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D E C I S I O N
of 3 April 2003

Case Number: T 0208/02 - 3.4.2
Application Number: 97915847.4
Publication Number: 0892933
IPC: G02B 6/16, G02B 6/245

Language of the proceedings: EN

Title of invention:

Process for preparation of optical fiber devices using optical fibers with thermally removable coatings

Applicant:

MINNESOTA MINING AND MANUFACTURING COMPANY

Opponent:

-

Headword:

-

Relevant legal provisions:

EPC Art. 56

Keyword:

"Inventive step of main request and first and second auxiliary requests (no), of third auxiliary request (remittal to the first instance for further prosecution)"

Decisions cited:

-

Catchword:

-



Case Number: T 0208/02 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 3 April 2003

Appellant: MINNESOTA MINING AND MANUFACTURING COMPANY
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 17 August 2001
refusing European patent application
No. 97 915 847.4 pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: E. Turrini
Members: G. M. Maaswinkel
B. J. Schachenmann

Summary of Facts and Submissions

I. The appellant (applicant) lodged an appeal, received on 17 October 2001, against the decision of the examining division, dispatched on 17 August 2001, refusing the European patent application No. 97 915 847.4. The fee for the appeal was paid on 17 October 2001. The statement setting out the grounds of appeal was received on 12 December 2001.

In its decision, the examining division held that the subject-matter of claim 1 of the main request then on file was not novel having regard to the following document:

(D1) Patent Abstracts of Japan, Vol. 009, No. 323
(P-414), 18 December 1985 & JP-A-60 149 003.

Furthermore, the subject-matter of this claim was also not novel over the disclosure in document D8 (EP-A-0 715 193) which was a document to be considered under Article 54(3) EPC. In the opinion of the examining division claim 1 according to the applicant's auxiliary request was not allowable because it did not involve an inventive step over the teaching of document D1.

II. In a communication pursuant to Article 11(2) of the Rules of Procedure of the Boards of Appeal the board referred to the following document

(D1a) English translation of JP-A-60 149 003
(document D1)

III. Oral proceedings were held on 3 April 2003 at the auxiliary request of the appellant.

During the oral proceedings reference was made to the following documents:

- (D3) Patent Abstracts of Japan, Vol. 009, No. 186 (P-377), 2 August 1985 & JP-A-60 055 303;
- (D4) Applied Optics, Vol. 22, No. 19, 1 October 1983, pages 2945 to 2947, T. Haibara et al.: "New fiber coat stripping method for high-strength splicing";
- (D7) Database WPI - Section E1, Week 8415 - Derwent Publications Ltd., London, GB; Class V07, AN 84-0973 & SU-A- 1 024 871.

IV. The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of the sets of claims filed at the oral proceedings as main request and first to third auxiliary request, respectively.

V. The wording of claim 1 of the main request reads as follows:

"A method of making an optical fiber device, comprising the following steps:

- (a) providing an optical fiber element comprising an optical fiber having at least one thermally removable polymeric coating thereon;
- (b) applying heat to a predetermined portion of said at least one thermally removable polymeric coating to thermally de-polymerize the coating by lowering

the molecular weight species of said polymeric coating and thus remove said predetermined portion of said at least one polymeric coating to sufficiently expose said optical fiber for a subsequent processing step, whereby the applied heat has a temperature of about 300 °C to about 900 °C, preferably about 400 °C to about 700 °C and most preferably to about 500 °C to about 600 °C;

- (c) measuring the fracture stress following coating removal by means of the FOTP-28 standard and
- (d) processing said optical fiber to provide an optical fiber device."

The wording of claim 1 of the first auxiliary request reads as follows:

"A method of making an optical fiber device, comprising the following steps:

- (a) providing an optical fiber element comprising an optical fiber having at least one thermally removable polymeric coating thereon;
- (b) applying heat to a predetermined portion of said at least one thermally removable polymeric coating to thermally de-polymerize the coating by lowering the molecular weight species of said polymeric coating and thus remove said predetermined portion of said at least one polymeric coating to sufficiently expose said optical fiber for a subsequent processing step, whereby the heat applied is such that the optical fiber retains a glass strength following the de-polymerization step that is at least 50% of the original glass strength of the optical fiber prior to de-polymerization step (b), as measured according to

- FOTP-28; and
- (c) processing said optical fiber to provide an optical fiber device."

Claim 1 of the second auxiliary request reads as claim 1 according to the first auxiliary request, wherein the feature in step (b) "*applying heat to a predetermined portion...*" is replaced by "*applying heat at a temperature of about 500 °C to about 600 °C to a predetermined mid-span section...*".

