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Datasheet for the decision of 20 September 2017

Case Number: T 0530/14 - 3.4.02

Application Number: 08008941.0

Publication Number: 2015130

IPC: G02F1/035, G02F1/225, H04B10/155

Language of the proceedings: EN

Title of invention:
Optical waveguide device based on a delay interferometer for transmitting return-to-zero pulses

Applicant:
Fujitsu Limited

Headword:

Relevant legal provisions:
EPC Art. 84, 54
RPBA Art. 13(1)

Keyword:
Claims - clarity - main request, first auxiliary request (no)
Novelty - second auxiliary request (no)
Third auxiliary request filed after arrangement of oral proceedings - request not clearly allowable - admitted (no)

Decisions cited:

Catchword:

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Chambres de recours

European Patent Office
D-80298 MUNICH
GERMANY
Tel. +49 (0) 89 2399-0
Fax +49 (0) 89 2399-4465

Case Number: T 0530/14 - 3.4.02

D E C I S I O N
of Technical Board of Appeal 3.4.02
of 20 September 2017

Appellant: (Applicant)	Fujitsu Limited 1-1, Kamikodanaka 4-chome Nakahara-ku Kawasaki-shi, Kanagawa 211-8588 (JP)
Representative:	Hoffmann Eitle Patent- und Rechtsanwälte PartmbB Arabellastraße 30 81925 München (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 12 August 2013 refusing European patent application No. 08008941.0 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	R. Bekkering
Members:	A. Hornung
	B. Müller

Summary of Facts and Submissions

I. The applicant appealed against the decision of the examining division refusing European patent application No. 08008941.0 on the basis of Article 54(1) and (2) EPC (main request then on file) and on the basis of Article 56 EPC (sole auxiliary request then on file).

II. The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of either
- claims 1 to 14 of the main request,
- claims 1 to 10 of the first auxiliary request,
- claims 1 to 14 of the second auxiliary request or
- claims 1 to 10 of the third auxiliary requests,
all claim requests filed with the letter of 18 August 2017.

III. Oral proceedings were held on 20 September 2017.

IV. The present decision refers to the following document:
D1: US2003/0210912 A

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

"An optical waveguide device, comprising:

a substrate (2) having an electro-optic effect;

an optical waveguide (3) formed on said substrate;

an electrode section (5, 6) adapted to supply an electric field for carrying out phase modulation synchronized with a clock signal to said optical waveguide, the clock signal being an electric signal having a predetermined wavelength outputted from a clock signal source (8); and

a Mach-Zehnder interferometer (4) connected to an output of said optical waveguide and including two branching waveguides (4b-1, 4b-2) having optical lengths different from each other,

characterized in that

said two branching waveguides (4b-1, 4b-2) are configured to have a difference between the optical lengths which corresponds to a half wavelength of the clock signal so as to be operable to vary the difference in modulation phase between the two optical signals propagated through the two branching waveguides (4b-1, 4b-2) respectively, within a range from 0 to π, by supplying the electrical field synchronized with the clock signal."

First auxiliary request

Independent claim 1 according to the first auxiliary request differs from claim 1 of the main request in that it comprises the following additional features at the end of the claim:

"... the device further comprises:

a clock modulation section (11) formed on said substrate (2) and adapted to carry out clock modulation for input light; and

a data modulation section (12) adapted to carry out data modulation for the light modulated by said clock modulation section (11),

said clock modulation section (11) includes: the optical waveguide (3), the electrode section (5, 6), and the Mach-Zehnder interferometer (4),

the device further comprises: a control electrode (31) adapted to apply a control electric field to said two branching waveguides (4f-1, 4f-2) which form said Mach-Zehnder interferometer (4), and

said control electrode (31, 32) includes three first voltage application electrodes (31a-c) and three second voltage application electrodes (32a-c) disposed alternately, and said first voltage application electrodes (31a-c) and said second voltage application electrodes (32a-c) are disposed such that electric fields having directions reversed from each other are applied to said two branching waveguides (4f-1, 4f-2),

wherein one of said second voltage application electrodes (32c) is formed so as to extend above and along one of said branching waveguides (4f-1), and two of said first voltage application electrode [sic] (31a, 31b) are formed so as to sandwich the one of said second voltage application electrodes (32c), and

wherein the remaining one of said first voltage application electrodes (31c) is formed so as to extend above and along the other one of the branching waveguides (4f-2), and remaining [sic] two of said second voltage application electrodes (32a, 32b) are formed so as to sandwich the remaining one of said first voltage application electrodes (31c)."

Second auxiliary request

Claim 1 of the second auxiliary request differs from claim 1 of the main request in that it comprises the following feature:

"a clock signal source (8) adapted to generate a clock signal".

