BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS | BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE | CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

Internal distribution code:
(A) [ ] Publication in OJ
(B) [ ] To Chairmen and Members
(C) [X] To Chairmen

D E C I S I O N
of 31 July 1995

Case Number: T 0092/93 - 3.4.1

Application Number: 87111831.1

Publication Number: 0256539

IPC: G01B 11/08

Language of the proceedings: EN

Title of invention:
Method and apparatus of measuring outer diameter and structure of optical fiber

Applicant:
SUMITOMO ELECTRIC INDUSTRIES LIMITED

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 52(1), 56

Keyword:
"Main request - inventive step (denied)"
"Auxiliary request including subject-matter not previously claimed and filed the day before oral proceedings - not admitted because not clearly allowable"

Decisions cited:
T 0153/85

Catchword:
-

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0092/93 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 31 July 1995

Appellant: SUMITOMO ELECTRIC INDUSTRIES LIMITED
No. 15, Kitahama 5-chome
Higashi-ku
Osaka-shi
Osaka 541 (JP)

Representative: Schumann, Klaus, Dr. rer.nat.
Patentanwälte
Grünecker, Kinkeldey,
Stockmair & Partner
Maximilianstrasse 58
D-80538 München (DE)

Decision under appeal: **Decision of the Examining Division of the European Patent Office dated 11 August 1992 refusing European patent application No. 87 111 831.1 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: G. D. Paterson
Members: Y. J. F. van Henden
U. G. O. Himmler

Summary of Facts and Submissions

I. European patent application No. 87 111 831.1 relating to a method and apparatus for measuring structural parameters of optical fibres was refused by a decision of the Examining Division.

II. The reasons given for the refusal are that the independent Claims 1 and 11 of the replacement set filed on 29 June 1992 were unclear, and that in view of the state of the art which can be derived from the documents

D1: US-A-4 067 651 and
D2: US-A-4 168 907,

the subject-matter did not involve an inventive step.

III. The Applicant lodged an appeal against the decision of the Examining Division.

The Statement of Grounds of Appeal was accompanied by a new set of nineteen claims comprising two independent Claims 1 and 11 drafted as follows:

"1. An apparatus for examining the structure of an optical fibre, said apparatus comprising:

optical measuring means comprising a light source (1) for irradiating the side wall of said optical fibre (3) with an observing light and a pickup system (4, 5) for detecting said observing light traversing said optical fibre, the optical axis of said optical measuring means extending from said light source to said pickup system;

an optical fibre mounting member (6) for mounting said optical fibre thereon, the axis of said optical fibre and the optical axis of said optical measuring means being set perpendicular to one another with one of said optical fibre mounting member and said optical measuring means being rotatable relative to the other; and

means (5, 7, 9) for calculating structural parameters on the basis of the measured light having traversed the optical fibre, **characterised in that**

said pickup system (4, 5) includes focusing means having its observing plane set as a position within or close to the diameter of the optical fibre;

said measuring means including said pickup system is capable of measuring a luminance distribution of the light passing through said optical fibre at said position; and by further comprising means (4, 5, 7, 8, 9) for correcting the lens effect on said luminance distribution of said light.

11. A method of examining the structure of an optical fibre, said method comprising the steps of:

providing optical measuring means comprising a light source for generating light and a pickup system for detecting said light;

providing an optical fibre mounting member for mounting said optical fibre thereon;

arranging said optical measuring means and said optical fibre mounting member in such a manner that the optical axis of said optical measuring means

extending from said light source to said pickup system is perpendicular to the optical axis of said optical fibre;

rotating one of said optical fibre mounting member and said optical measuring means relative on one another;

irradiating the side wall of said optical fibre with said light in the direction perpendicular to said axis of said optical fibre;

measuring said light traversing said optical fibre; and calculating structural parameters of said optical fibre on the basis of the measured light having traversed said optical fibre, **characterised in that** said step of measuring the light traversing said optical fibre comprises the step of setting an observing plane of said pickup system at a position within or close to the diameter of the optical fibre and measuring a luminance distribution of the light passing through said fibre at said position; and by further comprising the steps of

correcting the lens effect on said luminance distribution of said light on the basis of the position of said observing plane; and

calculating structural parameters of said optical fibre on the basis of said luminance distribution subjected to correction of the lens effect."

