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(54) Title: CONNECTOR WITH THERMAL VENTILATION

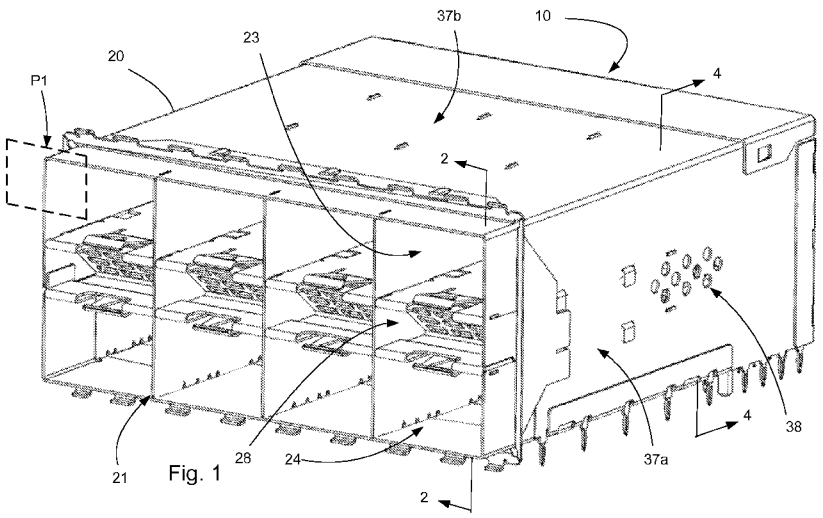


Fig. 1

(57) Abstract: A connector includes a cage that surrounds a housing. The cage defines two vertically spaced apart ports. A chamber is positioned between the ports. The chamber includes a vent wall that is angled to provide additional vent area so as to improve cooling of the connector. An aperture array in a rear wall of the cage can be used to further improve the cooling capabilities of the connector.

Connector With Thermal Ventilation

RELATED APPLICATIONS

[0001] This application claim priority to United States Provisional Application No. 61/935,684, filed February 4, 2014, which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] This disclosure relates to field of connectors, more specifically to field of connectors suitable for use with active electronics.

DESCRIPTION OF RELATED ART

[0003] There are two types of cable connectors that are commonly used for IO style connectors, passive connectors and active connectors. Passive connectors don't include active components and instead rely on an external chip to power the transmission of signals through the cable assembly. Active connectors, conversely, include active components that can amplify and/or retransmit the signal.

[0004] While passive components are desirable from a cost and reliability standpoint, as signaling frequencies have increased it has become more difficult to manage communication channels with passive connectors. Often a transceiver is placed some distance from an edge of a circuit board. Therefore, traces are provided in the circuit board and the traces extend from the transceiver to a receptacle connector mounted near the edge of the circuit board. It turns out that these traces are relative lossy for any type of board material that is reasonably cost effective and thus significant attenuation takes place over just 8 or 10 inches of traces. When the losses due to the board (both at the transmitting and receiving end) are taken into account the resultant channel may not be viable or may not provide sufficient margin for any reasonable connector design. Therefore, it is becoming increasingly desirable (from the standpoint of ensuring a viable communication channel) to use active connectors.

[0005] While active connectors help address some of the problems with existing architectures, they have a potential issue with thermal management. Active connectors generate waste heat and must be cooled if they are to be maintained at a temperature that does

not damage the internal components. Existing receptacle designs have used concepts such as riding heat sinks or spring fingers to engage active plug connectors and help transfer thermal energy away. Such designs have certain mechanical limitations and therefore further improvements would be appreciated by certain individuals.

SUMMARY

[0006] A connector is provided that includes improved ventilation capabilities in a compact form factor. In an embodiment the connector include a cage that includes a first and second port vertically arranged and the cage extends around a housing that includes a first and second card slot aligned with the first and second ports, respectively. The housing supports a plurality of terminals that have contacts that extend into the card slots. A chamber is defined between the ports and in an embodiment the chamber can be formed with an insert. A vent wall is positioned in the chamber and is angled so as to provide additional surface area for apertures. A aperture array can be provided in a rear wall of the cage and the vent wall and the aperture array can be in communication so that air can flow through the connector from front to back (or from back to front). The vent wall can be at an angle of 15 degrees or more, as desired, and at an angle of 45 degrees the vent wall can have a vent area that is substantially great than what would otherwise be possible as the surface area increases by about 40% compared to a vertically arranged vent wall.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The present invention is illustrated by way of example and not limited in the accompanying figures in which like reference numerals indicate similar elements and in which:

[0008] Fig. 1 illustrates a perspective view of an embodiment of a connector.

[0009] Fig. 2 illustrates a perspective cross sectional view taken along line 2-2 in Fig. 1.

[0010] Fig. 3 illustrates an elevated front view of the embodiment depicted in Fig. 1.

[0011] Fig. 4 illustrates a simplified perspective cross sectional view taken along line 4-4 in Fig. 1.

[0012] Fig. 5 illustrates another perspective view of the embodiment depicted in Fig. 4.

[0013] Fig. 6 illustrates another perspective view of the embodiment depicted in Fig. 4.

[0014] Fig. 7 illustrates a perspective view of another embodiment of a connector.

[0015] Fig. 8 illustrates a perspective exploded view of an embodiment of a cage.

[0016] Fig. 9 illustrates a perspective enlarged view of a chamber and insert suitable for use in the embodiment depicted in Fig. 8.

[0017] Fig. 10 illustrates a simplified perspective cross sectional view taken along line 10-10 in Fig. 7.

[0018] Fig. 11 illustrates a perspective view of an embodiment of an insert.

[0019] Fig. 12 illustrates an elevated front view of the insert depicted in Fig. 11.

[0020] Fig. 13 illustrates an elevated side view of the insert depicted in Fig. 11.

[0021] Fig. 14 illustrates an elevated front view of an embodiment of a vent wall.

[0022] Fig. 15 illustrates an elevated side view of an embodiment of a vent wall.

DETAILED DESCRIPTION

[0023] The detailed description that follows describes exemplary embodiments and is not intended to be limited to the expressly disclosed combination(s). Therefore, unless otherwise noted, features disclosed herein may be combined together to form additional combinations that were not otherwise shown for purposes of brevity.

[0024] The depicted figures illustrate various embodiments of connector configurations that can provide improved ventilation. The depicted embodiments include connectors that are in a stacked and ganged configuration. In an alternative embodiment the connector could just be stacked, thus the depicted configurations are not intended to be limiting..

[0025] As depicted, a connector 10 includes a cage 20 that defines a first port 23 and a second port 24 that are vertically spaced apart. The cage 20 has a front face 21 that defines a plane P1 that extends vertically. The depicted plane P1 is shown as being small for purposes

of illustration but in practice would extend along the full front face 21. The cage further includes a rear wall 32 that includes an aperture array 34.

[0026] Between the first port 23 and the second port 24 is a chamber 28 that provide an air pocket between the first and second ports. As air flows through the chamber 28 the air can help cool modules that are inserted into the ports. The chamber 28 can be defined by an insert 70 that includes a vent wall 80. The chamber 28 extends back to an EMI wall 60 that includes one or more notches 65 that allow air to flow past the EMI wall 60. The EMI wall 60 is optional but is beneficial to improving EMI performance and if included then the notches are helpful to allow for sufficient air flow.

[0027] The cage 20 includes sides 37a and a top wall 37b and a bottom wall 37c and is positioned around a housing 50 that includes a mating face 51 and a mounting face 52. The housing 50 includes a projection 53 that allows card slots 54, 55 (which are also vertically spaced apart) to be projected into the respective ports and such a construction is helpful in allowing for a secure connection to certain types of connectors but such a construction is not required. The housing 50 supports a plurality of terminals 58 that have tails positioned at the mounting face 52 and contacts positioned in both sides of the card slots 23, 24 near the mating face 51 (as can be appreciated from Fig. 3).

[0028] The depicted cage 20 defines a plurality of vertically spaced apart ports and an interior wall 29 is positioned between adjacent ports. The sides 37a and the interior wall 29 include vent apertures 38 that allow air to flow from the chamber 28 out of the cage 20. Thus air can flow through the vent wall 80, into the chamber 28 and the out of the chamber 28 via the vent apertures 38. While the vent apertures 38 are beneficial, for higher thermal loads and for situations where the connector has a ganged configuration of 2XN where N is greater than 2 the vent apertures 38 are insufficient to allow for sufficient cooling. To help address this issue the housing 50 is configured so that there is air space on at least one side of the housing 50 (preferably on both sides of the housing as is depicted in Fig. 4) so that air can flow past the housing 50 and through rear wall vents 34.

