PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :		(11) International Publication Number:
H04B 10/17, H01S 3/06	**A3**	**WO 98/06191**
		(43) International Publication Date: 12 February 1998 (12.02.98)

(21) International Application Number: PCT/US97/13470

(22) International Filing Date: 24 July 1997 (24.07.97)

(30) Priority Data:
08/688,588 30 July 1996 (30.07.96) US

(71) Applicant: TELLIUM, INC. [US/US]; 31 Northfield Avenue, Edison, NJ 08837 (US).

(72) Inventor: JACKEL, Janet; 31 Stony Brook Road, Holmdel, NJ 07733 (US).

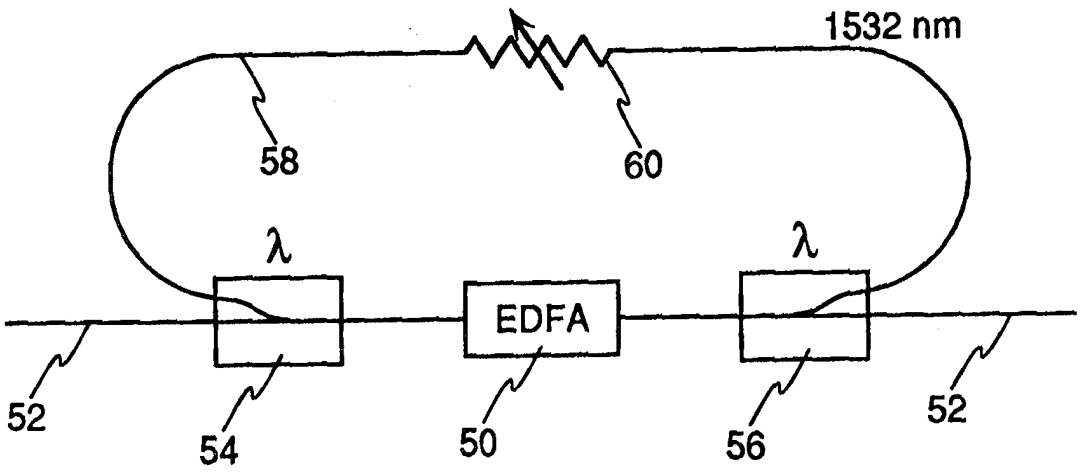
(74) Agents: GUENZER, Charles, S. et al.; Peters, Verny, Jones & Bikša, L.L.P., Suite 6, 385 Sherman Avenue, Palo Alto, CA 94306-1840 (US).

(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, TT, UA, UZ, VN, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(88) Date of publication of the international search report:
16 April 1998 (16.04.98)

