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Datasheet for the decision of 9 April 2010

Case Number: T 0813/08 - 3.4.02

Application Number: 04714200.5

Publication Number: 1604237

IPC: G02B 6/16

Language of the proceedings: EN

Title of invention:
Method of making a spun optical fiber with low polarization mode dispersion

Applicant:
Corning Incorporated

Opponent:
-

Headword:
-

Relevant legal provisions:
-

Relevant legal provisions (EPC 1973):
EPC Art. 56

Keyword:
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0813/08 **-** 3.4.02

D E C I S I O N
of the Technical Board of Appeal 3.4.02
of 9 April 2010

Appellant: Corning Incorporated
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Representative: Barth, Stephan Manuel
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 12 November 2007 refusing European application No. 04714200.5 pursuant to Article 97(1) EPC 1973.**

Composition of the Board:

Chairman: A. G. Klein
Members: F. J. Narganes-Quijano
D. S. Rogers

Summary of Facts and Submissions

I. The appellant (applicant) lodged an appeal against the decision of the examining division refusing European patent application No. 04714200.5 based on the International application No. PCT/US2004/005519 (published with the International Publication No. WO 2004/095097).

II. In the decision under appeal the examining division held by reference to previous communications that the subject-matter of claim 1 then on file did not involve an inventive step in view of the disclosure of document

D1 : WO-A-0203115.

III. With the statement setting out the grounds of appeal the appellant requested setting aside of the decision and the grant of a patent.

The appellant submitted with a letter dated 17.03.2010 a set of claims 1 to 9 amended according to a main request and with a letter dated 09.02.2010 a set of claims amended according to an auxiliary request. With the letter dated 09.02.2010 the appellant also submitted amended description pages 3, 8, 9 and 14 replacing the corresponding application documents on file, and clarified that the request for grant included page 4 of the description filed with the letter dated 07.03.2007 and the remaining description pages and drawing sheets of the application as published.

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

"1. A single mode optical fiber (32) exhibiting birefringence $\delta\beta$ corresponding to a beatlength $L_B = 2\pi/\delta\beta$ of greater than 5 meters, the fiber (32) having a longitudinal axis (Ax) with a permanent spin impressed on the fiber (32),

wherein in at least a portion of the fiber (32) the spin impressed on the fiber (32) is alternately clockwise and counter-clockwise, with a peak spin rate of at least 1.2 revolutions per meter and a spin repeat distance of at least 20 meters, said spin repeat distance sufficient to impart to said fiber (32) a polarization mode dispersion (PMD) which is less than 0.05 $ps/km^{1/2}$."

"8. A method of making an optical fiber (32) comprising:

heating at least a portion of an optical fiber preform (22); and

drawing optical fiber (32) from the heated preform (22) such that a spin is impressed on the fiber (32) by applying a torque to the fiber, said torque causing the fiber (32) to undergo rotation around a longitudinal axis (Ax) of the fiber (32) such that the spin is impressed on the fiber (32) as it is drawn from the preform (22);

wherein the optical fiber (32) is a single mode optical fiber that exhibits birefringence $\delta\beta$ corresponding to a beatlength $L_B = 2\pi/\delta\beta$ greater than about 5 meters, and in at least a portion of the fiber the spin impressed on the fiber (32) is alternately clockwise and counter-clockwise, with a peak spin rate of at least 1.2 revolutions per meter and a spin repeat distance of at least 20 meters, said spin repeat

distance sufficient to impart to said fiber (32) a polarization mode dispersion (PMD) which is less than 0.05 ps/$km^{1/2}$."

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

The wording of the claims of the auxiliary request is not relevant for the present decision.

V. The arguments submitted by the appellant in support of its requests can be summarised as follows:

Document D1 describes a method of reducing the PMD and requires that the polarisation dispersion vector has a periodicity which fulfils specific conditions. The periodicity cannot be derived explicitly and the document finds a solution by a numerical treatment. This makes it necessary to assume certain conditions (page 17, line 21, page 22, lines 32 to 35, and page 25, lines 5 to 13) and the authors of the document expected that a small spin repeat distance "p" provides better results than a large one. In particular, the document states that "advantageously, $p \leq L_B$" and that "typically, p is lower than 20 meters". For values of the spin repeat distance larger than L_B it is not demonstrated that a low PMD can be obtained.