The wording of claim 1 of the third auxiliary request reads as follows:

"A method of making an optical fiber device, comprising the following steps:

- (a) providing an optical fiber element comprising an optical fiber having at least one thermally removable polymeric coating thereon;
- (b) applying a heated stream of at least one gas to a predetermined portion of said at least one thermally removable polymeric coating to thermally de-polymerize the coating by lowering the molecular weight species of said polymeric coating and thus remove said predetermined portion of said at least one polymeric coating to sufficiently expose said optical fiber for a subsequent processing step, whereby the heat applied is such that the optical fiber retains a glass strength following the de-polymerization step that is at least 50% of the original glass strength of the optical fiber prior to de-polymerization step (b), as measured according to FOTP-28; and
- (c) processing said optical fiber to provide an optical fiber device."

VI. The arguments of the appellant may be summarised as follows.

Claim 1 of the main request is identical to claim 1 of the auxiliary request on which the decision under appeal was based. The examining division had considered that the subject-matter of this claim was new over the teachings of documents D1 and D8 and only had objected to lack of inventive step over the disclosure of D1, document D8 being a document under Article 54(3) EPC. Considering inventive step the closest prior art document D1 and its translation D1a, in contrast to the method of making an optical fiber device of the present patent application, relate to removing a coating from a fiber terminal in order to splice or connect two fibers. Therefore the documents only emphasise measuring the tensile breaking strength of the *jointed* fibers, as can be seen from page 4, second paragraph of document D1a. The improvement of the process of removing the coating from the fiber according to D1 resp. D1a over the prior art process in which the coating was removed chemically in a solvent and then wiped with a cloth (see page 2, Section "prior Art" in D1a) has a different cause than in the patent application under appeal, because in the process prior to D1a chemical or mechanical residues remained at the terminal end of the fiber, which upon splicing or welding two of such fibers resulted in a poor weld and a low tensile breaking strength. Thus, the improvement reported in D1a on page 4, second paragraph, that the tensile breaking strength at the joint is 1.8 to 2.0 kg compared with a joint prepared by the prior art method having a strength of 0.7 to 0.9 kg must be contributed to the cleaner fiber terminal end and is not a property

of the fiber itself. In contrast, the gist of the patent application is rather to remove a coating from a *mid-span portion* of a fiber, for instance for processing the fiber to provide an optical fiber device in a subsequent step. The tensile strength of a fiber end or joint is typically lower than that of mid-span portion of a fiber. Thus, it was uncertain for the skilled person at the priority date whether the improvement in the tensile breaking strength of a spliced fiber by applying the coating removal process of D1 resp. D1a would result in a similar improvement if this process was applied on a mid-span portion of a fiber. Hence the skilled person would not have had an incentive to adopt the process in document D1 or D1a for an incomparable situation. Furthermore it is pointed out that document D1 resp. D1a does not disclose or suggest to carry out step (c) of claim 1, i.e. to measure the fracture stress following the coating removal by means of the FOTP-28 standard, because document D1 is not concerned with the strength of the fiber but only with that of the joint and the measuring step is therefore carried out after the splicing process and not as an intermediate step.

The additional feature of claim 1 of the first auxiliary request that the heat is applied in such way that the fiber following the depolymerization step retains a glass strength that is at least 50% of the original glass strength is supported by the published application on page 8, lines 6 to 11. It is a surprising effect of the claimed process that by applying heat in a predetermined way the coating can be removed whilst preserving the fiber strength to at least 50% of its initial value. D1 does not disclose this feature. Rather, whereas, according to document

D1a, page 2, lines 19 to 20, the original optical fiber had a breaking strength of 6 kg, the breaking strength of the spliced fiber at the joint is only 1.8 to 2.0 kg (page 4, line 14), which is 33% of the original strength and below the claimed value.

Claim 1 according to the second auxiliary request explicitly defines that the coating is removed from a mid-span section of the fiber to sufficiently expose the fiber at this section for a subsequent processing step. Support for this feature is readily found in Figures 4 or 6. The claim furthermore defines the temperature range of the applied heat between 500°C and 600°C in order to preserve the fiber strength. This measure is disclosed in a general sense on page 4, line 3; page 7, line 8; and page 14, lines 25 to 31. The contribution of this feature to inventive step can be appreciated by comparing the strength when the heating process is carried out at a higher temperature (see page 15, line 12), in which case the strength of the fiber is lower (same page, line 18). As reasoned before, document D1 resp. D1a does not suggest removing a fiber coating from a mid-span section, furthermore the coating is removed at a higher temperature (page 3, line 7, "at least 630 °C"). The removal of a fiber coating from a mid-span section as such is disclosed in documents D3 or D7, however the processes disclosed in these documents involve much lower temperatures around 200°C and according to the Abstracts "the coating is... melted and scattered" (D3), respectively "this melts the coating and blows away the molten plastic" (D7). The processes in these documents therefore involve a phase transition of the material from solid to soft or fluid state and these coatings are therefore not depolymerized within the meaning of claim 1 involving

"lowering the molecular weight species" of the polymeric coating wherein the coating remains in the solid state. Furthermore, since the teachings of documents D3 or D7 are basically different from the disclosure in D1 resp. D1a the skilled person would not have an incentive to combine the teachings of these documents.

