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[Continued on next page]

(54) Title: TAMPER EVIDENT RISER CONNECTIONS

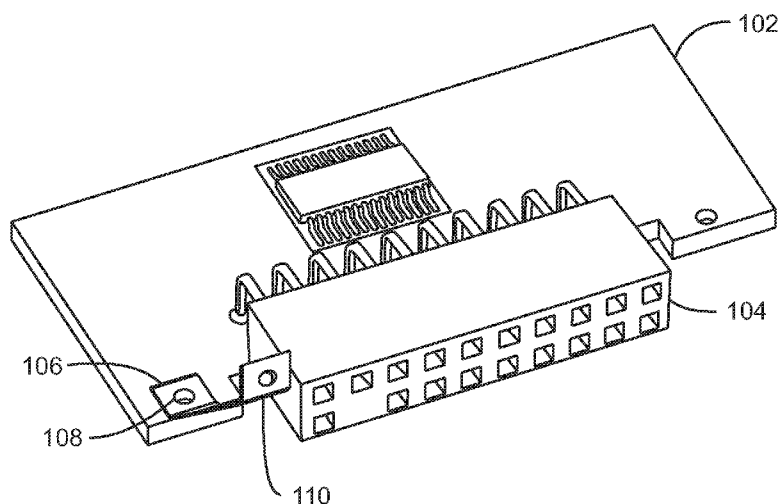


FIG. 1

(57) Abstract: Examples described herein relate to providing tamper evident connections between circuit boards is provided. For example, a method includes joining a connector on a first circuit board to a matching connector on a second board and joining a locking part mounted on the first circuit board to a locking structure on the second circuit board. The joining of the locking part to the locking structure cannot be reversed without causing substantial damage.



— *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))*

TAMPER EVIDENT RISER CONNECTIONS

BACKGROUND

[0001] Riser circuit boards are often used to provide functionality to a mother board. For example, a trusted platform module may be made on a riser board that is attached to a mother board to provide cryptographic keys. In this case, it is important that the removal of the module is obvious to prevent theft of the cryptographic keys, potentially compromising the security of the system.

DESCRIPTION OF THE DRAWINGS

[0002] Certain exemplary embodiments are described in the following detailed description and in reference to the drawings, in which:

[0003] Fig. 1 is an example drawing of a riser with a pin socket and a locking part, such a strap;

[0004] Fig. 2 is a drawing of a motherboard with a pin header and a locking structure, according to an example;

[0005] Figs. 3A-3C are example drawings of a tamper evident locking system;

[0006] Figs. 4A-4D are example drawings of a tamper evident locking system using an edge connector and a locking system;

[0007] Fig. 5 is a process flow diagram of an example method for locking a riser to a motherboard; and

[0008] Fig. 6 is a process flow diagram of an example method for building a riser with locking system.

DETAILED DESCRIPTION

[0009] Current tamper evident devices often have a riser card mounted parallel or perpendicular to the motherboard. As used herein a riser is a circuit board that provides functionality to a second circuit board, such as a motherboard. Examples of risers may include a trusted platform module or a circuit board to provide other cryptographic or security functions. Other examples of risers may include any type

of soldered down storage devices such as SATA, SAS, SSD drives, USB devices, or m.2 modules.

[0010] A hole in the riser card is aligned with a corresponding hole in the motherboard. A separate set of plastic parts, termed plastic rivets, may be inserted through the holes, locking the riser card to the motherboard. However, this solution uses separate parts that may be lost, difficult to manipulate, or otherwise inconvenient to use, especially in a production environment. Further, the solutions occupy space on the motherboard that may be used for other circuitry.

[0011] Electronic solutions may use a heartbeat detector that determines if the circuitry on the riser board is in communications with the circuitry on the motherboard. However, these methods may add to pin count or use additional software that may not be active early in a boot process.

[0012] The techniques described herein utilize a connector, mounted on a motherboard, to accommodate a mated connector on a riser. A locking part mounted on the riser is designed to connect to a locking structure on the motherboard, and prevent removal of the riser without substantial damage to any part. As used herein, substantial damage includes visible damage, functional damage, or both. The locking part may be soldered to the locking structure, or may be a barbed structure designed to insert and engage the locking structure. The mechanism provides for tamper evidence, and, in some cases, may provide mechanical support and electrical connectivity, for example, functioning as a power, ground, or signal pin.

[0013] The techniques described herein may be used with pin-through-hole (PTH). However, PTH connectors may often be limited due to manufacturing issues such as solder bridging. To mitigate solder bridging, a wider pitch may often be used which may impede the layout on the motherboard. In addition, the more common board-to-board PTH connectors are susceptible to EMI and SI issues that must be addressed by shrouding the connector which adds cost.

[0014] The issues with a PTH connector may be mitigated by using a surface mount connector, e.g., a card edge connector. Surface mount connectors are less expensive and may be less susceptible to solder bridging, denser, and support higher speeds. However, surface mount connectors are generally removable

connectors, so the addition of the mechanism described herein may improve security by allowing detection of removal even if the part is reinserted. Further, the use of the locking part to carry a signal may be used to disable the circuitry on the riser if removed, for example, by breaking a power connection, which cannot be easily reconnected, even if the part is reinserted.

[0015] Fig. 1 is a drawing of a riser 102 with a pin socket 104 and a locking part, such a strap 106. The strap 106 may be mounted to the riser 102, for example, snapped into a hole 108 and then soldered to the riser 102. The strap 106 may be made from a metal, allowing it to carry an electrical signal, such as a power supply or a detection signal. The strap 106 may have a fastener 110 designed to be inserted into a corresponding structure on a motherboard.

[0016] Fig. 2 is a drawing of a motherboard 200 with a pin header 202 and a locking structure. The locking structure may be as simple as a hole 204 in the motherboard 200 into which the locking part can be inserted. For example, if the strap 106 of Fig. 1 is used, the fastener 110 can be inserted into the hole 204. Further, the fastener 110 may be a spring loaded structure that snaps open after insertion, impeding removal without damage. The locking part can be soldered into the locking structure, further increasing the difficulty of removal. If the locking part is used to carry current or a signal, the damage caused by removal of the locking part from the locking structure may disable the riser, providing increased protection.