The remaining Claims 2 to 10 and 12 to 19 are respectively appended to Claim 1 and to Claim 11.

IV. The Board summoned the Appellant to oral proceedings to be held on 26 April 1995. In a communication dated

9 March 1995 and annexed to the summons in pursuance of Article 11(2) RPBA, the Board took the provisional view that, having regard to the disclosure in documents (D1) and (D2), the independent claims filed with the Statement of Grounds of Appeal lacked an inventive step. The Board also expressed the opinion that it was not apparent which part of the application could serve as a basis for new allowable claims, and stated that if nevertheless, particular subject-matter was regarded as patentable, new independent claims should be filed at least a month before the oral proceedings, and were in any event only admissible at the discretion of the Board.

V. On 25 April 1995 at about 1600 hrs., the Appellant filed via telefax a new set of thirteen claims, and asked that this be taken into consideration during the oral proceedings as an auxiliary request. The Appellant apologised for the late filing of this request, and pointed out that the communication accompanying the summons had only been received on 13 March 1995. In connection with the admissibility of the auxiliary request, the Board referred to Decision T 0153/85 (OJ EPO 1988, 1), and a copy of the headnote was handed to the Appellant's representative.

With respect to Claim 1 of the set of claims which was filed with the Statement of Grounds of Appeal, Claim 1 of this new set is distinguished in that "fibre", "traversing", "traversed", "characterised" and "observing plane" were replaced by "fiber", "passing", "passed", "characterized" and "focusing plane", respectively; in that the reference number (5) was detected in the last clause of the pre-characterising part; in that the phrase "including said pickup system" and the text following the semicolon were deleted in the last clause; and in that the additional clauses

(a) "the optical measuring means produce a substantially monochromatic observing light,"

(b) "said calculating means are capable of determining the distance (ΔX) of the focusing plane from the center of the optical fiber from the measurements of the distances (Z_n, Z^*_n) between peak positions (P_n, P^*_n) of diffraction fringes;"

(c) "said calculating means is capable of measuring distances within the luminance distribution of the light passing through the optical fiber at said position and correcting the measured distances in dependence of the determined distance (ΔX) between the center of the optical fiber and the focusing plane by a correction coefficient obtained from a relationship between such a correction coefficient and the distance (Z) of the focusing plane from the center of the optical fiber measured in advance"

were inserted in the characterising part as first, fourth and fifth clause, respectively.

The set of claims constituting the auxiliary request, which was received on 25 April 1995, comprises a further independent claim 10 which, with respect to Claim 11 of the set filed with the Statement of Grounds of Appeal, is distinguished in that, in the pre-characterising part, the same changes in the terminology were made; the clause "rotating one of said optical fibre mounting member and said optical measuring means relative to one another" was deleted; "measuring said light" was replaced by "measuring the light"; and in that its characterising part reads

"**characterized in that**

as the irradiating light a substantially monochromatic light is used,

said step of measuring the light passing said optical fiber comprises the step of setting a focusing plane of said pickup system at a position within or close to the diameter of the optical fiber and measuring a luminance distribution of the light passing said fiber at said position; and by further comprising the steps of

determining the distances between peak positions of diffraction fringes and calculating therefrom the distance between the center of the optical fiber and the focusing plane,

measuring distances within the luminance distribution of the light passing through the optical fiber, and correcting the measured distances in dependence of the calculated distance (ΔX) between the center of the optical fiber and the focusing plane by a correction coefficient obtained from a relationship between such a correction coefficient and the distance (Z) of the focusing plane from the center of the optical fiber measured in advance."

