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(54) Title: BLIND-MATE OPTICAL CONNECTORS

(57) Abstract: In one example, a system for a blind-mate optical connector includes a dock coupled to a system board, wherein the dock comprises an alignment feature to receive an optical connector module from a first direction and align a dock transceiver with a lens of the optical connector module in a second direction.

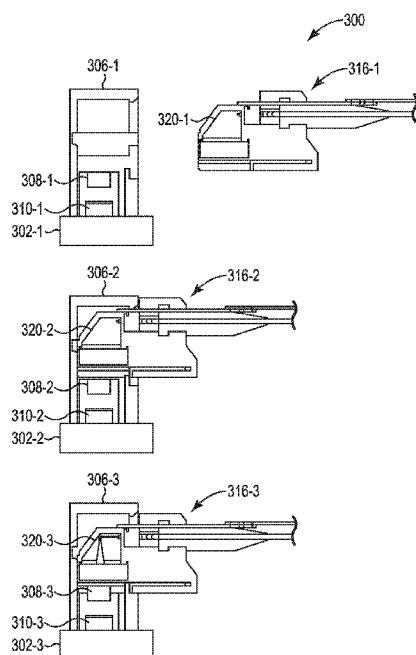


Fig. 3

BLIND-MATE OPTICAL CONNECTORS

Background

[0001] Computing systems can include a system board with a number of socket connectors to couple module boards to the system board. The module boards can be hot-pluggable transceiver modules. The hot-pluggable transceiver modules, such as 1-lane Small Form Factor Pluggable (SFP), 4-lane Quad Small Form Factor Pluggable (QSFP), and 12-Lane CXP, can be used for network data communications. The transceiver modules can be hot-pluggable to the system board, such as a printed circuit board of a network interface controller (NIC) installed in a server system. A system board can be behind a faceplate where connectors for coupling communication cables (e.g., fiber optic cables) to the transceiver modules are arranged.

Brief Description of the Drawings

[0002] Figure 1 illustrates a diagram of an example of a system for a blind-mate optical connector consistent with the present disclosure.

[0003] Figure 2 illustrates a diagram of an example of a system for a blind-mate optical connector consistent with the present disclosure.

[0004] Figure 3 illustrates a diagram of an example of a system for a blind-mate optical connector consistent with the present disclosure.

[0005] Figure 4 illustrates a diagram of an example of a system for a blind-mate optical connector consistent with the present disclosure.

Detailed Description

[0006] A number of examples for a blind-mate optical connector are described herein. In one example, a system for a blind-mate optical connector includes a dock coupled to a system board, where the dock comprises a mechanical alignment feature to receive an optical connector module from a first direction and align a dock transceiver with a lens of the optical connector module in a second direction.

[0007] In another example, a system for a blind-mate optical connector, can include: a plurality of vertical optical transceivers coupled directly to a system board, a dock coupled to the system board, where the dock encloses the plurality of vertical optical transceivers, and an alignment feature coupled to the dock to receive an optical connector module through an opening of the dock, where the alignment feature aligns a plurality of optical fibers within the optical connector module with the vertical optical transceivers.

[0008] In some examples, the plurality of optical fibers can be utilized to transfer optical signals from the vertical optical transceivers to a different optical waveguide device. In some examples, the plurality of optical fibers can be bent to transfer the optical signals in a direction that is perpendicular to the direction that the vertical optical transceivers transfer the optical signal. For example, the vertical optical transceivers can transfer optical signals in a vertical direction and the optical connector module can transfer the optical signals in a horizontal direction.

[0009] In some examples, the blind-mate optical connector described herein can include a dock that can enclose a number of optical transceivers that are coupled directly to a system board. The blind-mate optical connector described herein can provide optical connectivity to optical transceivers with a relatively small lane-count compared to previous systems by utilizing a jumperless connection (e.g., utilizing the optical connector module as described herein). In some examples, the blind-mate optical connector described herein can have a relatively lower cost, lower optical loss, and a relatively lower profile compared to previous systems and methods.

