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(54) CONTACT ELEMENT FOR A PRINTED CIRCUIT BOARD

(57) The present invention relates to a contact element (10) for electrically connecting a printed circuit board (40) to a counter connector, the contact element has a flat body (11), comprising a solder portion (18) that protrudes from a second contact element surface (17), wherein the solder portion is defined by an indention (20) in the flat body, wherein the indention forms a plane solder surface (19) that is parallel shifted from the second contact element surface, the contact element further comprises holding arms (24) protruding from a peripheral edge (12) of the flat body, wherein the solder portion and the holding arms protrude in the same direction, perpendicular to the second contact element surface of the flat body, wherein the distal ends of the holding arms have latching means.

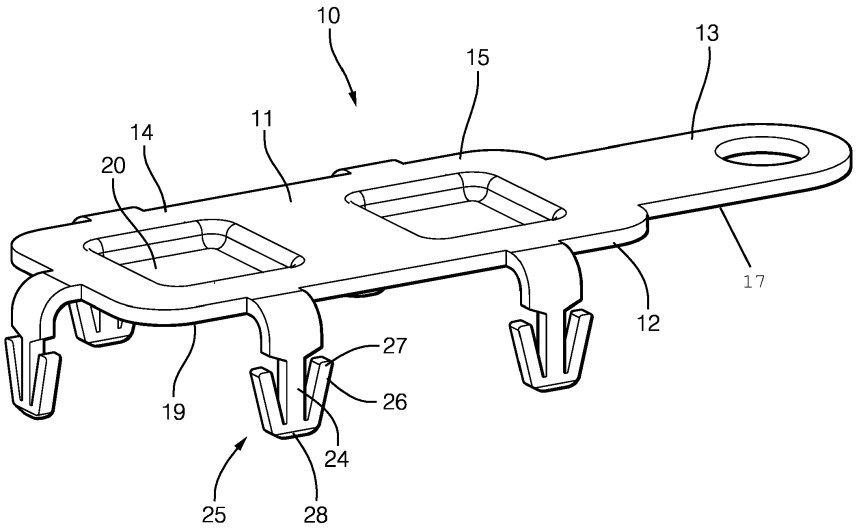

FIG. 1

EP 3 297 097 A1

Description

TECHNICAL FIELD OF INVENTION

[0001] The present invention relates to a contact element for electrically connecting a printed circuit board to a counter connector. It also relates to an electronic assembly comprising a contact element and a printed circuit board. It also relates to a method for producing the electronic assembly.

BACKGROUND OF INVENTION

[0002] While manufacturing electrical distribution boxes for electrical networks, especially in the automotive area, contact elements made of sheet metal are widely used. The contact elements are cut out the sheet metal and bent as required to fit to the design of the electrical distribution box. To connect this contact elements to a printed circuit board, pin shaped protrusions are also cut out of the sheet metal. The pin shaped protrusions are pressed into openings of the printed circuit board while assembly to connect the contact element with lead frames on the printed circuit board. This technology is flexible and inexpensive in production. One disadvantage of this technology is that production tolerances in the size of the pin shaped protrusions generate problems while inserting the pin shaped protrusions in the opening of the printed circuit board. The necessary press in force varies widely so that the process control is very difficult. To solve this problem an "eye of the needle" design was introduced to the pin shaped protrusions to make them softer while insertion. This design limited the variation in the necessary press in force but lowered the usable lead cross-section.

[0003] The increasing implementation of high power semiconductor devices in electronic boxes, especially in the automotive industry, forced the engineers to develop adapted contact elements for these boxes. The new contact elements also called bus bars have to be adapted to carry high currents and provide contact surfaces that enable low resistant connection to the printed circuit board. Furthermore the contact elements should also work as a heatsink for cooling the high powers semiconductor devices.

[0004] The object of the present invention is therefore to provide a contact element having a low electrical resistance when contacted to a printed circuit board and also cooling the semiconductor devices on the printed circuit board.

SUMMARY OF THE INVENTION

[0005] The present application relates to a contact element for connecting a printed circuit board to a counter connector, an electronic assembly comprising a contact element secured on a printed circuit board and a method for securing the contact element to the printed circuit board.