Claims 2 to 9 and Claims 11 to 13 of the auxiliary set are respectively appended to Claim 1 and to Claim 10.

VI. During oral proceedings which were held on 26 April 1995, the Appellant requested that the decision under appeal be set aside and that a European patent be granted on the basis of Claims 1 to 19 filed with the Statement of Grounds of Appeal or, as an auxiliary request, on the basis of Claims 1 to 13 filed on 25 April 1995.

VII. In support of these requests, the Appellant argued in substance as follows:

Document (D1) discloses a method and an apparatus which are completely unrelated to those of the present invention, since a complex scattering pattern is observed outside the optical fibre, and its modulations are measured at various angles. The arrangement of the apparatus is also different, since the detector is rotatable in order to detect at various scattering angles. This difference is more apparent in Figure 29, where a circular array of photoelectric devices surrounds the fibre. Moreover, document (D1) does not disclose the use of a focussing system in the detection of the scattered light since a slit detector is provided. Finally, in an apparatus according to Figure 28, the light beam of the laser is always received from the same side of the fibre, and only the spectrometer rotates with respect to the latter.

The closest prior art is document (D2), which makes use of the fact that reflection at the boundary between core and cladding results in dark lines appearing on a screen, which screen must be positioned beyond the focal point due to the converging action of the optical fibre. From such information, it is possible to determine the size and eccentricity of the core. Nevertheless, the result is dependent on how accurately the distance between the dark lines can be measured and, anyway, the outer diameter of the fibre is not accurately determined. Moreover, the apparatus described in document (D2) is not compact and does not provide an automatic monitoring of the structural parameters during the manufacture of the optical fibre. For these reasons, the disclosure of (D2) could not have helped to arrive at the claimed invention.

According to the present invention, the observing plane of the pickup system is set at a position within or close to the diameter of the optical fibre. As shown by Figures 4 to 6, shadow regions (B, C) are present there, through which regions the light beam of the laser does not pass, and the resulting pattern of light intensity is simple. By means of an apparatus which is compact, simple and easy to use, this distribution of light intensity can be measured with a high degree of accuracy. Admittedly, correcting for the lens effect on the luminance distribution is an essential part of the invention. Nevertheless, including in the claims the specific method steps disclosed in the application for this purpose would unduly restrict the conferred protection, for the person skilled in the art is well aware of the lens effect.

VIII. After deliberation by the Board, it was announced at the end of the oral proceedings that the Board reserved its decision on the appeal and would issue its decision in writing as to the allowability of the main request and as to the admissibility/allowability of the auxiliary request.

Reasons for the Decision

A. Main request

(i) *State of the art*

1. Document (D1) relates to non-destructive methods of measuring and monitoring such parameters of clad optical fibres as the diameter, the circularity and the eccentricity of the core - see column 1, lines 8 to 22. With reference to Figure 28, this document describes an

apparatus for examining the structure of a clad optical fibre (10), which apparatus comprises a spectrometer base (12), a holder (11) fastened to the base (12) for securing the fibre (10) to be measured, a radiant energy source (18) directing a light beam (19) at the fibre (10), and a spectrometer (16) mounted on a rotatable table (13) coaxial with the fibre and the base (12). In operation, the table (13) is driven by a motor (22) and a slit detector (17) of the spectrometer (16) views the scattering pattern produced by the clad fibre (10) - see from line 52 of column 15 to line 12 of column 16.

The fact that the light beam (19) is perpendicular to the axis of the optical fibre (10) is not stated expressis verbis in document (D1). However, the theoretical considerations developed in document (D1) are based on this assumption - see column 3, lines 59 to 63 - and none of the formulae disclosed there would be valid if such were not the case, since they do not include any symbol denoting the angle formed by the light beam and the axis of the fibre - see also Claim 2.

