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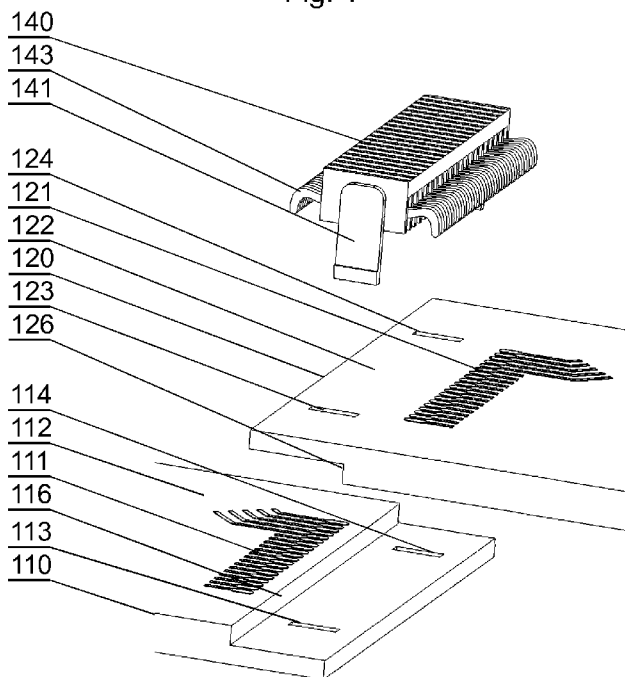
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[Continued on next page]

(54) Title: A PCB ARRANGEMENT

Fig. 1



(57) Abstract: A printed circuit board (PCB) arrangement, comprising a first PCB (110) with circuit paths (111) on a top plane (112), a second PCB (120) with circuit paths (121) on a top plane (122), partially overlapping the first PCB (110) in an overlap area (130), wherein each of the first PCB (110) and the second PCB (120) comprises at least one opening (113-123, 114-124) situated within the overlap area (130) such that the openings (113-123, 114-124) define a passage from the top plane (122) of the second PCB (120) to the bottom plane (115) of the first PCB (110) and wherein a connector (140) is mounted on the top plane (122) of the second PCB (120) by means of at least one fastening element (141, 142) extending through the passage defined by the openings (113-123, 114-124) and fixed to the bottom plane (115) of the first PCB, the connector (140) comprising a plurality of contact members (143) electrically coupled with the circuit paths (111, 121) of the top planes (112, 122) of the first PCB (110) and the second PCB (120).

**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))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

— of inventorship (Rule 4.17(iv))

Published:

- with international search report (Art. 21(3))
- with amended claims and statement (Art. 19(1))

A PCB ARRANGEMENT

DESCRIPTION

5 TECHNICAL FIELD

The present invention relates to an arrangement of printed circuit boards (PCB) wherein two boards are interconnected.

10 BACKGROUND ART

Modern electronic devices use electronic components of different complexity. On the one hand, sophisticated integrated circuit chips, such as signal processors operating at high frequencies with dozens or hundreds of input/output (I/O) lines are used, which require complicated routing of circuit paths. Such sophisticated chips have to be mounted on multi-layer PCBs, which are expensive and complicated to manufacture. On the other hand, simple devices such as power supply modules or low-speed input/output connectors are used, which require only a few signal path connections and can be mounted on single- or double-layer PCBs. So far, all devices have been usually mounted on a common circuit board. Such approach is not efficient, as the use of a multi-layer PCB for simple devices is not necessary.

There are known PCB arrangements in which two PCBs are coupled together. For example, a US patent application US20100134995A1 presents an electrical interconnection system comprising a pair of printed wiring boards have surfaces operable to be placed adjacent to one another such that an electrical circuit coupled to one printed wiring board is electrically coupled to another electrical circuit of the other printed wiring board by contact of the surface pads of each printing wiring board with one another. Such boards are relatively hard to manufacture and use dedicated, non-standard pads on the board.

The aim of the present invention is to provide an alternative PCB arrangement for interconnecting two boards, which allows manufacturing the PCBs in a standard technology.