[0017] The use of locking parts and locking structures is not limited to pin through hole connectors, as shown in Figs 1 and 2. The system may be used with any type of connector to indicate tampering or removal, as discussed further with respect to Figs. 3 and 4.

[0018] Figs. 3A-3C are drawings of a tamper evident locking system 300. As shown in Fig. 3A, a riser 302 with an edge connector 304 may have a locking part attached. In this example, the locking part is a strap 306 similar to that discuss for Fig. 1, attached to the riser 302, for example, through a solder joint 308 on a through hole fastener.

[0019] The motherboard 310 has a surface mount connector (SMC) 312 to mate with the edge connector 304 of the riser 302. Also, the motherboard 308 has a locking structure, which, in this example, is a hole 314. As for the example of Fig. 1,

a fastener 316 on the strap 306 may be inserted into the hole 314 and soldered or otherwise locked into the hole 314.

[0020] The assembled unit is illustrated in Fig. 3B. The fastener 316 has been inserted into the hole 314 on the motherboard 310, and is joined, forming a connection 318 that may cause damage is removed. The connection 318 may be a solder joint, allowing the strap 306 to carry current, such as power, ground, or a signal, between the riser 302 and the motherboard 310.

[0021] Fig. 3C is a cross sectional view through the riser 302, strap 306, and motherboard 310. The cross sectional view illustrates the solder joint 308, which includes a through hole fastener. The fastener 316 used to join the strap 306 to the motherboard 310 through the hole 314 may be used to form a similar solder joint connection. The fasteners are not limited to solder joint connections, e.g., one or both may include a spring loaded portion that opens up on the back side of the circuit board to hold the strap 306 in place. This may be used in addition to, or instead of, soldering in some examples.

[0022] Figs. 4A-4D are drawings of a tamper evident locking system 400 using an edge connector 304 and a locking system. Like numbered items are as described with respect to Figs. 3A-3C. As shown in Fig. 4A, the locking part may include a mount 402 holding a barb 404. The barb 404 may be made from a metal or from other materials, such as plastic. During insertion of the edge connector 304 into the SMC 312, the barb 404 is inserted into a locking part on the motherboard 310 that includes a lock 406 to engage the barb 404.

[0023] Once engaged, as shown in Fig. 4B, the edge connector 304 is engaged in the SMC 312, while the barb is locked into the lock 406 holding the riser 302 in place on the motherboard 310. If the riser 302 is removed, the metal barb, the mount 402, or the lock 406 may be damaged. The damage may be visible upon inspection, may break an electrical connection between the riser and the motherboard, or both.

[0024] Fig. 4C is a side cross sectional view of the barb 404 passed through the mount 402 and engaged in the lock 406. As can be seen in this view, the riser 302 cannot be removed from the SMC 312 with pulling the barb 404 from the lock 406.

However, as shown in Fig.4D, removal of the barb 404 from the lock 406 may be difficult.

[0025] Fig. 4D is a front cross sectional view of the barb 404 after insertion in the lock 406. The barb 404 includes backward facing points 408 that interact with locking structures 410 in the lock 406. Removal of the barb 404 from the lock 406 would require breaking the locking structures 408, the barb 404, or both. Further, the strength of the engagement may be high enough that an attempt at removing the riser 302 from the SMC 312 would break the mount 402 or the lock 406.

[0026] Fig. 5 is a process flow diagram of an example method 500 for locking a riser to a motherboard. At block 502 a connector on a first circuit board, e.g., a riser, is joined to a matching connector on a second circuit board, e.g., a motherboard. As described herein, the connector may be an edge connector matched to an SMC on the second circuit board, a PTH connector matched to a PTH socket on the second circuit board, and the like. The use of an edge connector paired with an SMC may provide increased signal speed and lower the amount of surface area the connector occupies on the second circuit board.

[0027] At block 504, a locking part mounted on the first circuit board is joined to a locking structure on the second circuit board. Once the locking part is joined to the locking structure, the parts may not be separated without causing damage, for example, to the locking part, the locking structure, or both. The damage may be visible upon inspection, may disrupt electrical circuits, or both. Further, the damage may disable the first circuit board, the second circuit board, or both, providing increased security.

[0028] The joining of the connector on the first circuit board to the matching connector on the second circuit board may take place substantially simultaneously with the joining of the locking part to the locking structure. As the first circuit board is aligned with the electrical connector, the locking part is aligned with the locking structure, and both are seated as the first circuit board is pushed into the connectors.

[0029] The locking part may be soldered to the locking structure. This may provide further reinforcement to prevent removal. Further, forming an electrical connection between the locking part and the locking structure, either by soldering or by a pressure contact between metal surfaces, may allow circuitry on the first circuit

board to be powered from the second circuit board. Accordingly, damage caused by removal and replacement may disable the circuitry on the first circuit board. Further, a circuit may be completed from the first circuit board through an electrical connection formed by the joining of the locking part to the locking structure, for example, to allow a signal line to indicate removal of the first circuit board.

[0030] Fig. 6 is a process flow diagram of an example method 600 for building a riser with locking system. As block 602, a locking part is mounted on a riser board, wherein the locking structure matches a locking structure on a motherboard.

[0031] As described herein, the locking part may be a strap with a fastener configured to lock to, or to be soldered to, a motherboard. Further, the locking part may be a barbed structure attached to riser, wherein the barbed structure is to be inserted into a structure on the motherboard that engages the barbs. It may be noted that other locking parts and locking structures that are mounted to the riser and motherboard, respectively, may be used.

[0032] The locking part on the riser board to an electrical line to complete an electrical connection through the locking structure on the motherboard once it is joined to the locking structure. The circuit may allow a circuit to be completed between the riser and the motherboard, for example, providing power, a ground, or a detection signal to indicate removal of the board.