The technical effect of applying a spin repeat distance of at least 20 meters to an optical fibre having a beatlength of at least 5 meters is that it reduces the PMD, and the object of the invention is a single mode

optical fibre which can be manufactured departing from the standard manufacturing process and has a low PMD.

There is lack of motivation to change the teaching of document D1 by using instead of a small spin repeat distance a large one of at least 20 meters. Document D1 clearly favours the use of small spin repeat distances as they are esteemed to give a better result (page 22, lines 32 to 34). Further, it is neither stated nor can it derived from document D1 that larger values of the spin repeat distance may reduce the PMD.

Reasons for the Decision

1. The appeal is admissible.

2. *Main request - Amendments*

The application documents amended according to the main request of the appellant satisfy the formal requirements of the EPC, and in particular those set forth in Article 123(2) EPC 1973. More particularly, claim 1 is based on claims 1 and 3 as published together with the first paragraph on page 2 and paragraphs [0010], [0012] and [0014] of the description of the application as published; independent claim 8 is based on claims 12 and 13 as published together with the corresponding amendments brought to present claim 1; and dependent claims 2 to 7 and 9 are respectively based on claims 2, 4 to 7, 9 and 14 as published together with paragraphs [0010] and [0014] of the description of the application as published.

The description has been 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. *Main request - Novelty and inventive step*

3.1 Claim 1 - Novelty

3.1.1 Document D1 addresses the same problem considered in the application in suit (see paragraph [0001] of the application), i.e. the reduction of the PMD (polarization mode dispersion) in a single mode optical fibre (D1, page 1, lines 4 to 6), and the document proposes - as is also the case of the application in suit, see present claims 1 and 8 - impressing a permanent periodic spin on a portion of the fibre so that the total birefringence $\delta\beta$ of the fibre results in values of the beatlength $L_B = 2\pi/\delta\beta$ greater than 5 meters (D1, page 2, lines 1 to 5, page 6, lines 19 and 20, page 8, lines 14 and 15, and page 22, lines 27 to 30 together with the examples on pages 34 to 36).

According to the disclosure of document D1, the spin parameters of the periodic spin impressed on the fibre determine the possible values of the PMD, and the document proposes spin functions having the following characteristics:

- the spin functions are sinusoidal, triangular or trapezoidal (page 6, lines 25 and 26 and page 8, lines 20 and 21 together with Figure 3), and therefore vary alternately clockwise and counter-clockwise;

- the spin functions have values of the peak spin rate lower than 50, preferably lower than 10, but preferably greater than 3 revolutions per meter

(page 6, lines 21 and 22, page 8, lines 16 and 17, and page 24, lines 10 to 13); and

- the spin functions have values of the spin repeat distance greater than 2 meters but typically lower than 20 meters, preferably lower than 5 meters and advantageously smaller than L_B (page 6, lines 4, 19 and 20, page 8, lines 14 and 15, page 22, last paragraph, and page 23, lines 8 to 12 and 32 to 35). According to document D1, these spin functions are such that the periodic spin impressed on the fibre causes a reduction of the PMD to values lower than 0.05 ps/km$^{1/2}$ (page 5, lines 1 to 5, page 8, lines 22 and 23, and the examples on pages 34 to 36 together with Table 1).

Claim 1 of the main request is also directed to a single mode optical fibre exhibiting a birefringence corresponding to a beatlength L_B greater than 5 meters and having in at least a portion of the fibre a permanent spin impressed thereon such that the PMD of the fibre is less than 0.05 ps/km$^{1/2}$ as disclosed in document D1. However, while claim 1 requires a peak spin rate of at least 1.2 revolutions per meter, and thus a range anticipated by the preferred upper range values 50 and 10 and also by the preferred lower range value 3 disclosed in document D1, the claim also requires a spin repeat distance of at least 20 meters and this feature is not anticipated by the disclosure of document D1, especially not in combination with the remaining claimed features. In particular, the claimed value range of at least 20 meters of the spin repeat distance is encompassed by the generic open-ended range "greater than 2 meters" disclosed in document D1, but is neither anticipated by the specific value 4.8 meters exemplified in the document (page 33, line 33, and