DISCLOSURE OF THE INVENTION

The object of the invention is a printed circuit board (PCB) arrangement, comprising a first PCB with circuit paths on a top plane, a second PCB with circuit paths on a top plane, partially overlapping the first PCB in an overlap area, wherein
5 each of the first PCB and the second PCB comprises at least one opening situated within the overlap area such that the openings define a passage from the top plane of the second PCB to the bottom plane of the first PCB, wherein a connector is mounted on the top plane of the second PCB by means of at least one fastening
10 element extending through the passage defined by the openings and fixed to the bottom plane of the first PCB, the connector comprising a plurality of contact members electrically coupled with the circuit paths of the top planes of the first PCB and the second PCB.

Preferably, the first PCB comprises a plurality of openings, which are coaxial
15 with corresponding openings of the second PCB and the connector comprises a plurality of fastening elements extending through the passages defined by the openings.

Preferably, within the overlap area the first PCB and the second PCB have complementary stepped edges.

Preferably, the top plane of the first PCB is coplanar with the top plane of the
20 second PCB.

Preferably, the top planes of the first PCB and of the second PCB are parallel and not coplanar.

Preferably, the contact members of the connector have a first portion for
25 contacting the circuit path and a second portion mechanically connected with the connector frame, wherein the first portion is resiliently movable with respect to the second portion.

Preferably, the contact members are made of resilient material.

Preferably, the fastening elements are snap-type fasteners permanently fixed
30 to the connector.

Preferably, the connector comprises means for attaching of fastening elements separate from the connector.

Preferably, the contact members and the circuit paths are made of or coated by non-oxidising metal.

Preferably, the PCB arrangement further comprises a connector mounted on the bottom plane of the first PCB by means of the pair of the fastening elements of the connector mounted on the top plane of the second PCB.

The object of the invention is also an electronic device comprising the PCB arrangement according to the invention.

The PCB arrangement according to the invention allows precise positioning of the PCBs, the connector and the circuit paths, by providing coaxial openings in the edge area of the PCBs, through which the fasteners coupled to the connector pass. This automatically positions all elements of the arrangement precisely with respect to each other. By providing resilient contact members, the arrangement is prone to vibrations and tolerant to dimensional imprecision of the PCBs. Due to contact-only connection, the connector can be easily decoupled and coupled to the PCB, without the need for soldering or other coupling, which allows easy mounting of the arrangement at the assembly stage and easy disassembly e.g. for servicing purposes. One of the PCBs may comprise electronic elements requiring complicated, multi-layer circuit paths or electronic elements operating with a high frequency, while the other PCB may comprise electronic elements requiring simple, single- or double-layer circuit paths or electronic elements operating with a low frequency.

BRIEF DESCRIPTION OF DRAWINGS

The object of the invention is shown by means of an exemplary embodiments on a drawing, in which:

Figs. 1-2 show an exploded and assembled view of one embodiment of the PCB arrangement,

Fig. 3 shows an assembled view of another embodiment of the PCB arrangement,

Fig. 4 shows an assembled view of yet another embodiment of the PCB arrangement,

Figs. 5-6 show one embodiment of the connector in a perspective and cross-sectional view,

Fig. 7 shows another embodiment of the connector in an exploded view,

5 MODES FOR CARRYING OUT THE INVENTION

The PCB arrangement according to the invention, shown in an exemplary embodiment in an exploded and assembled views on Figs. 1-2, comprises a first printed circuit board (PCB) 110 and a second PCB 120 which are arranged in a partially overlapping manner. The PCBs 110, 120 have circuit paths 111, 121 on their top planes 112, 122. The circuit paths 111, 121 guide electric signal to electric components mounted on the board. Preferably, one of the boards 110, 120 has more layers than the other board 110, 120, i.e. a board with a smaller degree of complexity is connected with a board of a higher degree of complexity. The area within which the boards 110, 120 overlap is designated as an overlap area 130. Within the overlap area 130, the first board 110 and the second board 120 have complementary stepped edges 116, 126. The edges of the boards within the overlap area 130 may be also shaped in a different manner, for example they can be chamfered. In the simplest embodiment, the edges may be straight and the boards 110, 120 may be overlaid one on another, which results that both the top surfaces 112, 122 and the bottom surfaces 115, 125 are parallel but not coplanar. The top planes 112, 122 of the boards may be coplanar as shown in the embodiment of Figs. 1-2 or parallel, but not coplanar, as shown in another embodiment of Fig. 3. Within the overlap area 130, the boards 110, 120 comprise at least a pair of coaxial openings 113-123, 114-124. A connector 140 is mounted on the top plane 122 of the second PCB 120 by means of at least a pair of fastening elements 141, 142. The fastening elements 141, 142 extend through the coaxial openings 113-123, 114-124 and are fixed to the bottom plane 115 of the first PCB. Furthermore, the connector 140 comprises a plurality of contact members 143, which are electrically coupled with the circuit paths 111, 121.

