection with a previous embodiment disclosed in the description with reference to Figure 1 - but not encompassed by the claimed invention - in which two fibres (the gain fibre 109 and the pump fibre 110) are optically coupled to each other by means of a reflector (106) and are mounted adjacent to each other within a glass capillary (108) that renders advantageous carrying out the polishing and exposing steps of both fibres within the glass capillary (page 6, lines 2 to 7 and page 9, lines 29 to 32). In the embodiment of the claimed invention disclosed in connection with Figure 7, however, these two fibres (fibres 501 and 503 of Figure 7 achieving the function of pump and gain fibres, respectively, see description of Figures 5 and 6) are not arranged in parallel, but spatially aligned and optically coupled

one in front of the other, and the skilled person understands that in this case the mounting, polishing and exposing steps of the tapered fibre referred to on page 9, line 1 together with line 29 *et seq*. would generally not require mounting in parallel a second fibre in the glass capillary, in agreement with the claimed feature objected to by the examining division.

In view of the above considerations, the Board concludes that the subject-matter of claim 1 amended according to the main request, and in particular the feature objected to by the examining division in the decision under appeal, satisfies the requirements of Article 123(2) EPC.

2.3 Independent claim 8 amended according to the main request is based on the combination of claims 1 to 3 and 8 as originally filed together with features based on the disclosure of Figures 1 and 5 to 7.

In the decision under appeal the examining division noted, by way of *obiter dictum*, that independent claim 8 then on file required that the multimode output fibre and the double-clad input fibre have the same outside diameter and the same numerical aperture, and that there was no basis in the application as originally filed in support of this feature (Article 123(2) EPC). However, the objected feature has been omitted in claim 8 amended according to the present main request and, consequently, the objection raised by the examining division no longer applies.

2.4 Dependent claims 2 to 7 and 9 are based on claims 31 to 34, 36, 39 and 11 as originally filed, respectively, and dependent claims 10 and 11 are based on the passages on page 9, line 31 to page 10, line 2, and

page 6, lines 4 to 6 of the description as originally filed.

2.5 The description has been thoroughly revised and brought into line with the invention as now claimed (Article 84 EPC 1973, second sentence, and Rules 27(1)(b) and (c) EPC 1973).

3. *Patentability*

In the decision under appeal the examining division also expressed by way of *obiter dictum* its opinion that the subject-matter of claim 1 then on file did not involve an inventive step (Article 56 EPC 1973) with regard to the disclosure of documents D1 and D2 and that the subject-matter of independent claim 8 then on file was anticipated by the disclosure of document D3 (Article 54(1) EPC 1973).

In view of the amendments made to the claims of the main request and after consideration of the disclosure of the documents on file and the arguments of the appellant (point V above), the Board is of the opinion that the subject-matter of present independent claims 1 and 8 - and consequently also that of dependent claims 2 to 7 and 9 to 11 - is novel and involves an inventive step over the available prior art (Article 52(1) EPC). In particular,

- document D1 discloses matching in an optical fibre amplifier (Figure 1) the diameters of an amplifying double-clad fibre and a pumping fibre (D1', paragraphs [0016], [0036] and [0037]) and teaches tapering the pumping fibre for the purposes of facilitating optical alignment with further elements such as a lens system (D1', paragraph [0042]), and there is no disclosure of

tapering the double-clad fibre, let alone for the purpose of reshaping the spatial properties of a multimode optical input,

- document D2 discloses the use of fibres having a tapered end for enhancing the optical coupling in wavelength division multiplexed couplers and also teaches polishing the tapered ends of the fibres mounted in a capillary (Figures 2A and 4B, paragraph bridging columns 3 and 4, and column 5, lines 34 to 61), but the document is silent as to both the use of double-clad fibres and the use of tapered fibres for reshaping and/or matching spatial properties of multimode optical inputs,
- document D3 discloses an optical amplification system comprising a double-clad multimode fibre amplifier optically coupled to a single-mode fibre and teaches tapering the core of the single-mode fibre along its length for mode matching purposes (Figures 1, 5 and 7 together with column 6, lines 6 to 25, column 9, lines 20 to 30, column 10, lines 19 to 40, column 11, line 39 *et seq.*, and claims 12 and 18), and there is no unambiguous indication in the disclosure of the document towards tapering the end of the double-clad fibre, and
- the remaining documents on file are less pertinent than documents D1, D2 and D3,

and none of the documents on file discloses or teaches modifying the spatial profile of a multimode optical input to be coupled into an output fibre by means of a double-clad fibre having a tapered end as defined in each of present independent claims 1 and 8.

4. The Board is also satisfied that the application documents amended according to the present main request and the invention to which they relate meet the

remaining requirements of the EPC within the meaning of Article 97(1) EPC. The Board therefore concludes that the decision under appeal is to be set aside and a patent be granted on the basis of the main request.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to grant a patent on the basis of the following application documents:
   - claims 1 to 11 of the main request filed with the letter dated 28 January 2011,
   - description pages 1 to 4, 9 and 11 filed with the letter dated 14 January 2011, pages 3(a) and 7 filed with the letter dated 28 January 2011 and pages 5, 6, 8 and 10 of the application as published under the PCT, and
   - drawing sheets 1/2 and 2/2 of the application as published under the PCT.

The Registrar: The Chairman:

M. Kiehl A. G. Klein