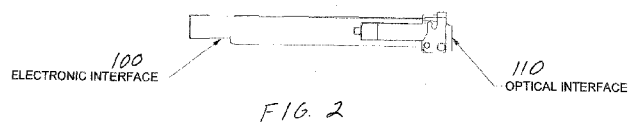




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61/629,029 10 November 2011 (10.11.2011) US
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- (63) Related by continuation (CON) or continuation-in-part (CIP) to earlier application:
US 13/672,714 (CON)
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- (74) Agent: BRUCKNER, John J.; John Bruckner PC, POB 835880, Richardson, TX 75083 (US).
- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH,

[Continued on next page]

(54) Title: BLIND MATE OPTOELECTRONIC DEVICE



(57) Abstract: A method includes connecting a first end of an optoelectronic device with an electrical back plate including blind mating; and connecting a second end of the optoelectronic device with an optical back plate including blind mating. An apparatus includes an optoelectronic device including a first end having an electrical interface for blind mating and a second end having an optical interface for blind mating.

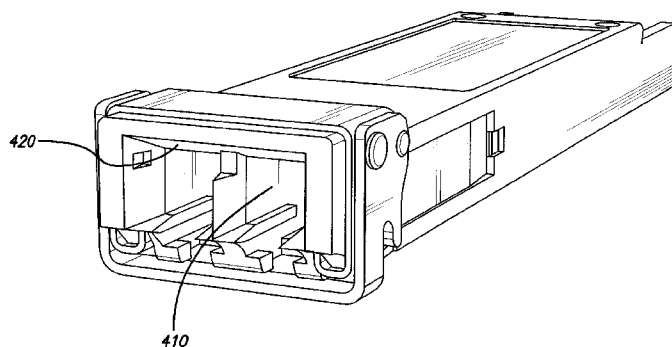


FIG. 5



GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU,
LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,

SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
GW, ML, MR, NE, SN, TD, TG).

Published:

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

DESCRIPTION

Blind Mate Optoelectronic Device

BACKGROUND

Broadband communication systems are complex systems with many factors to consider when designing RF circuits and connectors. Small form factor pluggable optical modules such as, but not limited to SFF, SFP, SFP+, XFP are designed to blind mate/plug in only the electrical interface while the optical interface is left open. The installer (e.g. CATV operator) must manually mate each optical connector to this exposed optical interface side with fiber optical cables protruding out.

SUMMARY

There is a need for the following embodiments of the present disclosure. Of course, the present disclosure is not limited to these embodiments.

According to an embodiment of the present disclosure, a process comprises: connecting a first end of an optoelectronic device with an electrical back plate including blind mating; and connecting a second end of the optoelectronic device with an optical back plate including blind mating. According to another embodiment of the present disclosure, a machine comprises: an optoelectronic device including a first end having an electrical interface for blind mating and a second end having an optical interface for blind mating. These, and other, embodiments of the present disclosure will be better appreciated and understood when considered in conjunction with the following description and the accompanying drawings. It should be understood, however, that the following description, while indicating various embodiments of the present disclosure and numerous specific details thereof, is given for the purpose of illustration and does not imply limitation. Many substitutions, modifications, additions and/or rearrangements may be made within the scope of embodiments of the present disclosure, and embodiments of the present disclosure include all such substitutions, modifications, additions and/or rearrangements.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings accompanying and forming part of this specification are included to depict certain embodiments of the present disclosure. A clearer concept of the embodiments described in this application will be readily apparent by referring to the exemplary, and

therefore nonlimiting, embodiments illustrated in the drawings (wherein identical reference numerals (if they occur in more than one view) designate the same elements). The described embodiments may be better understood by reference to one or more of these drawings in combination with the following description presented herein. It should be noted
5 that the features illustrated in the drawings are not necessarily drawn to scale.

FIG. 1 is an isometric view of an electronic interface end of an optoelectronic device, representing an embodiment of the present disclosure.

FIG. 2 is side view of the optoelectronic device of FIG 1.

FIG. 3 is an isometric view of an optical interface end of the optoelectronic device of FIGS 1-
10 2.

