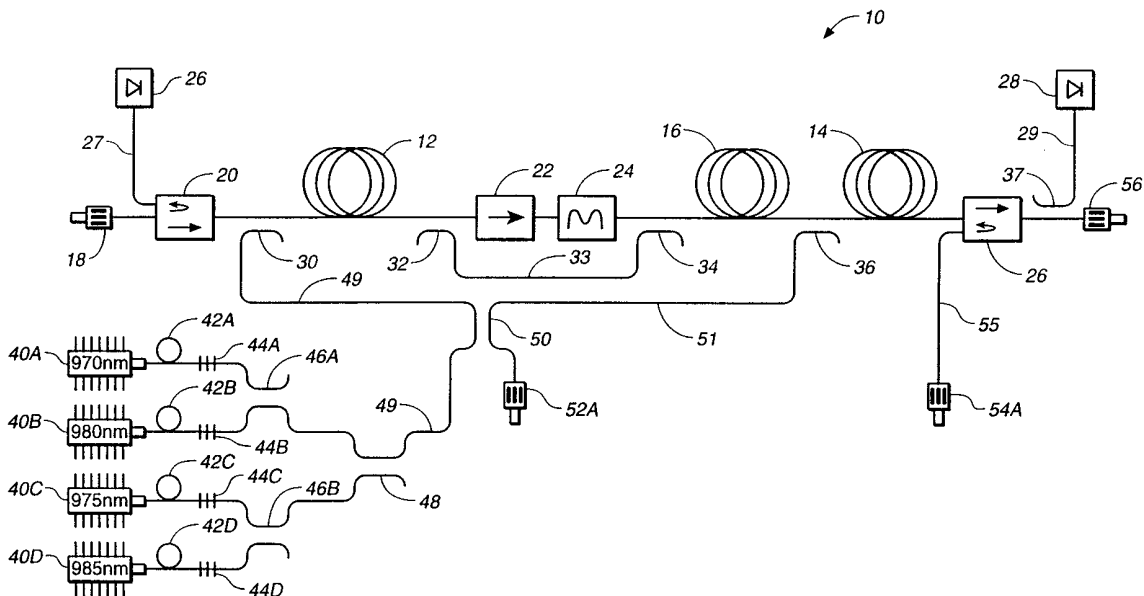




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification <sup>6</sup> : <b>H04B 10/17, H01S 3/06</b></p>	<p><b>A3</b></p>	<p>(11) International Publication Number: <b>WO 99/43117</b> (43) International Publication Date: 26 August 1999 (26.08.99)</p>
<p>(21) International Application Number: PCT/US99/03670 (22) International Filing Date: 19 February 1999 (19.02.99) (30) Priority Data: 60/075,621 20 February 1998 (20.02.98) US 60/075,385 20 February 1998 (20.02.98) US 60/075,744 23 February 1998 (23.02.98) US (71) Applicant: SDL, INC. [US/US]; 80 Rose Orchard Way, San Jose, CA 95134-1365 (US). (72) Inventors: FREEMAN, Paul, N.; 20116 Chateau Drive, Saratoga, CA 95070 (US). GRUBB, Stephen, G.; 5372 Racegate Run, Columbia, MD 21045 (US). RATOFF, Daniel, A.; 24 North 9th Street, San Jose, CA 95112 (US). MEHUYS, David, G.; 1538 Ashcroft Way, Sunnyvale, CA 94087 (US). (74) Agent: CAROTHERS, W., Douglas, Jr.; SDL, Inc., 80 Rose Orchard Way, San Jose, CA 95134-1365 (US).</p>		<p>(81) Designated States: CA, JP, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i> (88) Date of publication of the international search report: 29 December 1999 (29.12.99)</p>

(54) Title: UPGRADABLE, GAIN FLATTENED FIBER AMPLIFIERS FOR WDM APPLICATIONS



(57) Abstract

A multistage optical fiber amplifier (OFA) system is designed to be upgraded with the addition of pump power when signal capacity of an optical communication link is correspondingly increased. The system includes a gain flattening filter (GFF) that remains valid when the system is upgraded because of the system design. Also disclosed are ways to enhance the GFF as well as control the channel signal gain tilt as well as adjust the external gain uniformity to be the same for an assembly line of OFA systems.

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 99/03670

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 H04J

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 Y	EP 0 647 000 A (AT & T CORP) 5 April 1995 (1995-04-05)  column 3, line 43 -column 4, line 50; figures 1,4  ---  -/--	9, 12, 15-17, 25 13, 14, 21-24, 26, 28-30, 32-39, 43-45, 48

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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Date of the actual completion of the international search

7 October 1999

Date of mailing of the international search report

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## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 99/03670

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	PARK S Y ET AL: "THREE-STAGE ERBIUM-DOPED FIBER AMPLIFIER FOR WIDE DYNAMIC RANGE AND LOW NOISE FIGURE" OPTICAL FIBER COMMUNICATION. SUMMARIES OF PAPERS PRESENTED AT THE CONFERENCE OF C '95, SAN DIEGO, FEB. 26 - MAR. 3, 1995, 26 February 1995 (1995-02-26), page 171/172 XP000517688 INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS ISBN: 0-7803-2654-7 figure 2 ---	13, 14
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A	figures 1, 8, 10, 12 ---	20
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P, X	EP 0 859 480 A (LUCENT TECHNOLOGIES INC) 19 August 1998 (1998-08-19) column 5, line 15 - line 28; figure 2 ---	30, 32, 33
A	EP 0 782 225 A (LUCENT TECHNOLOGIES INC) 2 July 1997 (1997-07-02) page 3, line 27 - line 34; figure 1 ---	27
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	-/--	

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 99/03670

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 621 663 A (SUMITOMO ELECTRIC INDUSTRIES) 26 October 1994 (1994-10-26) column 14, line 18 - line 34; figure 5 -----	1, 2, 49, 51

# INTERNATIONAL SEARCH REPORT

international application No.  
PCT/US 99/03670

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
  
3.  Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1.  As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2.  As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3.  As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4.  No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

### Remark on Protest

- The additional search fees were accompanied by the applicant's protest.
- No protest accompanied the payment of additional search fees.

## INTERNATIONAL SEARCH REPORT

International Application No. PCT/US 99/03670

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-8;49-52

A multistage fiber amplifier system comprising at least an input and an output amplifier stages, a plurality of pump laser sources, a gain flattening filter between input and output stages, and input connectors.

2. Claims: 9-29

A multistage fiber amplifier system comprising at least an input and an output amplifier stages, a plurality of pump laser sources, and an optical coupler for splitting pump power between input and output stages.

3. Claims: 30-34

A multistage fiber amplifier system comprising at least an input and an output amplifier stages, a plurality of pump laser sources and an insertion loss apparatus between input and output stages.

4. Claims: 35-43;44-48

A multistage fiber amplifier system comprising at least an input and an output amplifier stages, a plurality of pump laser sources and a gain flattening filter designed specifically according to the two major gain peaks output by the input stage.

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 99/03670

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