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D E C I S I O N
of 16 November 1995

Case Number: T 0134/93 - 3.4.2

Application Number: 86201627.6

Publication Number: 0224282

IPC: G02B 6/26

Language of the proceedings: EN

Title of invention:
Optical transmission system comprising a radiation source and a multiple-clad monomode optical transmission fibre with a negative-step index profile

Patentee:
Philips Electronics N.V

Opponent:
Siemens AG

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step - prejudice in the art (no)"

Decisions cited:
-

Catchword:
General critical remarks in one textbook are not sufficient for substantiating an alleged prejudice, if a plurality of prior art documents point to the opposite.

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0134/93 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 16 November 1995

Appellant: (Proprietor of the patent)
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Representative:
-

Decision under appeal:
Decision of the Opposition Division of the European Patent Office posted 23 November 1992 revoking European patent No. 0 224 282 pursuant to Article 102(1) EPC.

Composition of the Board:

Chairman: E. Turrini
Members: W. W. G. Hofmann
B. J. Schachenmann

Summary of Facts and Submissions

I. The Appellants (Proprietors of the patent) lodged an appeal against the decision of the Opposition Division on the revocation of the patent No. 0 224 282. (Application No. 86 201 627.6).

Opposition had been filed against the patent as a whole and based on Article 100(a) EPC. The Opposition Division had held that the grounds for opposition mentioned in Article 100(a) EPC prejudiced the maintenance of the patent, having regard in particular to the documents

(D1) Applied Optics, vol. 19, 1980, pages 2578-2583,

(D2) GB-A-2 116 744.

II. In appeal, the following further documents were cited:

(D3) J. M. Senior: Optical Fiber Communications, Prentice Hall, 1985, pages 146/147, 156/157, 414-417, 444/445,

(D4) International Conference on Communications, Conference Record, Seattle, WA., 1980, pages 28.3.1-28.3.6,

(D5) Electronics Letters, vol. 15, 1979, pages 106-108,

(D6) Sixth European Conference on Optical Communication, York, U.K., 1980, pages 302-305,

(D7) The Bell System Technical Journal, vol. 56, 1977, pages 703-718,

(D8) H.-G. Unger: Optische Nachrichtentechnik, Elitera-Verlag, 1976, pages 24-28,

(D9) GB-A-2 083 646 (cited in the European search report).

III. Oral proceedings were held, at the end of which the Appellants requested that the decision under appeal be set aside and the patent be maintained as granted (main request) or with Claims 1 to 5 submitted at the oral proceedings (auxiliary request).

The Respondents (Opponents) requested that the appeal be dismissed.

IV. The wording of Claim 1 on file at the time of the present decision reads as follows:

Main request:

"1. An optical transmission system comprising a radiation source and a multiple-clad monomode optical transmission fibre at least one of the cladding layers of said multiple-clad monomode optical transmission fibre having a lower refractive index than the nearest cladding layer surrounding it, characterized in that a single-clad monomode optical transmission fibre, whose end portion which faces the radiation source has a tapered core, is arranged between the multiple-clad monomode optical transmission fibre and the radiation source."

Claims 2 to 6 are dependent on Claim 1.

Claim 1 according to the auxiliary request reads as that of the main request with the following text added at the end:

"..., and that the spot size at the straight other end of the single-clad monomode optical transmission fibre is substantially equal to the spot size of the multiple-clad monomode optical transmission fibre."

Claims 2 to 5 are dependent on Claim 1 according to the auxiliary request.

V. The Appellants essentially argued as follows:

A skilled person constructing an optical transmission system would first choose the fibre for the long distance transmission since this fibre gives the largest contribution to the loss in the system, ie he would start from D2 disclosing a multiple-clad optical fibre. For coupling the light from the light source into the fibre he would then, in accordance with D1, form a taper at the source end of the multiple-clad fibre. This would not lead to the subject-matter of Claim 1, nor would it provide suitable coupling. If the skilled person, however, started from the teaching of D1, he would also consider D4 and construct both the tapered end and the transmission fibre as single-clad monomode fibres. He would not in this context have been satisfied with the teaching of D2 because D2 gives a solution to a problem that he is not concerned with, ie the broadening of the range of wavelengths, and does not seem particularly promising regarding reduction of the losses of an optical transmission fibre. If the skilled person nevertheless wanted to try the multiple-clad transmission fibre of D2, the question would arise whether to use a single-clad or a multiple-clad fibre for the tapered end. He would then choose the

multiple-clad fibre in order to avoid the coupling losses which are to be expected from coupling between non-identical fibres. The difficulties with, or prejudice against coupling fibres with different characteristics can be seen from D3, D6 and D7. Thus, for arriving at the transmission system according to Claim 1, three non-obvious steps would be required. For arriving at the subject-matter of Claim 1 according to the auxiliary request, even a fourth non-obvious step (concerning the teaching of D7) would be required.

