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Datasheet for the decision of 26 February 2009

Case Number: T 0914/07 - 3.5.03

Application Number: 00309165.9

Publication Number: 1094625

IPC: H04B 10/18

Language of the proceedings: EN

Title of invention:
Dispersion slope equalizer

Applicant:
NIPPON TELEGRAPH AND TELEPHONE CORPORATION

Opponent:
-

Headword:
Dispersion slope equalizer/NTT CORP.

Relevant legal provisions:
EPC Art. 56, 84, 123(2)

Relevant legal provisions (EPC 1973):
-

Keyword:
"Inventive step (sole request) - yes"

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0914/07 **-** 3.5.03

D E C I S I O N
of the Technical Board of Appeal 3.5.03
of 26 February 2009

Appellant: NIPPON TELEGRAPH AND TELEPHONE CORPORATION
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 1 December 2006 refusing European application No. 00309165.9 pursuant to Article 97(1) EPC 1973.**

Composition of the Board:

Chairman: A. S. Clelland
Members: A. J. Madenach
R. Menapace

Summary of Facts and Submissions

I. The present appeal is against the decision of the examining division to refuse application no 00309165.9 on the ground of lack of inventive step (Article 56 EPC).

The examining division referred in its decision to the following documents

D1: EP 0 657 754 A1

D2: Koichi Takiguchi et al: "Dispersion compensation using a planar lightwave circuit optical equalizer", IEEE Photonics Technology Letters, New York, US, vol. 6, no. 4, 1 April 1994, pages 561-564

D3: EP 0 884 867 A2

and concluded that the subject-matter of independent claim 1 of the then main and auxiliary requests lacked an inventive step with respect to the teaching of documents D1 and D2 (Article 56 EPC).

II. In a notice of appeal and subsequently filed grounds of appeal the appellant requested that the decision be cancelled entirely and that a patent be granted on the basis of the former auxiliary request as submitted with letter of 16 October 2006 with the amendments as submitted with the grounds of appeal on 11 April 2008.

III. In a communication pursuant to Rule 100(2) EPC of 1 September 2008 the board gave its preliminary opinion and raised inter alia objections under Articles 84 and 123(2) EPC.

IV. With letter of 8 January 2009 the appellant filed amendments to the claims and the description and submitted that with those amendments the application satisfied the requirements of the EPC. He requested that it be allowed on appeal and be "forwarded for granting a patent".

V. Independent claim 1 according to the sole request reads as follows:

"A dispersion slope equalizer for compensating dispersion difference at each WDM channel of a WDM transmission system caused by the dispersion slope of a transmission line when transmitting Lightwave WDM signals via the transmission line of the WDM transmission system, said equalizer comprising:
N waveguides (3—1 to 3—N) wherein N is a natural number;
a N-channel output wavelength demultiplexer (2) or N—channel input wavelength multiplexer (5), or both thereof; and
K group delay controllers wherein K is a natural number, $K \leq N$;
said N waveguides (3—1 to 3—N) being connected to each of the respective outputs of said wavelength demultiplexer (2) or each of the respective inputs of said wavelength multiplexer (5) or both thereof; wherein in each of said group delay controllers, one or both of the input and output parts of lattice-form optical circuits (4-1 to 4—N) being set on said N optical waveguides (3—1 to 3—N);
each of said lattice-form optical circuits (4-1 to 4—N) having two waveguides (7a, 7b) interleaved with at least two directional couplers (8a to 8f); wherein

said two waveguides (7a, 7b) of each lattice-form optical circuit are so designed that the optical path lengths between said directional couplers (8a to 8f) are different; and
control parts of waveguides refractive index (9a to 9e) being located between each of said directional couplers (8a to 8f), or in each of said directional couplers (8a to 8f), so that group delay shall be varied to various values with both signs with increase of frequency; and semipermanent phase shift without electrical power being achieved in said control parts of waveguide refractive index (9a to 9e); wherein
for each said lattice—form optical circuit (4-1 to 4-N), an optical path length is different between two waveguides (7a, 7b), the number of said directional couplers (8a to 8f) is different, or both thereof, such that each of said lattice—form optical circuits (4—1 to 4-N) obtains a dispersion compensation corresponding to each wavelength component to be input into each of said lattice-form optical circuits."

Reasons for the decision

1. *Original disclosure of amendments (Article 123(2) EPC)*

1.1 Claim 1 is based on claim 1 of the auxiliary request considered by the examining division and derives from original claim 1 with clarifications in relation to a wavelength multiplex transmission system taken from column 1, lines 3-7 and column 1, line 55 to column 2, line 8 of the application as published, and additional features taken from column 7, lines 3-8 in combination with column 5, lines 44-54, from column 6, lines 30-41

and from column 6, lines 12-29 of the application as published.

1.2 The board in its communication of 1 September 2008 objected to the feature "semipermanent phase shift without electrical power being achieved in said control parts of waveguide refractive index (9a to 9e)", which derives from col. 6, lines 30-41 of the application as published, as originally requiring the presence of a demultiplexer **and** a multiplexer.