[0033] While the present techniques may be susceptible to various modifications and alternative forms, the exemplary examples discussed above have been shown only by way of example. It is to be understood that the technique is not intended to be limited to the particular examples disclosed herein. Indeed, the present techniques include all alternatives, modifications, and equivalents falling within the scope of the present techniques.

CLAIMS

What is claimed is:

1. A tamper evident riser connection system for mounting a first circuit board to a second circuit board, comprising:
the first circuit board, comprising:
a connector mounted to the first circuit board matched to a mated connector mounted on the second circuit board; and
a locking part mounted to the first circuit board to engage a locking structure on the second circuit board; and
the second circuit board, comprising:
the mated connector; and
the locking structure to engage the locking part when the connector is inserted into the mated connector, wherein the locking part, the locking structure, or both cannot be removed without causing substantial damage to the locking part, the locking structure, or both.
2. The system of claim 1, wherein the locking part is soldered to the first circuit board.
3. The system of claim 1, wherein the locking part is soldered to the locking structure.
4. The system of claim 1, wherein the locking part is to carry a current between the first circuit board and the second circuit board.
5. The system of claim 4, wherein the current comprises a signal.
6. The system of claim 4, wherein the current comprises a ground for the first circuit board.

7. The system of claim 1, wherein the connector comprises an edge connector, and the mated connector comprises a surface mount connector.
8. The system of claim 1, wherein the locking part comprises a barbed structure and the locking structure is to trap the barbed structure.
9. A method for creating a tamper evident riser connection, comprising:
joining a connector on a first circuit board to a matching connector on a second circuit board; and
joining a locking part mounted on the first circuit board to a locking structure on the second circuit board, wherein the joining of the locking part to the locking structure cannot be reversed without causing substantial damage to the first or second circuit boards.
10. The method of claim 9, wherein the joining of the connector to the matching connector and the joining of the locking part to the locking structure take place substantially simultaneously.
11. The method of claim 9, comprising soldering the locking part to the locking structure.
12. The method of claim 9, comprising powering circuitry on the first circuit board through an electrical connection formed by the joining of the locking part to the locking structure.
13. The method of claim 9, comprising: completing a circuit from the first circuit board through an electrical connection formed by the joining of the locking part to the locking structure.
14. A method for building a tamper evident riser connection, comprising mounting a locking part on a riser board, wherein the locking part matches a locking structure on a motherboard.

15. The method of claim 14, comprising coupling the locking part on the riser board to an electrical line to complete an electrical connection through the locking structure.

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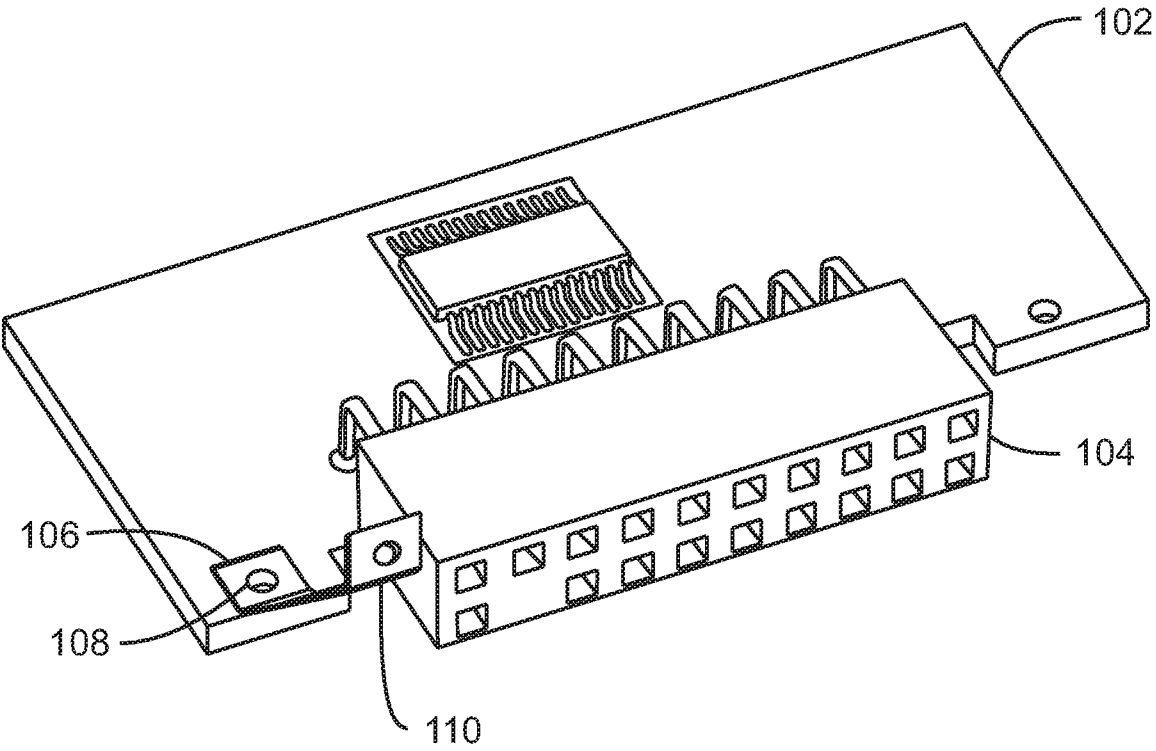