page 34, line 27) nor by the value range "typically lower than 20 meters" considered in the document, the claimed value range being in addition clearly distinct to, and distant from the range "lower than 5 meters" disclosed in the document as being preferred. In addition, document D1 teaches that it is advantageous to select the values of the spin repeat distance to be smaller (page 6, line 19, page 8, line 14, and page 23, lines 32 to 35) and even much smaller (page 25, lines 5 to 13) than the beatlength, and since in document D1 the value of the beatlength is generally greater than 0.5 and preferably greater than 5 meters (page 6, lines 19 and 20, page 8, lines 14 and 15, and page 22, lines 28 to 30) and exemplified by values between 15 and 25 meters (examples on pages 34 to 36), document D1 does not contain any clear and unambiguous disclosure of a spin repeat distance having the comparatively high values required by the claimed subject-matter.

3.1.2 Therefore, the claimed optical fibre differs from the optical fibre disclosed in document D1 in that the spin repeat distance of the permanent spin impressed on the fibre is of at least 20 meters.

3.2 Claim 1 - Inventive step

3.2.1 According to the disclosure of the application (paragraph [0010]) and the submissions of the appellant (point V above), the distinguishing feature identified in point 3.1.2 above in combination with the remaining claimed features results in a reduction of the PMD of the optical fibre to values below 0.05 ps/$km^{1/2}$ and therefore - in agreement with the examining division's finding in this respect and also in agreement with the

appellant's submissions (point V above, second paragraph) - the claimed subject-matter achieves the same technical effect already achieved in document D1. Accordingly, the objective technical problem solved by the claimed subject-matter over the disclosure of document D1 can only be seen in providing an alternative single mode optical fibre having a value of the PMD below 0.05 ps/$km^{1/2}$.

3.2.2 The question of inventive step therefore boils down to the question of whether the skilled person confronted with the problem of finding an alternative to the approach proposed in document D1 would have considered values of the spin repeat distance of at least 20 meters as an alternative to the values considered in document D1, without however changing thereby the remaining spin parameters and characteristics of the optical fibre (peak spin rate, beatlength and PMD) outside the claimed value ranges.

3.2.3 The approach proposed in document D1 is basically a mathematical approach (page 5, lines 7 to 10) consisting in finding solutions to a system of equations (page 5, line 12 to page 10, line 4, and page 12, line 11 to page 17, line 19) to obtain the optimum spin parameters, and the document proposes making some assumptions in order to find solutions to the system of equations (page 17, line 21 *et seq.*, in particular page 23, lines 32 to 35 and page 25, lines 1 to 22). One of the essential assumptions made in document D1 is the so called "short period assumption", according to which the spin repeat distance is smaller and even much smaller than the beatlength (page 23, lines 32 to 35 and page 25, lines 5 to 13), this

condition implying for the value range of the beatlength considered in the document that the spin repeat distance is generally below 20 meters as also expressly specified in the document (page 6, line 19, page 8, line 14, page 22, last sentence). The claimed subject-matter, however, requires values of the spin repeat distance above 20 meters and is therefore at variance with the essential assumption made in the approach proposed in document D1. In addition, document D1 specifies that the assumption "does not represent a significant limitation for this kind of fibres" (page 25, lines 5 to 13) and therefore teaches away from trying to find alternative solutions outside the assumption and therefore outside the ranges of the values of the spin parameters disclosed in the document. Accordingly, in view of the disclosure of document D1, it is not obvious to consider alternative solutions to those already proposed in document D1, let alone to consider possible solutions departing from the essential assumptions made in document D1 and more particularly solutions involving values of the spin repeat distance higher than 20 meters.

Consequently, the disclosure of document D1 does not suggest the claimed subject-matter and, additionally, teaches away from deviating from the so called "short period assumption" (D1, page 25, lines 5 to 13). Thus document D1 teaches away from the claimed solution to the problem formulated above involving long spinning periods (claim 1 together with paragraph [0027], page 10, lines 1 to 28, and page 13, line 4 to page 14, line 8 of the application).

