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D E C I S I O N
of 28 February 2000

Case Number: T 0338/96 - 3.2.2

Application Number: 90106662.1

Publication Number: 0392393

IPC: C03B 37/027

Language of the proceedings: EN

Title of invention:
Process for optical fibre drawing

Patentee:
SUMITOMO ELECTRIC INDUSTRIES, LTD.

Opponent:
ALCATEL CABLE

Headword:
-

Relevant legal provisions:
EPC Art. 123(2), 54, 56

Keyword:
"Amendments admissible"
"Novelty (yes) after amendment"
"Inventive step (yes) after amendment"

Decisions cited:
-

Catchword:
-

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Case Number: T 0338/96 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 28 February 2000

Appellant: (Opponent)
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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted 27 February 1996 concerning maintenance of European patent No. 0 392 393 in amended form.**

Composition of the Board:

Chairman: W. D. Weiß
Members: R. Ries
J. C. M. De Preter

Summary of Facts and Submissions

I. European patent No. 0 392 393 was granted on 27 October 1993 on the basis of European patent application No. 90 106 662.1.

II. The granted patent was opposed by the present appellants on the grounds that its subject matter lacked novelty and inventive step with respect to the state of the art (Article 100(a) EPC). The patent as amended in the opposition proceedings was also held to contravene Article 123(2) EPC.

The following prepublished documents were considered in the opposition proceedings:

D1: US-A-4 123 242

D2': JP-A-52-120 840 translated into French language

D2: JP-A-51-120 840

D3: Journal of Applied Physics, vol. 50, no. 10, October 1979, pages 6144 to 6148

D4: EP-A-0 320 384

III. With its decision posted on 27 February 1996, the Opposition Division held that the patent could be maintained in amended form on the basis of a set of claims 1 to 3 filed with letter dated 19 December 1995 (main request).

Independent claim 1 of this set of claims reads as follows:

"1. A drawing process for producing an optical fibre (11) which comprises drawing the optical fibre (11) from a preform (1) under tension to form the optical fibre while heating and melting the preform;

and wherein the drawing conditions are controlled by means of the deviation of the measured diameter of the uncoated fibre from a preselected outer diameter of the fibre when finished; characterized in that the diameter of the uncoated optical fibre (11) is measured at a position (Z) where the fibre is still in the state of shrinking and from which position further shrinkage of the outer diameter of the optical fibre (11), while stretched, to the diameter of this fibre when finished is not larger than 0.5%; and wherein the term "shrinkage" is a percentage ratio wherein the numerator is the difference in outer diameters between the optical fibre at said measuring position (Z) and the optical fibre when it has finished shrinking; and the denominator is the outer diameter of the optical fibre which has finished shrinking."

Dependent claims 2 and 3 relate to preferred embodiments of the drawing process defined in claim 1.

IV. An appeal against this decision was filed on 17 April 1996 by the opponents. On 25 June 1996, the statement of grounds was submitted where the following further documents were referred to:

D5: D.H. Smithgall et al., "Drawing lightguide fibre",

Western Electric Eng., Winter 1980, vol. 24, no. 1, pages 49 to 61

D6: D.H. Smithgall et al., "Characterization of the preform stretching process", Journal of Lightwave Technology, vol. Lt-5, no. 12, December 1987, pages 1755 to 1762

D7: D.H. Smithgall, "Application of optimization theory to the control of the optical fibre drawing process", Bell System Technical Journal, vol. 58, no. 6, July-August 1979, pages 1425 to 1435

Enclosed with its response to the grounds of appeal, the respondent (patentee) referred to the document

D8: Handbook of glass data, Part A, Silica glass and binary silicate glasses, Elsevier, pages 76 to 78

V. In a communication posted on 30 April 1999, the Board expressed as its provisional view that the claims of the auxiliary request submitted at the oral proceedings held on 30 January 1996 before the opposition division would not appear to contravene the requirements of Article 123(2) EPC.

VI. Oral proceedings before the Board were held on 23 September 1999 at which only the respondents were represented.

In a telecopy dated 2 April 1999 and confirmed by their letter received on 9 April 1999, the appellants had informed the Board that they would not attend the oral proceedings.

In their written submissions, the appellants had requested that the decision under appeal be set aside and the patent revoked in its entirety.