FIG. 1

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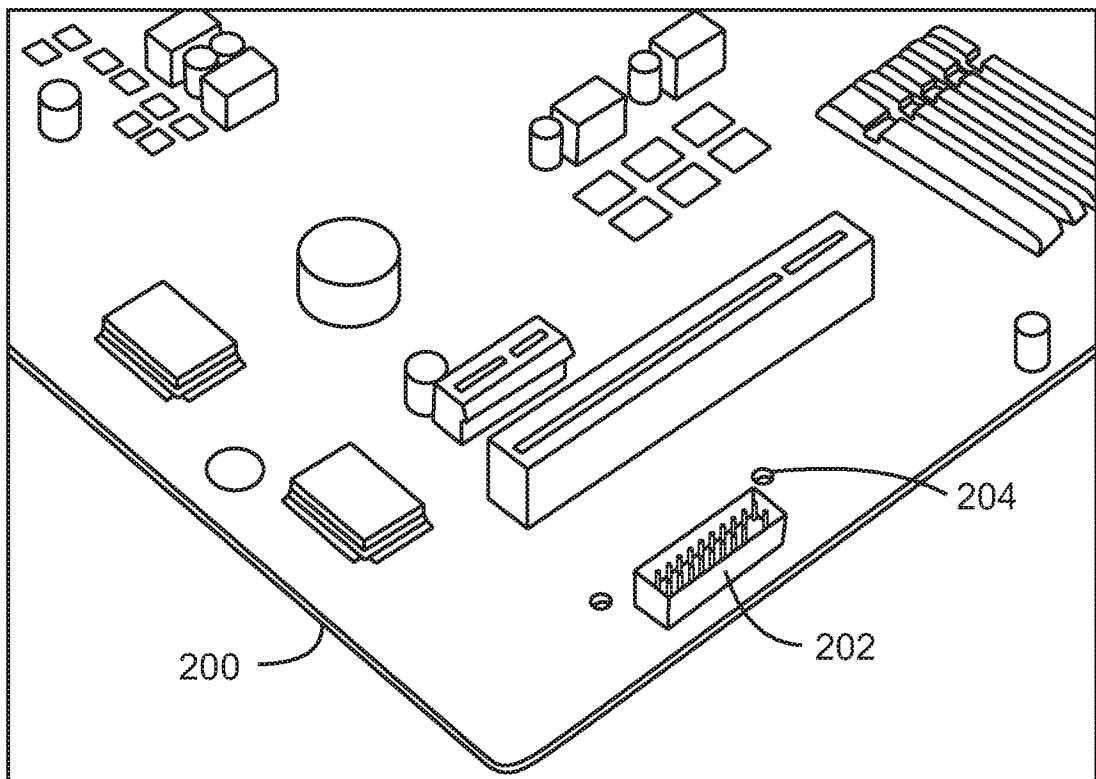
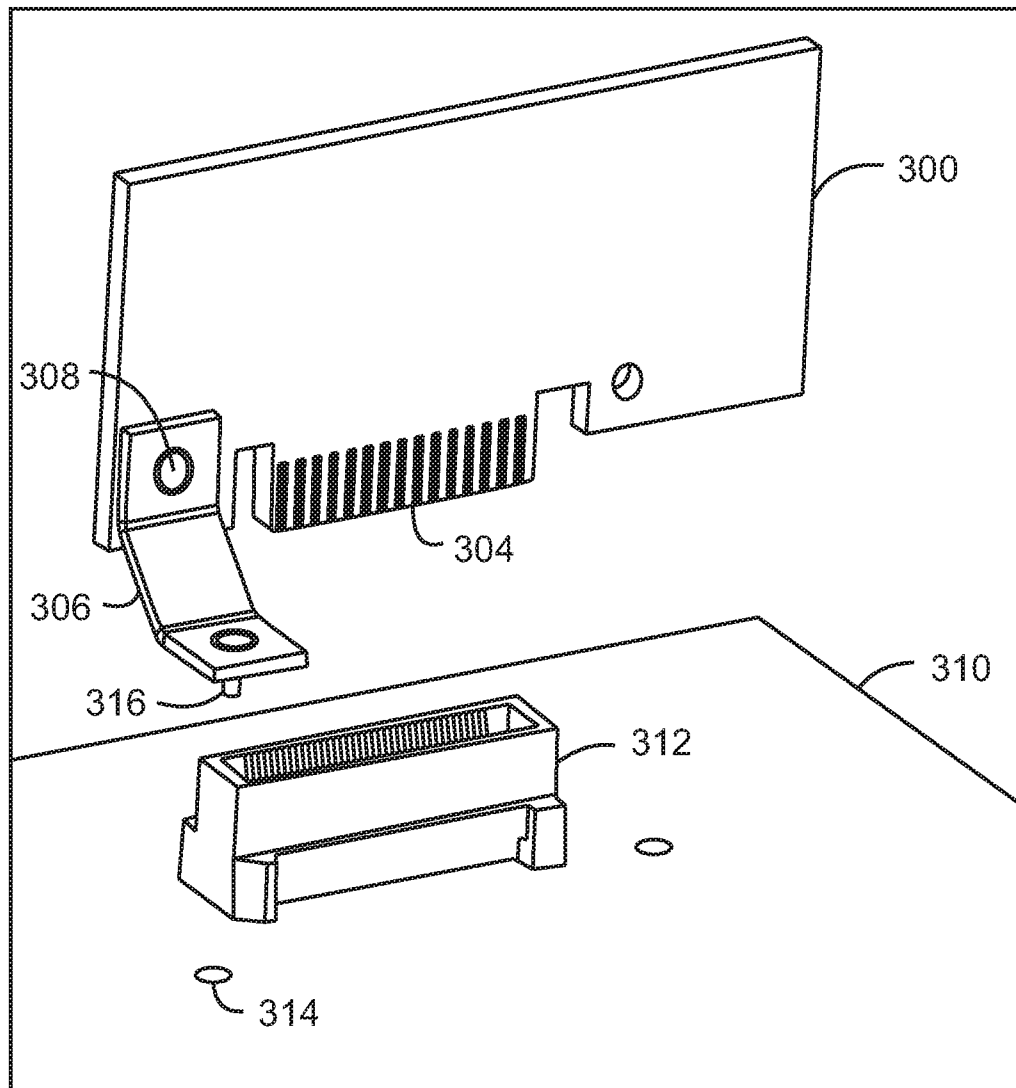