[0029] As can be appreciated, the vent wall 80 is provided in between two ports and the vent wall 80 is angled. To provide the vent wall 80 an insert 70 can be used. The insert 70 includes a first wall 72 and a second wall 74 and the first and second walls 72, 74 are coupled by bridge 75. The insert 70 can also include a blade 76 that can be inserted or can engage a

corresponding housing so as to provide a more robust structure. The vent wall 80 can be configured so that one end is a continuous part of the second wall 74 and an end 81 of the vent wall 80 presses against the first wall 72.

[0030] Preferably the vent wall 80 is angled at least 15 degrees from the plane P1 and more preferably is angled more than 30 degrees and it is expected that further benefits can be obtained if an angle of 45 degrees or more is provided. The vent wall 80, by being angled, can provide greater surface area so as to allow for additional apertures. The apertures, which may be limited in size to provide suitable EMI performance, can provide additional surface area due to the increased area provided by the vent wall and thus provide improved ventilation between the ports.

[0031] As can be appreciated from Figs. 13-15, the vent wall 80 has a length X and a width Y that define a surface area S, of which a vent area V is some portion of the surface area and the vent area V is defined as the sum of areas A of the apertures 88 or V = sum (A_1:A_n) where n is the number of apertures provided in the vent wall. To allow for sufficient structural rigidity the vent area V will typically be less than .7(S) and in many cases V $\leq$ .6(S). The upper limit on the percent of S that V can be will be determined by the materials used and the size of apertures 88 that are permissible for a given EMI performance (at 25 Gbps, for example, the size of the apertures preferably would be less than 7.5 mm so as to provide a safety factor). The width Y is determined based on width W of the chamber 28, which is defined by the size of the port (for example, the width of an SFP connector will be less than the width of a QSFP connector due to how the connectors are mechanically defined) and cannot be readily changed. In many cases the width Y can be substantially the same as the width W. The chamber 28 also has a height H and this is defined by the mechanical dimensions of the connector. The length X is based on the first angle β and can be defined by the equation $X = H/\cos \beta$. Thus, as angle β increases the length X also increases.

[0032] As can be appreciated, if the vent wall 80 was vertical (e.g., aligned with plane P1) then the vent area V could not exceed a percentage of the chamber area (where the chamber area is the width W times the height H). However, with an appropriate angle β the surface area S can substantially exceed the chamber area and area V can even equal or exceed the chamber area.

[0033] Figs. 7-10 illustrate an alternative embodiment of a connector 110. While the internal aspects of the connector 110 can be substantially the same as connector 10 (and thus the details discussed above with respect to connector 10 can also apply to connector 110), the connector 110 includes 8 ports aligned side by side (e.g., connector 110 is a 2X8 connector). The additional ports arranged side by side makes the use of an aperture array in the rear wall more desirable as otherwise it is more difficult to provide sufficient air flow through the connector.

[0034] The connector 110 includes a cage 120 with side walls 137a, a top wall 137b and a bottom wall 137c and also includes a rear wall 132. The gage 120 further includes interior walls 129 and the walls help define first ports 123 and 124. An insert 170 is included and helps define a chamber 128 that is positioned between the first and second ports 123, 124. The cage 20 also includes vent apertures 138 and an aperture array 134. As can be appreciated, the insert 170 includes a vent wall 180 that is angled and allows for air flow through the connector 110 similar to how air can flow through the connector 10.

[0035] It should be noted that while an insert is preferred, the vent wall and the top and bottom of the ports could be formed of individual components and thus the insert could be omitted. Applicant has found it preferable to include an insert for ease of assembly and to provide additional structure rigidity.

[0036] Thus the connector includes a cage and a housing and the cage and housing can be configured so that the air can flow in through an angled vent wall, through a chamber, around the housing and out the back of the connector through apertures in a rear wall in the cage. The connector can thus be configured to cool active modules inserted into the connector without requiring excessively large heat sinks but instead using air flow through the connector to directly cool the active modules.

[0037] The disclosure provided herein describes features in terms of preferred and exemplary embodiments thereof. Numerous other embodiments, modifications and variations within the scope and spirit of the appended claims will occur to persons of ordinary skill in the art from a review of this disclosure.

CLAIMS

We Claim:

1. A connector, comprising:

a housing that includes a mounting face and a mating face and a first card slot and a second card slot on the mating face, the first and second card slots being vertically spaced apart;

a plurality of terminals supported by the housing, the terminals including tails arranged at the mounting face and contacts positioned in the card slots;

a cage positioned around the housing, the cage having a front face that defines a first plane, the cage defining a first port and a second port that are aligned , respectively, with the first and second card slots, the cage including a chamber between the first and second ports; and

a vent wall positioned in the chamber adjacent the front face, the vent wall having a plurality of openings sized so as to block electromagnetic interference (EMI), the vent wall arranged at an angle from the first plane that is at least 15 degrees; wherein the plurality of openings collectively define a vent area.

2. The connector of claim 1, wherein the chamber has a first area corresponding to a height and a width of the chamber and the vent area is at least 60% of the first area.

3. The connector of claim 2, wherein the vent area is at least 75% of the first area.

4. The connector of claim 2, wherein the vent area is at least 100% of the first area.

5. The connector of claims 2-4, wherein the first angle is at least 30 degrees from the first plane.

6. The connector of claim 5, wherein the first angle is about 45 degrees.

7. The connector of claims 1-4, wherein the first angle is between 15 and 45 degrees from the first plane.

8. The connector of claims 1-7, wherein the connector further comprises an insert positioned between the first and second ports, the insert defining the chamber.

9. The connector of claim 8, wherein the insert includes the vent wall integrally formed in the insert.

10. The connector of claim 9, wherein the insert includes a top wall and a bottom wall and is configured to have an end of the vent wall press against one of the top and bottom walls.

11. A connector, comprising:

a housing that includes a mounting face and a mating face and a first card slot and a second card slot on the mating face, the first and second card slots being vertically spaced apart;

a plurality of terminals supported by the housing, the terminals including tails arranged at the mounting face and contacts positioned in the card slots;

a cage positioned around the housing, the cage having a front face that defines a first plane, the cage defining a first port and a second port that are aligned , respectively, with the first and second card slots, the ports having a first width; and

an insert positioned between the ports, the insert including a first wall that forms a bottom of the first port and a second wall that forms a top of the second port, the first and second wall spaced apart by a first height such that the first height and the first width define a chamber, the insert including a vent wall positioned in the chamber adjacent the front face, the vent wall having a plurality of openings sized so as to block electromagnetic interference

(EMI) and having a surface area that is greater than the first width times the first height; wherein the plurality of openings collectively define a vent area.

12. The connector of claim 11, wherein the first height and the first width define a chamber area and the vent area is at least 75% of the chamber area.

13. The connector of claims 11-12, wherein the vent wall is at a first angle that is at least 30 degrees from the first plane.

14. The connector of claims 11-13, wherein the cage includes a rear wall and an aperture array positioned in the rear wall, the aperture array in communication with vent wall so that air may flow from one to the other.

