



(51) International Patent Classification:

H01R 13/02 (2006.01) *H01R 12/70* (2011.01)

(21) International Application Number:

PCT/US2019/044481

(22) International Filing Date:

31 July 2019 (31.07.2019)

(25) Filing Language:

English

(26) Publication Language:

English

(71) Applicant: **HEWLETT-PACKARD DEVELOPMENT COMPANY, L.P.** [US/US]; 10300 Energy Drive, Spring, Texas 77389 (US).

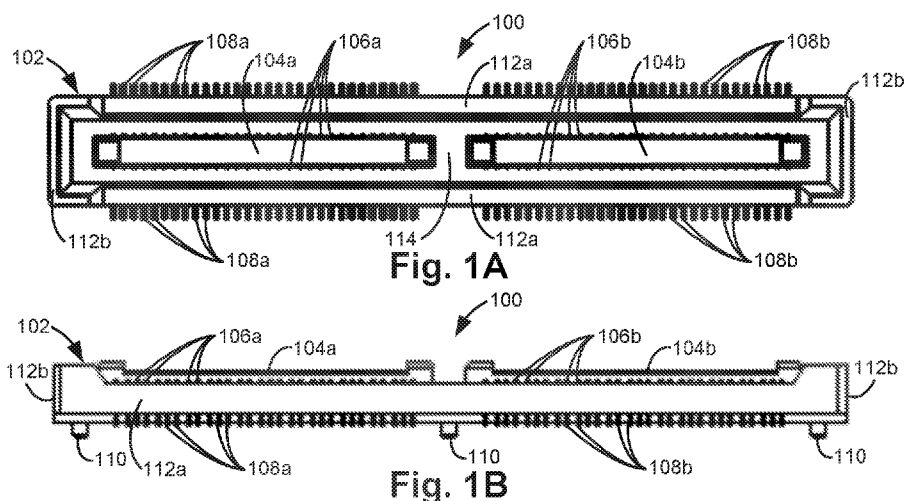
(72) Inventors: **LIN, Hung-Ming**; No. 66 Jing Mao 2 Road \$ 10F-2, NanGang District, Taipei City, 11568 (TW). **HO, Chin-Chang**; No. 66 Jing Mao 2 Road \$ 10F-2, NanGang District, Taipei City, 11568 (TW). **CHANG, Jui-Hsuan**; No. 66 Jing Mao 2 Road \$ 10F-2, NanGang District, Taipei City, 11568 (TW).

(74) Agent: **CARTER, Daniel J.** et al.; HP Inc., 3390 E. Harmony Road, Mail Stop 35, Fort Collins, Colorado 80528 (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, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, 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, SA, 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, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, 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, KM, ML, MR, NE, SN, TD, TG).

(54) Title: BOARD TO BOARD CONNECTORS



(57) Abstract: A board to board connector includes a first male connector and a second male connector. The first male connector includes a first number of pins. The second male connector is aligned with the first male connector and includes a second number of pins. The first male connector is configured to be removably electrically coupled to a first female connector including a third number of pins equal to the first number and the second male connector is configured to be removably electrically coupled to a second female connector including a fourth number of pins equal to the second number. The first male connector and the second male connector are also configured to be removably electrically coupled to a single third female connector including a fifth number of pins equal to the first number plus the second number.



Declarations under Rule 4.17:

- *as to the identity of the inventor (Rule 4.17(i))*
- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:

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

BOARD TO BOARD CONNECTORS

Background

[0001] Board to board connectors may be used to transfer electrical signals between a first board (e.g., a first printed circuit board) and a second board (e.g., a second printed circuit board) in systems. Board to board connectors may be used in a variety of systems, such as tower computers, desktop computers, small form factor computers, retail point of sale terminals, thin clients, workstations, etc.

Brief Description of the Drawings

[0002] Figures 1A-1B are schematic diagrams illustrating one example of a first half of a board to board connector.

[0003] Figures 2A-2B are schematic diagrams illustrating one example of a second half of a board to board connector.

[0004] Figures 3A-3B are schematic diagrams illustrating another example of a second half of a board to board connector.

[0005] Figures 4A-4D are schematic diagrams illustrating example connection options for the first half and second half of a board to board connector.

[0006] Figures 5A-5D are simplified schematic diagrams illustrating example systems including a board to board connector.

[0007] Figure 6 is a flow diagram illustrating one example of a method for fabricating a system.

Detailed Description

[0008] In the following detailed description, reference is made to the accompanying drawings which form a part hereof, and in which is shown by way of illustration specific examples in which the disclosure may be practiced. It is to be understood that other examples may be utilized and structural or logical changes may be made without departing from the scope of the present disclosure. The following detailed description, therefore, is not to be taken in a limiting sense, and the scope of the present disclosure is defined by the appended claims. It is to be understood that features of the various examples described herein may be combined, in part or whole, with each other, unless specifically noted otherwise.

[0009] A first board (e.g., a first printed circuit board) may need to transmit one or multiple types of electrical signals and/or power to a second board (e.g., a second printed circuit board), such as serial data signals, Video Graphic Array (VGA) signals, DisplayPort (DP) signals, High-Definition Multimedia Interface (HDMI) signals, Universal Serial Bus (USB) signals (e.g., Dual USB signals, Type C signals, Type C 100W Power Delivery (PD) signals), Thunderbolt™ signals (e.g., TBT 3.0 signals), 2.5G Local Area Network (LAN) signals, Fiber Network Interface Card (NIC) signals, and/or other signals. Each of the above signals may use a different number of pins to transmit the signals, thus resulting in board to board connectors designed specifically for each type of signal.