The PCB arrangement, as shown in yet another embodiment on Fig. 4, may further comprise a second connector 150, mounted on the bottom plane 115 of the first PCB 110 for connecting the circuit paths routed at the bottom planes 115, 125 and having fastening elements common with the first connector 140 and extending

through the same coaxial openings 113-123, 114-124 in the first PCB 110 and in the second PCB 120. In that case, the connectors 140, 150 can be configured according to the embodiment shown in Fig. 7 and the fastening elements may be screws joining the openings in the connectors.

5 The connector, as shown in one embodiment in a perspective and cross-sectional view in Figs. 5-6, has contact members 143 which have a first portion 144 for contacting the circuit path 111, 121 and a second portion 145 mechanically connected with the connector frame 146, wherein the first portion 144 is resiliently movable with respect to the second portion 145. The contact members 143 can be
10 made of a resilient material, such as phosphor bronze or beryllium bronze. The contact members 143 and the circuit paths 111, 121 can be made of or coated by non-oxidizing metal, such as gold, which guarantees good conductivity while the PCB arrangement is in use. When the connector is fastened to the board, the resiliency of the contact members 143 compensates any irregularities of the assembly and
15 guarantees constant contact of the members 143 and the circuit paths. Moreover, it allows to keep the contact even when the PCB arrangement is inclined or turned upside-down. The first portion 144 has a rounded edge so that contact with the circuit path is guaranteed. For more secure contact, the first portion 144 can be soldered to the circuit paths 111, 121.

20 The connector may comprise a slotted main frame 146 to which the contact members 143 are mounted and a bottom part 147 which holds the contact members 143 in place.

 The fastening elements 141, 142 can be snap-type fasteners permanently fixed to the connector 140, for example to its main frame 146 as shown in Fig. 5. In
25 another embodiment, as shown in Fig. 7, the fastening elements can be separate from the connector 140, and the connector may comprise means for attaching the fastening elements, for example openings 148, 149 for screws.

 The terms "top plane" and "bottom plane" as used throughout the description and claims are meant to clearly differentiate between two opposite planes of the
30 PCB. It is evident that the actual orientation of these planes in the PCB arrangement will be defined by the orientation of the PCB arrangement as a whole or as mounted in an electronic device, and the PCB arrangement can be mounted with its top plane pointing upwards, downwards or inclined with respect to the horizontal line.

CLAIMS

1. A printed circuit board (PCB) arrangement, comprising:

- a first PCB (110) with circuit paths (111) on a top plane (112),
- a second PCB (120) with circuit paths (121) on a top plane (122), partially overlapping the first PCB (110) in an overlap area (130),

characterized in that

- each of the first PCB (110) and the second PCB (120) comprises at least one opening (113-123, 114-124) situated within the overlap area (130) such that the openings (113-123, 114-124) define a passage from the top plane (122) of the second PCB (120) to the bottom plane (115) of the first PCB (110),
- wherein a connector (140) is mounted on the top plane (122) of the second PCB (120) by means of at least one fastening element (141, 142) extending through the passage defined by the openings (113-123, 114-124) and fixed to the bottom plane (115) of the first PCB, the connector (140) comprising a plurality of contact members (143) electrically coupled with the circuit paths (111, 121) of the top planes (112, 122) of the first PCB (110) and the second PCB (120).

2. The PCB arrangement according to claim 1, wherein the first PCB (110) comprises a plurality of openings (113, 114), which are coaxial with corresponding openings (123, 124) of the second PCB (120) and the connector (140) comprises a plurality of fastening elements (141, 142) extending through the passages defined by the openings (113-123, 114-124).

3. The PCB arrangement according to any of claims 1-2, wherein within the overlap area (130) the first PCB (110) and the second PCB (120) have complementary stepped edges (116, 126).

4. The PCB arrangement according to any of previous claims, wherein the top plane (112) of the first PCB (110) is coplanar with the top plane (122) of the second PCB (120).