The Appellant contested that the optical axis of the measuring means comprising the light source (18) and the "pickup system", formed by the spectrometer (16), the slit detector (17) and the rotatable table (13) would extend from said light source to said pickup system. However, document (D1) states that, in operation, the spectrometer (16) is rotated to the 0° position and that the table (13) is subsequently rotated so that the detector (17) views the entire scattering pattern after one complete revolution (360°) has been accomplished - see column 16, lines 3 to 8. For reasons of symmetry, it is thus clear that the axis of the spectrometer (16) at the 0° position - i.e. that of light scattered in the forward direction, as defined in column 4, lines 33 to 35 - and the light beam (19), of which said axis of the

spectrometer forms the prolongation at that position, constitute the optical axis of the optical measuring means described in document (D1). This is even more clear in the alternative embodiment of Figure 29 to which the Appellant drew attention, where a circular array of photodiodes (30) and a scanner (31) are substituted for the spectrometer (16), the rotatable table (13) and the motor (22) - column 16, lines 24 to 28. Therefore, keeping to the formulation and terminology of Claim 1, as apparatus according to Figure 28 of document (D1) comprises:

- optical measuring means comprising a light source for irradiating the side wall of an optical fibre with an observing light and a pickup system for detecting said observing light traversing said optical fibre, the optical axis of said optical measuring means extending from said light source to said pickup system, and

- an optical fibre mounting member for mounting said optical fibre thereon, the axis of said optical fibre and the optical axis of said optical measuring means being set perpendicular to one another.

Furthermore, in said apparatus,

"the measuring means including the pickup system is capable of measuring a luminance distribution of the light passing through the optical fibre".

2. Besides the light source (18) and the spectrometer (16), the Figure 28 of document (D1) shows a control circuit (24), a lock-in amplifier (26) and a pen recorder (27). Obviously, the amplifier and the pen recorder may not be considered as a calculation means, whereas the control

circuit is just said to drive the motor (22) rotating the spectrometer and to energize the light source - see from line 65 of column 15 to line 5 of column 16. Nevertheless, the cited passage of the description states that the amplifier (26) receives the output of the slit detector (17) and that, "in an on-line process, the output of amplifier (26), would be connected to suitable logic circuitry such that, if the parameter being measured ... exceeded or fell below some priorly established tolerance limit, a feed-back loop could make appropriate changes to the process". Furthermore, as stated in independent Claims 1 and 4 of document (D1), the core diameter and the cladding thickness are computed. Therefore, despite the lack of explicit disclosure, it appears that Figure 28 of document (D1) is only a partial representation of an apparatus which necessarily comprises

"means for calculating structural parameters (of a clad optical fibre) on the basis of the measured light having traversed the optical fibre".

3. The notion of "lens effect" is not clearly defined in the patent application. Nevertheless, the outer surface of an optical fibre's cladding being a cylindrical dioptre, the fringe pattern which can be observed from the outside is necessarily an image of the actual fringe pattern produced by light diffraction at the boarder between core and cladding. Furthermore, a cylindrical dioptre is a poor imaging device, and with increasing distance to the plane containing the light source and the axis of the fibre, said image becomes more and more distorted. Therefore, the lens effect mentioned in Claim 1 cannot be anything other than the distortion and/or magnification of the observed fringe pattern resulting from the convexity of the fibre's outer surface. As a matter of fact, in a reply dated

4 December 1991 to the first communication of the Examining Division, the Appellant made submissions which are in agreement with this conclusion.

Now, the "lens effect" of any dioptre or optical system is a consequence of the refraction of light by the dioptre and, therefore, is related to the deviation (θ) of the rays exiting the dioptre or the system. Furthermore, the formulae of document (D1) take this angle into account, in particular those numbered 13 to 19, of which the validity is readily apparent. Therefore, the calculating means provided according to document (D1) for determining structural parameters of an optical fibre on the basis of said formulae necessarily "correct the lens effect on the luminance distribution of the light passing through the optical fibre". The Appellant did not raise any objection regarding this point. On the contrary, it acknowledged that a person skilled in the art is well aware of the lens effect and submitted that including method steps for correcting this effect would result in unduly restricting the invention - see page 10 of the Statement of Grounds of Appeal.