The third auxiliary request defines as an additional feature to claim 1 of the first auxiliary request that the heat is applied as a heated stream of at least one gas. This is supported by the published description, see, for instance, page 4, line 27; and page 9, lines 18 to 27. By virtue of this feature the claimed process is distinguished from the process known from document D1 resp. D1a because, as shown in the Figure and the Abstract of D1, the fiber is inserted in a heating chamber 1a comprising electric heaters 4; subsequently the heater is turned off and a jet of dry air is blown on the fiber from nozzles. According to document D1, the processes of heating and air blowing are therefore separated. The reason for this, as explained in document D1a, page 3, lines 9 to 12, is to prevent that dust (other than a silicone resin for the particular coating) is present in the heating atmosphere. In any case, according to the same page, lines 24 to 27, even if the heating for heat degradation and the gas blast is performed simultaneously, document D1a recommends "to use a heat source of the radiant heating type" and therefore does not suggest the claimed process step of applying a heated gas stream. Since the inventors have found that the claimed process can be carried out to provide a fiber with a glass strength which is at least 50% of the original glass strength and since the method is

simpler than the one disclosed in D1 and D1a, the method defined in claim 1 of this request involves an inventive step.

VII. The board gave its decision at the end of the oral proceedings.

Reasons for the Decision

1. The appeal is admissible.
2. *Amendments - Article 123(2) EPC*

The board is satisfied that the claims according to the requests on file are fairly supported by the original application documents as argued by the appellant during the oral proceedings.

3. *Patentability*

3.1 Main request

3.1.1 The board agrees with the applicant that for the question of inventive step document D1, respectively its translation D1a, represents the closest prior art. In the decision under appeal document D1 had similarly been considered as the closest prior art for claim 1 of the auxiliary request then on file, which corresponds to present claim 1 of the main request.

3.1.2 Document D1 and the translation D1a of the corresponding Japanese patent application discloses a method of making an optical fiber device wherein the polymeric (silicone, see page 3, lines 4 and 5) coating

of an optical fiber element is thermally removed. According to the "Practical Example" on page 3 of document D1a, heat at a temperature of at least 630°C and most preferably 700°C to 800°C is applied in order to obtain pyrolysis of the coating, which temperature or temperature range is within the range defined in claim 1. The process of pyrolysis involves the decomposition of organic polymers caused by the effects of heat exclusive of oxidation. Document D1a, page 4, furthermore discloses that optical fibers, prepared in this way, are welded and that the tensile breaking strength of the joint of the spliced fibers is measured.

3.1.3 The method of making an optical fiber device in claim 1 according to the main request differs from the method disclosed in document D1a in that the fracture stress is measured following coating removal and by means of the FOTP-28 standard. The appellant has argued that, since the method known from document D1a was only applied to the splicing process, the skilled person was only interested in the strength of the joint and he would not have any incentive to measure the fracture stress immediately after removal of the coating.

3.1.4 The board does not concur with this view. Even if the final product of the method of document D1 was a spliced fiber for which the major concern may have been the breaking strength of the fiber juncture (see Abstract of D1, last sentence), the document's general background is the technology of making optical fiber devices. In all such processes the fiber optical coating must partly be removed which, according to the prior art, may cause problems in the deterioration of the fiber strength or in damaging the fiber core. This

problem is, for instance, equally discussed in documents D3, D4 or D7. It is to be expected that a skilled person, being aware of this problem, will carry out measurements of the fiber strength at various stages of the fabrication process in order to closely control the fiber mechanical properties. In particular during the development of a new experimental coating removing method such measurements will be carried out at frequent steps of the process and may be carried out according to any accepted industrial standard, as e.g. the FOTP-28 standard mentioned in claim 1 or according to DIN. By including these obvious steps in the method known from document D1a the skilled person would arrive at the subject-matter of claim 1 according to the main request without an inventive step being involved.

3.2 First auxiliary request

3.2.1 The subject-matter of claim 1 according to this request differs from the known method of D1, resp. D1a, in that the heat applied to the predetermined portion of the coating is such that the optical fiber retains a glass strength following the de-polymerization step that is at least 50% of the original glass strength of the optical fiber prior to the de-polymerization step, as measured according to FOTP-28. According to the appellant the finding that the heat can be applied in such way that the glass strength is preserved to such an extent is surprising, in particular because the data in document D1a do not suggest such high strength and in any way are data for the glass joint.