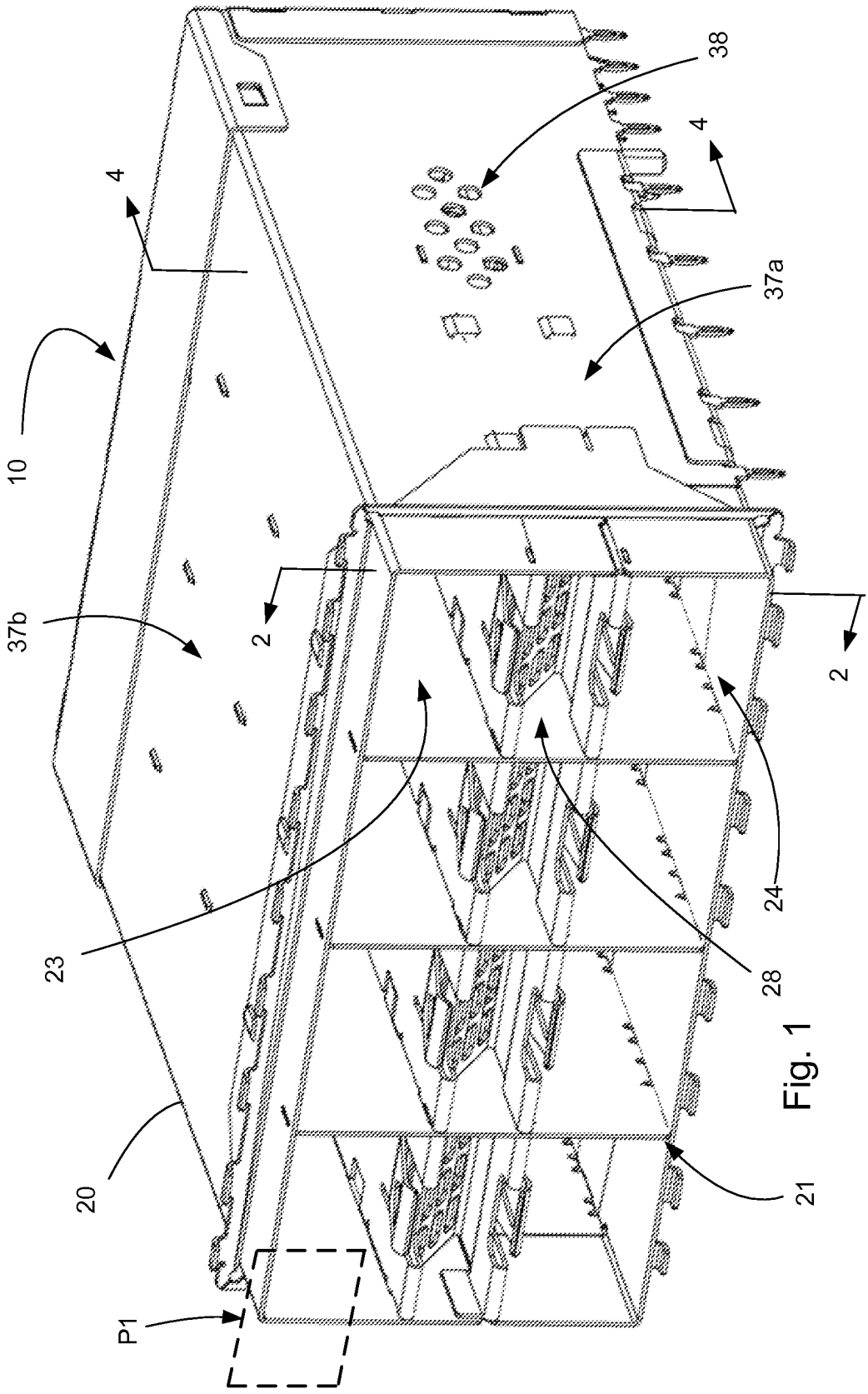


Fig. 1

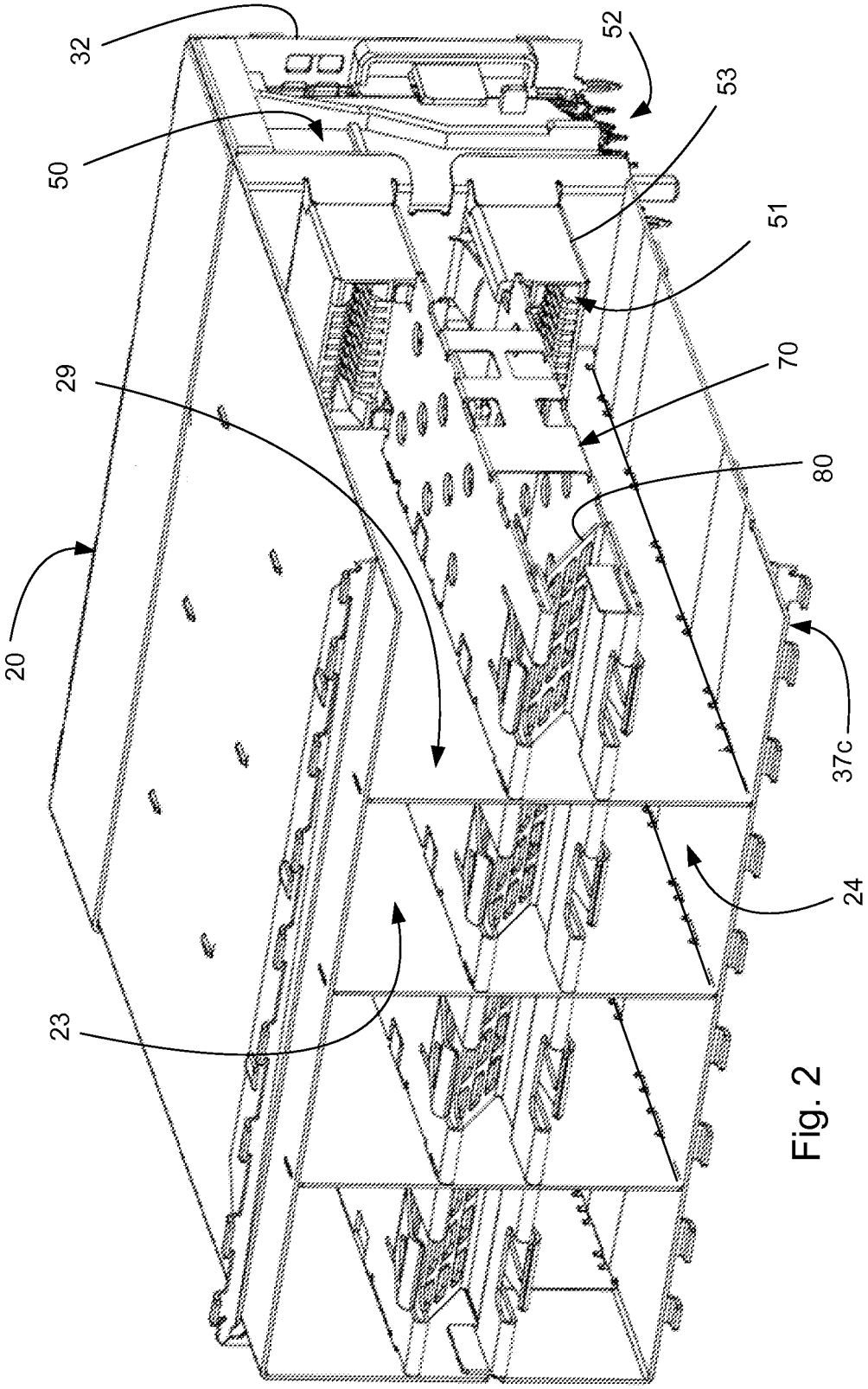


Fig. 2

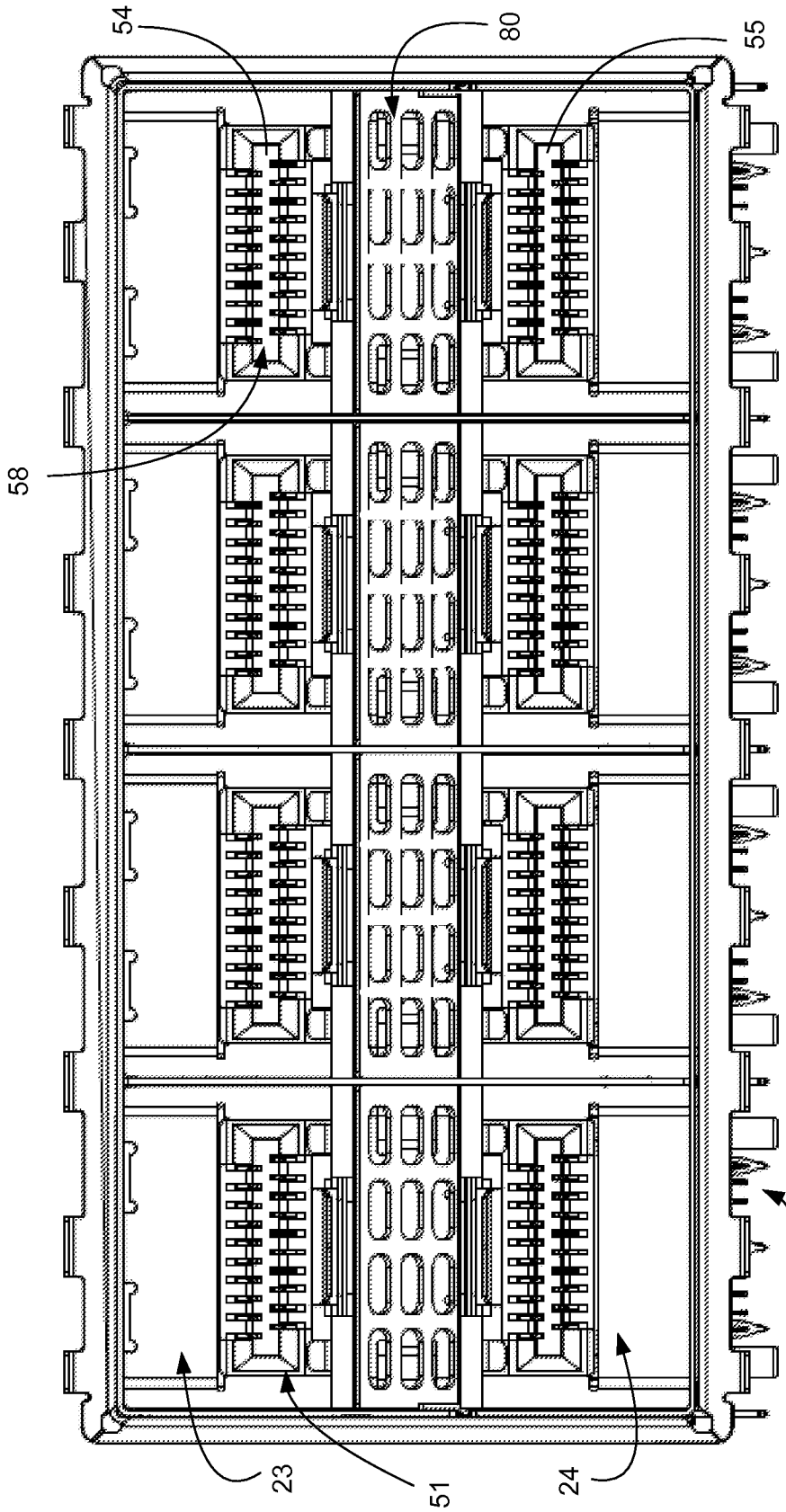


Fig. 3

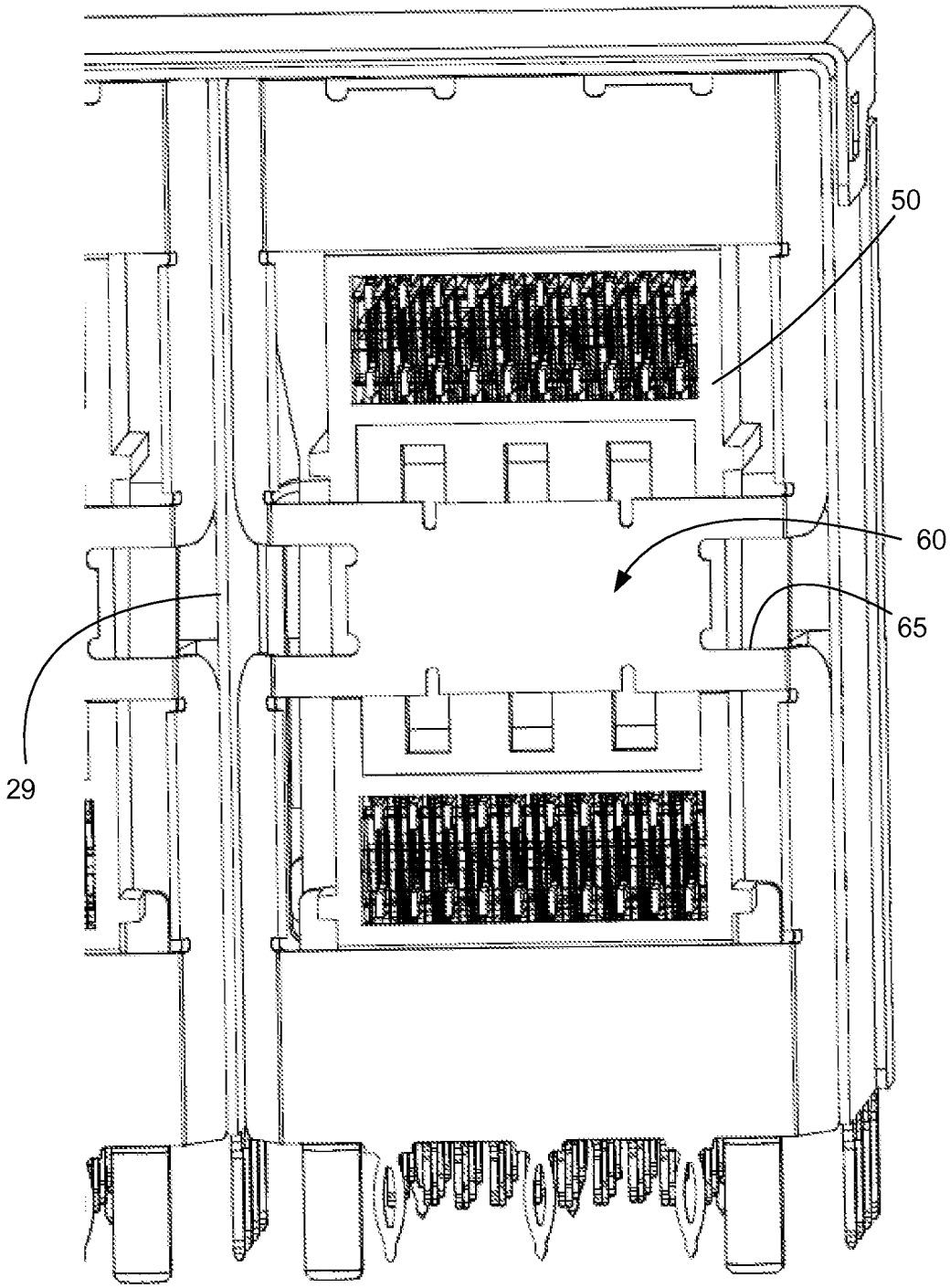


Fig. 4

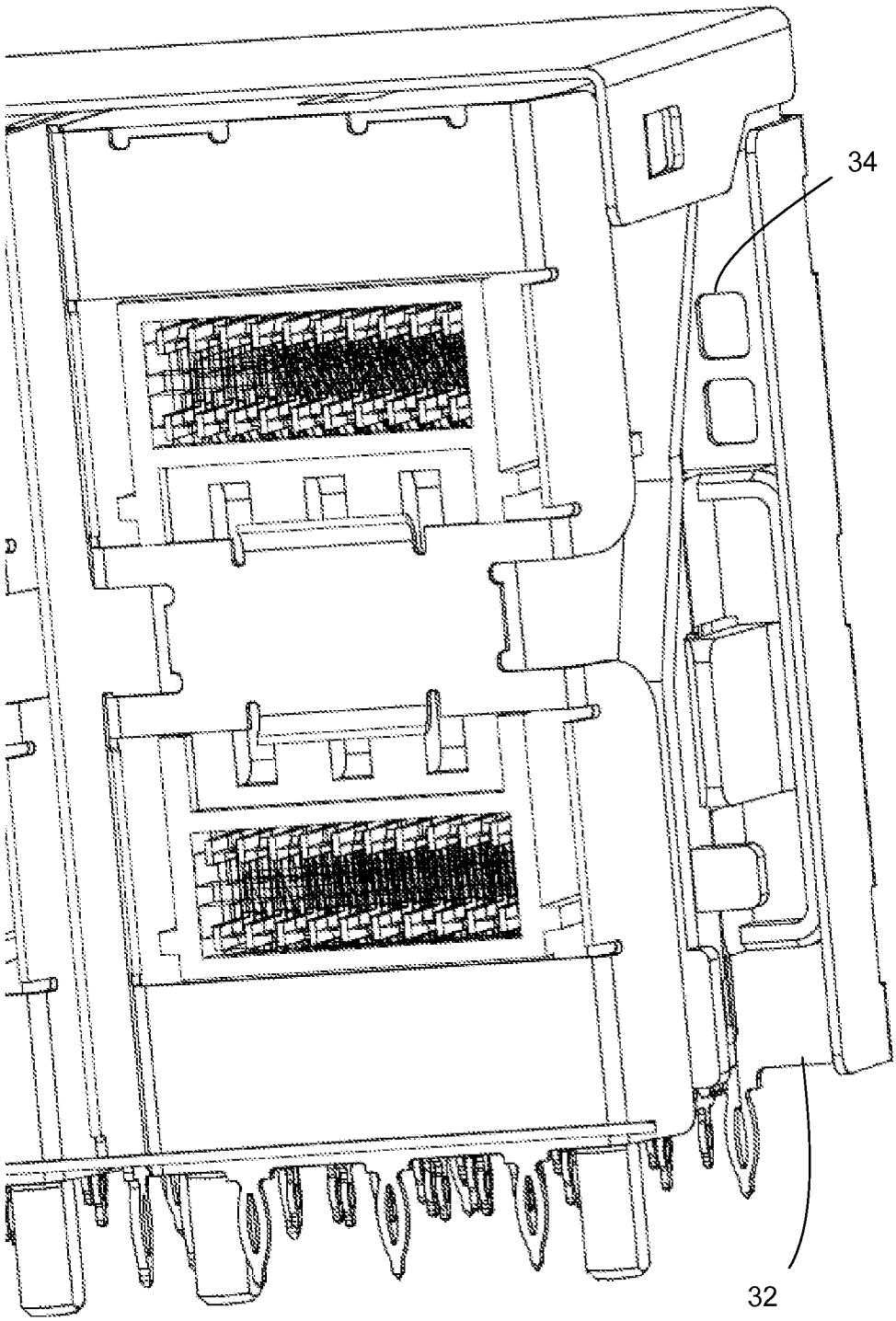


Fig. 5

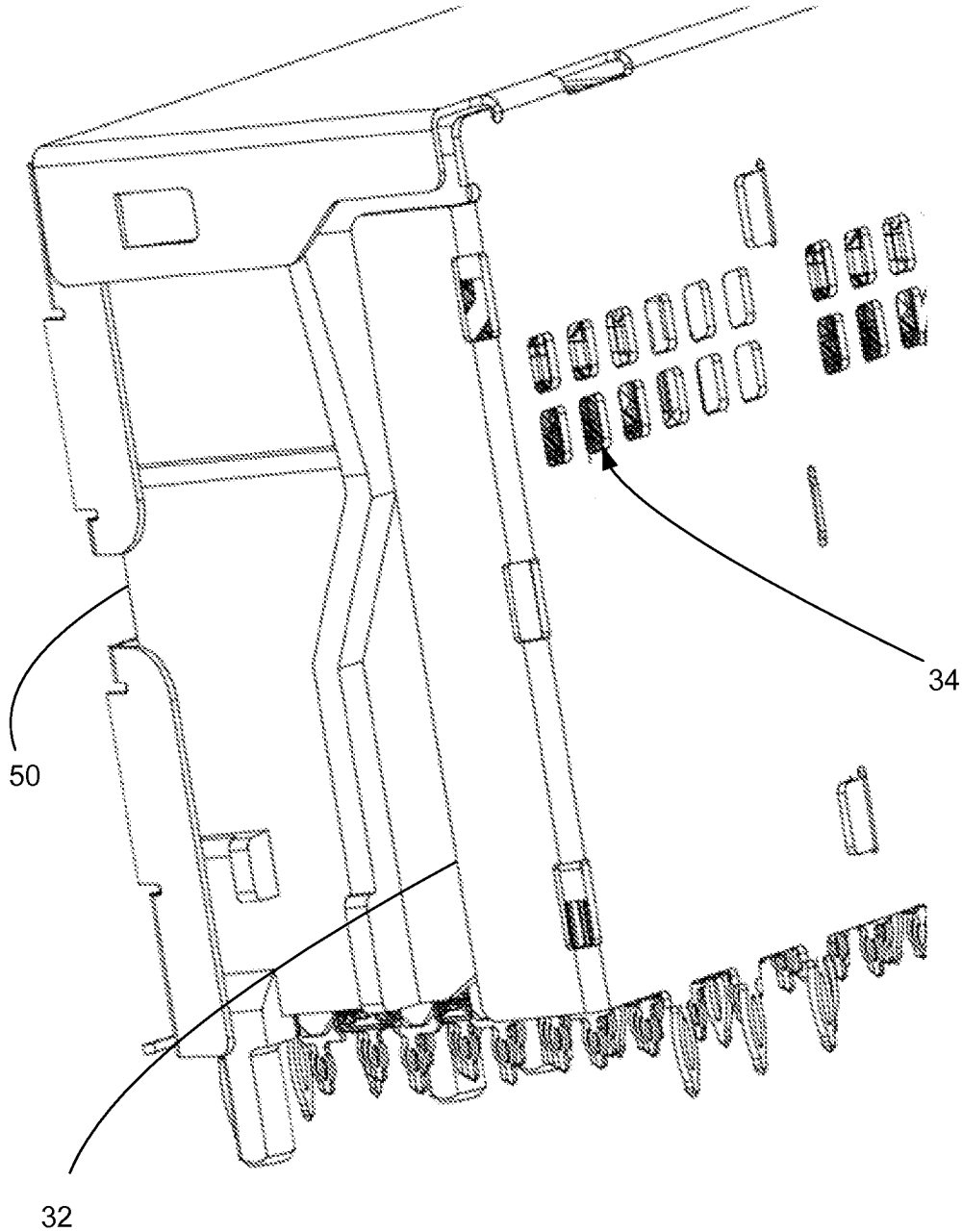


Fig. 6

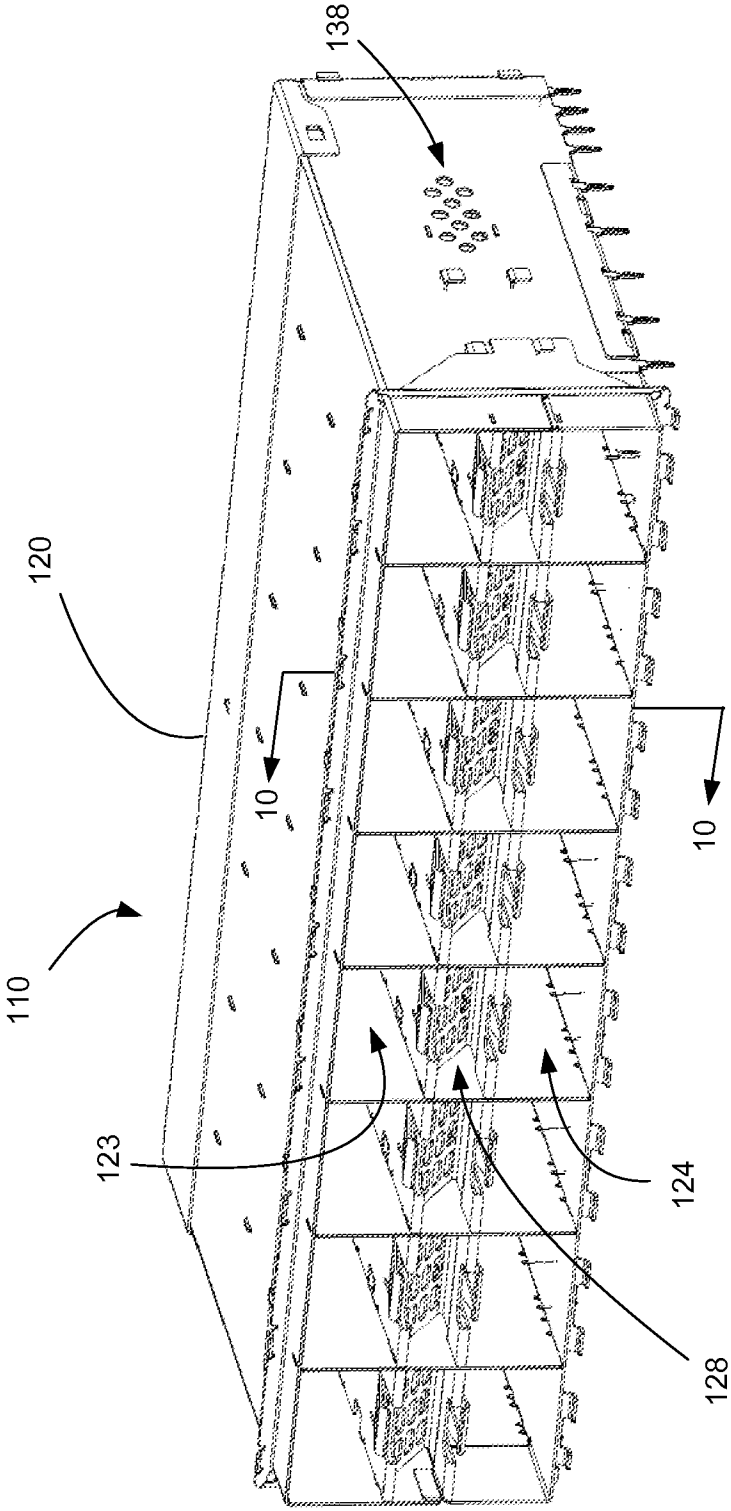


Fig. 7

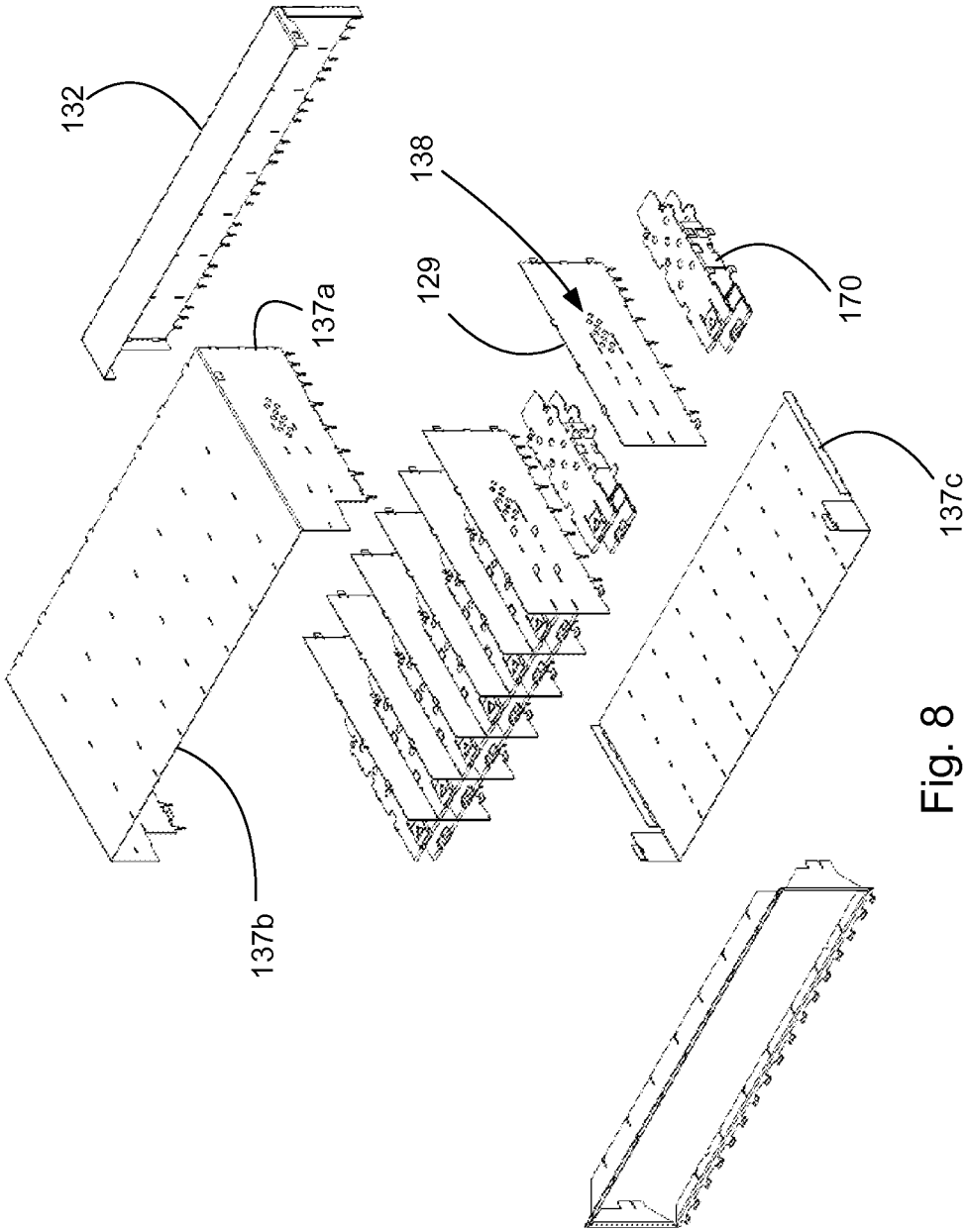


Fig. 8

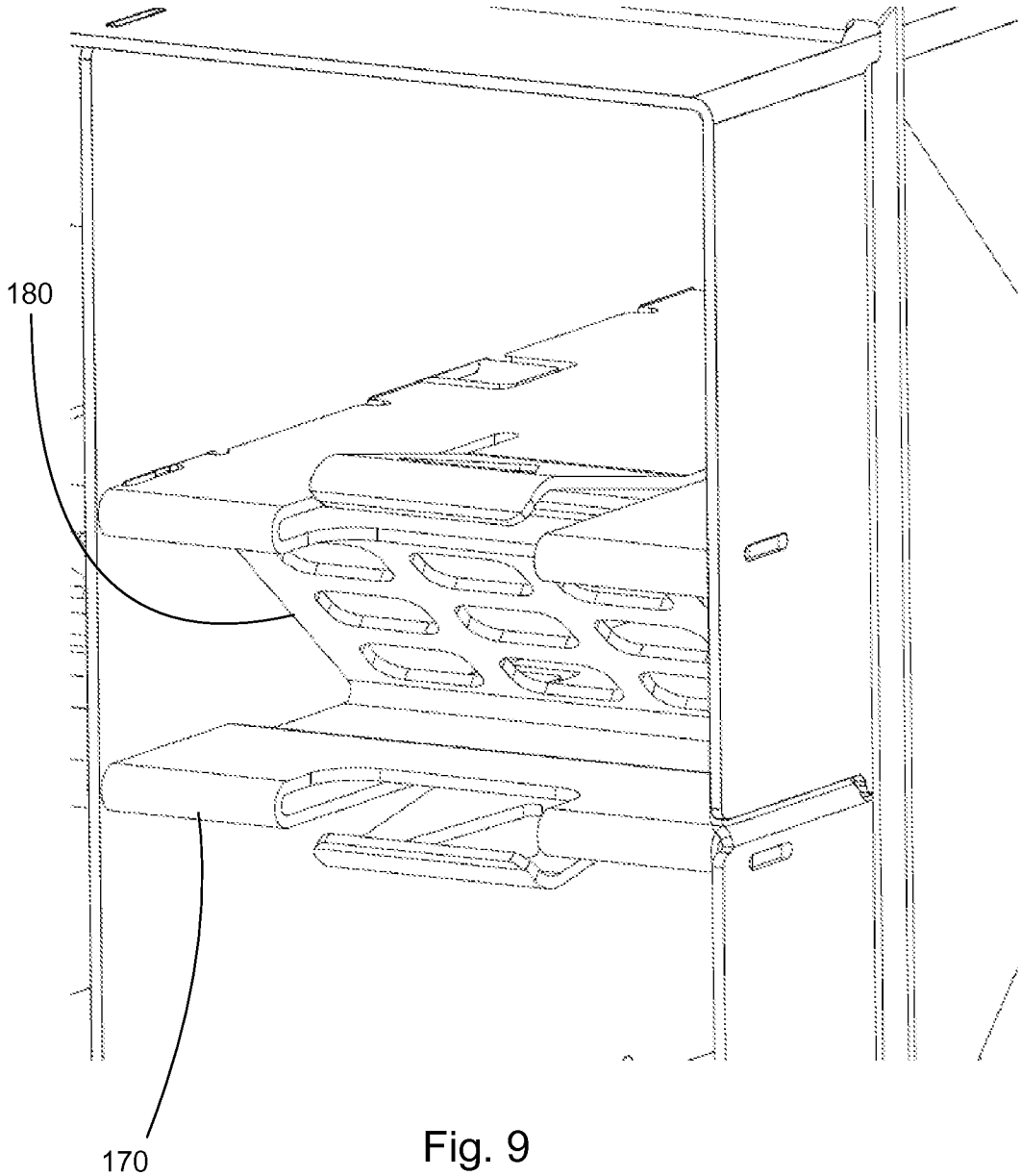


Fig. 9

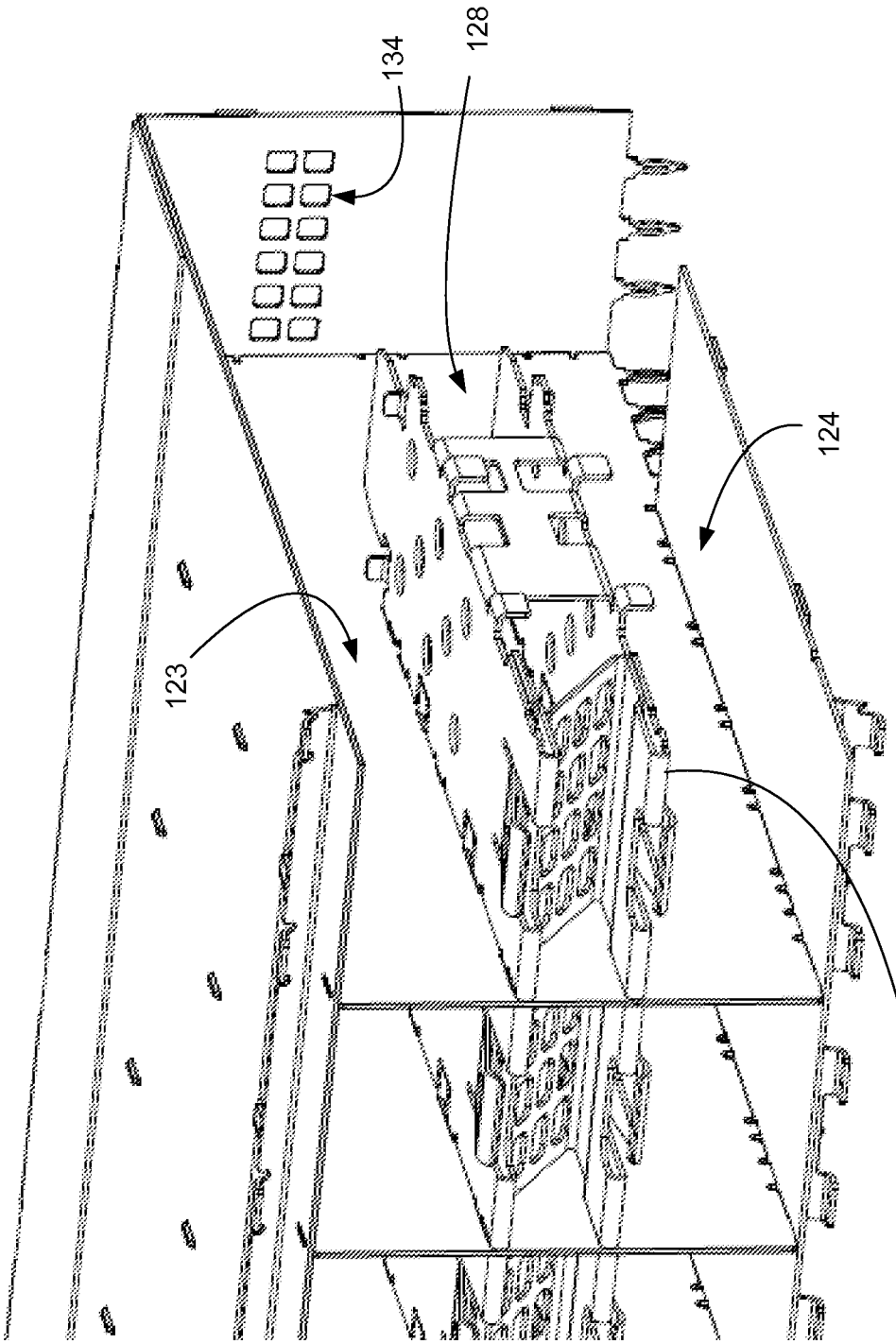


Fig. 10

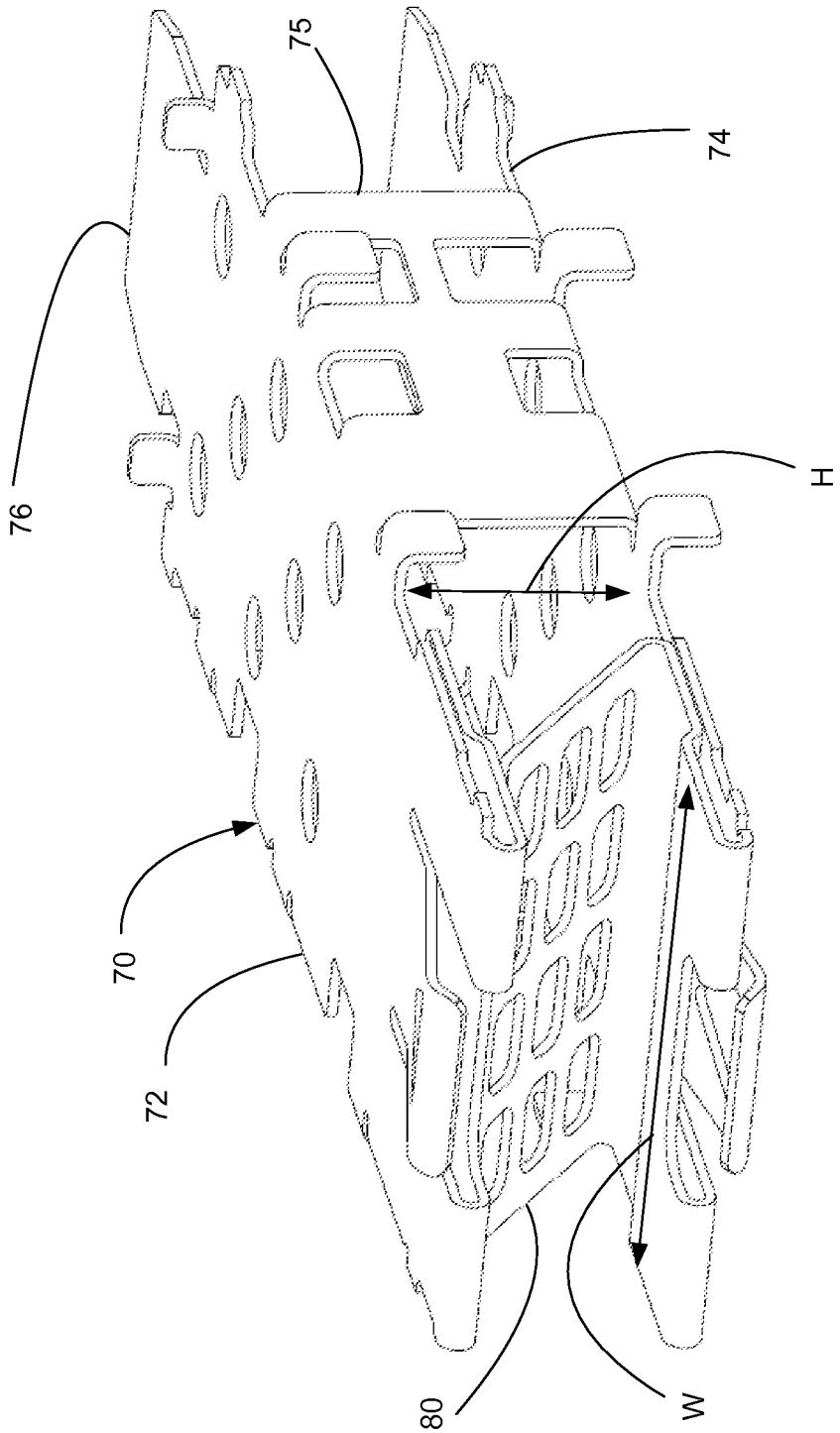