VI. The arguments of the Respondents may be summarised as follows:

It is correct to start from D1 for evaluating inventive step since only D1 shows an optical fibre transmission system comprising a source, a transmission fibre and a coupling device for coupling the transmission fibre to the source. According to D1, a radiation source is coupled to a single-clad monomode optical transmission fibre by means of a single-clad monomode pigtail fibre having a tapered end facing the radiation source. Knowing that for long distance transmission the multiple-clad monomode fibre described in D2 is better than the single-clad fibre, a person skilled in the art would consider replacing, in the system of D1, the single-clad transmission fibre with the fibre according to D2. A multiple-clad fibre is not basically different from a single-clad fibre, and, as the skilled person knows, it is not difficult to couple the light from the single-clad fibre into the multiple-clad fibre. For obtaining maximum coupling efficiency, it is only required to adjust the core diameters of the two fibres to each other as it is known from D7. Thus, an obvious combination of the teachings of D1 and D2 leads to the subject-matter of Claim 1.

Reasons for the Decision

1. The appeal is admissible.

2. *Main request*

2.1 Novelty

D1 describes an optical transmission system (see in particular "abstract"; page 2578, left-hand column, lines 1 to 3 and right-hand column, lines 9 to 11; and page 2583, left-hand column, lines 19/20) comprising, in correspondence with the subject-matter of the present Claim 1, a radiation source and a monomode optical transmission fibre. This known system further comprises a monomode optical transmission fibre whose end portion has a tapered core and faces the radiation source (see "abstract"; page 2578, left-hand column, lines 16 to 21; and Figure 2). It is clearly apparent from Table I on page 2579, which lists all the parameters of the fibre having the tapered end, that there is only a single cladding.

However, it cannot be seen directly from D1 whether the monomode (long distance) transmission fibre has a single or a multiple cladding. Regarding the actually used transmission system, D1 (see page 2578, right-hand column, line 11) makes reference to D4 which shows on page 28.3.5, paragraph 3, that the (long distance) transmission fibre (of the system common to D1 and D4) is a single-clad monomode fibre.

D2 describes a monomode optical transmission fibre (see in particular page 2, line 55, and Figure 3) having a multiple cladding so that at least one of the cladding layers of said fibre has a lower refractive index than the nearest cladding layer surrounding it.

No further elements of a transmission system (radiation source, coupling between source and transmission fibre) are mentioned.

D4 relates to the optical transmission system to which reference is made in D1. It describes a system comprising a radiation source, a monomode fibre pigtail having a tapered end facing the radiation source, and a monomode (long distance) transmission fibre connected thereto (see in particular page 28.3.1, right-hand column, lines 1 to 21; page 28.3.2, left-hand column, lines 5/6; page 28.3.5, paragraph 3, and Figure 13).

As already mentioned above, the (long distance) transmission fibre does not have a multiple, but only a single cladding.

The other cited documents D3 and D5 to D9 mention neither a tapered fibre end, nor a multiple-clad optical fibre.

At the oral proceedings, the Respondents submitted new pages of the document: H.-G. Unger: Optische Nachrichtentechnik, Elitera-Verlag, 1976, pages 97 to 99. Since these new pages were filed so late in the proceedings and their teaching, as far as its relevance for novelty and inventive step is concerned, does not go beyond what is already on file, said pages will not be further considered by the Board.

The subject-matter of Claim 1 is therefore novel in the sense of Article 54 EPC.

2.2 Inventive step

2.2.1 It has been controversially discussed whether a person skilled in the art would start from D1 or from D2, when constructing an optical transmission system. It will be seen below that both approaches lead to the same result regarding inventive step of the claimed subject-matter. Thus, too deep an investigation into the validity of the one or the other approach would not be worthwhile. It should be pointed out, however, that according to the EPC the person skilled in the art is considered to know every piece of the prior art, and therefore, in the view of the Board, evaluations of obviousness may in principle start from any document, the only question being whether obvious steps may lead the skilled person from its teaching to the claimed subject-matter. If there is one document from which an obvious sequence of steps leads to the claimed subject-matter, inventive step must be denied. Selecting the starting document is not in itself a mental step which could be considered more or less obvious.

2.2.2 In fact, contrary to D2, D1 explicitly mentions a whole transmission system comprising a radiation source, a tapered monomode fibre for providing an efficient coupling to the radiation source and a (long distance) monomode transmission fibre, and thus it can be expected that it is a reasonable starting point for the person skilled in the art.