3.2.2 In the opinion of the board these arguments are not persuasive. Document D1a indeed does not explicitly disclose values of the tensile strength of the fiber

after the coating removing process by applying heat. However, on page 2, lines 20 and 23 it is disclosed that the original tensile breaking strength of the fiber was 6 kg and that by removing the coating with a *conventional* method (immersing in hot sulphuric acid and wiping with a cloth) the tensile breaking strength "was lowered by 50%, becoming 2 to 3 Kg" which is already near the range defined in claim 1, in particular because, according to the passages in the description (page 8, line 10; page 9, line 2), the reduction in median fracture stress must not be more than "about 50%". According to document D1a, page 4, by removing the fiber coating by heat as disclosed in this document an improvement in the tensile breaking strength at the joint from 0.7 to 0.9 kg (prior art process) to 1.8 to 2.0 kg is obtained. It is therefore to be expected that also the fiber strength as such is improved. Furthermore with reference to document D4, Figure 3, it is noted that the preservation of the median strength of an optical fiber after stripping substantially above 50% of the original strength (in this case: 4.0 GPa compared to an original strength of 5.4 GPa) was a realistic value obtainable with modern stripping techniques before the priority date of the patent application. Therefore the board is not convinced that the value of 50% of the original strength is above the value obtained by applying the process disclosed in document D1a, and is of the opinion that in any case such a value was a normal design value for the skilled person at the priority date. The subject-matter of this request must therefore be considered as obvious in the light of the disclosure of D1a and the ordinary skill of the person in the field of fiber optics technology.

3.3 Second auxiliary request

3.3.1 Claim 1 according to this request defines additionally to the features of claim 1 of the first auxiliary request the temperature range of "about 500 °C to about 600 °C" at which the heat is applied; and that the predetermined portion at which the heat is applied for removing the coating is "a predetermined mid-span section". According to the appellant, this temperature range is neither disclosed in document D1 or D1a nor in documents D3 or D7, which in any case relate to a different kind of coating removing process.

Furthermore, since the teaching in document D1 or D1a is only related to fiber splicing and the underlying beneficial effect of the coating removal process occurs apparently at the fiber terminal end, the skilled person would not have considered applying that process for coating removal of a mid-span section of a fiber.

3.3.2 The board does not agree with this position of the appellant. As discussed in Section 3.1.4 *supra*, removing the coating of an optical fiber is an inherent step in the process of making an optical fiber device. The skilled person will as a matter of course consider every appropriate technique available for that purpose. He would therefore have considered applying the technique disclosed in document D1 resp. D1a also for removal of coatings from other sections of a fiber. A reference to the figures of documents D3 or D7 in this respect only confirms what was well known to the skilled person, i.e. to remove the coatings from other portions of an optical fiber, which fact could equally be documented by reference to textbooks on fiber technology. Furthermore it is observed that, according to the application as published, see for instance

page 1, line 6, the claimed process is also envisaged to be used for the preparation of optical devices "such as splitters, couplers and the like" in which case the fiber would have to be removed from a fiber end portion (see also the discussion on page 11, line 24). Therefore, in the opinion of the board, the application of the coating removal process disclosed in D1 resp. D1a to a mid-span section of an optical fiber appears to be a straightforward extension of this teaching for the skilled person. Neither does the explicit definition of the temperature range of the applied heat define a substantial difference to the values used in the process of D1, because the end values of the range defined in claim 1 of this request are only approximative ("about"), whence it is already arguable that the value of 630°C disclosed on page 3, line 7 of document D1a is not included in the approximative range. Furthermore it is clear to the skilled person that the temperature of the heat applied must be selected according to the type of polymer coating to be removed, and that it should be selected as low as possible but sufficient for pyrolysis to occur in order to avoid deterioration of the fiber core, as discussed in document D1a, page 3, lines 7 to 9. Therefore the subject-matter of this request does not involve an inventive step.

3.4 Third auxiliary request

- 3.4.1 Claim 1 of this request includes the further feature over claim 1 of the first auxiliary request that a *heated stream of at least one gas* is applied to a predetermined portion of the fiber, which results in the removal of the coating while the fiber retains a glass strength following the de-polymerization step

that is at least 50% of the original glass strength. The appellant has argued that this particular way of applying the heat is neither disclosed nor suggested by the available prior art, and in particular goes against the teaching of the closest prior art document D1 resp. D1a.

- 3.4.2 Since the decision under appeal was based on document D1 and the corresponding untranslated Japanese patent application and did not explicitly deal with the aspect referred to above, the board considers it appropriate that the issue of patentability of claim 1 of the third auxiliary request be reconsidered by the department of first instance taking into account in particular the translation D1a of document D1 in order not to deprive the appellant of an examination of this issue before two instances.

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 for further prosecution on the basis of claim 1 of the third auxiliary request filed at the oral proceedings on 3 April 2003.

The Registrar:

The Chairman:

P. Martorana

E. Turrini