[0010] Accordingly, disclosed herein are board to board connectors for transmitting electrical signals between a first board and a second board (e.g., a first printed circuit board and a second printed circuit board). The board to board connectors include a first half of the connector to be attached to the first board and a second half of the connector to be attached to the second board. The first half of the connector includes two male connectors. The second half of the connector may include a female connector to couple to either one of the two male connectors or a single female connector to couple to both of the male connectors as described in further detail below. Therefore, the board to board connectors disclosed herein provide flexibility by enabling multiple system

designs having different board to board signal requirements to use the same set of connectors.

[0011] Figure 1A is a top view and Figure 1B is a side view illustrating one example of a first half 100 of a board to board connector. First half 100 of the board to board connector includes a housing 102, a first male connector 104a including a first number of pins 106a, and a second male connector 104b including a second number of pins 106b. The second male connector 104b is aligned with the first male connector 104a. The first male connector 104a is configured to be removably electrically coupled to a first female connector (to be described below with reference to Figures 2A-2B) including a third number of pins equal to the first number. The second male connector 104b is configured to be removably electrically coupled to a second female connector (to be described below with reference to Figures 2A-2B) including a fourth number of pins equal to the second number. The first male connector 104a and the second male connector 104b are also configured to be removably electrically coupled to a single third female connector (to be described below with reference to Figures 3A-3B) including a fifth number of pins equal to the first number plus the second number.

[0012] The first number may be equal to the second number. In one example, the first number equals 60 and the second number equals 60. In other examples, the first number may be different from the second number. The first male connector 104a may be integral to the second male connector 104b via, for example, housing 102. Pins 106a of first male connector 104a are electrically coupled to corresponding pins 108a, which are configured to be electrically coupled to a first board. Likewise, pins 106b of second male connector 104b are electrically coupled to corresponding pins 108b, which are configured to be electrically coupled to a first board.

[0013] Housing 102 may include posts 110 for aligning and/or attaching the first half 100 of the board to board connector to a first board. Housing 102 also includes opposing sidewalls 112a along the length of first portion 100 and opposing sidewalls 112b along the width of the first portion 100. The sidewalls 112a and 112b define a socket 114. The first male connector 104a and the

second male connector 104b are arranged within the socket 114 between the sidewalls 112a and 112b. While in this example, the sidewalls 112b have a greater height than the sidewalls 112a, in other examples, the sidewalls 112a and 112b may have the same height.

[0014] Figure 2A is a top view and Figure 2B is a side view illustrating one example of a second half 200 of a board to board connector. Second half 200 of the board to board connector includes a housing 202, a female connector 204 including a third number of pins 208. The female connector 204 is configured to be removably electrically coupled to a first male connector (e.g., 104a) or a second male connector (e.g., 104b). Accordingly, the third number of pins 208 may equal the first number of pins 106a and/or the second number of pins 106b. In one example, the third number equals 60.

[0015] Female connector 204 is configured such that when female connector 204 is removably electrically coupled to the first male connector 104a or the second male connector 104b, pins 208 of female connector 204 are electrically coupled to corresponding pins 106a or 106b of first male connector 104a or second male connector 104b, respectively. Pins 208 of the second portion 200 of the board to board connector are configured to be electrically coupled to a second board.

[0016] Housing 202 may include posts 210 for aligning and/or attaching the second half 200 of the board to board connector to a second board. Housing 202 also includes opposing sidewalls 212a along the length of second portion 200 and opposing sidewalls 212b along the width of the second portion 200. The sidewalls 212a and 212b define female connector 204. Housing 202 of the second half 200 of the board to board connector is configured to be at least partially removably received within socket 114 of the first half 100 of a board to board connector.

[0017] Figure 3A is a top view and Figure 3B is a side view illustrating another example of a second half 300 of a board to board connector. Second half 300 of the board to board connector includes a housing 302, a single female connector including a first portion 304a including a third number of pins 308a and a second portion 304b including a fourth number of pins 308b such that the

single female connector includes a fifth number of pins equal to the third number plus the fourth number. The female connector 304a, 304b is configured to be removably electrically coupled to a first male connector (e.g., 104a) and a second male connector (e.g., 104b). Accordingly, the third number of pins 308a may equal the first number of pins 106a and the fourth number of pins 308b may equal the second number of pins 106b such that the fifth number of pins equals the first number plus the second number. In one example, the third number equals 60 and the fourth number equals 60 such that the fifth number equals 120.

[0018] Female connector 304a, 304b is configured such that when female connector 304a, 304b is removably electrically coupled to the first male connector 104a and the second male connector 104b, pins 308a of the first portion 304a are electrically coupled to corresponding pins 106a of the first male connector 104a, and pins 308b of the second portion 304b are electrically coupled to corresponding pins 106b of the second male connector 104b. Pins 308a and 308b of second portion 300 of the board to board connector are configured to be electrically coupled to a second board.

