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[Continued on next page]

(54) Title: OPTICAL WAVEGUIDES

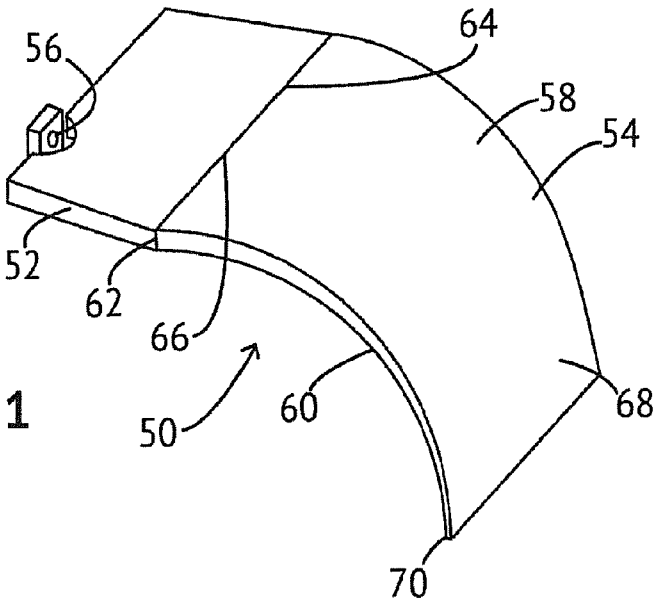

FIG. 1

(57) Abstract: An optical waveguide includes a coupling optic and a waveguide body. According to one embodiment, the body includes a first curved surface that extends between an input surface and an end surface and a second surface opposite the first surface. The input surface has a first thickness disposed between the first and second surfaces and the end surface has a second thickness disposed between the first and second surfaces less than the first thickness.

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— *with international search report (Art. 21(3))*

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(88) Date of publication of the international search report:
25 September 2014

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/013408

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - G02B 6/125 (2014.01)
USPC - 385/43
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(8) - G02B 6/00, 10, 12, 122, 125 (2014.01)
USPC - 385/14, 15, 43, 88, 129, 146

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC - G02B 6/00, 0001, 0028, 0073, 10, 12, 122, 125 (2014.02)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatBase, Google Patents, Google

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	WO 96/21884 (MCFARLAND et al) 11 January 1996 (11.01.1996) entire document	1-16, 20-72 --- 17-19, 73-80
Y	US 2009/0297090 A1 (BOGNER et al) 03 December 2009 (03.12.2009) entire document	17-19, 73-80, 90-95
Y	US 2004/0008952 A1 (KRAGL) 15 January 2004 (15.01.2004) entire document	90-95
A	US 2007/0139905 A1 (BIRMAN et al) 21 June 2007 (21.06.2007) entire document	1-80, 90-95
A	US 2011/0037388 A1 (LOU et al) 17 February 2011 (17.02.2011) entire document	1-80, 90-95
A	US 5,872,883 A (JINNAI et al) 16 February 1999 (16.02.1999) entire document	1-80, 90-95

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

* 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

Date of the actual completion of the international search	Date of mailing of the international search report
26 June 2014	17 JUL 2014
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/013408

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.:
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 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:
see extra 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 additional fees, this Authority did not invite payment of 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.:
1-80, 90-95

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

International application No.
PCT/US2014/013408

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claims 1-26, drawn to an optical waveguide including a curved surface with thickness.
Group II, claims 27-80, drawn to a waveguide body, comprising: a body of optically transmissive material with inflection regions.
Group III, claims 81-89, drawn to a waveguide, comprising: a body of optically transmissive material; a plurality of LEDs spaced about the body of optically transmissive material.
Group IV, claims 90-95, drawn to a coupling optic comprising: a coupling optic body including a plurality of input cavities for LEDs.

The inventions listed as Groups I, II, III or IV do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

The special technical feature of the Group I invention: optical waveguide body, comprising: a first curved surface that extends between an input surface and an end surface; a second surface opposite the first surface; wherein the input surface has a first thickness disposed between the first and second surfaces; and wherein the end surface has a second thickness disposed between the first and second surfaces less than the first thickness, as claimed therein is not present in the invention of Groups II, III or IV.

The special technical feature of the Group II invention: waveguide body, comprising: a body of optically transmissive material having an input surface for light to enter the body of optically transmissive material along a light path wherein the body of optically transmissive material is curved and has an inflection region that extends transverse to the light path, as claimed therein is not present in the invention of Groups I, III or IV.

The special technical feature of the Group III invention: waveguide, comprising: a body of optically transmissive material; a plurality of LEDs spaced about the body of optically transmissive material such that light developed by the plurality of LEDs is directed through an input edge surface of the body of optically transmissive surface; and extraction features carried by the body of optically transmissive material for directing light developed by the plurality of LEDs out of the body of optically transmissive material, as claimed therein is not present in the invention of Groups I, II or IV.

The special technical feature of the Group IV invention: coupling optic comprising: a coupling optic body including a plurality of input cavities each defined by a wall wherein a projection is disposed in each cavity and wherein a recess is disposed in each projection, wherein the recess of each projection is adapted to receive an associated LED, as claimed therein is not present in the invention of Groups I, II or III.

Groups I, II, III and IV lack unity of invention because even though the inventions of these groups require the technical feature of optical waveguide body, this technical feature is not a special technical feature as it does not make a contribution over the prior art. Specifically, US 5,872,883 A (JINNAI et al) 16 February 1999 (16.02.1999) teaches an optical waveguide body (abstract).

Since none of the special technical features of the Group I, II, III or IV inventions are found in more than one of the inventions, unity of invention is lacking.