Fig. 11

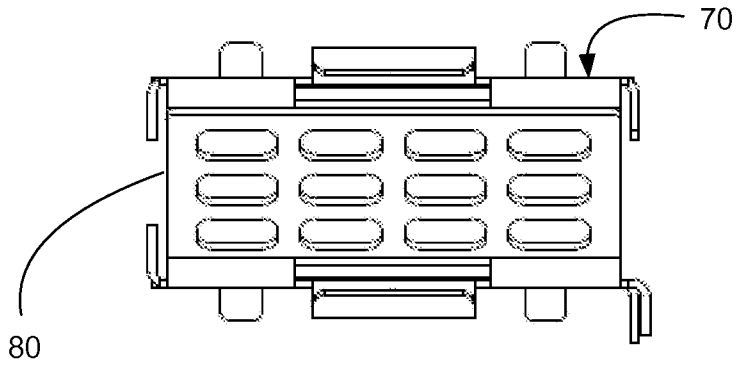


Fig. 12

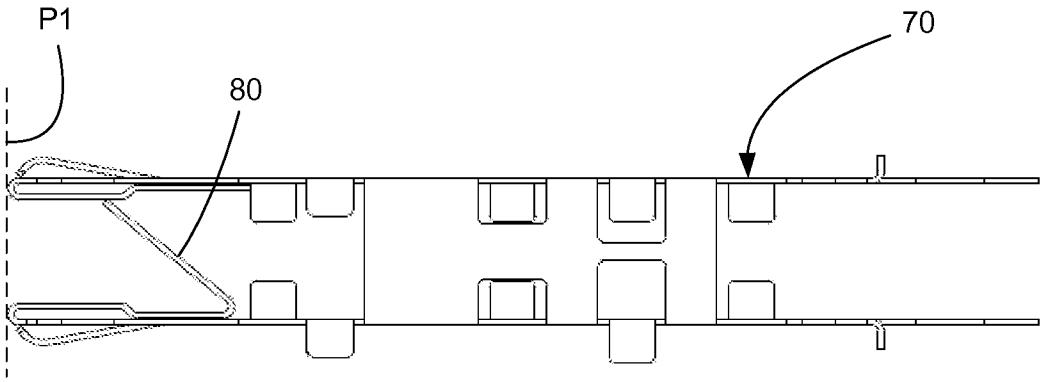


Fig. 13

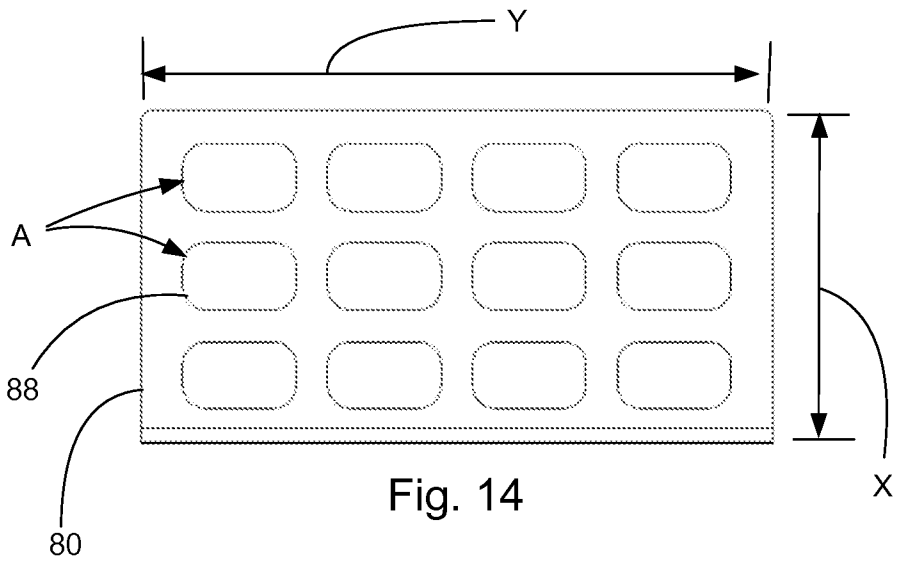


Fig. 14

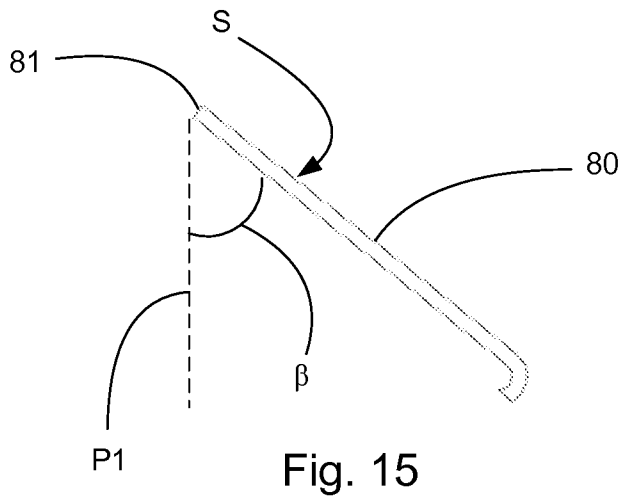


Fig. 15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/014423

A. CLASSIFICATION OF SUBJECT MATTER

H01R 13/533(2006.01)i, H01R 27/00(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)
H01R 13/533; H01R 24/04; H05K 7/14; H05K 7/20; H05K 7/20; B60R 16/02; H02G 3/16; H01R 13/73; H01R 27/00