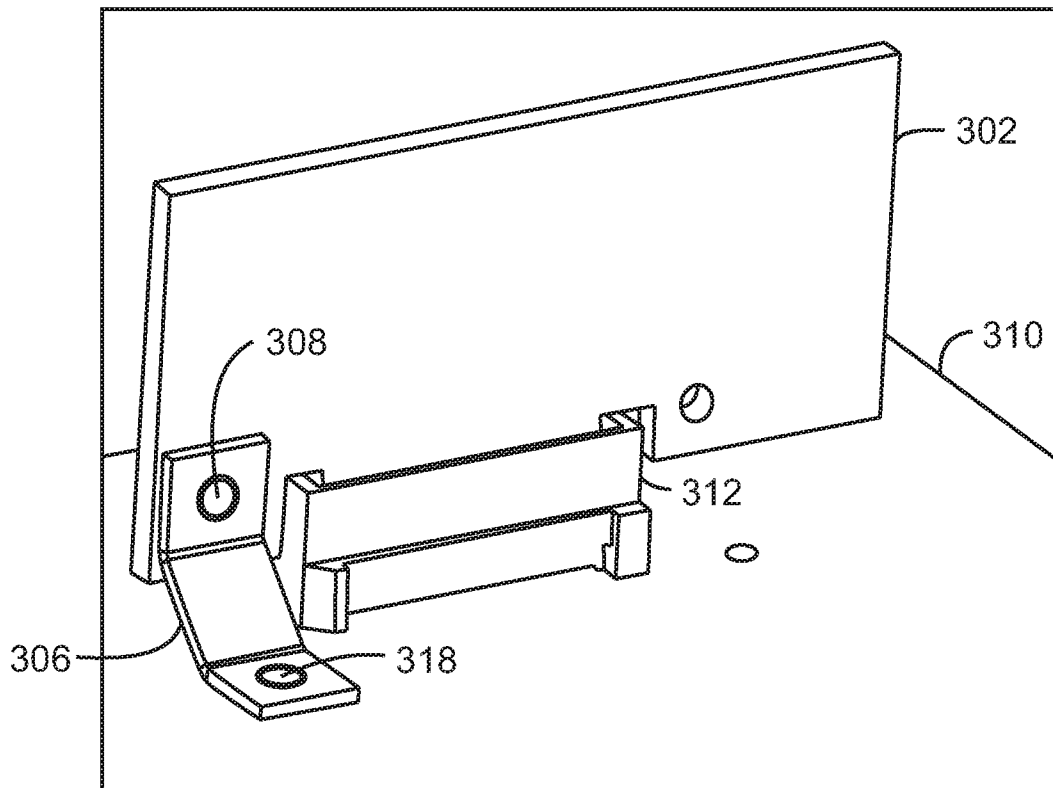
FIG. 2

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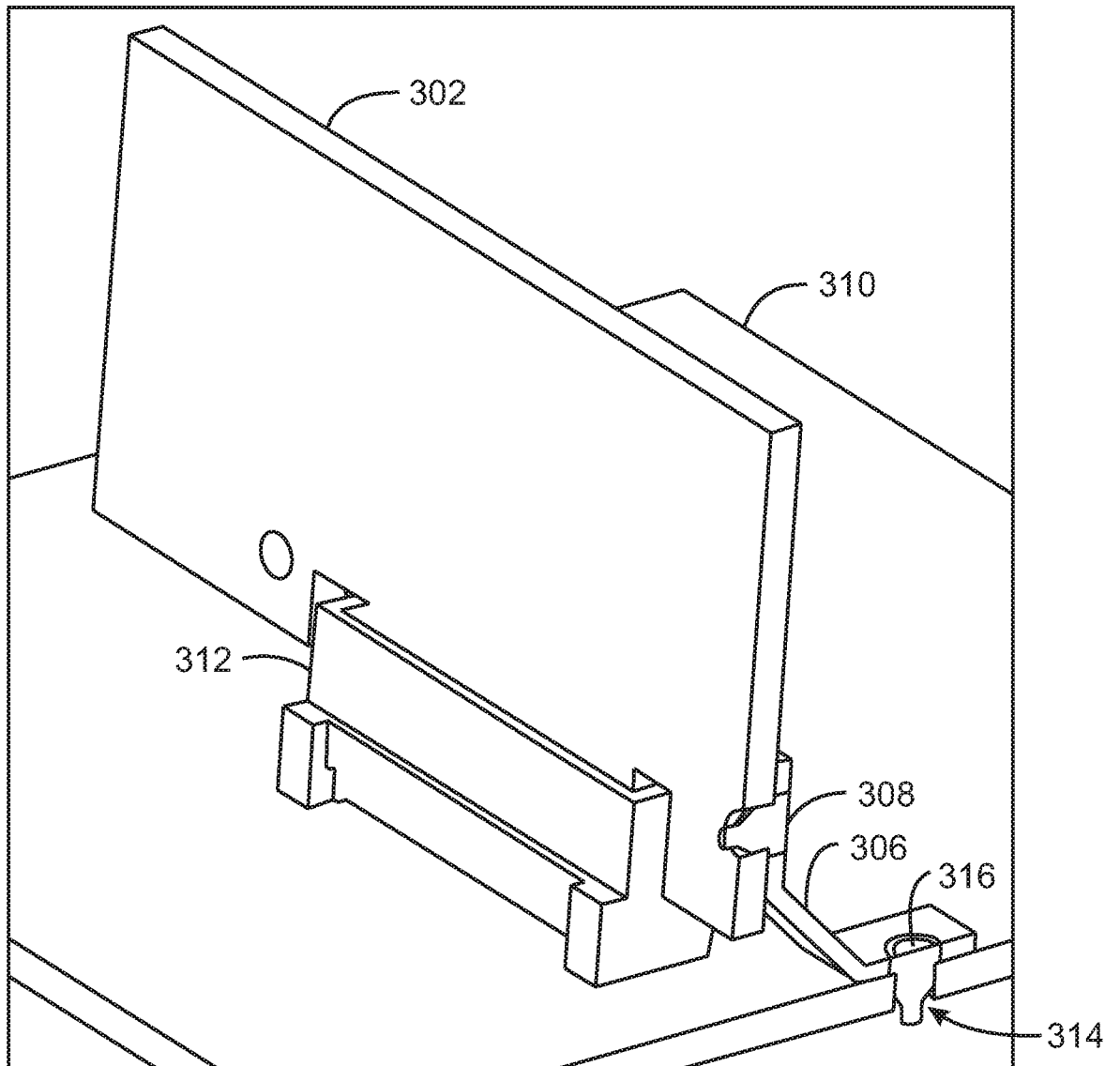
300
FIG. 3A