4. With respect to an apparatus embodying the teachings of document (D1), the subject-matter of Claim 1 is thus novel in that

- either the optical fibre mounting member or the optical measuring means is rotatable relative to the other, and in that

- the pickup system includes a focusing means having its "observing plane" set at a position within or close to the diameter of the optical fibre.

The latter feature actually means that, with respect to the focusing means, the luminance detecting member of the pickup system - typically, the target of a television pickup tube as may be inferred from Claim 2 - is located in a plane conjugate of an object plane which is at a position "within or close to the diameter of the optical fibre".

(ii) *Inventive step*

5. The methods of determining structural parameters of clad optical fibres or rods disclosed in the present application, in document (D1) and in document (D2) are based on measurements of distances between maxima and/or minima of a luminance distribution produced by the passage of a light beam through such an optical fibre or rod. Therefore, the requirement to be met in order to achieve an accurate determination of such parameters is either that the primary fringe pattern produced by the core-cladding interface be accessible to the measuring means or that a sharp image of said pattern be formed at some accessible place.

The Appellant did not contest that the primary fringes are produced within the bulk of the clad fibre or rod. In document (D2), which was considered by the Appellant to be the most relevant for assessing inventiveness, it is indeed stated that, between those rays that traverse only the cladding and those rays that traverse both the cladding and the core, there is a particular group of rays which are incident at a grazing angle and are totally reflected - see column 3, lines 14 to 20. Two dark regions are thus present within the bulk of the optical fibre or rod, which regions are part of the primary fringe pattern.

Therefore, when designing an apparatus of the kind covered by the pre-characterising clause of Claim 1, no exercise of inventive ingenuity is required from the skilled person to provide, in order to determine more accurately structural parameters of clad optical fibres, a focussing means such that an object plane located within or close to the diameter of the fibre to be examined and a plane coinciding with the target of a suitable pickup device be conjugate - see also column 5 of document (D2), lines 1 to 6. Besides, anyone having practical or theoretical knowledge of optics is well aware of the subsidiary advantage offered by such a measure, to wit a possible reduction in size of the apparatus.

6. Rotating the optical fibre relative to the pickup system of the claimed apparatus aims obviously at determining whether, and if so in which direction, the axis of the core is shifted with respect to the axis of the cladding's outer surface. However, both this measure and the result expected therefrom are known in the art - see column 4 of document (D2), lines 21 to 23 - and the Appellant did not contend that, taken alone, any of them might be considered as evidence of an inventive step.

7. In the Board's judgment, therefore, Claim 1 according to the Appellant's main request lacks an inventive step. Mutatis mutandis, the same reasons and the same conclusion apply to the independent method Claim 11.

8. Therefore, the Appellant's main request is not allowable having regard to Article 52(1) EPC in conjunction with Article 56 EPC.

B. Auxiliary request

Admissibility

1. The first part of the headnote of Decision T 153/85 reads as follows:

I. If an Appellant desires that the allowability of alternative sets of claims should be considered in an appeal, such alternative claims should normally be filed with the Statement of Grounds of Appeal or as soon as possible thereafter.

II. When deciding an appeal during oral proceedings, a Board of Appeal may refuse to consider alternative claims which have been filed at a late stage, e.g. during the oral proceedings, if such claims are not clearly allowable.

In the present case, the subject-matter of the characterising portion of Claim 1 of the auxiliary request (see paragraph V above) was not previously the subject-matter of any of the claims of the application, and has been derived from the description. Although it appears that no objection to this amended claim arises under Article 123(2) EPC, nevertheless the subject-matter of this claim has not been specifically considered by the Examining Division, and may not have been specifically searched by the Search Division.

As pointed out in paragraph 2.1 of Decision T 153/85:

"In relation to appeal proceedings, the normal rule is as follows: if an appellant wishes that the allowability of the alternative set of claims, which differ in subject-matter from those considered at first instance, should be considered (both in relation to Article 123

EPC and otherwise) by the Board of Appeal when deciding on the appeal, such alternative sets of claims should be filed with the grounds of appeal, or as soon as possible thereafter."