The respondents requested that the appeal be dismissed and the patent be maintained

- in the form agreed by the Opposition Division (main request) or, in the alternative,

- on the basis of the set of claims according to the auxiliary request submitted at the oral proceeding held on 23 September 1999 (first auxiliary request) or

- on the basis of claims 1 to 3 submitted at the oral proceedings before the Opposition Division (second auxiliary request).

Claim 1 of the first auxiliary request reads as follows:

"1. A drawing process for producing an optical fibre (11) which comprises drawing the optical fibre (11) from a preform (1) under tension to form the optical fibre while heating and melting the preform;

and controlling the drawing conditions by means of the deviation of the measured diameter of the uncoated fibre from a preselected outer diameter of the fibre when finished wherein, for a drawing rate of 200 m/min or greater, the diameter of the uncoated optical fibre (11) is measured at a position (Z) from which position further shrinkage of the outer diameter of the optical

fibre (11), while stretched, to the diameter of this fibre when finished is 0.5% to 0.08%;

and wherein the term "shrinkage" is a percentage ratio wherein the numerator is the difference in outer diameters between the optical fibre at said measuring position (Z) and the optical fibre when it has finished shrinking; and the denominator is the outer diameter of the optical fibre which has finished shrinking."

At the oral proceedings, the Board gave the decision that claim 1 according to the main request did not meet the requirements of the Article 123(2) EPC and that the procedure would be continued in writing on the basis of the first and the second auxiliary requests.

VII. Enclosed with the Official letter dated 14 October 1999, a copy of the minutes of the oral proceedings held on 23 September 1999 was sent to the appellants with the request to submit any comments within two months. In their letter received on 12 January 2000 i.e. after the expiry of the two month time limit, the appellants submitted further arguments, referring to

D9: AMRITSU CORPORATION, Instruction Manual M551A/B - SLB DIA Measuring System, 1984, V3, seven pages, pages 1 to 3

D10: EP-B-0 320 384

and confirmed their request for revocation of the patent.

VIII. The appellants, in their written submissions, argued as

follows:

There is no precise information in the application as filed which allows a clear definition of the term "shrinking". It must, however, be distinguished between different kinds of "shrinking" i.e. contractions caused:

(a) by the pulling forces on the fibre or

(b) by cooling the hot fibre to room temperature.

It was not clarified in the opposition proceedings whether the shrinkage results from cause (a), cause (b) or (a) plus (b). Irrespective of the meaning of the term "shrinkage", the general statement "at a position (Z) where the fibre is still in the state of shrinking" in the characterizing part of claim 1 of the main request (submitted on 19 December 1995) is not supported by the documents as originally filed. Contrary to the position of the opposition division, page 3, lines 11 to 3, page 4, lines 29 to 47 and page 5 lines 15 to 21 of the specification do not give any hint to the interpretation that "zero shrinkage" should be excluded. Consequently, amended claim 1 of the main request fails to meet the requirements of Article 123(2) EPC.

Moreover, the subject matter of claim 1 lacks novelty with respect to the technical teaching of documents D2, D4, D5 and D7. In D4, the fibre diameter is controlled by the measuring device 3 in Figure 1 when the fibre has at least solidified in its center, i.e. exhibits a temperature below 1600 °C and above 200 °C. Taking into

account the coefficient of expansion (COE) of silica, the shrinkage between 200°C and room temperature is about 0.02% which falls within the definition given in claim 1. A similar situation is found in document D2 in which the external temperature of the fibre is cooled down to room temperature before measuring its diameter. According to the teaching given in documents D5 and D7, the diameter of the fibre is measured at some point below the heat zone or shortly after the fibre is formed and, therefore, the fibre must be still in the state of shrinking. Document D6 additionally recommends controlling of the diameter at a point on the neck portion itself and not after the rod is formed and goes to say that the best control is achieved when a line on or near the first image caustic is selected.

As to inventive step, the claimed range of shrinkage of 0.5% or less is arbitrarily selected and fails to bring about a specific effect which could provide a solution to a specific problem. In particular, it can be learned from documents D5 to D7 that the position of the measuring device should not be extremely close to the furnace to protect it against damage by the strong radiation light of the furnace. On the other hand, the measuring device should be located as close as possible to the furnace to shorten the time of response, if the actual fibre diameter deviates from the nominal diameter. Given that the accuracy of the diameter usually required is 125 µm ± 1 µm corresponding to 0.8% as set in the disputed patent on page 2, lines 42/43, it goes without saying that the measuring device should be located at a position where the measuring error falls within the range of 0 to 0.8%. This corresponds to the range of 0 to 0.5% claimed in the disputed

patent. The subject matter of claim 1 of the main request is, therefore, neither novel nor involves an inventive step.