5. The PCB arrangement according to any of claims 1-3, wherein the top planes (112, 122) of the first PCB (110) and of the second PCB (120) are parallel and not coplanar.

6. The PCB arrangement according to any of previous claims, wherein the contact members (143) of the connector (140) have a first portion (144) for contacting the circuit path (111, 121) and a second portion (145) mechanically connected with the connector frame (146), wherein the first portion (144) is resiliently movable with respect to the second portion (145).

7. The PCB arrangement according to any of previous claims, wherein the contact members (143) are made of resilient material.

8. The PCB arrangement according to any of previous claims, wherein the fastening elements (141, 142) are snap-type fasteners permanently fixed to the connector (140).

9. The PCB arrangement according to any of previous claims, wherein the connector comprises means (148, 149) for attaching of fastening elements separate from the connector (140).

10. The PCB arrangement according to any of previous claims, wherein the contact members (143) and the circuit paths (111, 121) are made of or coated by non-oxidising metal.

11. The PCB arrangement according to any of previous claims, further comprising a connector (150) mounted on the bottom plane (115) of the first PCB (110) by means of the pair of the fastening elements (141, 142) of the connector (140) mounted on the top plane (122) of the second PCB (120).

12. An electronic device comprising the PCB arrangement according to any of previous claims.

AMENDED CLAIMS

received by the International Bureau on 6 December 2012 (06.12.2012)

- 5 1. A printed circuit board (PCB) arrangement, comprising:
- a first PCB (110) with circuit paths (111) on a top plane (112),
 - a second PCB (120) with circuit paths (121) on a top plane (122), partially overlapping the first PCB (110) in an overlap area (130),
 - wherein each of the first PCB (110) and the second PCB (120) comprises at
10 least one opening (113-123, 114-124) situated within the overlap area (130) such that the openings (113-123, 114-124) define a passage from the top plane (122) of the second PCB (120) to the bottom plane (115) of the first PCB (110),
 - wherein a connector (140) is mounted on the top plane (122) of the second
15 PCB (120) by means of at least one fastening element (141, 142) extending through the passage defined by the openings (113-123, 114-124) and fixed to the bottom plane (115) of the first PCB, the connector (140) comprising a plurality of contact members (143) electrically coupled with the circuit paths (111, 121) of the top planes (112, 122) of the first PCB (110) and the second
20 PCB (120).
- characterized in that
- the connector comprises a slotted main frame (146) configured to receive in the slots contact members (143) having end portions (144) for contacting the circuit path (111, 121) and resiliently movable with respect to a middle portion (145) held between the slotted main frame (146) and a bottom part (147) of
25 the connector, wherein the slots provide clearance for resilient deformation of the contact members (143) within the main frame (146) and wherein the clearance between the bottom part (147) and the main frame (146) of the connector is larger than the middle portion (145) of the connector to allow for
30 tilting of the middle portion (145) of the contact members (143).

2. The PCB arrangement according to claim 1, wherein the first PCB (110) comprises a plurality of openings (113, 114), which are coaxial with corresponding openings (123, 124) of the second PCB (120) and the connector (140) comprises a plurality of fastening elements (141, 142) extending through the passages defined by the openings (113-123, 114-124).

3. The PCB arrangement according to any of claims 1-2, wherein within the overlap area (130) the first PCB (110) and the second PCB (120) have complementary stepped edges (116, 126).

4. The PCB arrangement according to any of previous claims, wherein the top plane (112) of the first PCB (110) is coplanar with the top plane (122) of the second PCB (120).

5. The PCB arrangement according to any of claims 1-3, wherein the top planes (112, 122) of the first PCB (110) and of the second PCB (120) are parallel and not coplanar.

6. The PCB arrangement according to any of previous claims, wherein the contact members (143) are made of resilient material.

7. The PCB arrangement according to any of previous claims, wherein the fastening elements (141, 142) are snap-type fasteners permanently fixed to the connector (140).

8. The PCB arrangement according to any of previous claims, wherein the connector comprises means (148, 149) for attaching of fastening elements separate from the connector (140).

9. The PCB arrangement according to any of previous claims, wherein the contact members (143) and the circuit paths (111, 121) are made of or coated by
5 non-oxidising metal.
10. The PCB arrangement according to any of previous claims, further comprising a connector (150) mounted on the bottom plane (115) of the first PCB (110) by means of the pair of the fastening elements (141, 142) of the connector (140)
10 mounted on the top plane (122) of the second PCB (120).
11. An electronic device comprising the PCB arrangement according to any of previous claims.