The board is satisfied that it follows from column 7, line 50 to column 8, line 9 that the embodiments discussed there with reference to Figures 7 and 8 differ from the previous embodiments, which comprise the above feature, only by the omission of a demultiplexer or multiplexer, respectively. These embodiments, therefore, still comprise the feature relating to a semipermanent phase shift, which feature is, thus, originally disclosed as being independent of the presence of both a demultiplexer and multiplexer.

1.3 None of the other modifications give rise to an objection under Article 123(2) EPC, nor have they indeed been objected to by the examining division in their decision.

2. *Clarity (Article 84 EPC)*

2.1 The board, in its communication of 1 September 2008, pointed to a contradiction in claim 1 between the reference to a demultiplexer being optional on the one hand and the reference to demultiplexing by a wavelength

multiplexer on the other hand. This contradiction has been eliminated by removal of the latter feature.

2.2 In the same communication the board also objected to the term "semipermanent" as not being clear and that it was understood as implying that the phase shift is unaffected during intervals at which no electrical power is applied.

This interpretation was confirmed by the appellant. According to the description in column 6, lines 30-41, the "semipermanent" phase shift refers to a phase shift achieved by a photoelastic effect as opposed to a phase shift achieved by a thermo-optic or electro-optic effect. This requires applying local heating and quenching with high electrical power. The board accepts that the skilled person would have understood the "semipermanent" effect in the above sense as opposed to the non-permanent effect achieved by the thermo-optic or electro-optic effect.

2.3 The board, in its above mentioned communication, pointed also to an apparent contradiction between claims 1 and 6 as to the need for electrical power for achieving a phase shift, rendering claim 6 unclear.

This contradiction has been removed by an amendment to claim 6 which makes clear that the "semipermanent" phase is achieved after application of the local heating and quenching with high electrical power, i.e. as explained under point 2.2 above, and power need not be maintained for maintaining the phase shift. The board accepts that the skilled person would understand that the electrical

power is only needed to perform the necessary local heating and quenching.

2.4 There being no remaining objections as to the clarity of the claims, the requirements of Article 84 EPC are met.

3. *Inventive step (Article 56 EPC)*

3.1 In its decision the examining division considered D1 as representing the closest prior art. The board concurs.

3.2 D1 discloses a dispersion compensator for reducing the effect of group-velocity dispersion in optical fibers by restoring pulses to their original shape (column 1, lines 4-6 and column 3, lines 1-3). Such a compensator corresponds to the claimed slope equalizer for compensating dispersion difference caused by the dispersion slope of a transmission line when transmitting lightwave signals via the transmission line.

The known compensator comprises N waveguides (reference numeral 23 in Figure 2) wherein N is a natural number; a N-channel wavelength demultiplexer (21 in Figure 2) and a N—channel wavelength multiplexer (22 in Figure 2; and column 3, lines 9-14); and K group delay lines wherein K is a natural number, $K \leq N$ (23 in Figure 2; and column 3, lines 23-27 and lines 35-50). The group delay lines 23 of D1 serve to compensate the dispersion at the various wavelengths of a signal pulse (col. 3, lines 35-50). They therefore correspond to the claimed group delay controllers with the same function, see column 5, lines 16-22 of the application in suit.

The board notes that the numbers N and K can be equal, i.e. a number corresponding to the delay lines 23 shown in Figures 2 and 5 of D1.

The N waveguides are connected to each of the respective outputs of said wavelength demultiplexer or each of the respective inputs of said wavelength multiplexer or both thereof (see Figure 2).

3.3 The claimed invention thus differs from the device known from D1 by the following features:

(1) It is explicitly directed to the dispersion compensation of each WDM channel of a WDM transmission system whereas D1 deals with the dispersion compensation of a single signal, see column 5, lines 11-19.

(2) The group delay controllers comprise lattice-form optical circuits with one or both of their input parts being set on the N optical waveguides. The term "lattice-form" implies a structure having the geometrical form shown in Figure 2 of the application (two input arms, a series of directional couplers coupled by asymmetrical arms, and two output arms in the shown example) as opposed to the transversal form shown in Figure 15, or the cascaded form. In D1 there is no disclosure of group delay controllers 23 comprising lattice-form optical circuits with one or both of their input parts being set on the N optical waveguides.

(3) Each of said lattice-form optical circuits has two waveguides interleaved with at least two directional couplers, the two waveguides of each lattice-form

optical circuit being so designed that the optical path lengths between said directional couplers are different.

(4) Control parts of waveguides refractive index are located between each of said directional couplers, or in each of said directional couplers, so that group delay can be varied to various values with both signs with increase of frequency.

(5) Semipermanent phase shift without electrical power is achieved in said control parts of waveguide refractive index.

