BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

A		B		C	X

File No.: T 0720/91 - 3.4.2

Application No.: 87 310 871.6

Publication No.: 0 275 654

Classification: G02B 6/06

Title of invention: Optical fiber array

D E C I S I O N
of 8 July 1993

Applicant: MITSUBISHI RAYON CO., LTD.

Proprietor of the patent:

Opponent:

Headword:

EPC: Art. 56

Keyword: "Inventive step (no)"

Headnote
Catchwords

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Case Number: T 0720/91 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 8 July 1993

Appellant: MITSUBISHI RAYON CO., LTD.
3-19, Kyobashi 2-chome
Chuo-Ku
Tokyo 104 (JP)

Representative: West, Alan Harry
R.G.C. Jenkins & Co.
26 Caxton Street
London SW1H 0RJ (GB)

Decision under appeal: **Decision of the Examining Division of the European Patent Office dated 24 April 1991 refusing European patent application No. 87 310 871.6 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: E. Turrini
Members: W.W.G. Hofmann
M.K.S. Auz Castro

Summary of Facts and Submissions

I. European patent application No. 87 310 871.6 (publication No. 0 275 654) was refused on 24 April 1991 by decision of the Examining Division.

II. The reasons given for the refusal were that Claim 1 lacked clarity (Article 84 EPC) and that the subject-matter of Claim 1 did not involve an inventive step (Articles 52(1) and 56 EPC), having regard to the documents

(D4) DE-A-2 505 995 and
(D7) EP-A-0 131 058.

III. On 24 June 1991, the Appellant (Applicant) lodged an appeal against the decision. The Grounds for Appeal were received on 3 August 1991.

IV. Together with summons to oral proceedings, the Board sent a communication in which it expressed its view that the subject-matter of Claim 1 appeared to lack an inventive step.

V. With the letter of 8 June 1993, the Appellant filed a new set of Claims 1 to 6.

VI. Oral proceedings were held on 8 July 1993. At the oral proceedings, the Appellant submitted a further set of Claims 1 to 5 as an auxiliary request.

Claim 1 under consideration (main request) reads as follows:

"1. An optical fiber bundle comprising a multiplicity of multifilament plastics optical fibers (11) each

multifilament fiber having an islands (12) in the sea (13) structure and a section which is a substantially rectangular two-dimensional array of from 10 to 10,000 individual light-transmitting filaments each having a circular section of diameter from 5 to 200 µm, the multifilament plastics optical fibers (3, 43) being arranged into a substantially rectangular or substantially circular array (2, 42) at one end of the bundle and into one or more lines (1, 41) at the other end of the bundle."

The set of claims further comprises dependent Claims 2 to 6.

The auxiliary version of Claim 1 differs from the above text only by the insertion of "hexagonal-stacked" between "10,000" and "individual light-transmitting filaments".

The auxiliary set of claims further comprises dependent Claims 2 to 5.

VII. The arguments presented by the Appellant were substantially as follows:

D4 describes an image dissector in which the individual fibres consist of a core rod 11 surrounded by a coating pipe 12. This coating pipe is relatively thick, so that in the array the rods are necessarily kept at a distance with regard to each other. The separation of the rods leads to unsatisfactory spatial resolution of the image transmitting system. No great improvement would be achieved if the rods of D4 were replaced by the optical fibre assemblies described in D7 since according to D7 the individual fibres are also separated from each other by a relatively thick embedding layer. This problem is solved by the present invention since in the islands in

the sea structure of the present invention there is substantially no embedding layer between the filaments.

The hexagonal-stacked arrangement of the filaments in the multifilament fibres according to the auxiliary request further assists the dense packing of the filaments and thus improves the image resolution.

VIII. The Appellant requested that the decision under appeal be set aside and that a patent be granted

by way of the main request: on the basis of Claims 1 to 6, filed on 8 June 1993, with the description and drawings yet to be adapted,

by way of an auxiliary request: on the basis of Claims 1 to 5 filed during the oral proceedings as auxiliary request, with the description and drawings yet to be adapted.

Reasons for the Decision

1. The appeal is admissible.

2. *Clarity*

In the appealed decision, the Examining Division objected to the term "fiber" used in the claims and the description for defining a structure comprising 10 to 10,000 "light-transmitting filaments".

It is true that the term "fiber" normally describes only a single light-transmitting element and the term "filament" is not usual in optics for defining optical fibres. In the opinion of the Board, however, the fact

that the meaning of the term "multifilament optical fiber" is further defined even in Claim 1 itself ("including from 10 to 10,000 individual light-transmitting filaments", i.e: individual optical fibres), sufficiently guarantees that no ambiguity regarding the meaning of the terms can arise. Moreover, a similar term ("multifiber") is used in one of the prior art documents (US-A-3 238 837) cited in the European Search Report.