FIGS. 4A-4B are cross-sectional and end views of the optoelectronic device of FIGS. 1-3.

FIG. 5 is another isometric view of the optical interface end of the optoelectronic device of FIGS 1-4.

FIGS. 6A-6B are top assembled (6A) and top disassembled (6B) views of the optoelectronic
15 device of FIGS. 1-5 in association with an optical interface (plate and/or plane), representing an embodiment of the invention.

DETAILED DESCRIPTION

Embodiments presented in the present disclosure and the various features and
20 advantageous details thereof are explained more fully with reference to the nonlimiting embodiments that are illustrated in the accompanying drawings and detailed in the following description. Descriptions of well known signal processing techniques, components and equipment are omitted so as not to unnecessarily obscure the embodiments of the present disclosure in detail. It should be understood, however, that the detailed description and the
25 specific examples are given by way of illustration only and not by way of limitation. Various substitutions, modifications, additions and/or rearrangements within the scope of the underlying inventive concept will become apparent to those skilled in the art from this disclosure.

Embodiments of the invention relate to transmission of analog and/or digital signals over
30 fiber optics. More specifically, some embodiments of the invention relate to small form factor

pluggable modules for transmission systems such as, but not limited to, CATV systems. The disclosure of this application is marginally related to copending U.S. Ser. Nos. 13/672,712, filed November 9, 2012, 13/672,714, filed November 9, 2012, 13/672,716, filed November 9, 2012, 13/672,717, filed November 9, 2012, 13/672,718, filed November 9, 2012 the entire contents of all of which are hereby expressly incorporated by reference for all purposes.

Embodiments of the invention enable blind mating of both optical and electronics sides of an optoelectronic device. This means embodiments of the invention can include an optoelectronic device for optical and/or electrical blind mating on a first and/or a second side (end).

Embodiments of the invention enable the optical interface of an optoelectronic device to also be blind mateable so that an optoelectronic device can blind-mate interface with an optical back plate (plane), as well as blind mate with an electrical back plate (plane). Embodiments of the invention provide an important commercial advantage in that without embodiments of the invention, in the context of a(n) (partially) installed system, the installer and/or end user (CATV operator) must manually mate the optical connector to this exposed side with fiber optical cables protruding out.

In this design scenario with embodiments of the invention, all the optical connectors can be configured and routed into an optical housing with all the fiber connections done internally. Embodiments of the invention provide another important commercial advantage in that In the case of transmitter failure, the (e.g. small form factor pluggable) optoelectronic device can be easily removed and replaced without interrupting the other devices in the system.

Embodiments of the invention can include a plurality of optical connections. Embodiments of the invention can include a plurality of electronic connections.

Referring to FIGS. 3-5, embodiments of the invention can include a substantial angle on optical interface to allow for blind mating. Such an angle can be defined by a chamfered entry for blind mate applications located on the optical end of the optoelectronic device. Similarly, embodiments of the invention can include a substantial angle on electronic interface to allow for blind mating. Such an angle can be defined by a chamfered entry for blind mate applications located on the electronic end of the optoelectronic device.

Referring to FIGS. 1-2, an optoelectronic device includes a first end having an electrical interface 100 for blind mating and a second end having an optical interface 110 also for blind mating. Referring to FIG. 1, the electrical interface includes an alignment entry channel 120.

Referring to FIG. 3, the optical interface 110 includes a latching connector. Embodiment of the invention can include an optical interface that includes, but is not limited to, LC (latching connector), SC (snap connector), MPO (multiple port/position optic). Embodiments of the invention can include an electronic interface that includes, but is not limited to, SFP (small form factor pluggable), XFP (form factor pluggable).

Referring to FIGS. 4A-4B and 5, the optical interface defines a plurality of lumen 410. In this example, the lumen is by a latching connector. Alternatively the lumen could be defined by a snap connector or a multiple port/position optic. Still referring to FIGS. 4A-4B and 5, the lumen defines a chamfered entry 420 for blind mate applications. In this example, the chambered entry is substantially 4-fold symmetric with regard to a principal axis defined by the lumen.