3.2.4 As regards the reasons given in the decision for the refusal of the application, the Board does not find the line of argument followed by the examining division convincing for the following reasons:

In its decision the examining division held that document D1 refers to "low birefringence fibres" having a value of the beatlength between 10 and 100 m and teaches selecting the spin repeat distance to be smaller than the beatlength, so that the skilled person can be expected to start with a low birefringence fibre and to choose a spin repeat distance lower than the beatlength which can be up to 100 meters. The examining division concluded that the skilled person would expect a beneficial effect on the PMD also for spin repeat distances above 20 meters and that the claimed subject-matter did not involve an inventive step.

The Board notes, however, that document D1 refers to such low birefringence fibres only in the introductory part of the disclosure (section "Related art" on pages 1 to 4) in which it is stated with regard to optical fibres generally known in the prior art that the beat lengths observed in practice "range from as short as 2-3 mm (high birefringence fibres) to as long as 10-100 m (low birefringence fibres)" (page 2, lines 4 to 6). In addition, the document does not contain any suggestion towards the application of the pertinent teaching of the document to fibres having a beatlength value corresponding to the highest (i.e. close to 100 m) of the broad range between 2 mm and 100 m specified in the introductory part of the document. On the contrary, the pertinent disclosure of the document refers consistently to optical fibres having a value of

the beatlength greater than 0.5 and preferably greater than 5 meters or of the order of a few tens of meters (page 25, lines 6 and 7), preferably between 20 and 25 meters (page 25, lines 9 to 11), and the document exemplifies the pertinent disclosure with fibres having values of the beatlength of 15, 20, 24 and 25 meters (page 33, lines 31 to 33, page 34, lines 25 to 28, page 35, lines 7 and 21, and page 36, line 15), and only hindsight knowledge of the claimed invention would suggest operating with optical fibres having a beatlength close to 100 m as held by the examining division.

In addition, even if it were assumed that the skilled person would have considered such optical fibres having a beatlength close to 100 m as the starting point for solving the objective problem formulated above and assuming further that the skilled person would have considered the application of the pertinent teaching of document D1 to such fibres, the line of argument followed by the examining division would still not allow the conclusion that the application of the approach followed in document D1 to such fibres having such a high value of the beatlength and therefore a very low value of the birefringence would require peak spin rates of at least 1.2 revolutions per meter and spin repeat distances of at least 20 meters in order to achieve a value of the PMD below 0.05 $ps/km^{1/2}$ as claimed, it being noted that - as acknowledged in the application, see first sentence of paragraph [0027] - the reduction of the PMD is strongly related to the fibre beatlength and the spinning conditions.

3.2.5 The remaining documents on file are less relevant than the disclosure of document D1, and in view of the considerations in points 3.2.3 and 3.2.4 above, the Board concludes that the subject-matter of claim 1 is novel and involves an inventive step with regard to the prior art presently on file.

3.3 *Independent claim 8*

Claim 8 is directed to a method of making an optical fibre, the steps of the method resulting in an optical fibre having all the features of the optical fibre defined in claim 1. In view of the conclusion drawn in points 3.1 and 3.2 above that the optical fibre defined in claim 1 is novel and involves an inventive step over the prior art presently on file, the same conclusion is to be drawn with regard to the method of making the corresponding fibre defined in claim 8.

3.4 The Board concludes that the subject-matter of independent claims 1 and 8 of the main request, as well as that of claims 2 to 7 and 9, respectively dependant thereto, is novel and involves an inventive step over the state of the art on file (Article 52(1) EPC).

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 application documents amended according to the present main request of the appellant.

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 in the following version:
   - claims: claims 1 to 9 of the main request filed with the letter dated 17.03.2010,
   - description: pages 1, 2, 5 to 7 and 10 to 13 of the application as published, pages 3, 8, 9 and 14 filed with the letter dated 09.02.2010, and page 4 filed with the letter dated 07.03.2007, and
   - drawing: sheets 1/6 to 6/6 of the application as published.

The Registrar: The Chairman:

M. Kiehl A. G. Klein