[0006] Generally preferred, the contact element is adapted for electrically connecting a printed circuit board to a counter connector. The contact element has a flat body, defining a first contact element surface and a second contact element surface opposite to the first contact element surface. A solder portion protrudes from a second contact element surface. The solder portion is defined by an indention in the flat body, wherein the indention forms a plane solder surface that is parallel shifted from the second contact element surface. The contact element further comprises holding arms protruding from a peripheral edge of the flat body. The solder portion and the holding arms protrude in the same direction, perpendicular to the second contact element surface of the flat body. The distal ends of the holding arms have latching means.

[0007] An electronic assembly comprises the contact element and a printed circuit board. The printed circuit board has a first board surface and a second board surface, wherein the first board surface has a solder pad and wherein the printed circuit board has openings. The contact element is arranged on the first board surface of the printed circuit board in that way that the solder surface is in contact with the solder pad. The holding arms protrude trough the openings, wherein the latching means secure the contact element in this position

[0008] A method to assemble an electronic assembly comprising the steps:

a) providing an contact element and a printed circuit board accordingly
b) align the contact element to the first board surface of the printed circuit board in a position so that the solder surface of the contact element is opposite the solder pad and the holding arms are aligned to the openings
c) move the contact element and/or the printed circuit board to each other until the at least one flexible leg snaps in its end position

[0009] Advantageously, the latching means have an arrow shaped structure pointing away from the flat body. The arrow shaped structure comprises at least one flexible leg that protrudes from an arrow tip toward the flat body in an angle to the holding arm that is smaller than 45°. The arrow shaped structure guides the holding arm into the opening while the operator feeds the holding arm into the opening in the printed circuit board. The flexible leg flexes toward the holding arm while passing the opening. After the arrow shaped structure has passed the opening the leg flexes back to its end position thereby looking the holding arm. The force required to bend the flexible leg is quite low so that the insertion force is also quite low while mounting the contact element to the printed circuit board. On the other hand the pull out force to separate the contact element is very high. It is unlikely, that the contact element is removed accidentally un-

locked.

[0010] According to a preferred embodiment, the solder surface is located between a pair of holding arms. Positioning the latching arms so that they are on opposite sides of the solder surface, makes sure that the solder surface is positioned flat on the solder pad of the printed circuit board.

[0011] Preferably, the solder surface is spaced from the peripheral edge of the flat body. The supply with current to the semiconductor is best when the solder surface is located in the center of the contact element, because the resistance is than the lowest caused by the biggest volume of conductive material. In addition the heat generated by the semiconductor can be distributed in the contact element that works as a heatsink.

[0012] In a preferred embodiment, the contact element is formed integrally of a piece of sheet metal. The contact element can for example be stamped out of a metal sheet that makes cheap production possible.

[0013] According to a preferred embodiment, the solder portion is stamped in the contact element. At the same time when the contact element is stamped out of for sheet metal, the solder portion can be stamped. This makes the production cheap because no additional working step is necessary.

[0014] Preferably, the contact element comprises a connector portion that is adapted to be connected to a counter contact element. The contact element connects the printed circuit board and the semiconductor to the printed circuit board. To be connected to a counter connector or counter terminal a connector portion is provided. The connector portion is adapted to the requirements of the counter connector or counter contact event.

[0015] In a preferred embodiment, a leg end of the at least one flexible leg, of the arrow shaped structure, is in flexible contact with the second board surface. The flexible leg is dimensioned in that way that the leg end abuts the second board surface of the printed circuit board. This provides a little tension between the contact element and the printed circuit board and this way force the solder surface of the contact element to the solder pad of the printed circuit board and generates good conditions for the solder process.

[0016] According to a preferred embodiment, the contact element is spaced apart from the first board surface in regions beside the solder pad. Because the contact element is formed this way it touches the first surface of the printed board only in the region of the solder pad. Air can move between the contact element and the printed board. This improves the cooling of the contact element.

[0017] Preferably, the solder surface of the contact element is at least partly soldered to the solder pad on the printed circuit board. The electrical conductivity and also the heat dissipation are improved when the solder surface is soldered to the solder pad on the printed circuit board.

[0018] In a preferred embodiment, a semiconductor device is mounted on the second board surface of the printed circuit board opposite to the solder pad on the first board surface of the printed circuit board. The position of the solder pad opposite to the semiconductor device provides the shortest way for the current and also for the heat transfer. The surfaces of the printed circuit board are connected in this area by vias.

[0019] According to a preferred embodiment, the holding arms and/or the arrow shaped structure of the contact element is at least partly soldered to a first board surface or/and second board surface of the printed circuit board. If necessary also other parts as the solder portion can be soldered to the printed circuit board. That makes it possible to use more than one current path to supply the semiconductor devises on the printed circuit board.