[0019] Housing 302 may include posts 310 for aligning and/or attaching the second half 300 of the board to board connector to a second board. Housing 302 also includes opposing sidewalls 312a along the length of second portion 300 and opposing sidewalls 312b along the width of the second portion 300. The sidewalls 312a and 312b define the female connector 304a, 304b. Housing 302 of the second half 300 of the board to board connector is configured to be at least partially removably received within socket 114 of the first half 100 of a board to board connector.

[0020] Figure 4A is a schematic diagram illustrating one example of a board to board connector 400. Board to board connector 400 includes a first half 100 and a second half 200 as previously described and illustrated with reference to Figures 1A-1B and Figures 2A-2B, respectively. In this example, the second half 200 is removably electrically and mechanically coupled to the first male connector 104a (not visible) of the first half 100.

[0021] Figure 4B is a schematic diagram illustrating one example of a board to board connector 402. Board to board connector 402 includes a first half 100 and a second half 200 as previously described and illustrated with reference to Figures 1A-1B and Figures 2A-2B, respectively. In this example, the second half 200 is removably electrically and mechanically coupled to the second male connector 104b (not visible) of the first half 100.

[0022] Figure 4C is a schematic diagram illustrating one example of a board to board connector 404. Board to board connector 404 includes a first half 100 and a second half 300 as previously described and illustrated with reference to Figures 1A-1B and Figures 3A-3B, respectively. In this example, the second half 300 is removably electrically and mechanically coupled to the first male connector 104a and the second male connector 104b of the first half 100.

[0023] Figure 4D illustrates a cross-sectional view of board to board connector 404 of Figure 4C. A similar cross-sectional view is also applicable to board to board connector 400 of Figure 4A and board to board connector 402 of Figure 4B. As illustrated in Figure 4D, the first male connector 104a engages the first portion 304a of the female connector such that the opposing sidewalls 312a of the female connector are between the opposing sidewalls 112a of the first half 100 of the board to board connector 404. With the first male connector 104a engaged with the first portion 304a of the female connector, pins 108a of first half 100 of the board to board connector 404 are electrically coupled to corresponding pins 308a of the second half 300 of the board to board connector 404.

[0024] Figure 5A is a simplified top view illustrating one example of a system 500 including a board to board connector 502. System 500 includes a first board 504, a second board 506, and board to board connector 502 electrically coupling the first board 504 to the second board 506. Board to board connector 502 may include board to board connector 400, 402, or 404 as previously described and illustrated with reference to Figures 4A-4D and as further described and illustrated with reference to the following Figures 5B-5D. While in this example first board 504 is larger than second board 506, in other examples, first board 504 may be the same size or larger than the second board 506.

[0025] In one example, first board 504 is a mother board, and second board 506 is an input/output board. System 500 may be part of a tower computer, a desktop computer, a small form factor computer, a retail point of sale terminal, a thin client, a workstation, or another suitable system. Board to board connector 502 may pass one or multiple electrical signals and/or power between first board 504 and second board 506, such as serial data signals, VGA signals, DP signals, HDMI signals, USB signals (e.g., Dual USB signals, Type C signals, Type C 100W PD signals), Thunderbolt™ signals (e.g., TBT 3.0 signals), 2.5G LAN signals, Fiber NIC signals, and/or other signals.

[0026] Figure 5B is a simplified side view illustrating one example of a system 510 including a board to board connector 400 as previously described and illustrated with reference to Figure 4A. In this example, the first board 504 includes the first half 100 of the board to board connector 400, and the second board 506 includes the second half 200 of the board to board connector 400. In other examples, the board to board connector 400 may be reversed such that the first board 504 includes the second half 200 of the board to board connector 400, and the second board 506 includes the first half 100 of the board to board connector 400. In this example, first board 504 may be a mother board, and second board 506 may be an input/output board including a serial port, a VGA port, a DP port, an HDMI port, a Type C port, a Dual USB port, and/or another suitable port that may be electrically coupled to mother board 504 through board to board connector 400. Therefore, the first board 504 may transmit one of Serial, VGA, DP, HDMI, Type C, and Dual USB signals through the first male connector 104a to the female connector 204.

[0027] Figure 5C is a simplified side view illustrating one example of a system 512 including a board to board connector 402 as previously described and illustrated with reference to Figure 4B. In this example, the first board 504 includes the first half 100 of the board to board connector 402, and the second board 506 includes the second half 200 of the board to board connector 402. In other examples, the board to board connector 402 may be reversed such that the first board 504 includes the second half 200 of the board to board connector 402, and the second board 506 includes the first half 100 of the board to board

connector 402. In this example, first board 504 may be a mother board and second board 506 may be an input/output board including a 2.5G LAN port, a Fiber NIC port, and/or another suitable port that may be electrically coupled to mother board 504 through board to board connector 402. Therefore, the first board 504 may transmit one of 2.5G LAN and Fiber NIC signals through the second male connector 104b to the female connector 204.

[0028] Figure 5D is a simplified side view illustrating one example of a system 514 including a board to board connector 404 as previously described and illustrated with reference to Figure 4C. In this example, the first board 504 includes the first half 100 of the board to board connector 404, and the second board 506 includes the second half 300 of the board to board connector 404. In other examples, the board to board connector 404 may be reversed such that the first board 504 includes the second half 300 of the board to board connector 404, and the second board 506 includes the first half 100 of the board to board connector 404. In this example, first board 504 may be a mother board and second board 506 may be an input/output board including a TBT 3.0 port, a Type C 100W PD port, and/or another suitable port that may be electrically coupled to mother board 504 through board to board connector 404. Therefore, the first board 504 may transmit one of TBT 3.0 and Type C 100W PD signals through the first and second male connectors 104a and 104b to the female connector 304a, 304b.

