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D E C I S I O N
of 22 October 1998

Case Number: T 0211/97 - 3.5.1

Application Number: 93108342.2

Publication Number: 0572890

IPC: H04J 14/08

Language of the proceedings: EN

Title of invention:
Optical demultiplexing system

Applicant:
CSELT Centro Studi e Laboratori Telecomunicazioni S.p.A.

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step - yes"

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0211/97 - 3.5.1

D E C I S I O N
of the Technical Board of Appeal 3.5.1
of 22 October 1998

Appellant: CSELT
Centro Studi e Laboratori
Telecomunicazioni S.p.A.
Via Guglielmo Reiss Romoli, 274
10148 Turin (IT)

Representative: Riederer Freiherr von Paar zu Schönau, Anton
Lederer, Keller & Riederer
Postfach 26 64
84010 Landshut (DE)

Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 27 August 1996 refusing European patent application No. 93 108 342.2 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: P. K. J. van den Berg
Members: A. S. Clelland
C. Holtz

Summary of Facts and Submissions

I. This appeal is against the decision of the examining division to refuse the application on the ground that the subject-matter of the single claim lacked an inventive step (Articles 52(1) and 56 EPC). The decision was formal in nature and followed a request from the applicant (the present appellant) for a decision according to the state of the file. The formal decision refers to a communication from the examining division dated 8 March 1996 in which the following documents are discussed:

D1: Electronics Letters, vol. 27, No. 11, 23 May 1991, pages 922-924, Andrekson et al.: "16 Gbits/s All-Optical Demultiplexing Using Four-Wave Mixing".

D2: Proc. IEE Part J, vol. 139, No. 2, April 1992, pages 93-100: "Crosstalk Reduction in Semiconductor Laser Amplifiers".

II. On 18 October 1996 the appellant (applicant) lodged an appeal against the decision and paid the prescribed fee. The appellant requested that the decision under appeal be set aside and a patent be granted as requested on 23 August 1995, namely on the basis of the following documents:

Claims: single claim filed on 23 August 1995;

Description: pages 1 and 4 as originally filed, with the amendment to page 4 requested on 23 August 1995;
pages 2 and 3a, filed on 30 December 1994;
page 3, filed on 23 August 1995;

Drawings: single sheet, as originally filed.

A statement of grounds of appeal was subsequently filed. After a communication, oral proceedings were held before the Board on 22 October 1998. At the oral proceedings the appellant maintained as a **main request** grant on the basis of the documents set out above and filed a new claim as the basis of an **auxiliary request**.

III. The claim of the main request reads as follows:

"Optical demultiplexing system, wherein from an optical carrier at a first wavelength (L1), modulated by a TDM data flow, one or more tributaries are extracted to be forwarded to relevant optical receivers (RX) for successive processing operations, which comprises:
one or more sources (SC), apt to generate sampling optical carriers reaching their maximum amplitude only in the time intervals wherein the relevant tributary to be extracted is present;
an optical coupler (OC1), whereto said optical carrier at the first wavelength and the sampling optical carrier(s) at different wavelength(s) (L2, L3, L4,...) are sent;
an optical non-linear interaction means (SA), whose input receives the sum of said optical carriers, present at the output of said optical coupler (OC1);
a second optical coupler (OC2), which subdivides the power supplied at the output by said optical non-linear interaction means (SA);
optical filters (FI1, FI2), to whose input there is sent the signal supplied by said second optical coupler,
characterised in that
the optical non-linear interaction means, the interaction therein varying with the increasing of the total power of the input carriers, is a semiconductor optical amplifier (SA) whose amplifier gain decreases

with the increasing of the total power, and in that said optical filters (FI1, FI2) have pass bands centred on said first wavelength (L1) for extracting said optical carrier modulated by the TDM data flow, and centred on the wavelength (L2, L3, L4,...) of one of the sampling optical carriers for supplying said one or more tributaries to the receivers (RX), respectively."

IV. The claim of the auxiliary request differs from the above claim in its two-part form and in a more detailed definition of the optical filters.

V. The appellant argued as follows:

The appellant did not claim to have invented the technique of demultiplexing using a sampling carrier and a non-linear optical device, or to have discovered the phenomenon of gain saturation in a semiconductor optical amplifier, but to have improved the known technique using the latter phenomenon.