Third auxiliary request

Claim 1 of the third auxiliary request differs from claim 1 of the first auxiliary request in that it comprises the following feature:

"a clock signal source (8) adapted to generate a clock signal".

Reasons for the Decision

1. Main request

1.1 Claim 1 of the main request lacks clarity (Article 84 EPC).

Claim 1 refers to a clock signal which, however, does not form part of the optical waveguide device. Therefore, the intended limitation corresponding to the clock signal is unclear (Article 84 EPC). In particular, since the clock signal is undefined, the difference between the optical lengths of the two branching waveguides is undefined, too.

1.2 The applicant argued that the device of claim 1 was to be operated. During this operation a signal was formed or used. It was usual in such a case that the claim did not need to include the signal generation means. In the present case, it was clear from the wording of the claim that the two branching waveguides had a difference in optical lengths which corresponded to a half wavelength of the clock signal which was applied to the device. Obviously the range of the difference in optical lengths was not limited in the claim,

but it would be unreasonable to limit the claim to a single embodiment having a particular difference in optical length. The claim related to an optical waveguide device which sufficiently limited the possible range of the differences in optical lengths.

1.3 The board is not convinced by these arguments since they do not contradict the board's finding that the clock signal's wavelength and, hence, the difference in optical lengths of the two branching waveguides, is left undefined in claim 1.

2. First auxiliary request

Claim 1 lacks clarity for the same reasons as those given in point 1.1 above. The applicant did not provide any further arguments.

3. Second auxiliary request

The subject-matter of claim 1 lacks novelty with respect to the disclosure of D1 (Article 54(1) and (2) EPC).

3.1 D1 discloses, with reference to figure 1, an optical waveguide device comprising:

a substrate (9; 11) having an electro-optic effect *(see the electro-optic materials listed in [0026] of D1)*,

an optical waveguide (11) formed on said substrate *(the phase modulator for modulating light from the CW laser is integrated on the same substrate as the interferometer, thereby implicitly comprising an optical waveguide; see [0021] and [0063] of D1)*,

an electrode section (11) adapted to supply an electric field for carrying out phase modulation synchronized with a

clock signal to said optical waveguide *(the above-mentioned phase modulator implicitly comprises such an electrode section because D1, [0035], discloses an example in which the CW laser is phase modulated by a phase modulation function Φ(t) = π/2 * sin(Ωt), which is synchronized with a clock signal having a frequency equal to the phase modulation frequency Ω/2π = 5 GHz),*

a Mach-Zehnder interferometer (9) connected to the output of the optical waveguide (11) and including two branching waveguides (13, 15) having a difference between the optical lengths which corresponds to a half wavelength of the clock signal *(the relative delay between the two arms of the interferometer is 100 ps (see [0036]), which corresponds to half of the 200 ps period of the clock signal ($5Ghz^{-1}$ = 200 ps))*,

so as to be operable to vary the difference in modulation phase between the two optical signals propagated through the two branching waveguides (13, 15) respectively, within a range from 0 to π, by supplying the electrical field synchronized with the clock signal *(this results from the combined presence of a sinusoidal phase modulation having a peak to peak phase shift of π, i.e. from -π/2 to +π/2 (see the mathematical expression in [0035]) and the relative delay of a half wavelength of the phase modulation function Φ(t) between the two arms (13, 15) of the Mach-Zehnder interferometer (see [0036]))*.

It follows that D1 discloses an optical waveguide device comprising all the features of claim 1.

3.2 The applicant, for the first time during the appeal proceedings, presented arguments based on considerations relating to the duty cycle of the output signal. According to the applicant, the invention as defined in claim 1

related to a symmetric output signal having a 50% duty cycle, whereas D1 disclosed a first embodiment having an asymmetric output signal with a duty cycle of 33% or 67% (cf. figures 2A and 2B of D1) which therefore could not anticipate the claimed waveguide device. D1 disclosed a second embodiment having a symmetric output signal with a duty cycle of 50% (cf. the description of D1 starting at paragraph [0053]) which, however, did not achieve a frequency doubling of the output signal, contrary to the device of the present invention (cf. paragraph [0054] of D1 disclosing a modulation frequency $\Omega/2\pi$ being equal to the pulse repetition rate R). Therefore, the second embodiment of D1 did also not anticipate the optical waveguide of claim 1. The applicant concluded that the subject-matter of claim 1 was novel because D1 did not disclose the feature "so as to be operable to vary the difference in modulation phase between the two optical signals propagated through the two branching waveguides respectively, within a range from 0 to π, by supplying the electrical field synchronized with the clock signal".