The only feature of Claim 1 lacking in D1 is the multiple-clad (long distance) transmission fibre. Thus, the objective problem solved by the claimed subject-matter is to broaden, in the system according to

D1, the wavelength range of low chromatic dispersion, which broadening would mean a higher (long distance) transmission capacity of the system (cf the patent specification, column 1, lines 23 to 30 and 62 to 65).

2.2.3 It is clearly expressed in D2 that by choosing a multiple-clad transmission fibre (having at least one cladding layer whose refractive index is lower than that of the nearest cladding layer surrounding it) the wavelength range of low chromatic dispersion is broadened (see eg page 3, lines 24 to 26). Therefore, the skilled person derives the suggestion from D2 that the use of a multiple-clad transmission fibre in the system according to D1 (which, as indicated in the reference made in D1, is actually the system further described in D4) would be able to solve the above-mentioned problem with respect to dispersion. It is normal for the skilled person in such a situation to try to integrate a new development into an existing system, in order to profit from the advantages which it provides.

It is true that in the present case this integration could, in principle, be undertaken in two different ways. Either, in view of the fact that the (long distance) transmission fibre according to D1 (including the reference to D4) is anyway connected to the pigtail fibre by a fibre coupling, only the transmission fibre could be replaced by the multiple-clad fibre, or both of the fibres, ie the transmission fibre as well as the pigtail, could be replaced by multiple-clad fibres. Both possibilities will be discussed below.

2.2.4 In the view of the Board, it is primarily the first possibility which presents itself to the skilled person, since in this case the essential parts of the teachings of both documents remain unchanged, ie the successful

coupling of the light source into a fibre end and the broad band low dispersion (long distance) transmission. This first way of combining D1 and D2 directly leads to the subject-matter of Claim 1.

The Appellants argued that this combination is not obvious since a skilled person would try to avoid the necessity of coupling, as distinct from the system of D1, a pigtail and a transmission fibre of different types, the one being a single clad and the other a multiple-clad monomode fibre.

Seen from an objective point of view, there is no particular difficulty in connecting the single-clad monomode fibre to the multiple-clad monomode transmission fibre, which fact is underlined by the patent itself where the coupling between the two fibres requires nothing but the usual adaptation of the spot sizes. Thus, any inhibition on the side of the skilled person to choose this combination could not come from real difficulties, but only from a prejudice, ie difficulties erroneously assumed at the time before the priority date of the patent.

2.2.5 The Appellants based their argument concerning the prejudice mainly on the textbook D3, where it is expressed (on page 146) that any deviations in the geometrical and optical parameters of two optical fibres which are joined will affect the optical attenuation through the connection, that there are inherent connection problems when joining fibres with, eg, different core and/or cladding diameters or different relative refractive index differences, and that the best results are therefore achieved with compatible (same) fibres which are manufactured to the lowest tolerance. Multiple-clad monomode fibres, or even monomode fibres in general, are not mentioned in D3. It is, however,

true that multiple-clad monomode fibres may have core and cladding diameters and index differences deviating from single-clad monomode fibres, and thus are included in the statements of D3.

The Board finds that, firstly, the statements in D3 are relatively general, they neither distinguish between multimode and monomode fibres, nor between specific deviations. They also do not principally reject the combination of fibres of different types as disadvantageous. The Board interprets these statements rather in the sense that the least amount of consideration is required if two identical fibres are chosen. Moreover, and this is the main point, for judging a technical prejudice one single opinion should not be taken in isolation; the whole prior art should be taken into account and it should be examined whether the prejudice reflects the common thinking in the relevant technical world. However, in the number of further documents on file, the Board cannot find support for a general prejudice against the coupling of fibres of different construction. On the contrary, these documents show that, although care must be taken to avoid certain foreseeably lossy combinations, it is not the different construction of fibres in general which makes a fibre splice or coupling lose energy:

D6 deals with splice loss effects of non-identical multimode fibres and comes to the conclusion (see in particular page 304 and Figure 4) that while splices "large into small core" cause loss of power, splices "small into large core" even produce a reduction of loss as compared with a continuous, unspliced fibre.

D9 (see in particular Figure 1 and "abstract") describes the use of a pigtail monomode fibre for coupling the light from a laser diode into a multimode transmission

fibre, and the coupling from the monomode fibre into the multimode fibre (as well as the coupling from one multimode fibre to the next one of increased size), is considered advantageous. D7 is the only document dealing with joining two monomode fibres. It states (see in particular page 713, lines 1 to 4, and Figure 7) that fibres having different refractive index distributions and core diameters may be represented by the width parameter of the optimum gaussian field distribution (ie the "spot size"), and that the power transmission coefficient as a function of the ratio of the two spot sizes has a broad maximum corresponding to practically no loss for equal spot sizes.