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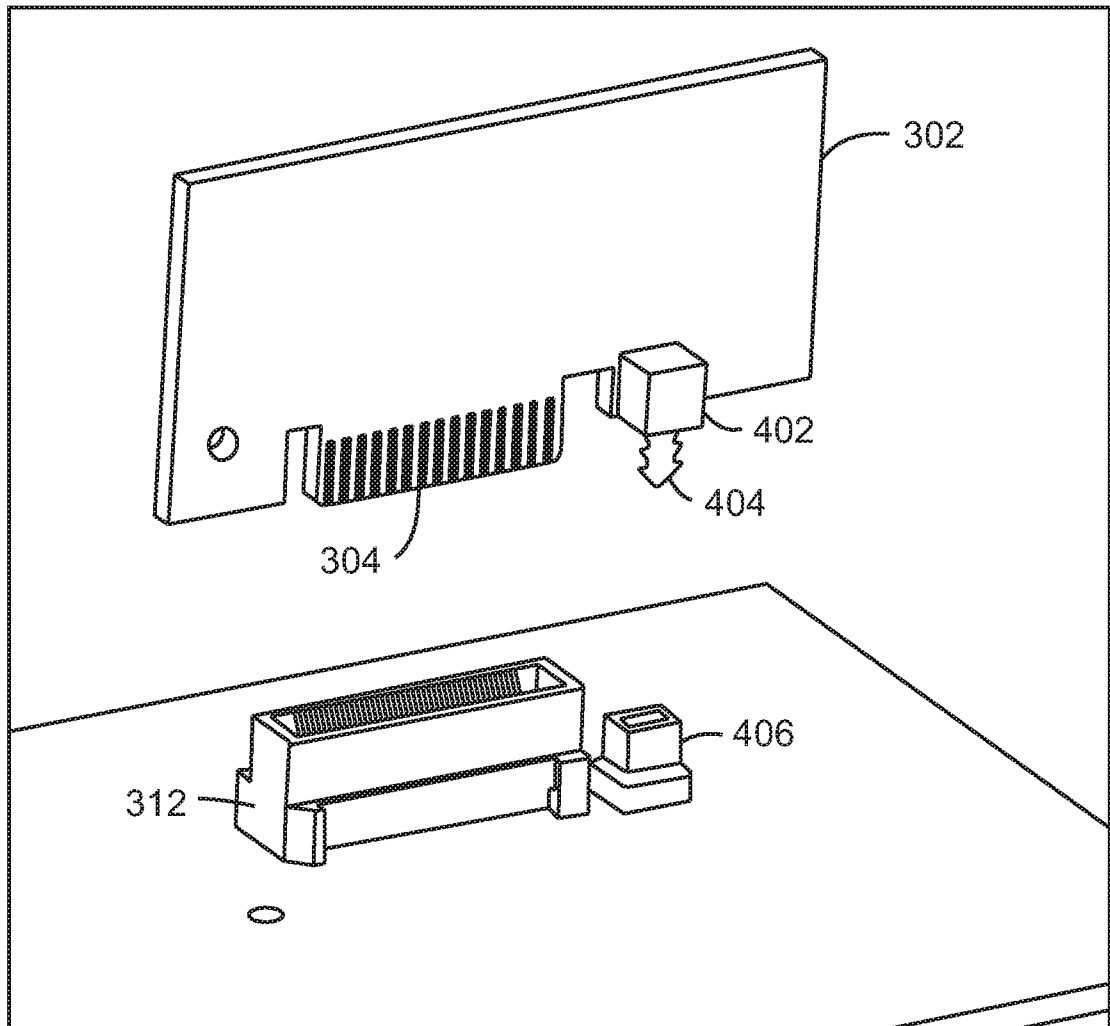
300
FIG. 3B