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, cage, housing, vent, chamber, opening, surface area

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2009-0298349 A1 (SVEN FILIPON et al.) 03 December 2009 See abstract, paragraphs [0052]-[0084], claim 4, and figures 1-7.	1-14
A	US 6377470 B1 (C. MICHAEL HAYWARD et al.) 23 April 2002 See column 4, line 66 - column 6, line 7, claim 1, and figures 1-2.	1-14
A	US 2001-0028550 A1 (HIDEAKI MIYAKE et al.) 11 October 2001 See paragraphs [0034]-[0049], claims 3, 5, and figures 1-3.	1-14
A	JP 2006-254528 A (SUMITOMO WIRING SYST LTD.) 21 September 2006 See paragraphs [0017]-[0026], claim 1, and figures 1-2, 5-6.	1-14
A	US 2007-0293084 A1 (HUNG VIET NGO) 20 December 2007 See paragraphs [0083]-[0094], claim 9, and figures 1-2.	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
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 May 2015 (15.05.2015)	**15 May 2015 (15.05.2015)**

Name and mailing address of the ISA/KR
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2015/014423

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2009-0298349 A1	03/12/2009	CN 100517883 C	22/07/2009
		CN 100544131 C	23/09/2009
		CN 101002367 A	18/07/2007
		CN 101044661 A	26/09/2007
		EP 1761976 A1	14/03/2007
		EP 1766732 A1	28/03/2007
		US 2008-248684 A1	09/10/2008
		US 7854634 B2	21/12/2010
		US 8043112 B2	25/10/2011
		WO 2006-000238 A1	05/01/2006
		WO 2006-000261 A1	05/01/2006
US 6377470 B1	23/04/2002	AT 244499 T	15/07/2003
		AU 1999-38739 A1	06/12/1999
		CA 2330640 A1	25/11/1999
		CA 2330640 C	12/06/2007
		DE 69909289 T2	12/02/2004
		EP 1078560 A1	28/02/2001
		EP 1078560 B1	02/07/2003
		JP 2002-516494 A	04/06/2002
		JP 4674314 B2	20/04/2011
		US 6381147 B1	30/04/2002
		WO 99-60834 A1	25/11/1999
US 2001-0028550 A1	11/10/2001	JP 2001-242964 A	07/09/2001
JP 2006-254528 A	21/09/2006	None	
US 2007-0293084 A1	20/12/2007	CN 101467311 A	24/06/2009
		CN 102157815 A	17/08/2011
		EP 2036167 A2	18/03/2009
		EP 2036167 A4	09/06/2010
		EP 2284962 A2	16/02/2011
		EP 2284962 A3	23/03/2011
		JP 2009-540527 A	19/11/2009
		KR 10-2009-0018950 A	24/02/2009
		US 7726982 B2	01/06/2010
		WO 2007-145793 A2	21/12/2007
		WO 2007-145793 A3	28/08/2008