Statement under article 19(1)

Replacement pages 6a, 7a, 7b, which replace the original pages 6-7 of the International application as filed, contain amended claims under Article 19 PCT.

Claim 1 replaces the original claim 1.

Claim 6 is deleted.

Claims 7-12 are renumbered to claims 6-11.

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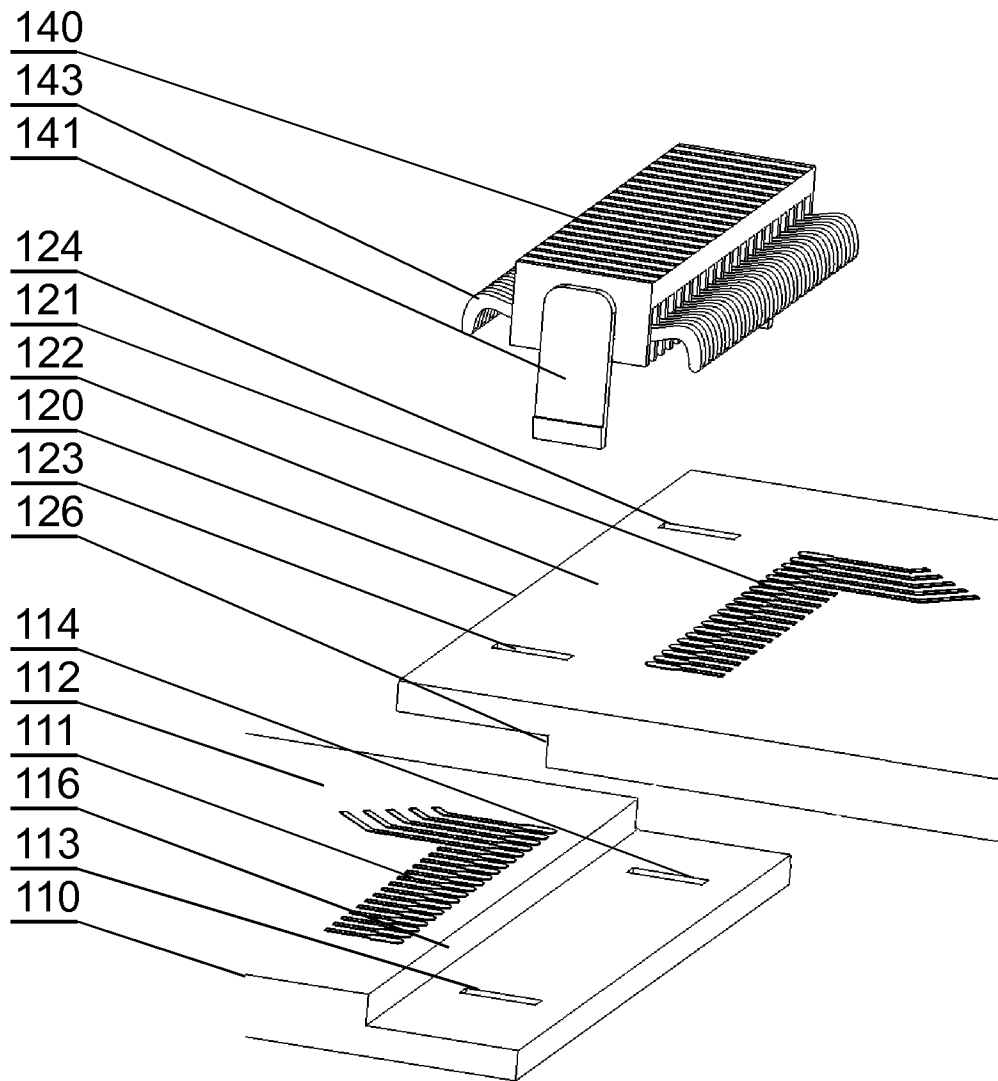