Still referring to FIGS. 4A-4B and 5, the optical interface includes a plurality of lumen 410 each of which defines a chamfered entry 420 for blind mate applications. In this example, each chamfered entry is substantially 4-fold symmetric. In this example, the plurality of lumen define a plural of principal axes that are substantially coplanar.

Referring to FIGS. 6A-6B, the optoelectronic device is shown in an assembly on the left. An optical back plate 600 is shown on the left.

Definitions

The term lumen is intended to mean an inner open space or cavity of a tubular structure, as of a latching connector or of a snap connector or of a multiple port/position optic, having one or more of a circular, square, polyhedral or other cross sectional shape. The term chamfered is intended to mean a substantial angle (e.g. at least approximately 10°) relative to an axis, such as a central axis of a lumen. The phrase blind mating is intended to mean aligning while the distance between two subassemblies is reduced until assembly is completed, without the electrical or optical connection points being visible. The phrase radio frequency (RF) is intended to mean frequencies less than or equal to approximately 300 GHz as well as the infrared spectrum.

The term substantially is intended to mean largely but not necessarily wholly that which is specified. The term approximately is intended to mean at least close to a given value (e.g., within 10% of). The term generally is intended to mean at least approaching a given state. The term coupled is intended to mean connected, although not necessarily directly, and not necessarily mechanically.

The terms first or one, and the phrases at least a first or at least one, are intended to mean the singular or the plural unless it is clear from the intrinsic text of this document that it is meant otherwise. The terms second or another, and the phrases at least a second or at least another, are intended to mean the singular or the plural unless it is clear from the intrinsic text of this document that it is meant otherwise. Unless expressly stated to the contrary in the intrinsic text of this document, the term or is intended to mean an inclusive or and not an exclusive or. Specifically, a condition A or B is satisfied by any one of the following: A is true (or present) and B is false (or not present), A is false (or not present) and B is true (or present), and both A and B are true (or present). The terms a and/or an are employed for grammatical style and merely for convenience.

The term plurality is intended to mean two or more than two. The term any is intended to mean all applicable members of a set or at least a subset of all applicable members of the set. The term means, when followed by the term "for" is intended to mean hardware, firmware and/or software for achieving a result. The term step, when followed by the term "for" is intended to mean a (sub)method, (sub)process and/or (sub)routine for achieving the recited result. Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this present disclosure belongs. In case of conflict, the present specification, including definitions, will control.

The described embodiments and examples are illustrative only and not intended to be limiting. Although embodiments of the present disclosure can be implemented separately, embodiments of the present disclosure may be integrated into the system(s) with which they are associated. All the embodiments of the present disclosure disclosed herein can be made and used without undue experimentation in light of the disclosure. Embodiments of the present disclosure are not limited by theoretical statements (if any) recited herein. The individual steps of embodiments of the present disclosure need not be performed in the disclosed manner, or combined in the disclosed sequences, but may be performed in any and all manner and/or combined in any and all sequences. The individual components of embodiments of the present disclosure need not be combined in the disclosed configurations, but could be combined in any and all configurations.

Various substitutions, modifications, additions and/or rearrangements of the features of embodiments of the present disclosure may be made without deviating from the scope of the underlying inventive concept. All the disclosed elements and features of each disclosed embodiment can be combined with, or substituted for, the disclosed elements and features of every other disclosed embodiment except where such elements or features are mutually

exclusive. The scope of the underlying inventive concept as defined by the appended claims and their equivalents cover all such substitutions, modifications, additions and/or rearrangements.

5 The appended claims are not to be interpreted as including means-plus-function limitations, unless such a limitation is explicitly recited in a given claim using the phrase(s) "means for" and/or "step for." Subgeneric embodiments of the invention are delineated by the appended independent claims and their equivalents. Specific embodiments of the invention are differentiated by the appended dependent claims and their equivalents.