[0010] Figure 1 illustrates a diagram of an example of a system 100 for a blind-mate optical connector consistent with the present disclosure. The system 100 can be

utilized to provide optical communication between a system board 102 and a different optical waveguide utilizing an optical connector module 116. As used herein, the optical connector module 116 can include an optical module lens 118, an optical transfer device 120, and/or an optical path 122 to transmit optical communication signals. In some examples, the optical connector module 116 can be coupled to a different optical waveguide device or optical waveguide system. In some examples, the optical connector module 116 is a passive device (e.g., includes no active devices, includes no optical transceiver device, etc.).

[0011] In some examples, the system board 102 can include a number of components 104 (e.g., processor, memory, heat sinks, etc.). For example, the system board 102 can include a network controller and/or memory to perform data communication functions. In some examples, the system 100 can be utilized to perform data communication functions with a different device or system when the optical connector module 116 is coupled to the dock 106.

[0012] In some examples, the system 100 can include a dock 106. In some examples, the dock 106 can include an enclosure that is coupled to the system board 102. In some examples, the dock 106 can be an enclosure to protect an optical transceiver 110 (e.g., dock transceiver) and transceiver lens 108 from dust and/or other elements that can damage the optical transceiver 110 and transceiver lens 108. In some examples, the optical transceiver 110 and transceiver lens 108 can be a vertical optical transceiver. As used herein, a vertical optical transceiver can include an optical transceiver that can transmit and receive an optical signal in a vertical direction compared to the system board 102. For example, the vertical optical transceiver can transmit and receive an optical signal in a direction that is substantially perpendicular to the plane of the system board 102.

[0013] In some examples, the dock 106 can include an aperture 114 for receiving the optical connector module 116. In some examples, the dock 106 can include a door 112-1 and hinge 112-2 to allow the optical connector module 116 to be inserted into the dock 106, and enclose the optical transceiver 110 and transceiver lens 108 when the optical connector module 116 is removed from the dock 106. In some examples, the system 100 can utilize an optical connector module 116 that can transmit and receive

data with the system board 102 via an optical transceiver coupled to the optical connector module 116. In some examples, the optical connector module 116 can be coupled to a computing device such that the computing device can communicate with the system board 102 when the optical connector module 116 is coupled to the dock 106.

[0014] In some examples, the optical connector module 116 can include an optical module lens 118, an optical transfer device 120, and/or an optical path 122. In some examples, the optical module lens 118, optical transfer device 120, and the optical path 122 can be utilized to receive optical signals from the optical transceiver 110 and/or transmit optical signals to the optical transceiver 110. In some examples, the optical module lens 118 can be protected by a lid 124 when the optical connector module 116 is decoupled from the dock 106. In some examples, the lid 124 can be a sliding lid that can be moved from covering the optical module lens 118 when the optical connector module 116 is coupled to the dock 106. For example, the lid 124 can contact a lip 126 when the optical connector module 116 is coupled to the dock 106. In this example, the lid 124 can slide away from the optical module lens 118 as the optical connector module 116 is inserted into the aperture 114.

[0015] In some examples, the optical connector module 116 can include a locking mechanism 128-1 that can couple to a receiving mechanism 128-2 attached to the dock 106. In some examples, the locking mechanism 128-1 can couple the optical connector module 116 to the dock 106. In some examples, the locking mechanism 128-1 can lock the optical connector module 116 in a position that aligns the lens 108 of the dock 106 with the optical module lens 118 of the optical connector module 116. That is, the locking mechanism 128-1 and receiving mechanism 128-2 can be utilized as part of an alignment feature. For example, the alignment feature can include a number of rails coupled to the dock 106 to help guide the optical connector module 116 into a position that aligns the lens 108 of the dock 106 with the optical module lens 118 of the optical connector module 116.

[0016] The system 100 can be utilized to provide optical communication between the system board 102 and a different device coupled to the optical connector module 116. The system 100 can lower cost, increase optical signal quality, and/or decrease a

footprint of the optical transceiver 110 coupled to the system board 102. In addition, the system 100 can provide an orthogonal coupling (e.g., parallel insertion with the system board 102) of the optical connector module 116 into an aperture 114 of the dock 106. Furthermore, the system 100 can provide a horizontal coupling with a vertical optical transceiver that provides optical signals to the optical connector module 116 coupled to the dock 106. In this example, the optical connector module 116 can alter the direction of the optical signals such that the optical signals are transferred horizontally (e.g., same direction as the coupling between the optical connector module 116 and the dock 106).