[0029] Figure 6 is a flow diagram illustrating one example of a method 600 for fabricating a system, such as system 500, 510, 512, or 514 previously described and illustrated with reference to Figures 5A-5D. At 602, method 600 includes electrically coupling a first half of a board to board connector to a mother board, the first half of the board to board connector comprising a first male connector comprising a first number of pins and a second male connector aligned with the first male connector and comprising a second number of pins. At 604, method 600 includes electrically coupling a second half of a board to board connector to an input/output board, the second half of the board to board connector comprising any one of the following: a first female connector comprising a third number of pins equal to the first number, a second female connector comprising

a fourth number of pins equal to the second number, and a single third female connector comprising a fifth number of pins equal to the first number plus the second number. At 606, method 600 includes removably electrically coupling the first half of the board to board connector to the second half of the board to board connector.

[0030] Although specific examples have been illustrated and described herein, a variety of alternate and/or equivalent implementations may be substituted for the specific examples shown and described without departing from the scope of the present disclosure. This application is intended to cover any adaptations or variations of the specific examples discussed herein. Therefore, it is intended that this disclosure be limited only by the claims and the equivalents thereof.

CLAIMS

1. A board to board connector comprising:
a first male connector comprising a first number of pins; and
a second male connector aligned with the first male connector and comprising a second number of pins;
wherein the first male connector is configured to be removably electrically coupled to a first female connector comprising a third number of pins equal to the first number and the second male connector is configured to be removably electrically coupled to a second female connector comprising a fourth number of pins equal to the second number, and
wherein the first male connector and the second male connector are configured to be removably electrically coupled to a single third female connector comprising a fifth number of pins equal to the first number plus the second number.
2. The board to board connector of claim 1, wherein the first number is equal to the second number.
3. The board to board connector of claim 1, wherein the first number equals 60 and the second number equals 60.
4. The board to board connector of claim 1, wherein the first male connector is integral to the second male connector.
5. A system comprising:
a first board comprising a first half of a board to board connector, the first half of the board to board connector comprising a first male connector comprising a first number of pins and a second male connector aligned with the first male connector and comprising a second number of pins;

a second board comprising a second half of a board to board connector, the second half of the board to board connector comprising any one of the following:

a first female connector comprising a third number of pins equal to the first number and removably electrically coupled to the first male connector,

a second female connector comprising a fourth number of pins equal to the second number and removably electrically coupled to the second male connector, and

a single third female connector comprising a fifth number of pins equal to the first number plus the second number and removably electrically coupled to the first and second male connectors.

6. The system of claim 5, wherein the first number is equal to the second number.

7. The system of claim 5, wherein the first number equals 60 and the second number equals 60.

8. The system of claim 5, wherein the first male connector is integral to the second male connector.

9. The system of claim 5, wherein the first board is to transmit one of Serial, VGA, DP, HDMI, Type C, and Dual USB signals through the first male connector to the first female connector.

10. The system of claim 5, wherein the first board is to transmit one of 2.5G LAN and Fiber NIC signals through the second male connector to the second female connector.

11. The system of claim 5, wherein the first board is to transmit one of TBT 3.0 and Type C 100W PD signals through the first and second male connectors to the third female connector.

12. A method for fabricating a system, the method comprising:

electrically coupling a first half of a board to board connector to a mother board, the first half of the board to board connector comprising a first male connector comprising a first number of pins and a second male connector aligned with the first male connector and comprising a second number of pins;

electrically coupling a second half of a board to board connector to an input/output board, the second half of the board to board connector comprising any one of the following:

a first female connector comprising a third number of pins equal to the first number,

a second female connector comprising a fourth number of pins equal to the second number, and

a single third female connector comprising a fifth number of pins equal to the first number plus the second number; and