Fig. 1

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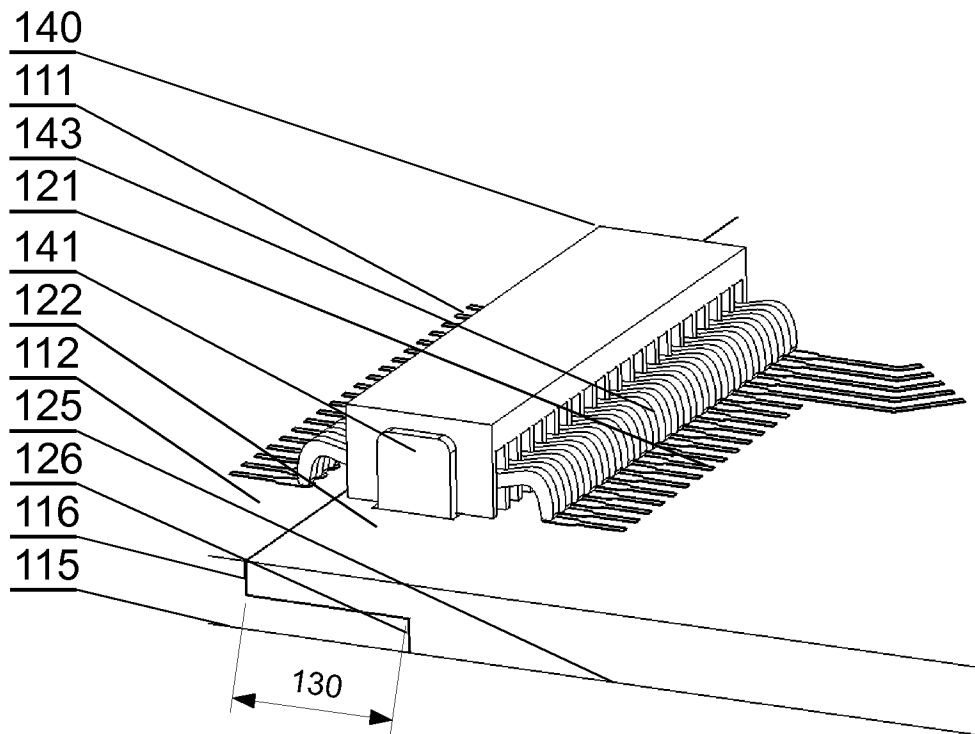