CLAIMS

What is claimed is:

1. A method, comprising:
 - 5 connecting a first end of an optoelectronic device with an electrical back plate including blind mating; and
 - connecting a second end of the optoelectronic device with an optical back plate including blind mating.
- 10 2. The method of claim 1, wherein blind mating the second end includes aligning a principal axis defined by a lumen defined by the optoelectronic device with the optical back plate by moving the optoelectronic device.
3. The method of claim 2, wherein aligning includes
 - 15 reversibly moving the optoelectronic device substantially orthogonally with regard to a principal axis that is normal to a plane defined by the optical back plate and
 - pushing a 4-fold symmetric chamfered entry on the optoelectronic device onto the optical back plate.
- 20 4. The method of claim 1, wherein blind mating the second end includes aligning the optical back plate with a principal axis defined by a lumen defined by the optoelectronic device by moving the optical interface.
5. The method of claim 4, wherein aligning includes
 - 25 reversibly moving the optical back plate substantially orthogonally with regard to the principal axis defined by the lumen defined by the optoelectronic device and
 - pushing the optical back plate into a 4-fold symmetric chamfered entry on the optoelectronic device.

6. An apparatus, comprising an optoelectronic device including a first end having an electrical interface for blind mating and a second end having an optical interface for blind mating.

5 7. The apparatus of claim , wherein the optical interface defines a lumen.

8. The apparatus of claim , wherein the lumen is defined by one member selected from the group consisting of a latching connector, a snap connector or a multiple port/position optic.

10

9. The apparatus of claim , wherein the lumen defines a chamfered entry for blind mate applications.

15

10. The apparatus of claim , wherein the chambered entry is substantially 4-fold symmetric with regard to a principal axis defined by the lumen.

11. The apparatus of claim , wherein the optical interface includes a plurality of lumen each of which defines a chamfered entry for blind mate applications.

20

12. The apparatus of claim , wherein each chamfered entry is substantially 4-fold symmetric.

13. The apparatus of claim , wherein the plurality of lumen define a plural of principal axes that are substantially coplanar.

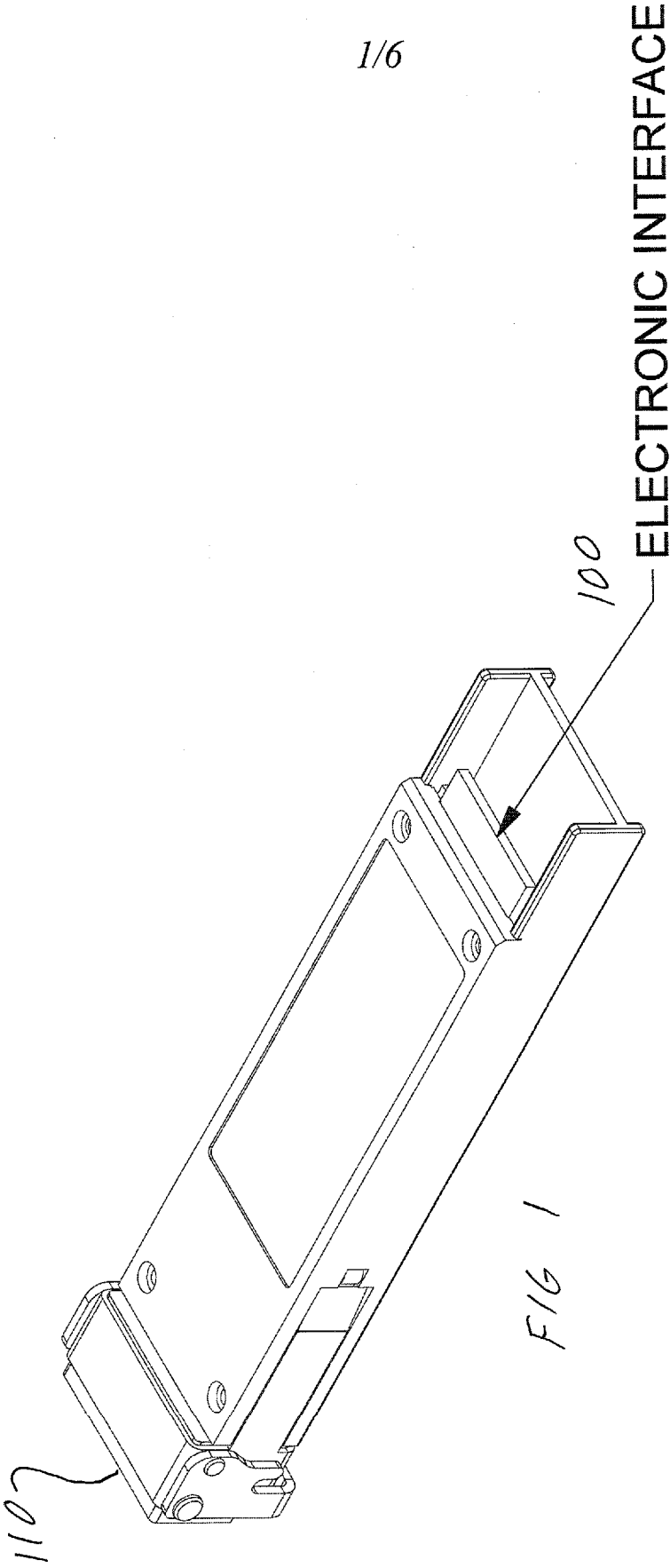
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14. The apparatus of claim , wherein the electrical interface includes an alignment entry channel.