Furthermore:

"In all normal circumstances, an appellant has ample time and opportunity, both during the proceedings at first instance and during the appeal proceedings, to consider and formulate the full range of claims that he may desire, well prior to the oral hearing (in the appeal proceedings). This is especially applicable to the present case. During the proceedings before the Examining Division, following a first communication issued on 25 July 1991, in a second communication issued on 17 February 1992 the Examining Division specifically considered the inventiveness of Claim 11 (a method claim), being the narrower of the two independent Claims 1 and 11, and stated not only that Claim 11 did not involve an inventive step having regard to documents (D1) and (D2), but also that "the description does not provide any method steps which could render Claim 11 inventive" (paragraph 2.7), and that "The Applicant should be aware that there appears to be no inventive material in the application and continuation of the examination procedure appears likely, at this stage, to result in a refusal".

Thus the Appellant has had at least three years since receipt of such communication, and before receipt of the Board's communication dated 9 March 1995, in which to propose the set of claims which was first filed on 25 April 1995, the evening before oral proceedings before the Board of Appeal, as an auxiliary request. The Board's communication dated 9 March 1995, which the Appellant received on 13 March 1995, merely developed

the reasoning of the Examining Division for a possible finding of lack of inventive step with respect to the set of claims filed with the Statement of Grounds of Appeal, on the basis of documents (D1) and (D2).

In the Board's view, an alternative set of claims such as the auxiliary request which was filed on 25 April 1995, including new claims with subject-matter which had not previously been included in the claims, should have been filed with the Statement of Grounds of Appeal, or at least soon after, if the Appellant wished such claims to be fully considered in these proceedings.

2. In the circumstances that this auxiliary request was only filed the evening before oral proceedings before the Board of Appeal, the Board would only admit this auxiliary request into the proceedings if the claims were "clearly allowable", in the sense that they can quickly be seen by the Board both to introduce no objections under the EPC and to meet all outstanding objections under the EPC.

In this connection the Board observes as follows:

(i) All transparent substances have a refractive index which varies as a function of the wave length of light. The use of a non-monochromatic light, therefore, would be detrimental to the sharpness of the luminance distribution detected by the pickup system.

(ii) That the measuring means be capable of measuring the luminance distribution of the light passing through the optical fibre at the position (P_x) - in fact: capable of determining said

distribution - is a condition sine qua non to be met for determining structural parameters of said fibre.

(iii) The distances (Z_n, Z^*_n) are also dependent on the diameters of the core and the cladding, which diameters are not previously known. How the calculating means could determine the distance (ΔX) from these data is consequently unclear.

(iv) Stating that a calculating means measures distances is unclear. This lack of clarity is the more showing as it is further stated that the calculating means is capable of "correcting the measured distances ..." In fact: the position of the "focussing plane" - i.e. the object plane, as may be inferred from Figure 13A - is dependent upon the convergence of the focussing means, its distances to the centre of the fibre and the target of the pickup tube (14), the diameter and the refractive index of the cladding. Said focussing plane is the one of which the image formed by the cylindrical dioptre is conjugate of said target with respect to the focussing means (18). This remark strengthens the conclusion under 3.

(v) Claim 1 according to the Appellant's auxiliary request is unclear and fails to define completely and correctly its subject-matter. As appears from the preceding, removing these drawbacks reveals that the claim lacks an inventive step, because as indicated generally by the Examining Division in its communication dated 17 February 1992 (see paragraph B(1)

above), the claimed features are trivial to any one knowing the elementary laws of geometrical optics.

3. In these circumstances, in the Board's judgment the subject-matter of the claims of the auxiliary request filed on 25 April 1995 is not clearly allowable in the sense set out in paragraph B(2) above, and this auxiliary request is therefore inadmissible.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

M. Beer G. D. Paterson