Fig. 2

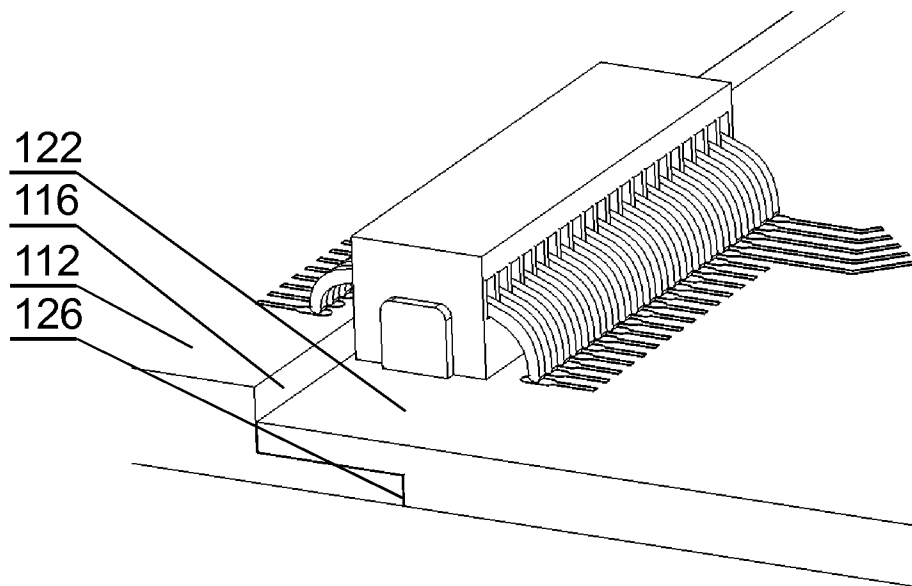


Fig. 3

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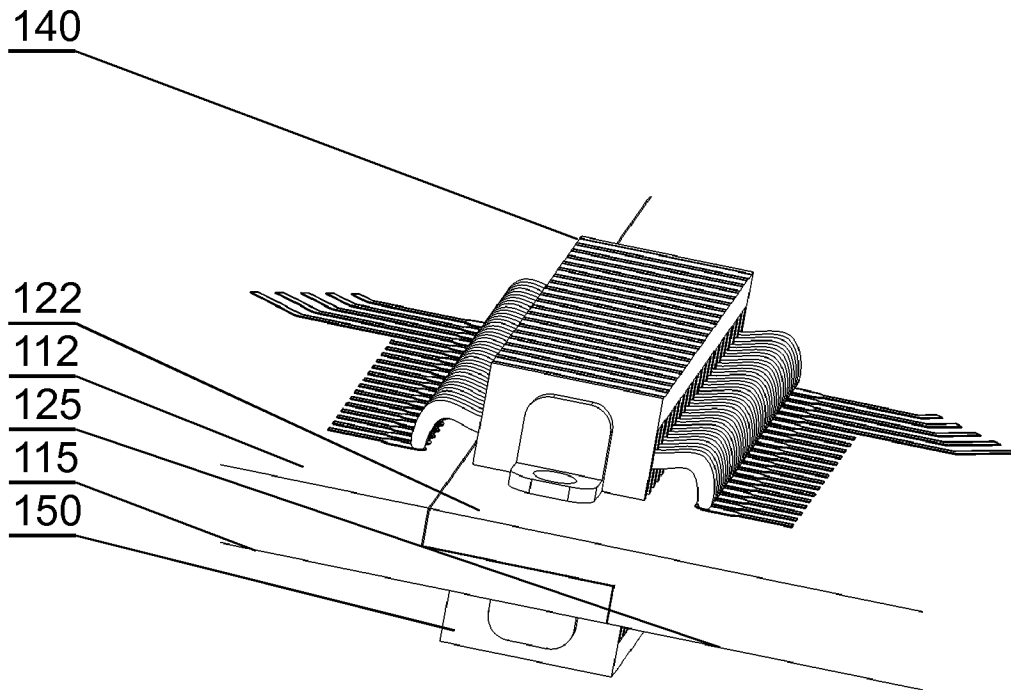


Fig. 4

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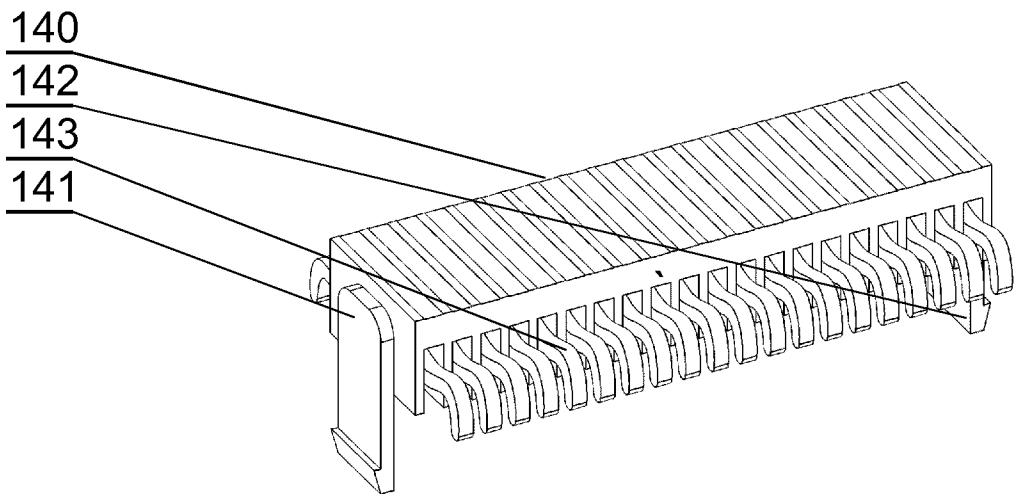