15. A device/method substantially as herein described.

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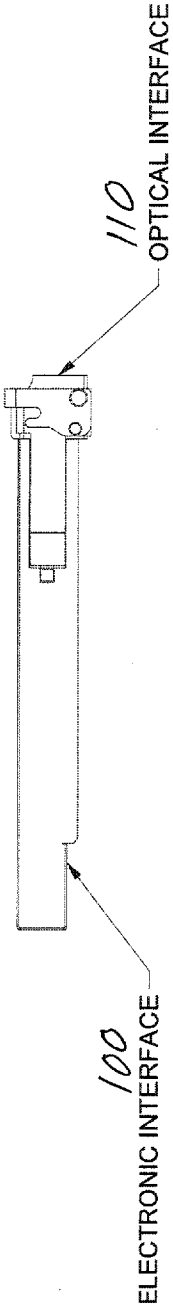
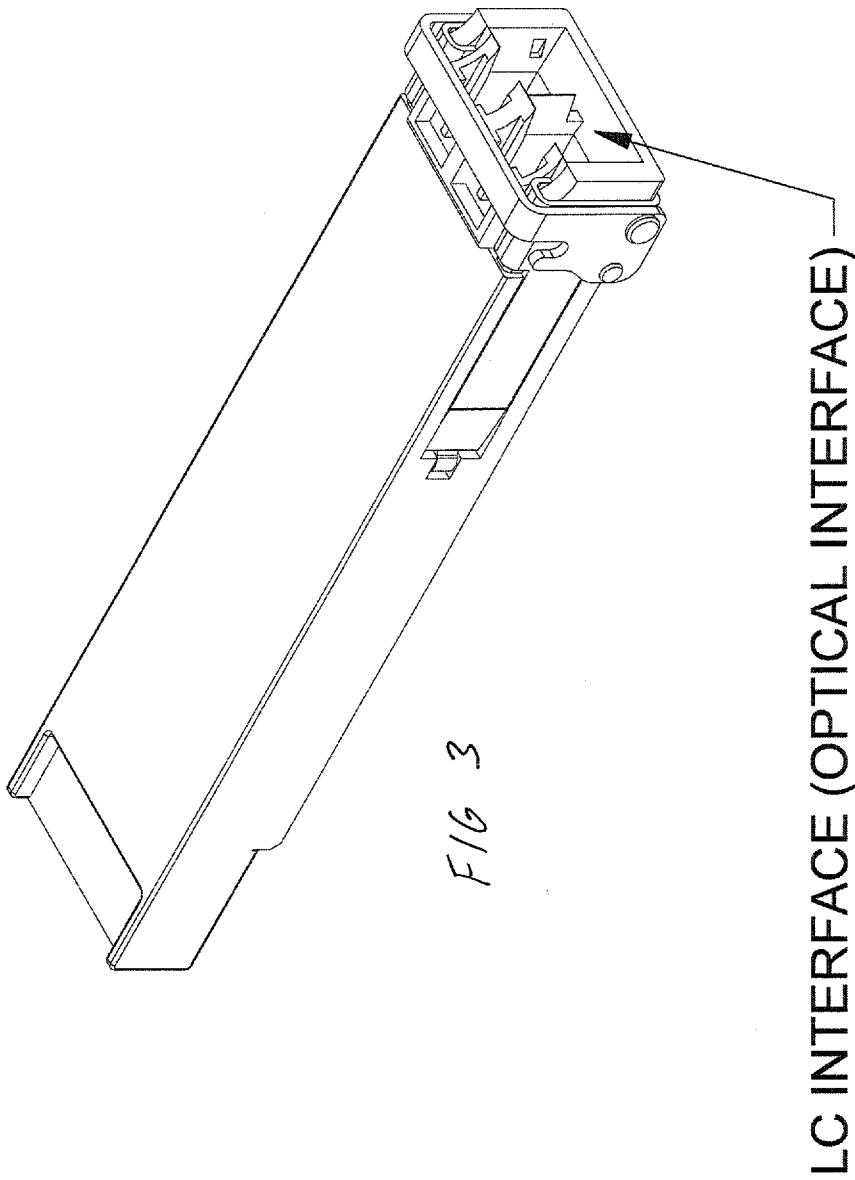
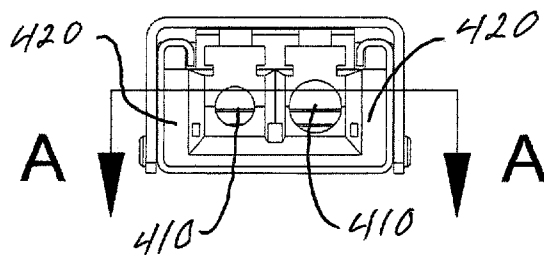
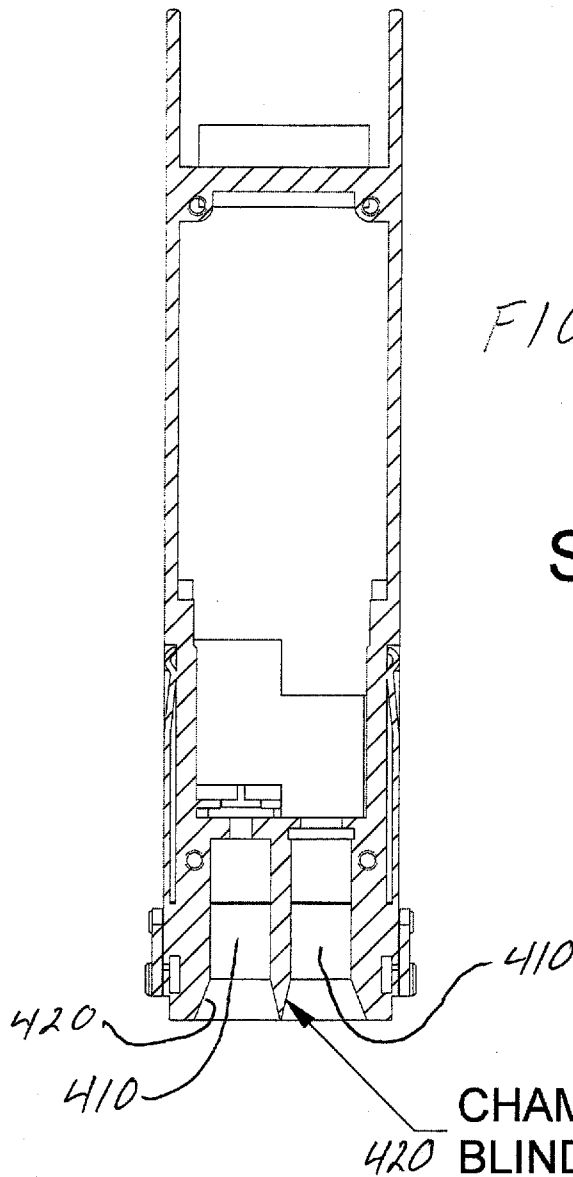