(54) Title: AUTOMATIC FEEDBACK GAIN CONTROL IN A DOPED FIBER AMPLIFIER



(57) Abstract

An apparatus and method for controlling the gain in an erbium-doped fiber amplifier (EDFA) incorporated into a multi-wavelength communication system so as to amplify each of the wavelength signals. The amplifier operates near to saturation so that, if one or more of the multi-wavelength signals is removed from the transmission, the remaining channels are increasingly amplified, leading to problems with other components in the system which depend upon intensity. According to the invention, an optical signal at a wavelength that is not within any of the transmission channels is selectively fed back around the amplifier and caused to lase in a wavelength-filtered ring-laser configuration. The lasing signal governs the saturation of the amplifier such that any gain shed by a disappearing data signal is predominately used by the lasing signal, not by the remaining data signals. Thereby, the data signals do not experience gain variations dependent upon the number of data signals being amplified. In a chain of amplifiers on a long link, the wavelength of the lasing signal is chosen to lie within the gain flat band of the amplifier and is output from the equalized amplifier with the same efficiency as all the transmission signals to be received by the next amplifier. Thereby, only the first amplifier needs to be equalized.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania
AM	Armenia
AT	Austria
AU	Australia
AZ	Azerbaijan
BA	Bosnia and Herzegovina
BB	Barbados
BE	Belgium
BF	Burkina Faso
BG	Bulgaria
BJ	Benin
BR	Brazil
BY	Belarus
CA	Canada
CF	Central African Republic
CG	Congo
CH	Switzerland
CI	Côte d'Ivoire
CM	Cameroon
CN	China
CU	Cuba
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
ES	Spain
FI	Finland
FR	France
GA	Gabon
GB	United Kingdom
GE	Georgia
GH	Ghana
GN	Guinea
GR	Greece
HU	Hungary
IE	Ireland
IL	Israel
IS	Iceland
IT	Italy
JP	Japan
KE	Kenya
KG	Kyrgyzstan
KP	Democratic People's Republic of Korea
KR	Republic of Korea
KZ	Kazakstan
LC	Saint Lucia
LI	Liechtenstein
LK	Sri Lanka
LR	Liberia
LS	Lesotho
LT	Lithuania
LU	Luxembourg
LV	Latvia
MC	Monaco
MD	Republic of Moldova
MG	Madagascar
MK	The former Yugoslav Republic of Macedonia
ML	Mali
MN	Mongolia
MR	Mauritania
MW	Malawi
MX	Mexico
NE	Niger
NL	Netherlands
NO	Norway
NZ	New Zealand
PL	Poland
PT	Portugal
RO	Romania
RU	Russian Federation
SD	Sudan
SE	Sweden
SG	Singapore
SI	Slovenia
SK	Slovakia
SN	Senegal
SZ	Swaziland
TD	Chad
TG	Togo
TJ	Tajikistan
TM	Turkmenistan
TR	Turkey
TT	Trinidad and Tobago
UA	Ukraine
UG	Uganda
US	United States of America
UZ	Uzbekistan
VN	Viet Nam
YU	Yugoslavia
ZW	Zimbabwe

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/US 97/13470

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04B10/17 H01S3/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04B H01S

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 497 491 A (AMERICAN TELEPHONE & TELEGRAPH) 5 August 1992 see abstract	1-7, 18-20
Y	see column 3, line 9 - column 4, line 58 see column 5, line 29 - line 47	21
A	see figures 1,8	17
	--- -/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

1

Date of the actual completion of the international search	Date of mailing of the international search report
5 March 1998	11/03/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Ribbe, A

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Inter onal Application No
PCT/US 97/13470

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication.where appropriate, of the relevant passages	Relevant to claim No.
Y	HARUO OKAMURA: "AUTOMATIC OPTICAL LOSS COMPENSATION WITH ERBIUM-DOPED FIBER AMPLIFIER" JOURNAL OF LIGHTWAVE TECHNOLOGY, vol. 10, no. 8, 1 August 1992, pages 1110-1116, XP000288348 cited in the application see abstract see page 1111, left-hand column, paragraph 1 see page 1111, right-hand column, paragraph 2 see page 1112, left-hand column, paragraph 2 - paragraph 3 see page 1113, right-hand column - page 1114, left-hand column	9-11, 13-16,21
A	see figures 2,11	8,12,22, 23

Y	GB 2 281 669 A (NORTHERN TELECOM LTD) 8 March 1995 see abstract see figure 1	9-11, 13-16

A	ZIRNGIBL M: "GAIN CONTROL IN ERBIUM-DOPED FIBRE AMPLIFIERS BY AN ALL-OPTICAL FEEDBACK LOOP" ELECTRONICS LETTERS, vol. 27, no. 7, 28 March 1991, pages 560-561, XP000227080 cited in the application see abstract see page 561, right-hand column	22,23

1

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter onal Application No
PCT/US 97/13470

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0497491 A	05-08-92	US 5088095 A	11-02-92
		CA 2056642 A,C	01-08-92
		DE 69204483 D	12-10-95
		DE 69204483 T	22-02-96
		JP 2087491 C	02-09-96
		JP 4318526 A	10-11-92
		JP 7117670 B	18-12-95
GB 2281669 A	08-03-95	NONE	