[0017] Figure 2 illustrates a diagram of an example of a system 200 for a blind-mate optical connector consistent with the present disclosure. In some examples, the system 200 can include the same and/or similar elements as system 100 as referenced in Figure 1. The system 200 can represent when an optical connector module 216 is coupled to a dock 206 that is coupled to a system board 202.

[0018] In some examples, the system 200 can include a system board 202. The system board 202 can include a number of components 204 (e.g., network controller, processor, memory, heat sink, etc.). As described herein, the dock 206 can be utilized to enclose and/or protect an optical transceiver 210 and transceiver lens 208. As described herein, the optical connector module 216 can be horizontally inserted (e.g., substantially at a right angle with the system board 202, etc.) into the dock 206 via the aperture 214. In some examples, the optical connector module 216 can be inserted into the dock 206 by depressing a door 212-1 coupled to a hinge 212-2. In some examples, the hinge 212-2 can utilize a spring mechanism to remain closed when the optical connector module 216 is removed from the dock 206.

[0019] As described herein, the optical connector module 216 can include a lid 224. In some examples, the lid 224 can be a sliding lid that can slide away from the optical module lens 218 of the optical connector module 216 when the optical connector module 216 is coupled to the dock 206. As described herein, the optical connector module 216 can include a locking mechanism 228-1 that can be coupled to a receiving mechanism 228-2 when the optical connector module 216 is coupled to the dock 206. In some examples, the locking mechanism 228-1 is coupled to the receiving mechanism

228-2 when an optical transceiver 210 and transceiver lens 208 are aligned to an optical module lens 218 of the optical connector module 216.

[0020] As described herein, the optical transceiver 210 can transmit and receive optical signals with the optical connector module 216 when the optical connector module 216 is coupled to the dock 206. In one example, the optical transceiver 210 can transmit an optical signal through the lens 208. In this example, the optical signal can be received at the optical module lens 218 of the optical connector module 216. In this example, the optical signal can be directed from the optical module lens 218 to an optical path 222 by an optical transfer device 220 (e.g., mirrored device, device capable of changing a direction of an optical signal, etc.). In some examples, a fiber optic or other optical waveguide device can be utilized to capture the received optical signal from the lens and alter the direction of the optical signal. For example, the optical signal can be received at a first direction (e.g., substantially vertical direction, perpendicular direction compared to the service board 202, etc.) and altered to a second direction (e.g., substantially horizontal direction, parallel direction compared to the service board 202, etc.).

[0021] Figure 3 illustrates a diagram of an example of a system 300 for a blind-mate optical connector consistent with the present disclosure. In some examples, the system 300 can include the same and/or similar elements as system 100 as referenced in Figure 1 and system 200 as referenced in Figure 2. For example, the system 300 can include a system board 302-1, 302-2, 302-3 with a dock 306-1, 306-2, 306-3 to enclose an optical transceiver 310-1, 310-2, 310-3 and transceiver lens 308-1, 308-2, 308-3. As described herein, the dock 306-1, 306-2, 306-3 can be utilized to protect the optical transceiver 310-1, 310-2, 310-3 and transceiver lens 308-1, 308-2, 308-3 from dust and other elements.

[0022] In one example, the system 300 can include an optical connector module 316-1 that is decoupled from the dock 306-1. In this example, the optical connector module 316-1 is removed from the dock 306-1 and is unable to communicate with the optical transceiver 310-1. As described herein, the dock 306-1 can include a door that can be closed when the optical connector module is decoupled from the dock 306-1. In

addition, the optical connector module 316-1 can include a lid that can enclose or cover a lens of the optical connector module 316-1.

[0023] In another example, the system 300 can include an optical connector module 316-2 that is partially coupled to the dock 306-2. As described herein, a portion of the optical connector module 316-2 can be inserted into the dock 306-2 via an aperture/door of the dock 306-2. In some examples, a lid of the optical connector module 316-2 can be depressed or moved away from the lens of the optical connector module 316-2. In this example, the optical connector module 316-2 may not be fully coupled to the dock 306-2 and thus the optical connector module 316-2 may not be able to receive signals from the optical transceiver 310-2.