The use of gain saturation involved different frequencies and different filters and was therefore not a simple substitution in the four-wave mixing arrangement known from D1 as stated by the examining division.

By using several sampling carriers, the invention enabled simultaneous multiple channel demultiplexing, whereas D1 only disclosed demultiplexing each channel individually by adjusting a delay element. Simple multi-channel demultiplexing was very desirable.

Reasons for the Decision

1. The appeal complies with Article 106 to 108 and Rule 64 EPC and is, therefore, admissible.

2. Inventive step is the only issue to be decided.

3. *Background to the invention*

3.1 The application concerns the problem of extracting or demultiplexing a particular channel or tributary from an optical time-division multiplexed (TDM) data stream. Document D1 discloses an experimental arrangement for achieving this using what is normally regarded as an undesirable form of crosstalk, namely four-wave mixing caused by non-linearity in an optical fibre. "Four-wave mixing" is essentially a form of third-order modulation, producing sidebands at two additional frequencies neighbouring the two input frequencies. In D1, a four channel TDM data signal is generated which consists of a sequence of amplitude modulated pulses at a certain optical frequency. A probe pulse signal is generated which consists of pulses at a closely spaced optical frequency (a difference of 8Å is mentioned), synchronised to one of the data channels. The data pulses and probe pulses are both sent down a 14 km long single-mode optical fibre. Where the pulses overlap, four-wave mixing occurs. The selected channel is demultiplexed by filtering the output with a Fabry-Perot interferometer set to the wavelength of one of the two generated four-wave mixing components, i.e. a wavelength different from that of both the data and probe signals.

3.2 Document D2 is concerned with the reduction of crosstalk and presents four-wave mixing as a deficiency of semiconductor laser amplifiers compared with fibre-based amplifiers. It also describes the problem of gain saturation, which arises when the gain of a signal in one channel is affected by the signal in the other channel. Several ways to reduce both these effects are proposed. In D2 all crosstalk is seen as undesirable.

4. *Inventive step (Article 56 EPC) - main request*

4.1 The claimed optical demultiplexing system differs from D1 firstly in using a semiconductor optical amplifier instead of a single-mode optical fibre as the mixing element, and secondly in extracting the selected channel with a filter centred on the wavelength of the probe pulse, thereby simplifying the construction of the demultiplexer. The Board considers that the problem solved by the invention can be seen as how to make use of non-linear effects in a fibre optic system to extract a tributary without having the disadvantages of the D1 system.

4.2 Although the use of a semiconductor amplifier instead of a fibre-based amplifier is accepted to be a matter of normal design choice, the Board does not consider that the skilled person would use a semiconductor amplifier in the D1 arrangement for the purpose of providing a non-linear effect based on gain saturation. D1 achieves the required non-linear effect - four-wave mixing - using an optical fibre and not a fibre-based amplifier, so that the skilled person would have no good reason to replace the amplifier and remove the optical fibre.

4.3 Even if for the sake of argument a semiconductor amplifier were provided in the D1 arrangement in order to cause crosstalk, the Board considers that the skilled person would only do so because, as taught by D2, such an amplifier *inter alia* provides four-wave mixing, so that the need for 14 km of optical fibre would be obviated. However this solution, which solves the problem posed, would result in a system using the four-wave mixing effect. It would require an additional step on the part of the skilled person to realise that the system could be further improved by using the gain saturation characteristic of the semiconductor amplifier and extracting the carrier at the probe pulse frequency. The Board finds no such suggestion in D1, which only mentions four-wave mixing, or in D2, which does not deal with a demultiplexing technique.

4.4 The examining division were of the opinion that selecting gain saturation instead of four-wave mixing is merely a design option. It will however be apparent from the above discussion that the invention does not merely lie in the substitution of one crosstalk mechanism by another, but makes use of mixing terms which are not used in D1 and which require a different filter frequency.

5. The Board is accordingly of the opinion that the claim of the main request involves an inventive step. It has not therefore been necessary to consider the auxiliary request.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to grant a patent in accordance with the appellant's main request.

The Registrar: The Chairman:

M. Kiehl P. K. J. van den Berg