Having regard to the first auxiliary request, there is no basis in the application as originally filed disclosing a lower limit of 0.08% for the range of shrinkage and hence this amendment contravenes Article 123(2) EPC. Moreover, the limit of 0.08% is below the accuracy of the diameter measuring device which was used in 1989 by the respondents. As set out in document D9, 1.3, the accuracy of repeatability is at its best ±0.1 µm or ±0.2 µm which corresponds to ±0.08% or ±0.16%, respectively. Consequently, the lower limit of 0.08% in practice corresponds to a "zero shrinkage" which, however, has no basis in the application as filed and, therefore, fails to meet the requirements of Article 123(2) EPC. In addition, the subject matter of the claims according to the first auxiliary request lack novelty and inventive step for the same reasons set out above with respect to the claims of the main request.

The respondents argued as follows:

A distinction between different types of contractions as specified by the opponent is unnecessary since in the present patent, "shrinkage" results from (i) the pulling force and (ii) the thermal contraction. Moreover, the term "shrinkage" has been clearly defined in amended claim 1 submitted on 19 December 1995 (main request).

Contrary to the opponent's position, the expression

"...still in the state of shrinking" is supported by the application as filed. Reference is made in this context to page 3, line 11 to 13 according to which "the term "shrinkage" is intended to mean a ratio of difference in diameters between the optical fibre at the measuring position and the optical fibre which has been finished shrinking to the outer diameter of optical fibre which has finished shrinking". This definition makes clear to the expert that the measuring device should not be located at a position where the fibre has already finished shrinking. Further support for this estimation is also found on page 3, line 54 bridging page 4, line 21, in particular the formula given on page 3, line 56 showing that the temperature T_m of the fibre at the measuring position (Z) is always higher than the room temperature T_0. Hence, there is always shrinkage at the position (Z). The experimental data given in the Table on page 5, including a drawing rate of 100 m/min whereby the measured outer diameter equals the true diameter of the fibre does not represent an example according to the invention. Consequently, Article 123(2) EPC is not infringed by amended claim 1 of the main request.

As to novelty and inventive step, none of the cited documents discloses the position of the measuring device at a place, where the fibre is still in the state of shrinking. In document D2, the fibre has already cooled down to room temperature at the diameter measuring position and also in document D4, the fibre has solidified completely when is passes the measuring device ("solidifié a coeur"), thus excluding further shrinkage. In document D5, the measurement point is located at some unspecified distance below the preform

which essentially complies with the statement given in document D7, saying that "the measuring process must always be located at some distance away from the point or region where the diameter of the molten zone changes in response to the variations in the drawing velocity". Moreover, according to the teaching of document D6, the diameter of the fibre should be measured in the drawing furnace which is not a teaching that the measurement of the optical fibre diameter should be made at a position where the subsequent fibre shrinkage is 0.5% or lower. Hence, the claimed process is clearly distinguished from the prior art which also fails to give any hint to the expert to determine the diameter of the fibre at a position where its subsequent shrinkage is not larger than 0.5% as claimed in the invention.

Reasons for the Decision

1. The appeal is admissible.

2. *Original disclosure (main request)*

It is noted that claim 1 of the main request does not comprise a limitation of the drawing rate. Therefore, claim 1 encompasses **all** drawing rates, also including for instance the conventional drawing rate of 100 m/min (cf. page 2, lines 33/34). It is, however, unambiguously disclosed in the patent in suit that for a conventional (low) drawing rate of 100 m/min, "zero shrinkage" of the fibre diameter is possible (cf. page 2, lines 33, 34; Table on page 5). It is furthermore evident in the specification that "zero shrinkage" is only excluded for "high" drawing rates, i.e. 200 m/min, 300 m/min or higher (cf. page 4: examples; page 5, lines 15 to 21; Table). Given this situation, the wording in claim 1 "*where the fibre is still in the state of shrinking*" is not disclosed for **all** drawing rates in the application as filed and, in consequence thereof, the requirements of Article 123(2) EPC are not met.