[0024] Furthermore, in another example, the system 300 can include an optical connector module 316-3 that is coupled to the dock 306-3. In this example, a locking mechanism of the optical connector module 316-3 can be coupled to a receiving mechanism as described herein. In this example, a lens of the optical connector module 316-3 can be aligned with the lens 308-3 and optical transceiver 310-3. The system board 302-3 can communicate with a device coupled to the optical connector module 316-3 via optical communication when the optical connector module 316-3 is aligned with the lens 308-3 and optical transceiver 310-3.

[0025] Figure 4 illustrates a diagram of an example of a system 400 for a blind-mate optical connector consistent with the present disclosure. The system 400 can include the same and/or similar elements as system 100 as referenced in Figure 1, system 200 as referenced in Figure 2, or system 300 as referenced in Figure 3. For example, the system 400 can include a system board 402-1, 402-2, a dock 406-1, 406-2, and/or an optical connector module 416.

[0026] The system 400 can represent a dock 406-1, 406-2 with a plurality of optical transceivers 410-1, 410-2 and transceiver lenses (e.g., lens 408, etc.). For example, the dock 406-1, 406-2 can include four optical transceivers 410-1, 410-2. In some examples, the optical transceivers 410-1, 410-2 can be vertical optical transceivers. As described herein, utilizing vertical optical transceivers can take up less space on the system board 402-1, 402-2 (e.g., relatively small lane count) and include a relatively lower height compared to non-vertical optical transceivers. In addition, as

described herein, the system 400 can utilize optical transceivers 410-1, 410-2 such that there is a jumperless connection between the optical transceivers 410-1, 410-2 and a different optical waveguide device.

[0027] In some examples, the optical connector module 416 can include a number of divided portions to enclose transceiver lenses for each of the optical transceivers 410-2. For example, each optical transceiver 410-1, 410-2 can include a designated transmitting and receiving portion. In this example, the optical connector module can include a similar designated transmitting and receiving portion for each of the plurality of optical transceivers 410-1, 410-2. In some examples, the optical connector module 416 can include a separate optical path for each of the plurality of optical transceivers 410-1, 410-2. For example, the optical connector module 416 can include a first lens and a first optical path (e.g., bent optical path) for a first optical transceiver and a second lens and a second optical path for a second optical transceiver. In this example, each separate path can be separated by a physical barrier to prevent the optical signals from interrupting other optical signals from a different optical transceiver (e.g., neighboring optical transceiver, etc.). In some examples, the optical path of the optical connector module 416 can include a plurality of optical fibers that are bent to transfer optical signals from each of the corresponding optical transceivers 410-1, 410-2.

[0028] The above specification, examples and data provide a description of the method and applications, and use of the system and method of the present disclosure. Since many examples can be made without departing from the spirit and scope of the system and method of the present disclosure, this specification merely sets forth some of the many possible example configurations and implementations.

What is claimed:

1. A system for a blind-mate optical connector, comprising:
a dock coupled to a system board, wherein the dock comprises an alignment feature to receive an optical connector module from a first direction and align a dock transceiver with a lens of the optical connector module in a second direction.
2. The system of claim 1, wherein the first direction is substantially parallel with the system board and the second direction is substantially perpendicular with the system board.
3. The system of claim 1, wherein the optical connector module includes a locking mechanism to couple the optical connector module to the dock when the dock transceiver is aligned with the lens of the optical connector module.
4. The system of claim 1, wherein dock transceiver is a vertical optical transceiver.
5. The system of claim 1, wherein the optical connector module includes a sliding lid positioned over the lens of the optical connector module when the optical connector module is decoupled from the dock.
6. The system of claim 5, wherein the sliding lid is positioned away from the lens of the optical connector module when the optical connector module is coupled to the dock.
7. The system of claim 1, wherein the dock comprises an enclosure with a door to receive the optical connector module.
8. A blind-mate optical connector dock, comprising:
a vertical optical transceiver coupled to a system board;
an enclosure coupled to the system board around the vertical optical transceiver;

an opening of the enclosure to receive an optical connector module; and
an alignment feature coupled to the enclosure to align a lens of the optical connector module with a lens of the vertical optical transceiver.

9. The blind-mate optical connector dock of claim 8, wherein the opening is coupled to a hinged door to enclose the vertical optical transceiver when the optical connector module is decoupled from the enclosure.