3.3 The board cannot accept the applicant's argument because claim 1 neither defines any duty cycle of the output signal, nor did the applicant provide evidence or convincing arguments that a duty cycle of 50% could be implicitly deduced from claim 1. Indeed, the duty cycle of the output signal depends upon various parameters, e.g. the actual fine tuning of the phase difference or the exact shape of the clock signal, which both are not defined in claim 1. While the board agrees that D1 discloses two embodiments as described by the applicant, the board notes that the subject-matter of claim 1 is anticipated essentially by the general teaching of D1, paragraphs [0033] to [0036]. Whether the two embodiments of D1 also anticipate the claimed waveguide device is not relevant for the board's decision of lack of novelty.

4. Third auxiliary request - admissibility

4.1 The board decided not to admit into the proceedings the third auxiliary request, filed in response to the summons to oral proceedings (Article 13(1) RPBA).

According to well-established case law, one of the criteria for assessing the admittance of new requests with amended claims during appeal proceedings is whether the amendments are *prima facie* clearly allowable or whether the amended claims are at least likely to overcome the objections in response to which the request has been filed (see "Case Law of the Boards of Appeal", 8th edition 2016, chapter IV.E. 4.4.2). The present amendment of claim 1 does not fulfil this criterion since prima facie it entails an infringement of the requirements of at least Article 123(2) and 84 EPC.

- Added subject-matter

Claim 1 has been amended inter alia by adding the following feature "wherein one of said second voltage application electrodes (32c) is formed so as to extend above and along one of said branching waveguides (4f-1), and two of said first voltage application electrode [sic] (31a, 31b) are formed so as to sandwich the one of said second voltage application electrodes (32c), and wherein the remaining one of said first voltage application electrodes (31c) is formed so as to extend above and along the other one of the branching waveguides (4f-2), and remaining two of said second voltage application electrodes (32a, 32b) are formed so as to sandwich the remaining one of said first voltage application electrodes (31c)." According to the applicant, the basis for this feature can be found on page 30, lines 9 to 20, of the description as originally

filed. This feature, however, seems to form an integral part of the embodiment shown in figure 9 and it would appear that it cannot be isolated from other essential features of this embodiment described on page 28, line 15 to page 32, line 26, without infringing Article 123(2) EPC. For instance, the amended feature is originally disclosed only in relationship with "electric fields whose signs are different from each other but whose magnitudes are substantially equal" (see page 31, lines 2 to 8), with "electrode portions each having a semicircular portion" (see page 29, line 27 to page 30, line 8) and having the effect of providing a "matched phase relationship between the lights propagated through the branching waveguides" (see page 29, lines 7 to 26). Therefore, the amendment of present claim 1 appears to constitute an inadmissible intermediate generalisation of the embodiment shown in figure 9.

- Clarity

It appears to be unclear in claim 1 what the control electrode (31, 32) with the six voltage application electrodes (31a-c; 32a-c) controls and how it operates. In view of the description of the embodiment of figure 9, missing essential features appear to be inter alia the phase matching of light propagating through the two branching waveguides and the monitoring photodiode. It follows that the present amendment does not appear to overcome the objection of lack of clarity raised in point 8 of the annex to the summons, in response to which the present request appears to have been filed.

- Divergent development and features taken from the description

The present request represents a divergent development with respect to the evolution of the subject-matter claimed during first-instance proceedings. Indeed, the subject-matter of the auxiliary request underlying the appealed decision related to claim 7 as originally filed, i.e. to "waveguides curved and folded back". This feature of curved waveguides has been abandoned in the present request and replaced by features relating to control electrodes. Such a change of direction at the current late stage of proceedings is contrary to the need of procedural efficiency. Moreover, the amended features were, in part, taken from the description. Such type of an amendment is complex since (i) it may open, as it did in the present case, the debate about the compliance of the amendment with respect to the basic requirements of Article 123(2) and 84 EPC and (ii) it defines subject-matter which was not previously claimed and, therefore, may require an additional search and substantive examination to be restarted.

For the above reasons, the board decides not to admit the third auxiliary request into the proceedings.

4.2 The applicant argued in favour of admitting the third auxiliary request by noting that claim 1 was based essentially on dependent claims as originally filed, which should not take the board by surprise. Moreover, the amendments were clearly directed to the embodiment of figure 9 of the application as filed, in particular to a specific configuration of electrodes disclosed in the application as originally filed on page 30, lines 9 to 20. Therefore, the amendment did not comprise added subject-matter.

4.3 While the board acknowledges that the amendment of claim 1 is, in part, based on claims as originally filed and, in part, on the recited passage of the description, the board

is not convinced by the applicant's remaining arguments since they do not include any reasoning why the board should change its view explained above on the issues of inadmissible intermediate generalisation, lack of clarity and divergent development relating to claim 1.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

S. Sánchez Chiquero R. Bekkering

Decision electronically authenticated