The patentee has pointed in this context to the definition of the term "shrinkage" given on page 3, lines 11 to 13 (corresponding to $S = (D_m-D_f)/D_f$; D_m = measured diameter; D_f = true diameter of the finished fibre) which in its view gives support to the amendment in claim 1 and referred to formula (I) on page 3, line 56, according to which the temperature of the optical fibre at position (Z) is always higher than

room temperature. However, it cannot be understood why the definition actually excludes the case S = 0 if D_m equals D_f. Furthermore, the temperature of fibre at position (Z) calculated by formula (I) can be so low that further shrinkage does not occur. As to the experimental data given in the Table on page 5, no information is found in the specification indicating that the results for the conventional drawing rate of 100 m/min should be merely comparative and do not represent an embodiment of the invention.

In view of these considerations, the amendments to claim 1 of the main request do not fulfil the requirements of Article 123(2) EPC.

3. *Auxiliary Request*

3.1 Amendments:

In claim 1 of the auxiliary request, (i) the wording "*where the fibre is still in the state of shrinking*" has been deleted, (ii) the term "*characterized by*" has been replaced by "*wherein, for a drawing rate of 200 m/min or greater"* and (iii) the range of shrinkage was restricted to *"0.5% to 0.08%"* in lines 13/14. While the wording (i) has been deleted in order to satisfy Article 123(2) EPC, the lower limit of 200 m/min of the drawing rate (ii) and the term "or greater" find support on page 5, Table and lines 15 to 21 and 34 to 36 (corresponding to page 10, the last three paragraphs of the application as originally filed) which conspicuously disclose that the drawing rate can be 300 m/min or higher. The lower limit (0,08%) of the range of shrinkage (iii) is derivable from the Table on

page 5 which specifies for a drawing rate of 200 m/min a measured outer diameter of 125.1 µm. Replacement of the wording "*wherein ..are controlled*" by "*controlling*" simply represents an editorial amendment. Dependent claims 2 and 3 which also include reference signs fully comply with claims 2 and 3 as originally filed.

Hence, there are no formal objections to the claims.

3.2 Clarity

As to the clarity and meaning of the term "shrinkage" or "shrinking" objected to by the appellants, claim 1 gives a clear definition and, consequently, there is no need to distinguish between different types of shrinkage which are brought about by different effects, as proposed by the appellants.

Turning to the accuracy of measuring the fibre diameter, document D9 clearly indicates in section 1.3 for the Laser Diameter Monitor 551A a reproducibility of ±0.1 µm to ±0.2 µm in the range of 50 to 300 µm (the fibre diameter generally is about 125 µm). This accuracy corresponds to that given in the Table of the patent at issue and enables a distinction to be made between "zero shrinkage" and a shrinkage of 0.08%. In this context it has to be taken into account that the shrinkage is defined by a difference of two values and not by their absolute figures and that, therefore, the relative accuracy and not the less precise absolute accuracy has to be considered. Therefore, the appellants' reference to documents D9 and D10 has no bearing.

In view of these considerations, claim 1, in its present form, defines the claimed process clearly and, therefore, satisfies the requirements of Article 84 EPC.

3.3 Novelty

The novelty objections raised by the opponents are essentially based on the "zero shrinkage" situation which is, however, excluded by the wording of claim 1. In addition thereto, claim 1 defines a minimum drawing speed of 200 m/min.

In document D1, the diameter of an optical fibre is measured by a non-contact type fibre detector (4) connected to a fibre measuring device (5) which are both located between the end of protection tube 3 and drum 6 (cf. e.g. Figure 9). The output of the fibre measuring device (5) V_{in} is added to reference voltage V_{ref}, whereby both V_{in} and V_{ref} are aimed at being equal (cf. column 7, lines 9 to 34). A drawing out speed in the range of 10 m/min to 500 m/min is mentioned in column 8, lines 29 to 34. Nothing is found in D1 about a shrinkage occurring after measuring the fibre diameter or about even mentioning this particular problem.

