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(54) Title: WAVEGUIDE DESIGN FOR LINE SELECTION IN FIBER LASERS AND AMPLIFIERS

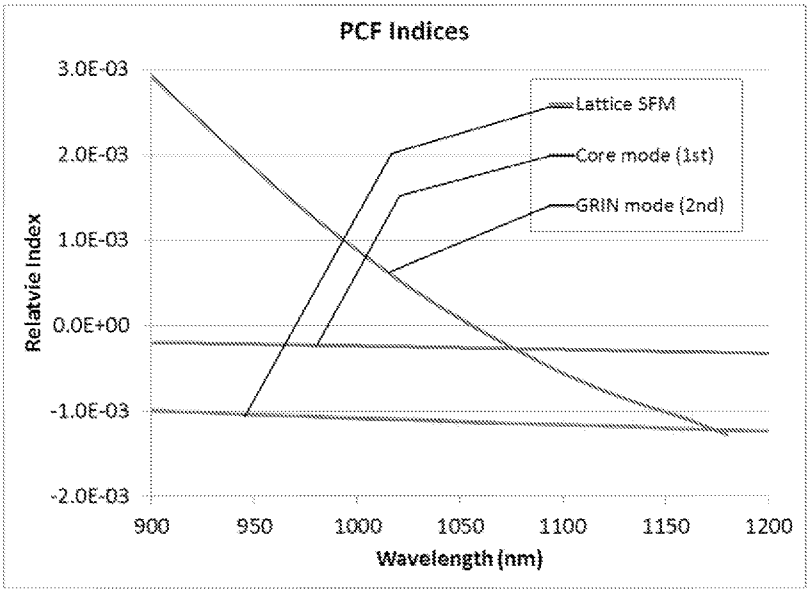


FIG. 1

(57) Abstract: Rare earth doped fiber lasers can be robust and efficient sources of high quality light, but are usually limited to the highest gain transitions of the active species. But rare earths typically possess a multitude of potentially useful transitions that might be accessed if the dominant transition can be suppressed. In fiber lasers this suppression is complicated by the very high net gain the dominant transitions exhibit; effective suppression requires some mechanism distributed along the length of the fiber. We have developed a novel waveguide with resonant leakage elements that frustrate guidance at well-defined and selectable wavelengths. Based on this waveguide, we have fabricated a Large Mode Area Neodymium doped fiber with suppression of the four-level transition around 1060 nm, and demonstrated lasing on the three-level transition at 930 nm with good efficiency.

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[Continued on next page]

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**INTERNATIONAL SEARCH REPORT**

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**A. CLASSIFICATION OF SUBJECT MATTER**

**H01S 3/067(2006.01)i, G02B 6/02(2006.01)i, G02B 6/14(2006.01)i, H01S 3/16(2006.01)i**

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)
H01S 3/067; H01S 3/10; H01S 5/026; G02B 6/26; G02B 6/04; G02B 6/02; H01S 3/00; G02B 6/22; F21V 7/04; G02B 6/14; H01S 3/16

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: waveguide, line, sink, wavelengh, auxiliary

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | US 6363194 B1 (DAVID JOHN DIGIOVANNI et al.) 26 March 2002<br>See column 3, lines 29-67, column 4, lines 4-37, claim 1 and figures 4-6. | 1-13,15-35 |
| Y | US 4986629 A (JACQUES AUGE et al.) 22 January 1991<br>See claims 1-4 and figure 1. | 1-13,15-35 |
| A | US 2003-0185505 A1 (ORI WEISBERG et al.) 02 October 2003<br>See paragraphs [0068]-[0069] and figures 1-2. | 1-13,15-35 |
| A | US 9217826 B2 (CORNING INCORPORATED) 22 December 2015<br>See claims 1-3 and figure 2. | 1-13,15-35 |
| A | US 2009-0016387 A1 (MICHAEL KEVAN DURKIN et al.) 15 January 2009<br>See paragraph [0109] and figures 3,14. | 1-13,15-35 |

☐ Further documents are listed in the continuation of Box C.

☒ See patent family 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 application or patent 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

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**INTERNATIONAL SEARCH REPORT**

International application No.
**PCT/US2017/015577**

**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 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.: 14
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:
Claim 14 is missing in this application (PCT Rule 6.1(b)).

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 No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)**

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

1. ☐ As all required addtional 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 fees, this Authority did not invite payment of any additional fees.

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 and, where applicable, the payment of a protest fee.
☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
☐ No protest accompanied the payment of additional search fees.

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2017/015577**

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