(6) For each said lattice—form optical circuit, an optical path length is different between two waveguides, the number of said directional couplers is different, or both thereof, such that each of said lattice—form optical circuits obtains a dispersion compensation corresponding to each wavelength component to be input into each of said lattice-form optical circuits.

3.4 The examining division in their decision explicitly identified the above features (3) to (5) (see points 2.1, 4th paragraph, 2.4, 2nd paragraph, and 3.1 of the decision under appeal). Feature (1) was acknowledged at point 2.3 of the decision. Feature (6) was not mentioned.

3.5 The examining division took the view that the problem to be solved by feature (3) was how to implement the group delay controllers.

However, in D1 fixed delay lines with various lengths are disposed between wavelength multiplexers/demultiplexers for compensating for the

dispersion of signal components (see col. 3, line 55 - col. 4, line 20). Thus, D1 already implements group delay controllers (see also point 3.2 above).

The objective problem is therefore not a matter of implementation but rather of improving the known solution by enabling adjustment of the dispersion to both positive and negative values.

This problem is also relevant in the light of features (2) and (4)-(6) as identified at point 3.3 above.

3.6 Various prior art documents are concerned with improved dispersion compensation in optical fiber transmission, see in particular D2, chapter I "Introduction", relied upon by the examining division in their decision.

The examining division essentially argued that it would have been obvious for the skilled person to combine the teaching of D1 and D2 and arrive at an apparatus as claimed in claim 1.

In D2 dispersion compensation is achieved by lattice form optical circuits (see Fig. 1) using Mach-Zehnder-Interferometers forming couplers with asymmetrical arms (see chapter II "Fabrication"). The asymmetrical arms are provided with a chromium heater to provide TO phase control (page 561, right hand column, 2nd paragraph, 3rd sentence). However, this passage is silent about achieving a phase shift which would be "semipermanent" in the sense explained at point 2.3 above. No photoelastic effect which, in an embodiment of the application in suit (column 6, lines 30-41), leads to the "semipermanent" phase shift is mentioned. It appears

rather that in the device described in D2 the constant application of electrical power is required to achieve phase control and, thus, dispersion compensation.

Therefore, even if for the sake of argument it is assumed that D2 shows or suggests features (2) and (4)-(6), and that the skilled person would have found it obvious to improve the dispersion compensation known from D1 by the lattice form optical circuits as known from D2, this implies that the constant application of electrical power is required to achieve phase shift.

The passage in D2 which the examining division cited as divulging this feature (i.e. page 561, section III, first paragraph, last sentence and section II, first paragraph, last sentence) only contains a general reference to the asymmetrical arms of Mach-Zehnder-Interferometers. How the asymmetry is actually achieved is only specified at page 561, right hand column, 2nd paragraph, 3rd sentence, which, as has already discussed above, cannot be interpreted as disclosing or suggesting a "semipermanent" phase shift in the sense used in the present application.

There is, thus, no disclosure in D2 of achieving a phase shift without the constant application of electrical power.

3.7 Of the further prior art documents cited in the European Search Report, D3 shows pulse shaping of optical signals using semiconductor optical amplifiers (see abstract). Such amplifiers are electrically pumped and thus driven by electrical power. Thus, D3 gives no indication for

pulse shaping or dispersion compensation without the constant application of electrical power.

The further prior art documents cited in the European Search Report show dispersion compensation achieved in a manner similar to that known from D1 to D3 or are less relevant.

3.8 In conclusion, since at least one feature of the invention claimed in claim 1 is neither known from any of the cited prior art documents, nor does it appear to have been part of the skilled person's general knowledge, nor would the skilled person have arrived at it in an obvious manner on the basis of these documents or his general knowledge, either in combination or individually, the subject-matter of claim 1 is novel and involves an inventive step over the cited prior art. Claim 1, therefore, fulfils the requirements of Articles 54 and 56 EPC.

3.9 Claims 2-6 are dependent on claim 1 and thus also fulfil the requirements of Articles 54 and 56 EPC.

3.10 In claim 6, the evident typographical error "slop" is to be corrected so that this word reads "slope". Likewise, on page 2, line 1 "(distance between repeaters)" is to be corrected to read "the distance between repeaters".

4. As all further requirements of the EPC are met, the present appeal is allowed.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to grant a patent based on

- claim 1: pages numbered 20 and 21 filed as auxiliary request and received on 16 October 2006 and page numbered 22 received on 8 January 2009;

- claims 2-6 received on 8 January 2009 with the correction to claim 6 indicated at point 3.10 of the reasons for the present decision;

- description pages 1, 6, 8-14 as originally filed;

- description pages 2, 5, 19 as received on 13 January 2005 with the correction to page 2 indicated at point 3.10 of the reasons for the present decision;

- description pages 7, 15-18 as received on 2 December 2005;

- description pages 3, 4a filed as auxiliary request and received on 16 October 2006;

- description page 4 as received on 8 January 2009;

- drawing sheets 1/21 - 21/21 as originally filed.

The Registrar

D. Magliano

The Chairman

A. S. Clelland