[0020] Preferably, the method to assemble the electronic assembly comprises additional steps:

a) the solder surface and the solder pad are pre-tinned;

d) the electronic assembly is heated to solder the solder surface and the

solder pad. The pre-tinned surfaces melt together immediately when heated and provide good electrical and thermal conductivity.

Description of the preferred embodiments

[0021] In the following, the invention is described exemplarily with reference to the enclosed figures, in which

Fig. 1	shows perspective view of a contact element in accordance with the present invention;
Figs. 2	shows perspective view of a second board surface of a printed circuit board in accordance with the present invention;
Fig. 3	shows perspective view of a first board surface of a printed circuit board in accordance with the present invention;
Fig. 4	shows perspective view of a contact element assembled to the printed circuit board in accordance with the present invention;
Fig. 5	shows a cut view of the assembly shown in Fig. 4 with the cut along line C;
Fig. 6	shows a detailed cut view of the assembly shown in Fig. 4 with the cut along line D;
Fig. 7a-7c	shows the behavior of the arrow shaped structure while assembling that contact element to the printed circuit board;
Fig. 8	shows a side view of the assembly shown

in Fig. 4

[0022] Figure 1 shows a perspective view of a contact 10 for electrically connecting a printed circuit board 40 to a counter connector, the contact element 10 has a flat body 11, comprising a solder portion, the solder portion is defined by an indention 20 in the flat body 11. At one end of the contact element 10 a connector portion 13 is formed, that is adapted to be connected to a counter contact element. The contact element 10 further comprises holding arms 24 protruding from a peripheral edge 12 of the flat body 11. The solder portion and the holding arms 24 protrude in the same direction, perpendicular to a second contact element surface of the flat body 11. The flat body 11 defines a first contact element surface 15 opposite to the second contact element surface. In figure 1 the first contact element surface 15 is shown as an upper contact element surface and the second contact element surface 17 is shown as a lower contact element surface. The second contact element surface 17 is facing towards a printed circuit board 40. The distal ends of the holding arms 24 have latching means which have an arrow shaped structure 25, pointing away from the flat body 11. The arrow shaped structure 25 comprise at least one flexible leg 26 that protrudes from an arrow tip 28 toward the flat body 11 in an angle to the holding arm 24 that is smaller than 45°. The contact element 10 is formed integrally of a piece of sheet metal.

[0023] Figure 2 shows a second board surface 44 of the printed circuit board 40. Semiconductor devises 47 are mounted on the second board surface 44. Openings 48 in the printed circuit board 40 are arranged beside the semiconductor devices 47.

[0024] Figure 3 shows a first board surface 42 of a printed circuit board 40. Solder pads 45 are attached on the first board surface 42. Openings 48 in the printed circuit board 40 are arranged beside the solder pads 45.

[0025] Figure 4 shows an electronic assembly 100 comprising the contact element 10 and a printed circuit board 40. The contact element 10 is arranged on the first board surface 42 of the printed circuit board 40 in that way that the holding arms 24 protrude trough the openings 48 in the printed circuit board 40. The latching means secure the contact element 10 in this position.

[0026] Figure 5 shows that contact element 10 in the cut view. The indention 20 deforms the sheet metal and defines a solder portion 18 that protrudes from the second contact element surface 17. The surface of the solder portion 18 defines a solder surface 19. The solder surface 19 is parallel shifted from the second contact element surface 17. The solder surface 19 of the contact element 10 is in contact with the solder pad 45 of the printed circuit board 40 when the contact element 10 is assembled to the printed circuit board 40. The holding means hold the contact element 10 tightly to the printed circuit board 40. The semiconductor devices 47 are arranged on the second board surface 44 opposite the solder surface 19 of the contact element 10.

[0027] Figure 6 shows a detailed cut view of the assembly shown in figure 5. After assembly, the leg end 27 of the flexible leg 26, of the arrow shaped structure 25, protrudes against the second board surface 44 of the printed circuit board 40. Depending on the requirements of the electronic assembly 100, the flexible leg 26 can be designed more flexible or rigid. The solder surface has a high shift 23 to the second contact element surface 17. Due to this the second contact element surface 17 is spaced apart from the first board surface 42 outside the solder portion 18. This enables air flow between the first board surface 42 and the second contact element surface 17, which improves cooling ability.