10. The blind-mate optical connector dock of claim 8, wherein the vertical optical transceiver utilizes a jumperless connection when the optical connector module is coupled to the enclosure.

11. The blind-mate optical connector dock of claim 8, wherein the vertical optical transceiver is directly coupled to the system board.

12. A system for a blind-mate optical connector, comprising:
a plurality of vertical optical transceivers coupled directly to a system board;
a dock coupled to the system board, wherein the dock encloses the plurality of vertical optical transceivers; and
an alignment feature coupled to the dock to receive an optical connector module through an opening of the dock, wherein the alignment feature aligns a plurality of optical fibers within the optical connector module with the vertical optical transceivers.

13. The system of claim 12, wherein the plurality of vertical optical transceivers are directly coupled to the system board without electrical connectors.

14. The system of claim 12, wherein the alignment feature receives the optical connector module substantially parallel to the system board.

15. The system of claim 12, wherein the plurality of vertical optical transceivers each direct an optical signal in a direction that is substantially perpendicular to the system board.

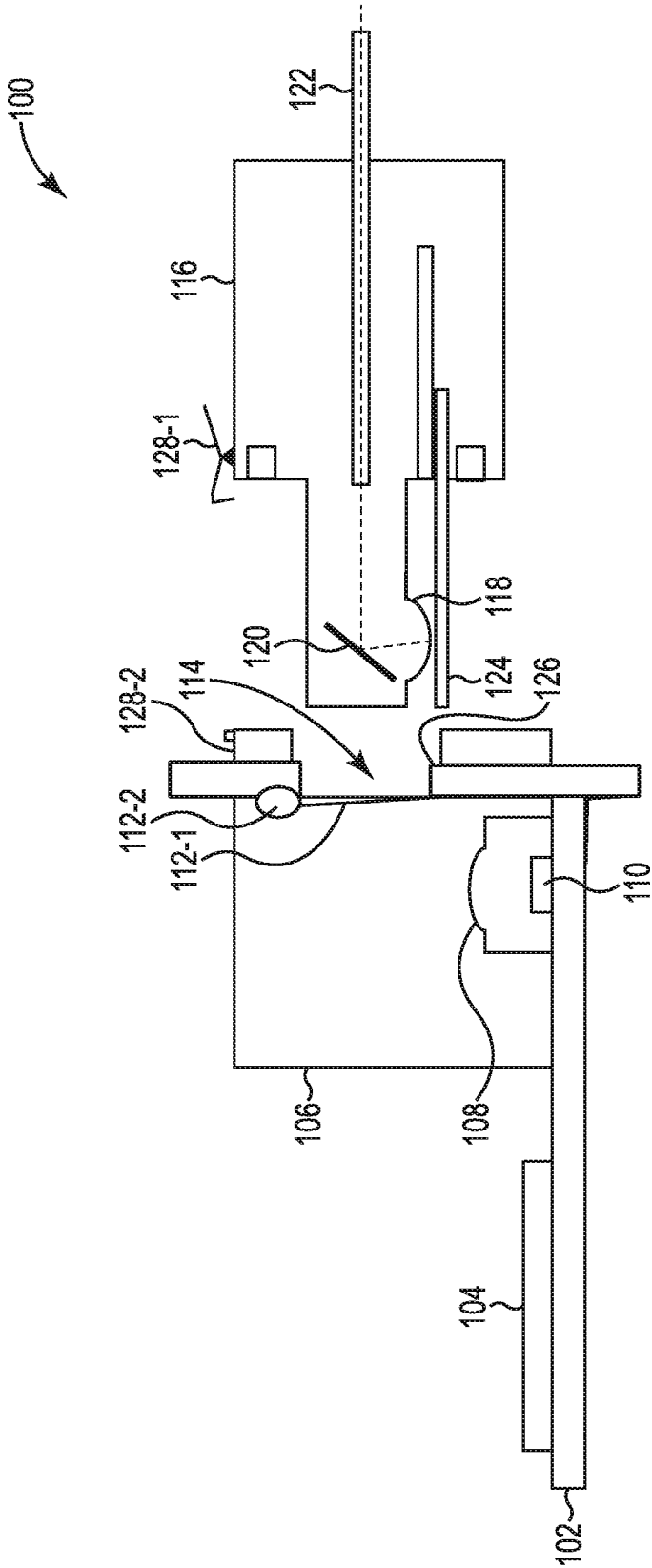


Fig. 1

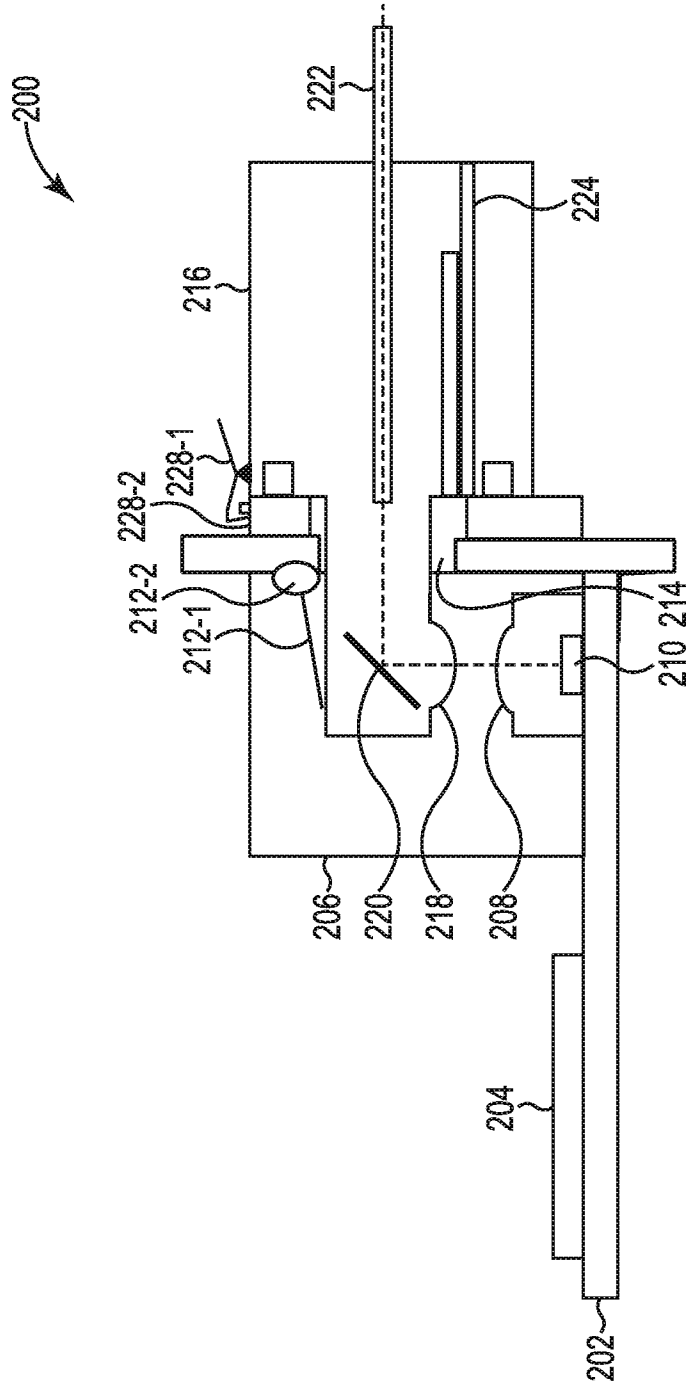
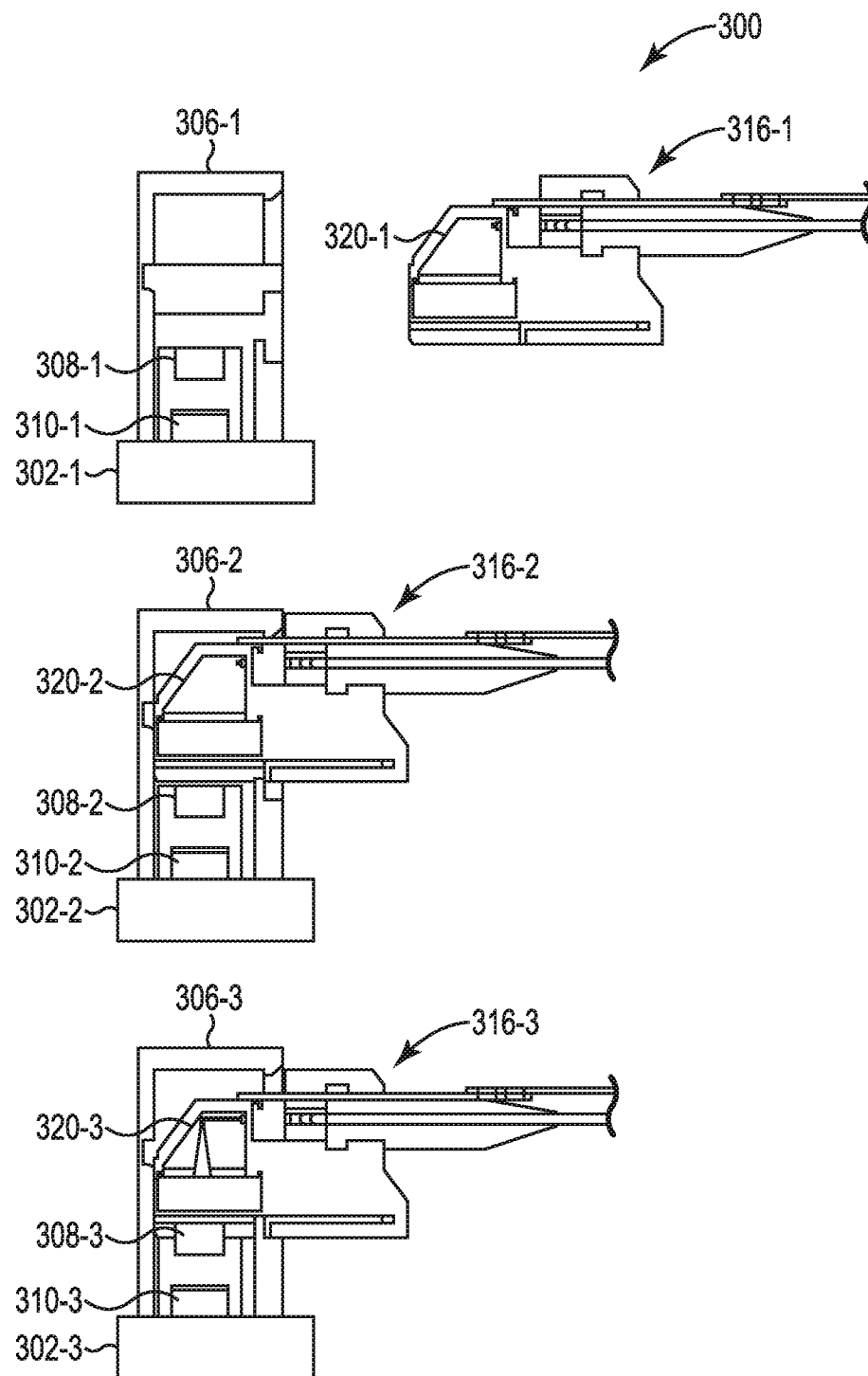