The dependent Claims 4 and 5 (Claims 3 and 4 according to the auxiliary request) only specify the results to be achieved. In the view of the Board, however, a person skilled in the art would be able to find a way to realise these results.

Thus, the Board does not raise objections regarding the clarity of the claims (Article 84 EPC).

3. *Novelty*

3.1 D4 discloses an optical fibre bundle (cf. in particular Figures 1 and 9) comprising a multiplicity of plastics optical fibres (the mention of light guiding thermoplastic material in Claim 17 can only mean "plastics") of substantially rectangular cross-section (cf. e.g. page 5, lines 27 to 30). The optical fibres are arranged into a rectangular array at one end of the bundle and into one line at the other end of the bundle (cf. Claim 10 and page 1, lines 7 to 12).

The subject-matter of present Claim 1 (main request) differs from this known fibre bundle by the fact that the fibres are multifilament fibres having a section which is a two-dimensional array of from 10 to 10,000 individual light-transmitting filaments (fibres) each having a circular section of a diameter from 5 to

200 µm. (The only additional information which can be derived from the expression "islands in the sea structure" is the fact that the filaments - like islands in the sea - do not directly touch each other.)

Claim 1 according to the auxiliary request additionally differs from the teaching of D4 by the fact that the filaments are "hexagonal-stacked", in other words: each row of filaments forming the two-dimensional array is shifted with respect to the neighbouring rows by half the distance of the centres of the individual filaments in the row.

3.2 D7 (cf. in particular "abstract" and Figures 4b, 4c, and 4d) describes two-dimensional arrays of plastics optical fibres embedded in a "sea" material. According to the example shown in Figure 4b, the section of the array is substantially rectangular. The array may contain e.g. 64 (cf. page 15, line 32) or thousands (cf. page 13, lines 2 to 5) of individual fibres. The individual fibres have a circular section and a diameter (core + cladding) of e.g. 86 µm (page 15, line to page 16, line 1). The structure of these arrays thus corresponds to the structure of the multifilament fibres specified in present Claim 1.

The subject-matter of Claim 1 differs from this prior art by the fact that a multiplicity of the multifilament fibres (arrays) are arranged in bundles (forming a substantially rectangular or circular array at one end and one or more lines at the other end). On page 17, lines 7 to 10, and in Figure 4d, D7 also mentions and shows bundles of fibre arrays, but only for the embodiment relating to triangular arrays.

The hexagonal-stacked arrangement of the filaments specified in Claim 1 according to the auxiliary request

is also shown in D7 only for the case of triangular arrays.

3.3 The subject-matter of Claim 1 according to both requests is thus novel in the sense of Article 54 EPC.

4. *Inventive step*

4.1 Main request

4.1.1 As was shown above, replacing the fibres (rods) of the fibre bundle according to D4 by the fibre arrays (multifibres) according to D7 would lead directly to the claimed subject-matter. The question to be considered is therefore whether it was obvious for a person skilled in the art to combine the features according to D4 and D7 for solving the problem underlying the claimed subject-matter.

4.1.2 The present description does not expressly state the problem - starting from the prior art as represented by D4 - to be solved by the subject-matter of the application. It can, however, be derived from the description as a whole (cf. page 10, lines 16, 17 and page 12, lines 8, 9, (numbering of the pages in accordance with the originally filed as well as the amended description, received on 5 November 1990)) that in particular a high image resolving power is to be achieved. This resolving power is also linked with the degree of evenness of the transmitted light distribution (for the case of homogeneous illumination of the other end of the fibre bundle) (cf. page 9, lines 31 to 33).

The fact that achieving high resolving power is the problem underlying the present subject-matter, was also stressed by the Appellant in his letters and at the oral proceedings.

To obtain good image resolution is a usual aim in optics. The fact *per se* of recognising this problem therefore did not require inventive skill.

4.1.3 Since the image transmitted by a bundle of fibres is composed of the points of light (pixels) transmitted by the individual fibres, it is clear that the number of individual fibres per area is directly related to the image resolution. It is therefore immediately obvious that replacing each of the relatively thick (cf. the term "rods" on page 5, line 3) fibres of D4 by a multiplicity of (consequently thinner) fibres, corresponding to the replacement of the rods by arrays of fibres according to D7, must improve the image resolution.

Improving the image resolution by combining the features according to documents D4 and D7 is therefore obvious for a person skilled in the art.