Thus, D6, D9 and, in particular, D7 confirm that the skilled person was not deterred from joining different types of fibres, but would only, when joining monomode fibres, try to adapt the spot sizes to each other. Neither one of D6, D9 or D7 specially deals with joining multiple-clad monomode fibres, but the same is true for D3. No arguments have been presented why multiple-clad fibres should be expected to behave fundamentally differently from ordinary monomode fibres and not be adaptable to connections with ordinary fibres by a proper choice of the spot sizes.

Therefore, the argument concerning a prejudice against coupling a multiple-clad monomode fibre to a single-clad monomode fibre is not convincing.

2.2.6 Moreover, even if a skilled person, in trying the promising combination of the teachings of D1 and D2, at first preferred the second possibility indicated at the end of paragraph 2.2.3 above, replaced both fibre sections by the multiple-clad fibre and found a much lower coupling efficiency into the pigtail fibre than indicated in D1, it would have been evident that this

was due to the only change with respect to the teaching of D1, ie the multiple cladding of the tapered fibre. The skilled person would then necessarily return to the tapered single-clad fibre for the coupling end section as it is described in D1, and thus come to the subject-matter of Claim 1.

In this context, the following comment should be added:

The fact that the coupling of the radiation source to the tapered fibre end is sensitive to a change from single to multiple cladding while the coupling from the single-clad fibre into the transmission fibre is not, is not surprising for the person skilled in the art. The light emerging from the source is highly divergent and has to be coupled into the tapered fibre via the cladding, while the light emerging from the single-clad fibre is composed of only a single mode and is thus mainly coupled into the core of the multiple-clad fibre.

2.2.7 The Board therefore comes to the conclusion that it was obvious to modify the teaching of D1 by means of the teaching of D2 and thus arrive at the subject-matter of Claim 1.

2.2.8 Although the demonstration of one obvious line of thought leading to the claimed subject-matter is sufficient for showing lack of inventive step, the Board wishes to point out that choosing - as proposed by the Appellants - D2 as the starting document for the evaluation of inventive step, would not lead to a different result. In this case, the objective problem would be to complement the known optical transmission line so that an optical transmission system providing optimum coupling of the radiation from the source into the transmission fibre is obtained.

Since D1 (supplemented with some details described more clearly in D4) reports on a system having a good coupling efficiency from the source into the transmission fibre obtained by means of a tapered pigtail fibre arranged in between, this provides an incentive to use the construction known from D1 for complementing the transmission line of D2. This combination directly leads to the subject-matter of Claim 1.

In this context the same questions as already discussed above may arise, ie the question of a prejudice of the skilled person against coupling different type fibres, so that this person would either not try the system of D1 at all, or would further modify the system of D1 by replacing the single-clad pigtail fibre by a multiple-clad fibre in a superfluous and detrimental attempt to adapt the system to the multiple-clad transmission fibre. However, the Board's views on these issues were already set out in paragraphs 2.2.4 to 2.2.6.

Thus, even starting from D2, the combination of teachings leading to the subject-matter of Claim 1 must be considered obvious.

2.2.9 For these reasons, 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 (Article 52 EPC).

3. *Auxiliary request*

Claim 1 according to the auxiliary request corresponds to a combination of Claims 1 and 2 as granted. It thus contains, in addition to the features of Claim 1 according to the main request, the feature that the spot size at the non-tapered end of the single-clad monomode fibre is substantially equal to the spot size of the multiple-clad monomode transmission fibre.

This feature has already been mentioned above in the context of a possible prejudice against such a combination of non-identical fibres. It corresponds to the well-known fact (see D7, in particular Figure 7) that optimum transmission (of practically no loss at all) between two monomode fibres of different construction can be achieved if the spot sizes of the two fibres are made equal. D7 relates to differences of construction comprising differences of refractive index distribution and core diameter (see page 713, first paragraph). Multiple claddings (where at least one of the cladding layers has a lower refractive index than the nearest cladding layer surrounding it) are not specifically mentioned. Since, however, both fibres to be coupled are in any case monomode fibres, it could be expected that the rules governing their coupling efficiency would be similar to those of all the other monomode fibres, and the skilled person would at least have tried the relationship of spot sizes indicated in D7 as being optimal.

The fact that the teachings of three documents (D1, D2 and D7) are required for arriving at the subject-matter of Claim 1, cannot support the presence of an inventive step since these teachings do not act in combination, but each one serves to solve a separate part of the problem: D1 teaches the coupling to the radiation

source, D2 teaches long distance transmission with a broad wavelength band of low dispersion, and D7 teaches the best way of coupling the pigtail fibre to the transmission fibre.

For these reasons, the subject-matter of Claim 1 according to the auxiliary request does not involve an inventive step in the sense of Article 56 EPC. The auxiliary request is therefore also not allowable (Article 52 EPC).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

P. Martorana E. Turrini