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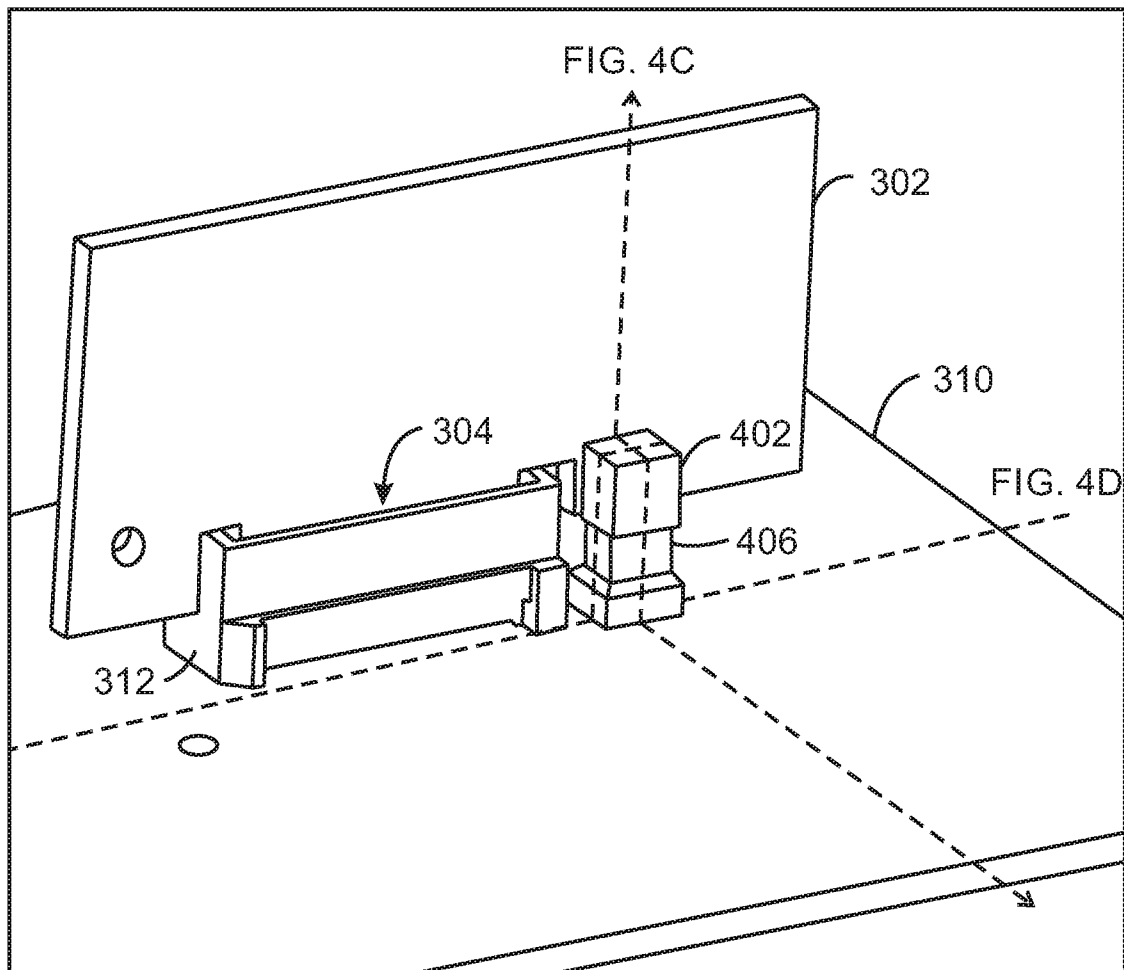
300
FIG. 3C

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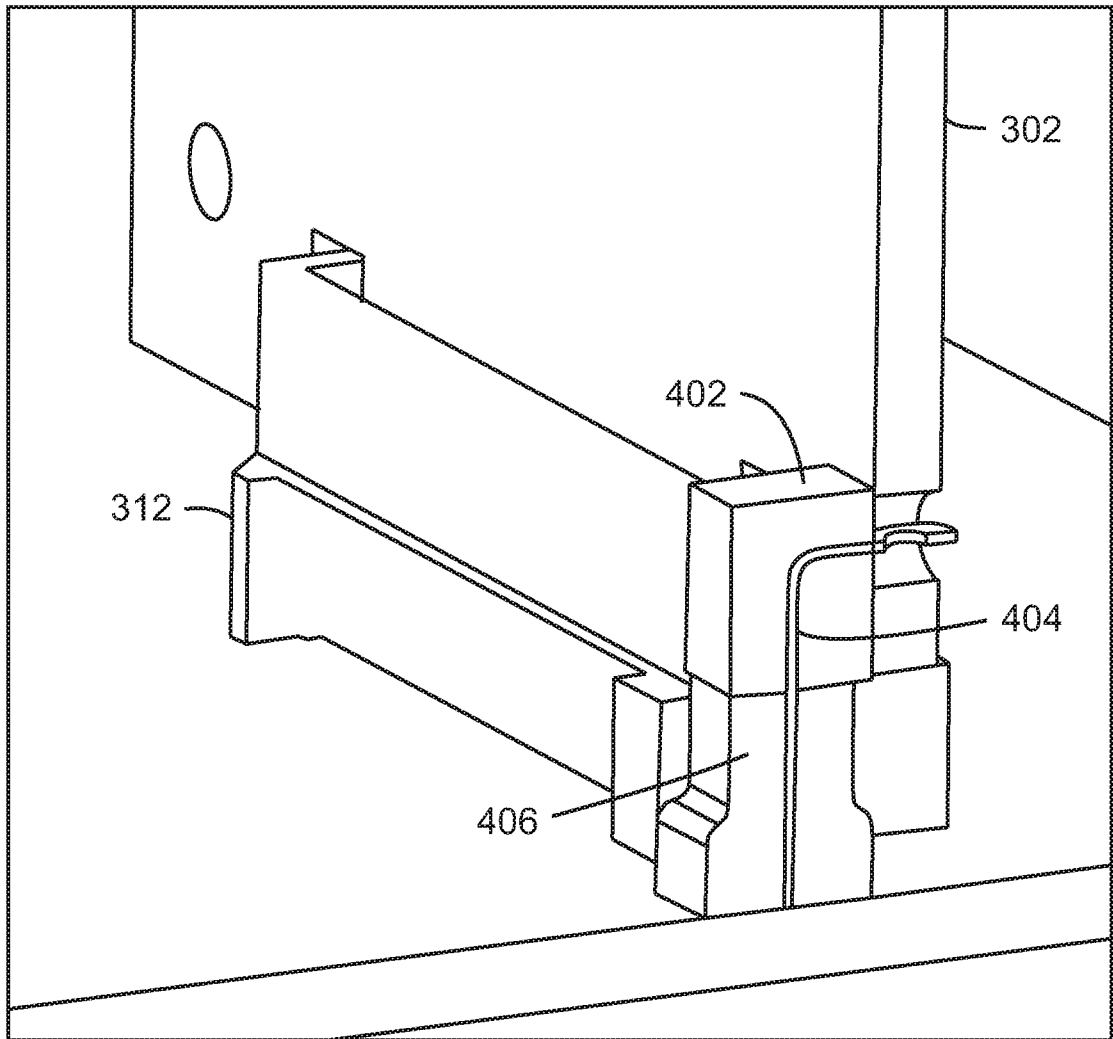
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FIG. 4A