Fig. 5

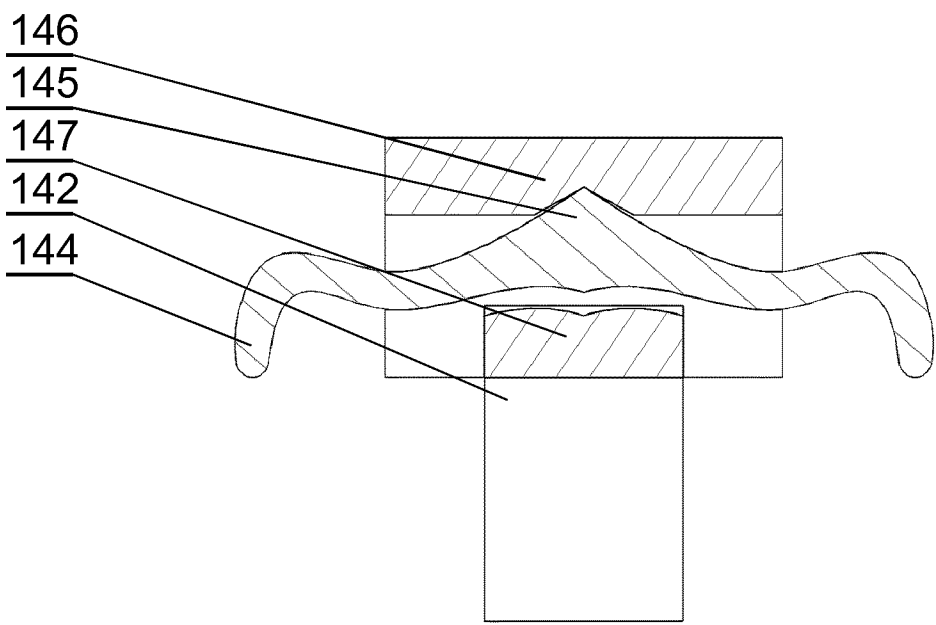


Fig. 6

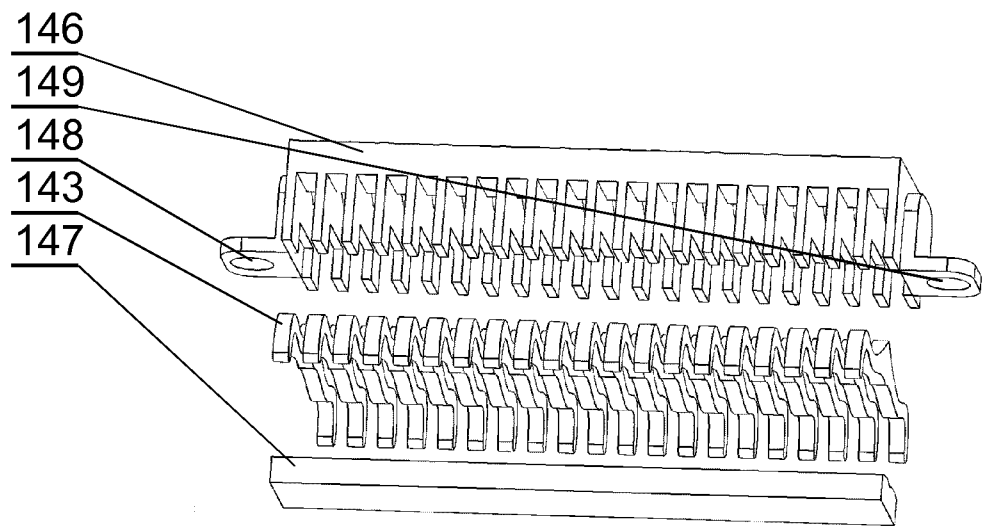


Fig. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/064880

A. CLASSIFICATION OF SUBJECT MATTER
INV. H05K1/14 H01R12/73
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H05K H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 263 868 A (RENN ROBERT M [US] ET AL) 23 November 1993 (1993-11-23)	1-5,7, 9-12
Y	abstract; figures 1-4 column 2, line 51 - column 3, line 25 -----	6-8
Y	GB 2 251 128 A (TANASHIN DENKI CO [JP]) 24 June 1992 (1992-06-24)	6-8
A	abstract; figures 1-3 -----	1-5,9-12
A	US 2010/134995 A1 (STRICKLAND JULIE N [US]) 3 June 2010 (2010-06-03) cited in the application paragraphs [0018], [0019]; figures 1-3 -----	1-12
A	DE 10 2007 039618 A1 (CONTINENTAL AUTOMOTIVE GMBH [DE]) 26 February 2009 (2009-02-26) abstract; figure 1 -----	1-12
	-/-	

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

28 September 2012

Date of mailing of the international search report

09/10/2012

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/064880

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6 109 927 A (SCHOLZ JAMES PAUL [US] ET AL) 29 August 2000 (2000-08-29) abstract; figures 1-5 page 3, lines 22-62 -----	6
A	JP 7 321152 A (CITIZEN WATCH CO LTD) 8 December 1995 (1995-12-08) abstract; figure 6 -----	1-12

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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