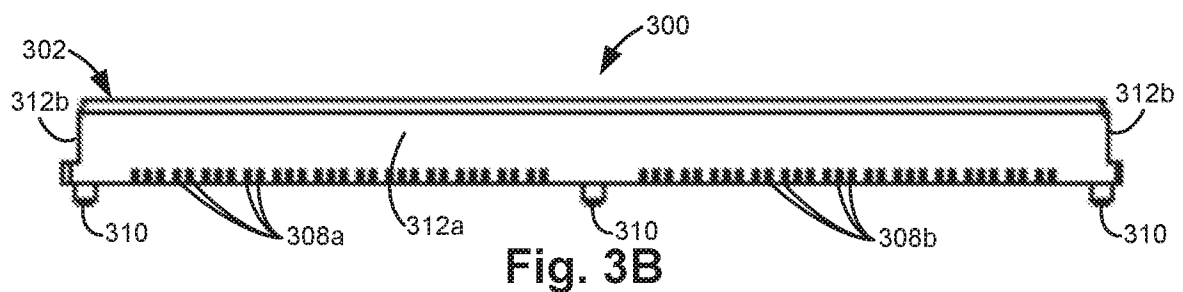
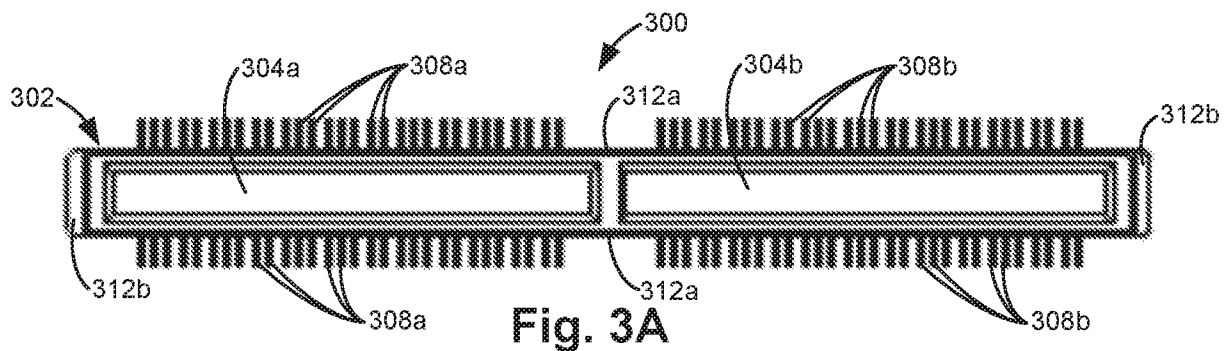
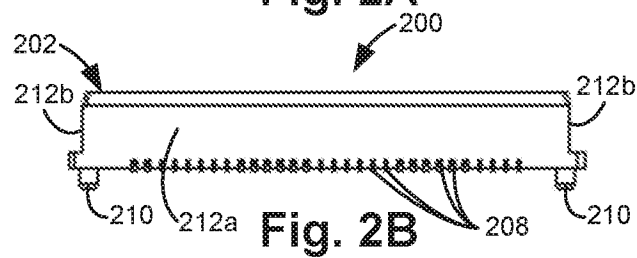
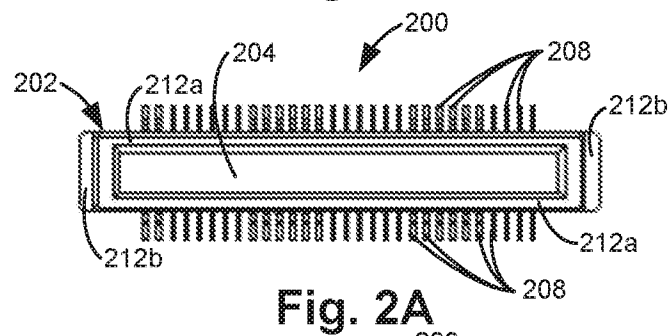
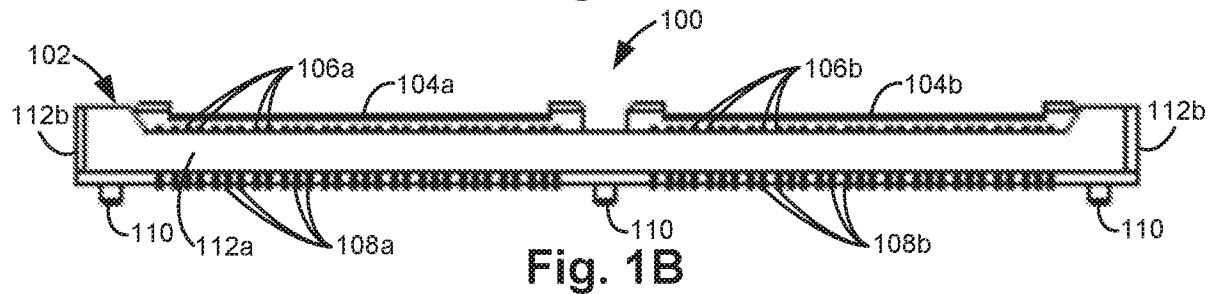
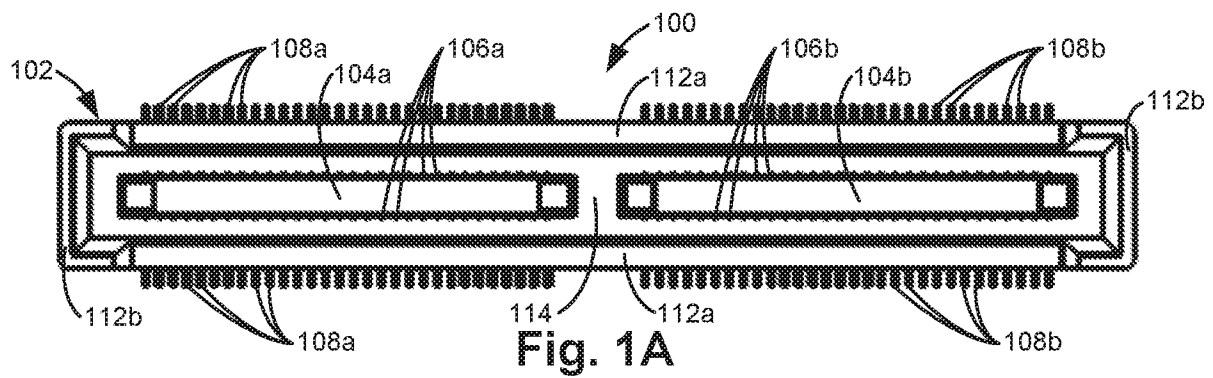
removably electrically coupling the first half of the board to board connector to the second half of the board to board connector.