Fig. 2

**Fig. 3**

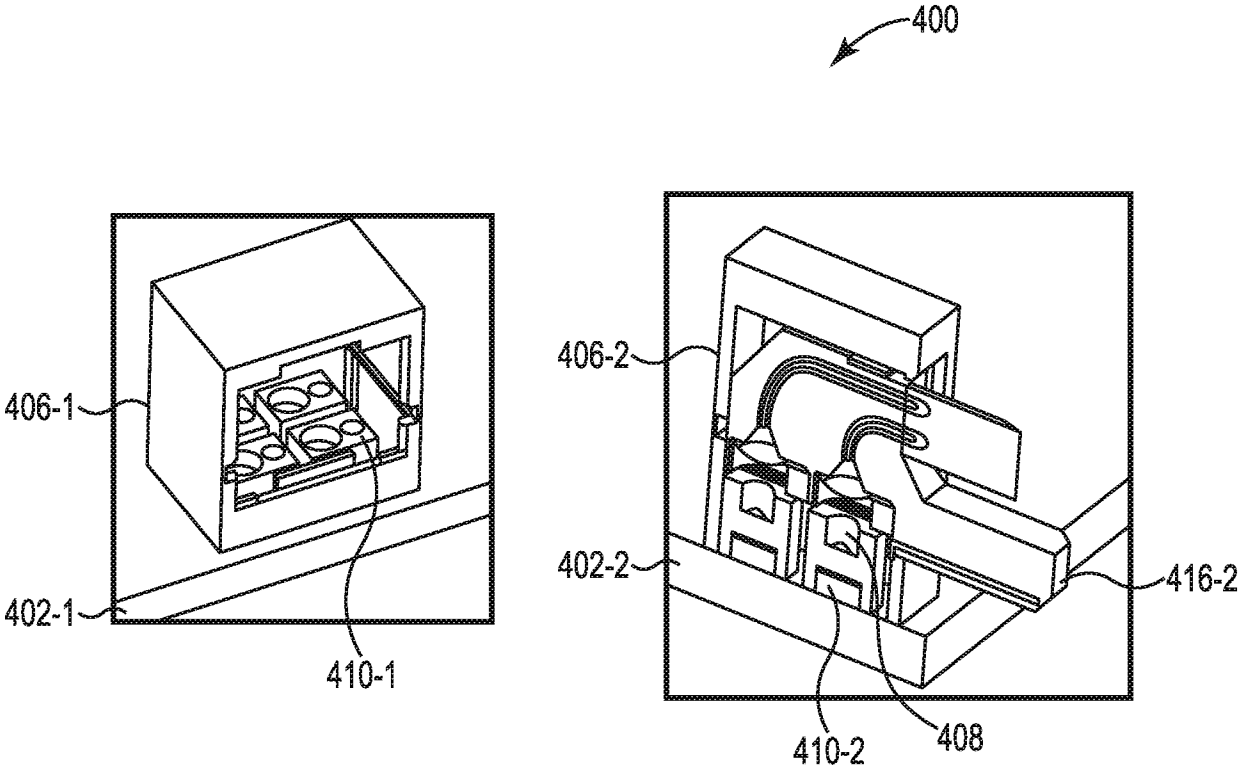


Fig. 4

A. CLASSIFICATION OF SUBJECT MATTER**G02B 6/12(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)

G02B 6/12; G02B 6/43; G02B 6/26; G02B 6/38; H05K 3/36; G02B 6/42; G02B 6/36

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: optical, connector, dock, alignment, blind-mate

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2015-0086210 A1 (DUANE QUIET et al.) 26 March 2015 See paragraphs [0008]–[0009] and claims 1,9,11.	1–15
Y	US 2015-0219863 A1 (3M INNOVATIVE PROPERTIES COMPANY) 06 August 2015 See paragraph [0006] and claims 11,13–14,18.	1–15
A	US 2008-0166090 A1 (SEPEHR KIANI et al.) 10 July 2008 See abstract, paragraphs [0038]–[0040] and figure 2.	1–15
A	US 2014-0056560 A1 (LAURENCE R. MCCOLLOCH) 27 February 2014 See claims 1–13.	1–15
A	US 2013-0087690 A1 (APPLE INC.) 11 April 2013 See paragraphs [0050]–[0066] and figures 2A–4.	1–15



Further documents are listed in the continuation of Box C.



See patent family annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2015-0086210 A1	26/03/2015	CN 104516849 A EP 2851721 A1 EP 2851721 A8	15/04/2015 25/03/2015 17/02/2016
US 2015-0219863 A1	06/08/2015	CN 104781709 A JP 2015-530628 A WO 2014-055361 A1	15/07/2015 15/10/2015 10/04/2014
US 2008-0166090 A1	10/07/2008	US 2006-0002659 A1 US 7331717 B2 WO 2006-007482 A1	05/01/2006 19/02/2008 19/01/2006
US 2014-0056560 A1	27/02/2014	DE 102013216589 A1 US 8801297 B2	27/02/2014 12/08/2014
US 2013-0087690 A1	11/04/2013	CN 102269849 A CN 102269849 B EP 2577372 A1 JP 2013-533503 A KR 10-1530768 B1 KR 10-2013-0021418 A TW 201213915 A TW I471625 B US 2013-0089290 A1 US 8974126 B2 WO 2011-153132 A1 WO 2011-153132 A9	07/12/2011 10/09/2014 10/04/2013 22/08/2013 22/06/2015 05/03/2013 01/04/2012 01/02/2015 11/04/2013 10/03/2015 08/12/2011 26/07/2012