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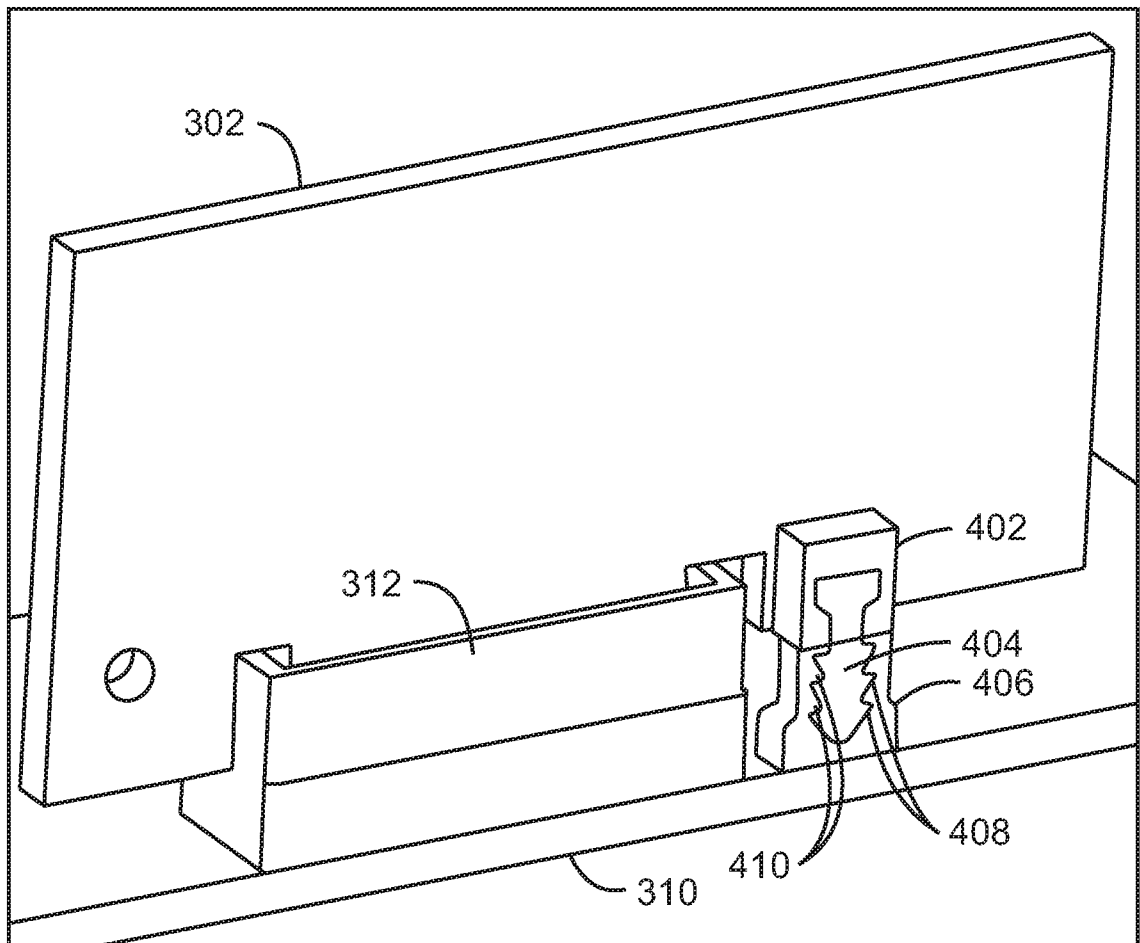
400
FIG. 4B

8/11



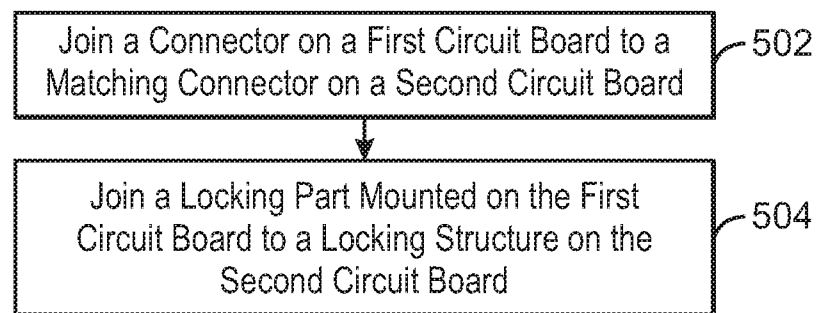
400
FIG. 4C

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400
FIG. 4D

10/11



500
FIG. 5

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Mount a Locking Part on a Riser Board,
Wherein the Locking Structure Matches a
Locking Structure on a Motherboard

602

600
FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/014889**A. CLASSIFICATION OF SUBJECT MATTER****H01R 12/71(2011.01)i, H01R 12/82(2011.01)i, H05K 7/14(2006.01)i, G06F 21/88(2013.01)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)

H01R 12/71; H01R 23/68; H01R 13/74; H01R 12/70; H01R 9/09; H01R 24/00; H05K 5/00; H01R 9/00; H01R 12/82; H05K 7/14; G06F 21/88

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: connector, circuit board, riser, locking part, locking structure

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011-0211317 A1 (DONALD LIEBERMAN) 01 September 2011 See paragraphs [0055]-[0056] and figures 20-21.	14-15
Y		1-13
Y	US 4907987 A (GEORGE H. DOUTY et al.) 13 March 1990 See column 2, lines 41-63, column 3, lines 21-65 and figures 1-3.	1-13
A	JP 2718898 B2 (ITT INDUSTRY. INC) 25 February 1998 See paragraphs [0005]-[0006], [0010], [0013], claim 1 and figures 1-3, 10.	1-15
A	JP 08-213074 A (MOLEX INC.) 20 August 1996 See paragraphs [0020]-[0028], claims 1-2 and figures 3-5.	1-15
A	US 2011-0143557 A1 (PETER KUO) 16 June 2011 See paragraphs [0015]-[0022], claim 1 and figures 1-2, 5.	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

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"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

20 October 2016 (20.10.2016)

Date of mailing of the international search report

20 October 2016 (20.10.2016)

Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2016/014889

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