13. The method of claim 12, wherein the first number is equal to the second number.

14. The method of claim 12, wherein the first number equals 60 and the second number equals 60.

15. The method of claim 12, wherein the first male connector is integral to the second male connector.

1/4



2/4

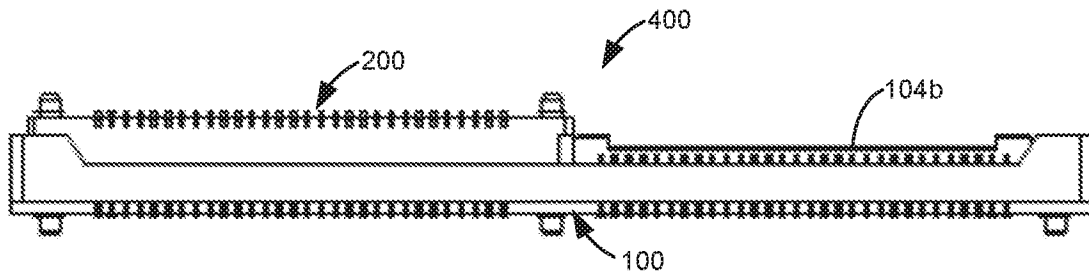


Fig. 4A

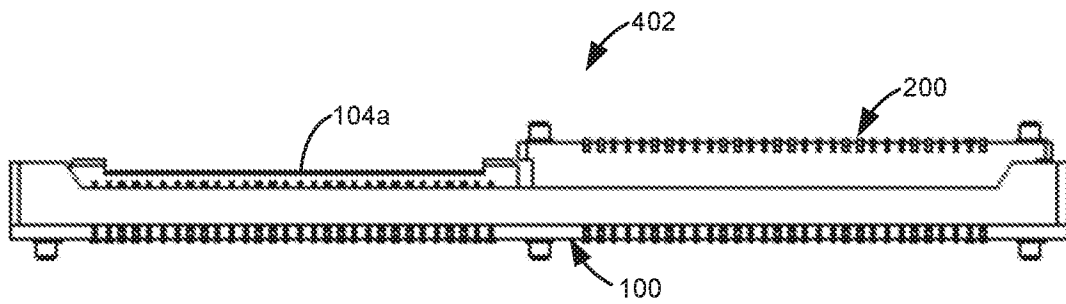


Fig. 4B

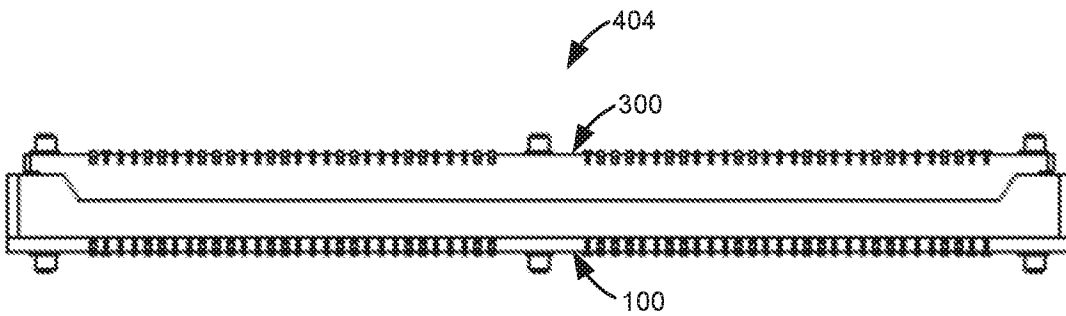


Fig. 4C

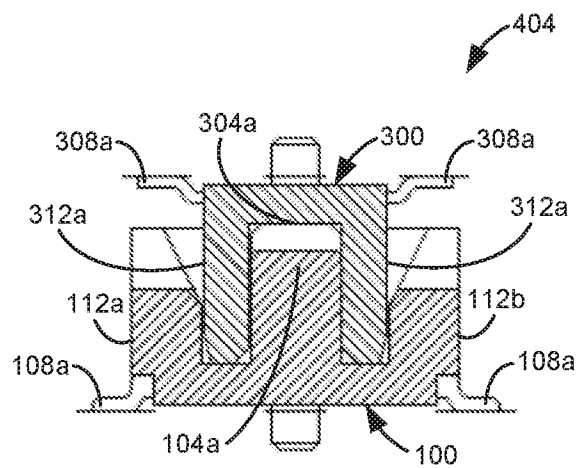


Fig. 4D

3/4

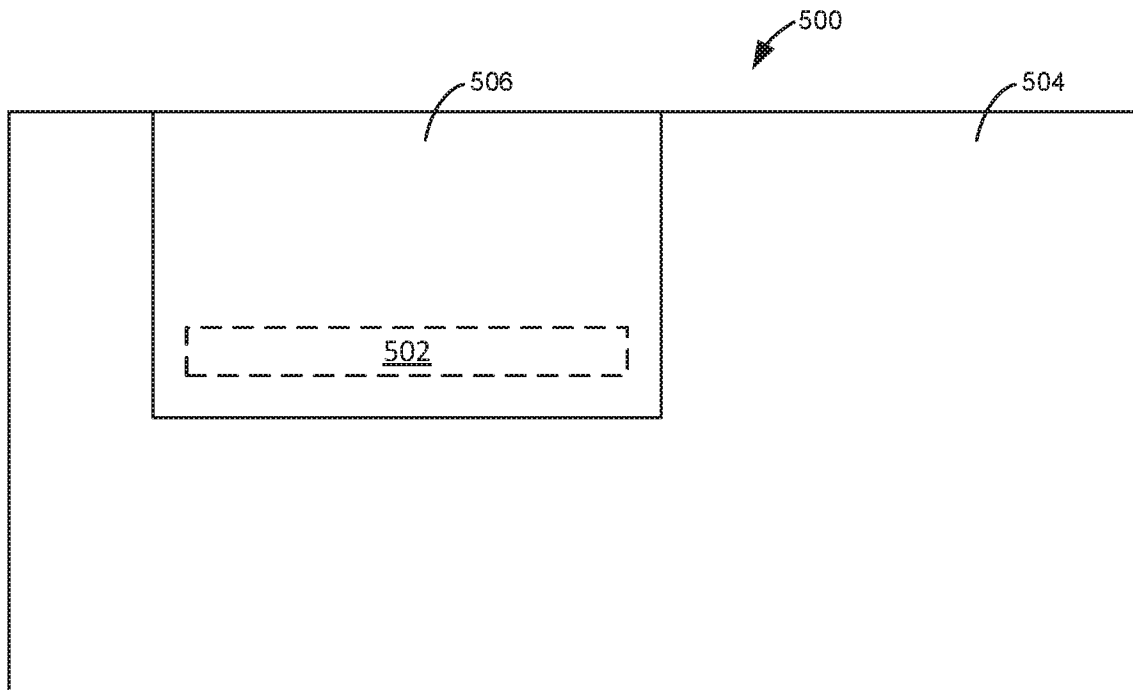


Fig. 5A

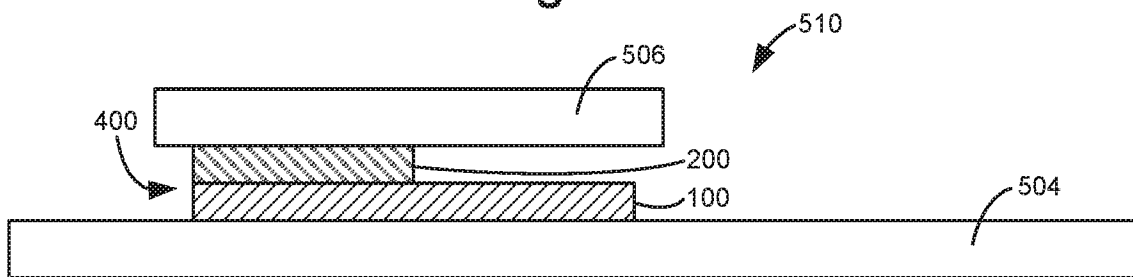


Fig. 5B

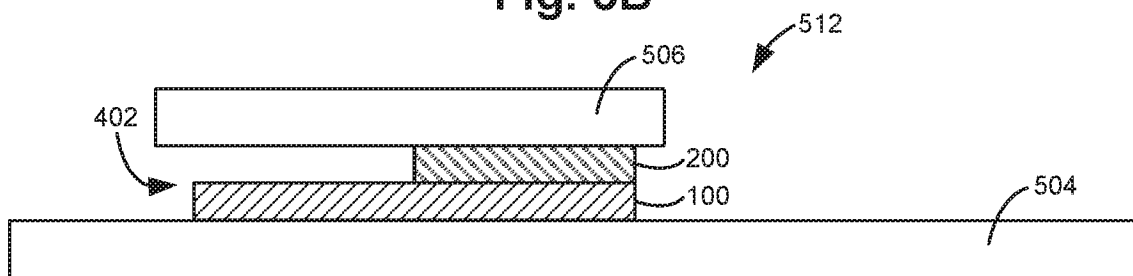


Fig. 5C

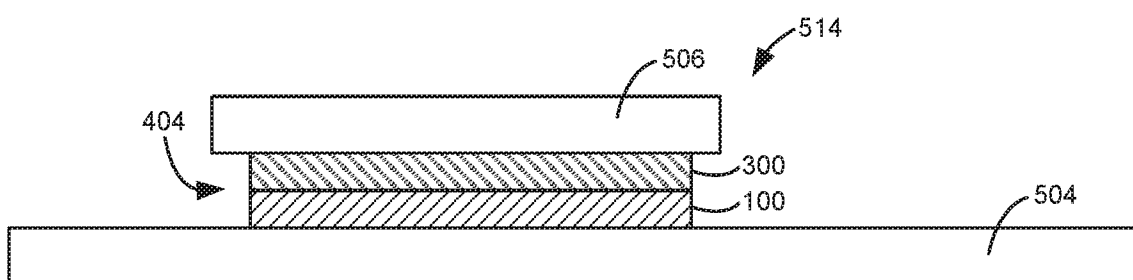


Fig. 5D

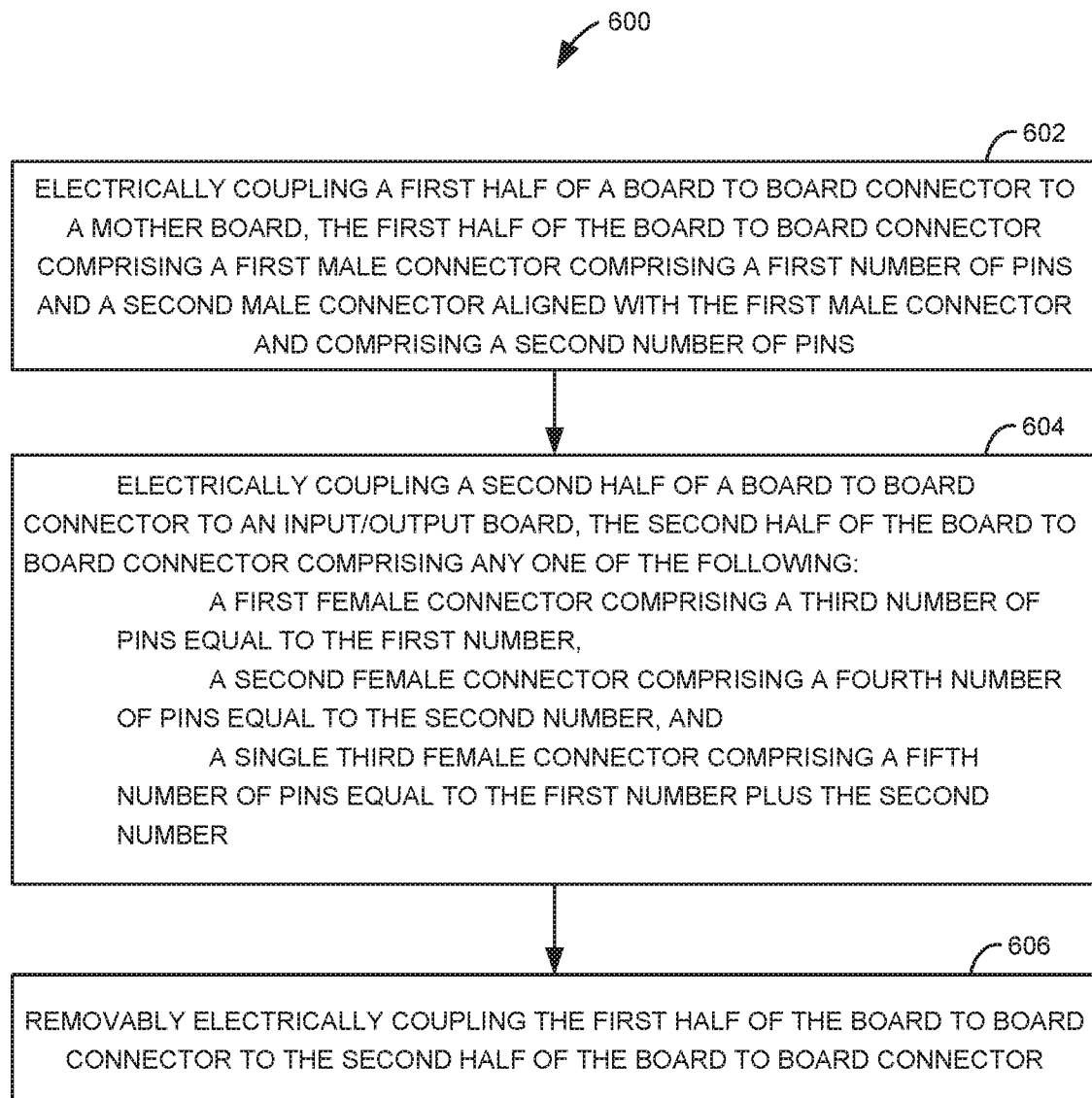


Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 2019/044481

A. CLASSIFICATION OF SUBJECT MATTER