FIG. 2

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4/6



5/6

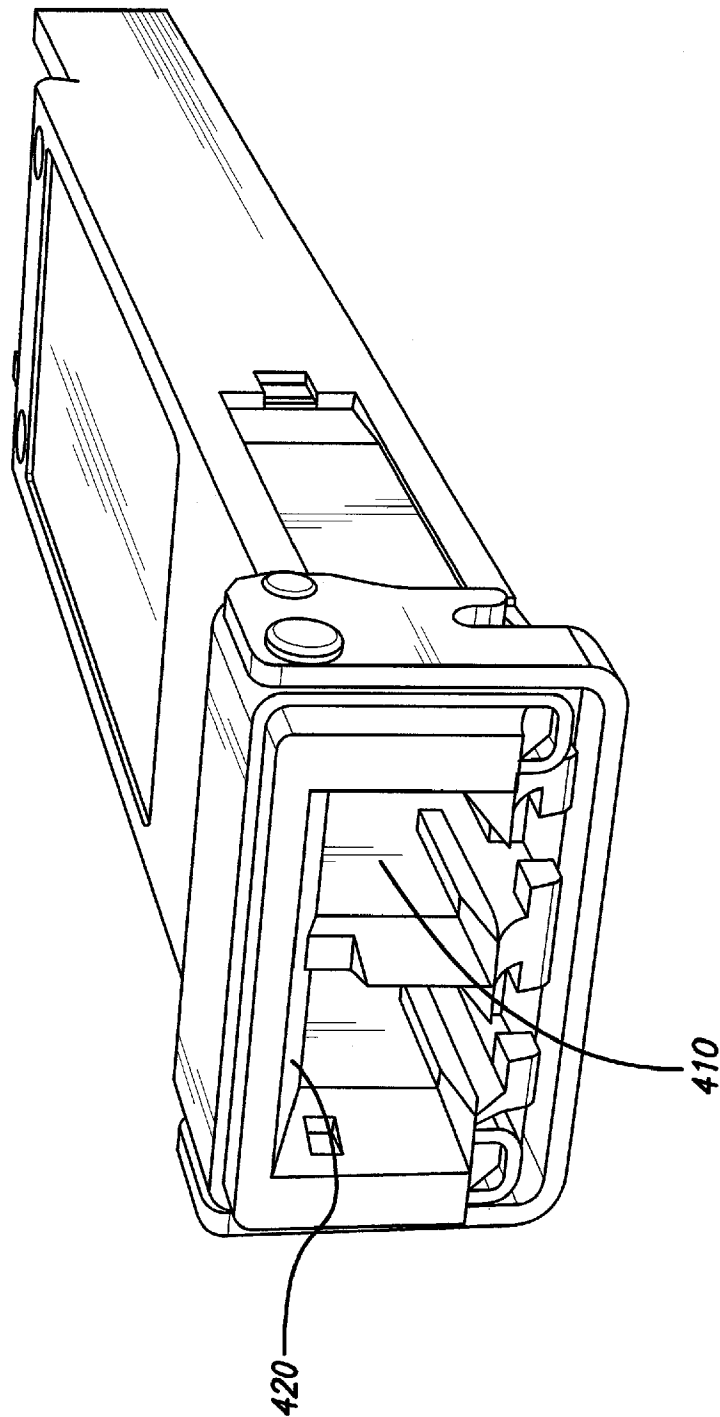


FIG. 5

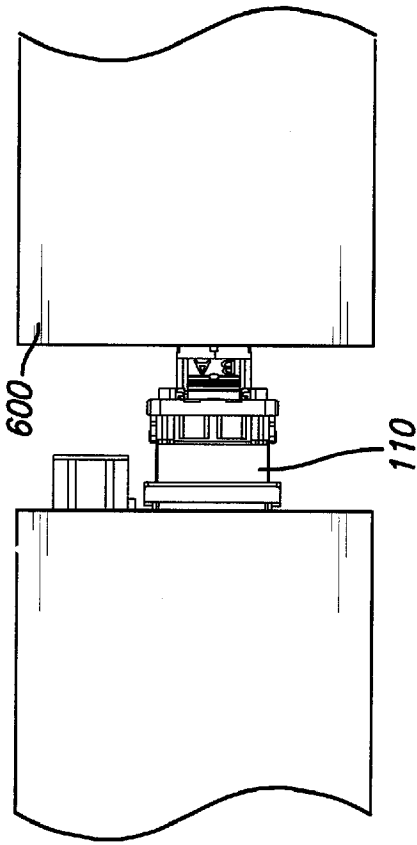


FIG. 6A

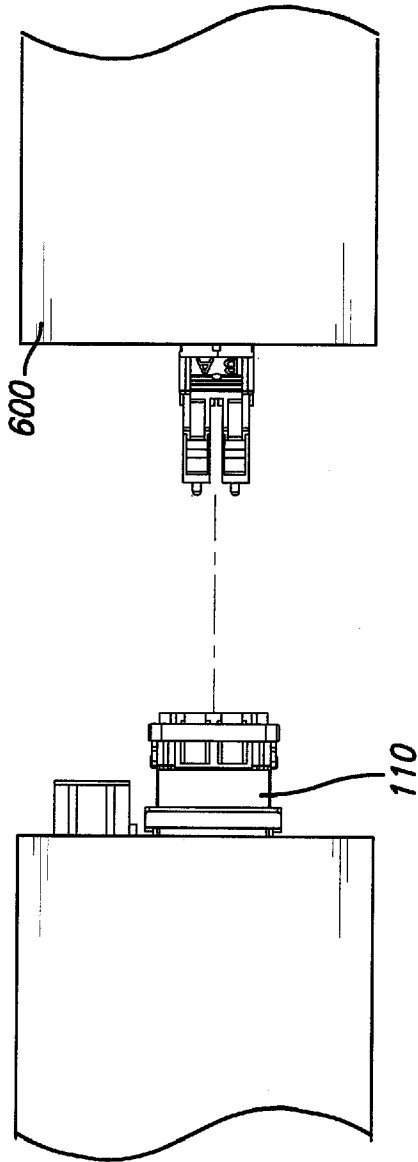


FIG. 6B

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/064455

A. CLASSIFICATION OF SUBJECT MATTER
INV. G02B6/42
ADD.

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)
G02B

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 practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/008494 A1 (ROTH RICHARD F [US]) 15 January 2004 (2004-01-15) paragraphs [0073], [0107] - [0117]; figures 1A,1B -----	1-14
X	US 2011/053423 A1 (SONG SEAH0 [CA] ET AL) 3 March 2011 (2011-03-03) paragraphs [0002], [0036] - [0038]; figures 1,2 -----	1-14
X	US 2007/286555 A1 (KIANI SEPEHR [US] ET AL) 13 December 2007 (2007-12-13) paragraphs [0007], [0020] - [0025], [0051], [0061]; figure 1 -----	1-14
A	US 6 822 874 B1 (MARLER BRUCE [US]) 23 November 2004 (2004-11-23) paragraphs [0046] - [0059]; figures 5-7 ----- -/-	1-14



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

Date of the actual completion of the international search

8 February 2013

Date of mailing of the international search report

18/02/2013

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
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Fax: (+31-70) 340-3016

Authorized officer

Cohen, Adam

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2012/064455

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2011/002591 A1 (LU YU [US] ET AL) 6 January 2011 (2011-01-06) paragraph [0064] -----	9,11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/064455

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.: 15
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:
see FURTHER INFORMATION sheet PCT/ISA/210
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 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 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.:
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.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 15

Claim 15 does not meet the clarity requirements of Art. 6 PCT, because it is recited in the form of two mutually exclusive categories ("device/method"), and furthermore because it is recited in an extremely unclear manner, viz. "substantially as herein described". It is not clear to what "herein" refers, however it is assumed this is a vague reference to the entire application, namely including the description and drawings. Pursuant to R. 6.2(a) PCT, references to the description and drawings are not allowed in the claims. Claim 15 has consequently not been searched.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.2), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2012/064455

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