According to the process given in document D2', the fibres are drawn with a drawing speed of 30 m/min and the external surface of the fibre is cooled down to room temperature before passing the diameter control unit 4',5 (cf. page 6, lines 6 to 10; page 15, lines 2 to 4, Figures 1, 2; page 16, line 3) and in document D4 which does not mention a drawing velocity, the diameter

measuring device 3 is located at a position where the fibre has completely solidified ("soldifiée à coeur"), cf. column 5, lines 33 to 36; Figure 1. In documents D5 (no drawing speed disclosed) and D7 specifying a drawing speed of maximum 60 m/min, the diameter is measured at a point shortly after the fibre is formed (cf. D5, page 52, left hand column, lines 1 to 14) or at some point below the heating zone, respectively (cf. D7, page 1428, last paragraph and line 14 from the bottom). Nothing is said in these documents about the degree of shrinking of the diameter of the fibre after passing the diameter control unit. Document D6 recommends controlling the diameter of a point on the neck itself and not after the rod is formed, without giving any information about the degree of shrinking (cf. page 1756, II. Neck Profile Measurements, lines 5 to 9; page 1759, IV, Process Control: lines 1 to 5; page 1760, right hand column, second paragraph lines 5 to 10). Documents D3 and D8 are more remote in that D3 does not deal with fibre diameter control and in that D8 relates to viscosity data of silica glasses.

Hence, the subject matter of claim 1 is novel.

3.4 Inventive Step

Given that document D1 discloses an apparatus which allows a drawing-out speed V_f of the optical fibre in the range of 10 m/min to 500 m/min and a fibre diameter measuring device 4, 5 to stably control the fibre diameter to 125 µm ± 1%, this document is regarded as being the closest prior art (cf. D1, column 2, lines 30 to 40; lines 55 to 59, column 8 lines 32 to 34).

Starting from document D1 as nearest prior art, the problem underlying the opposed patent is, therefore, seen in providing a drawing process for producing an optical fibre in which - at drawing speeds as high as 200 m/min or more - an improved accuracy of the absolute value of the fibre diameter is ensured and in which the difference between the measured outer diameter detected by a measuring device and the true diameter of the finished fibre is smaller than that obtained in conventional processes.

The solution to this problem consists in that the diameter measuring unit is located at a position (Z) from which the shrinkage of the diameter of the optical fibre, while stretched, to the diameter of the fibre when finished is 0.08 to 0.5%. It is apparent from the examples given on page 5 of the application that the problem has been successfully solved for drawing rates of 200 or 300 m/min, respectively.

It is noted that none of the cited prior art documents actually deals with optical fibre drawing speeds of 200 m/min or higher and none of them addresses the problem underlying the patent at issue. Although document D1 refers to drawing speeds desirably set within the range of 10 m/min to 500 m/min, the drawing speed V_f in the particular embodiment given in column 4, lines 51 to 55 is 38 m/min which is far outside the range claimed in the patent at issue. No information whatsoever is found in document D1 to detect the fibre diameter at a position where the fibre is still shrinking between 0.08 to 0.5%. This statement also applies to the processes disclosed in the remaining documents which all use fibre drawing speeds lower than 200 m/min, with documents D4 to D6 not even mentioning a drawing speed. Moreover, none of the cited documents not even remotely gives any hint as to how the accuracy of the final fibre diameter could be improved at drawing speeds higher than 200 m/min and at which position between the neck portion of the preform and the winding drum the diameter detecting unit is to be situated to achieve optimized fibre diameters. Only general statements with respect to the latter point are found in the prior art, according to which the diameter is measured "shortly after the fibre is formed" (cf. D5, left hand column lines 5 to 7) or "at some point below the heat zone" (cf. D7, page 1428, last paragraph). In the process according document D6, the diameter of the neck portion itself is measured and the diameter is not controlled after the rod (fibre) has formed. This is a method totally different to that used in the patent at issue. Thus, also a combination of the teaching of document D1 with any of documents D2 to D7 would not lead to the claimed process.

In conclusion, the solution to the technical problem in the present case was not obviously derivable by a skilled person from the state of the art. Consequently, the subject matter of claim 1 of the auxiliary request involves an inventive step. The dependent claims 2 and 3 relate to preferred embodiments of the process described in claim 1 and are, therefore, supported by the main claim.

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 with the order to maintain the patent with Claims 1 to 3, according to the first auxiliary request submitted on 23 September 1999 and a description to be adapted.

The Registrar: The Chairman

S. Fabiani W. D. Weiß