*H01R 13/02 (2006.01)**H01R 12/70 (2011.01)*

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)

H01R 13/02, 12/70

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)

PatSearch (RUPTO Internal), USPTO, PAJ, Espacenet, Information Retrieval System of FIPS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 10028403 B1 (DELL PRODUCTS L.P.) 17.07.2018, abstract, fig. 2a, 2b, 2c, 3a, col. 1, lines 33-50, col. 2, lines 1-18, col. 3, line 51 – col. 6, line 43	5, 8, 12, 15
A		1-4, 6-7, 9-11, 13-14
A	US 2007/0101037 A1 (HON HAI PRECISION INDUSTRY CO., LTD.) 03.05.2007, abstract, fig. 1-4	1-15
A	US 5758100 (SUN MICROSYSTEMS, INC.) 26.05.1998, abstract, fig. 2a, 2b, 2c	1-15
A	US 5902136 A (BERG TECHNOLOGY, INC.) 11.05.1999, abstract, fig. 1, 2, 4, 5	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:	"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
"A" document defining the general state of the art which is not considered to be of particular relevance	"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
"E" earlier document but published on or after the international filing date	"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
"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)	"&" document member of the same patent family
"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	

Date of the actual completion of the international search

20 March 2020 (20.03.2020)

Date of mailing of the international search report

16 April 2020 (16.04.2020)

Name and mailing address of the ISA/RU:
Federal Institute of Industrial Property,
Berezhkovskaya nab., 30-1, Moscow, G-59,
GSP-3, Russia, 125993
Facsimile No: (8-495) 531-63-18, (8-499) 243-33-37

Authorized officer

O. Tsykanovskaya

Telephone No. 8(495) 531-64-81