4.1.4 The Appellant has submitted that the resolution achieved by the subject-matter of the present application is even better than that of the fibre array disclosed in D7 since according to D7 (see in particular Figures 4a, 4b and 4c) all the fibres are completely surrounded by an embedding material which separates the fibres (core + cladding) from each other, thus increasing their distance, while according to the present application the fibres ("filaments", "islands") directly touch each other, and the embedding material ("sea-forming" material) only fills the (three- or four-cornered) spaces remaining among the fibres.

The Board, however, cannot find any support for this argument in the present application: First of all, Claim 1 does not specify in any way how the "sea" material is distributed among the "islands". Contrary to

the argument of the Appellant, the expression "islands in the sea structure" rather points to the fact that the islands - like the fibres in the case of D7 - are completely surrounded by the sea and the "sea" does not only form isolated patches surrounded by the "islands".

Moreover, neither the description nor the drawings contain any indication that the fibres are meant to touch each other without any layer of embedding material in between. The drawings (in particular Figures 1A, 1B and 2; Figure 8 is no longer covered by Claim 1) are only schematic and thus not precise enough to allow judgment on the presence or absence of layers among the fibres; and the sentence pointed out by the Appellant, on page 8, lines 7 to 18 of the originally filed or the amended version of the description, only mentions that the spaces among the "islands" are filled, but does not exclude that "sea-forming polymer" may also remain all around the "islands" (the said sentence expresses, on the contrary, that during fabrication, the "sea-forming polymer" adheres to the **periphery** of the fibre-forming polymer). Finally, the text on page 4, lines 10 to 12, of the originally filed and the amended description states that the "sectional sea occupancy ratio" in the multifilament optical fibre is preferably 5 to 40%, particularly 10 to 20%. With such a low occupancy ratio, it is not credible that the fibres are meant to touch each other directly.

Since in Claim 1 (and also in the description) the crucial parameter for the spatial resolution, i.e. the distance between the fibres ("filaments", "islands"), is left open (the diameter of the fibres themselves is the same as according to D7), it is not credible that the spatial resolution achieved by the multifilament fibres according to present Claim 1 is better than what a

person skilled in the art would expect for the fibre arrays according to D7.

The same is true for the resolution of the claimed fibre bundle as a whole as compared with that of a fibre bundle corresponding to the combination of the features of D4 and D7, in which combination the - according to the presumption of the Appellant - relatively large distance (caused by the thickness of the coating) between the surfaces of the light guiding fibre rods in the fibre bundle according to D4 might have been maintained. In this respect it is again to be noted that Claim 1 does not define the thickness of the embedding ("sea") layer, and that the embedding layer may also be present in those regions separating the fibres of the one multifibre from those of the other.

Any other effects achieved by the subject-matter of Claim 1 have not been put forward by the Appellant.

The Board, therefore, cannot see any surprising effect achieved by the combination of the features according to D4 and D7.

4.1.5 Consequently, the Board comes to the conclusion that the subject-matter of Claim 1 according to the main request lacks an inventive step in the sense of Article 56 EPC.

The main request is therefore not allowable in view of Article 52(1) EPC).

4.2 Auxiliary request

Claim 1 according to the auxiliary request contains the additional feature that the individual light-transmitting filaments are "hexagonal-stacked" (former Claim 2). Such an arrangement of bodies having a

circular cross-section is well known (cf. the arrangement of the fibres in the array according to Figure 4c of document D7) and was, therefore, obviously suited for the fibres according to the present application.

Even apart from the question whether denser packing achieved by this arrangement would be surprising, it must be stated that Claim 1 does not even guarantee that a dense packing is actually achieved since the thickness of "sea" material separating the fibres from each other is not defined. The "hexagonal-stacked" arrangement therefore does not produce any particular effect.

Thus, the subject-matter of Claim 1 according to the auxiliary request also lacks an inventive step in the sense of Article 56 EPC, and the auxiliary request is also not allowable in view of Article 52(1) EPC.

4.3 Although the lack of inventive step of the subject-matter of Claim 1 is sufficient for rendering the corresponding request unacceptable, the Board also considered those dependent claims the features of which had not been introduced into Claim 1 of one of the requests:

The additional features of Claims 3 and 6 (numbering according to the main request) are known from D4 and D7, respectively.

Claims 4 and 5 are directed to ranges of the resolving power intended to be achieved by the claimed fibre bundle. It is clear that the skilled person will, in principle, always aim at as high a resolving power as possible, in full correspondence with the range, open towards the upper end, aimed at according to Claim 4.

In practice, depending on the practical conditions of the fabrication method used (which is not specified in the claims), limitations to the resolving power will prove to be necessary. Which range of resolving powers is then achievable (e.g. the range specified in Claim 5), will emerge from practical experience and not from inventive ingenuity.

Therefore, no inventive features could be found in any of the dependent claims.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

E. Görgmaier E. Turrini