[0028] Figure 7a-7c shows the insertion of the arrow shaped structure 25 into the opening 48 of the printed circuit board 40 while assembling the contact element 10 to the printed circuit board 40. In this embodiment with two flexible legs 26, the two flexible legs flex toward the holding arm 24 to fit through the opening 48. After passing the opening 48 the flexible legs 26 flex back so that the leg ends 27 protrude to the second board surface 44 close to the opening 48.

[0029] Figure 8 shows a side view of the electronic assembly 100 in a side view. The contact element 10 is spaced apparat from the printed circuit board 40 in regions beside the solder pad pads 45. Air flow is passible between areas of contact element 10 and printed circuit board 40.

Claims

1. A contact element (10) for electrically connecting a printed circuit board (40) to a counter connector, the contact element has a flat body (11) defining a first contact element surface (15) and a second contact element surface (17) opposite to the first contact element surface, wherein a solder portion (18) protrudes from the second contact element surface (17), wherein the solder portion is defined by an indention (20) in the flat body, wherein the indention forms a plane solder surface (19) that is parallel shifted from the second contact element surface, the contact element further comprises holding arms (24) protruding from a peripheral edge (12) of the flat body, wherein the solder portion and the holding arms protrude in the same direction, perpendicular to the second contact element surface of the flat body, wherein the distal ends of the holding arms have latching means.

2. The contact element (10) according to claim 1, **characterized by** the latching means having an arrow shaped structure (25), pointing away from the flat body (11) wherein the arrow shaped structure comprise at least one flexible leg (26) that protrudes from an arrow tip (28) toward the flat body in an angle to the holding arm (24) that is smaller than 45°.

3. The contact element (10) of any of the preceding claims, **characterized by** the solder surface (19) being located between a pair of holding arms (24).

4. The contact element (10) of any of the preceding claims, **characterized by** the solder surface (19) being spaced from the peripheral edge (12) of the flat body (11).

5. The contact element (10) of any of the preceding claims, **characterized by** the contact element being formed integrally of a piece of sheet metal.

6. The contact element (10) of any of the preceding claims, **characterized by** the solder portion (18) being stamped in the contact element.

7. The contact element (10) of any of the preceding claims, **characterized by** the contact element comprising a connector portion (13) that is adapted to be connected to a counter contact element.

8. An electronic assembly (100) comprising the contact element (10) according of any of the preceding claims and a printed circuit board (40) comprising a first board surface (42) and a second board surface (44), wherein the first board surface has a solder pad (45) and wherein the printed circuit board has openings (48), the contact element is arranged on the first board surface of the printed circuit board in that way that the solder surface (19) is in contact with the solder pad (45) and the holding arms (24) protrude trough the openings (48), wherein the latching means secure the contact element in this position.

9. An electronic assembly (100) according to claim 8, **characterized by** a leg end (27) of the at least one flexible leg (26) of the arrow shaped structure (25), being in flexible contact with the second board surface (44).

10. An electronic assembly (100) according to claims 8-9, **characterized by** that the contact element (10) is spaced apart from the first board surface (42) in regions beside the solder pad (45).

11. An electronic assembly (100) according to claims 8-10, **characterized by** the solder surface (19) of the contact element being at least partly soldered to the solder pad (45) on the printed circuit board (40).

12. An electronic assembly (100) according to claims 8-11, **characterized by** a semiconductor device (47) being mounted on the second board surface (44) of the printed circuit board (40) opposite to the solder pad (45) on the first board surface (42) of the printed circuit board.

13. An electronic assembly (100) according to claims 8-13, **characterized by** the holding arms (24) and/or the arrow shaped structure (25) of the contact element (19) being at least partly soldered to a first board surface (42) or/and second board surface (44) of the printed circuit board (40).

14. A method to assemble an electronic assembly according to claims 8-13, wherein the method comprises the steps as follows:

    a) providing a contact element (10) according claims 1-7 and a printed circuit board (40) according claims 8-13
    b) align the contact element to the first board surface (42) of the printed circuit board in a position so that the solder surface (19) of the contact element is opposite the solder pad (45) and the holding arms (24) are aligned to the openings (48)
    c) move the contact element and/or the printed circuit board towards each other until the at least one flexible leg (26) snaps in its end position.

15. Method to assemble an electronic assembly according to claims 8-13, **characterized in that** in step a) the solder surface (19) and the solder pad (45) are pre-tinned and in a step d) the electronic assembly (100) is heated to solder the solder surface (19) and the solder pad (45).

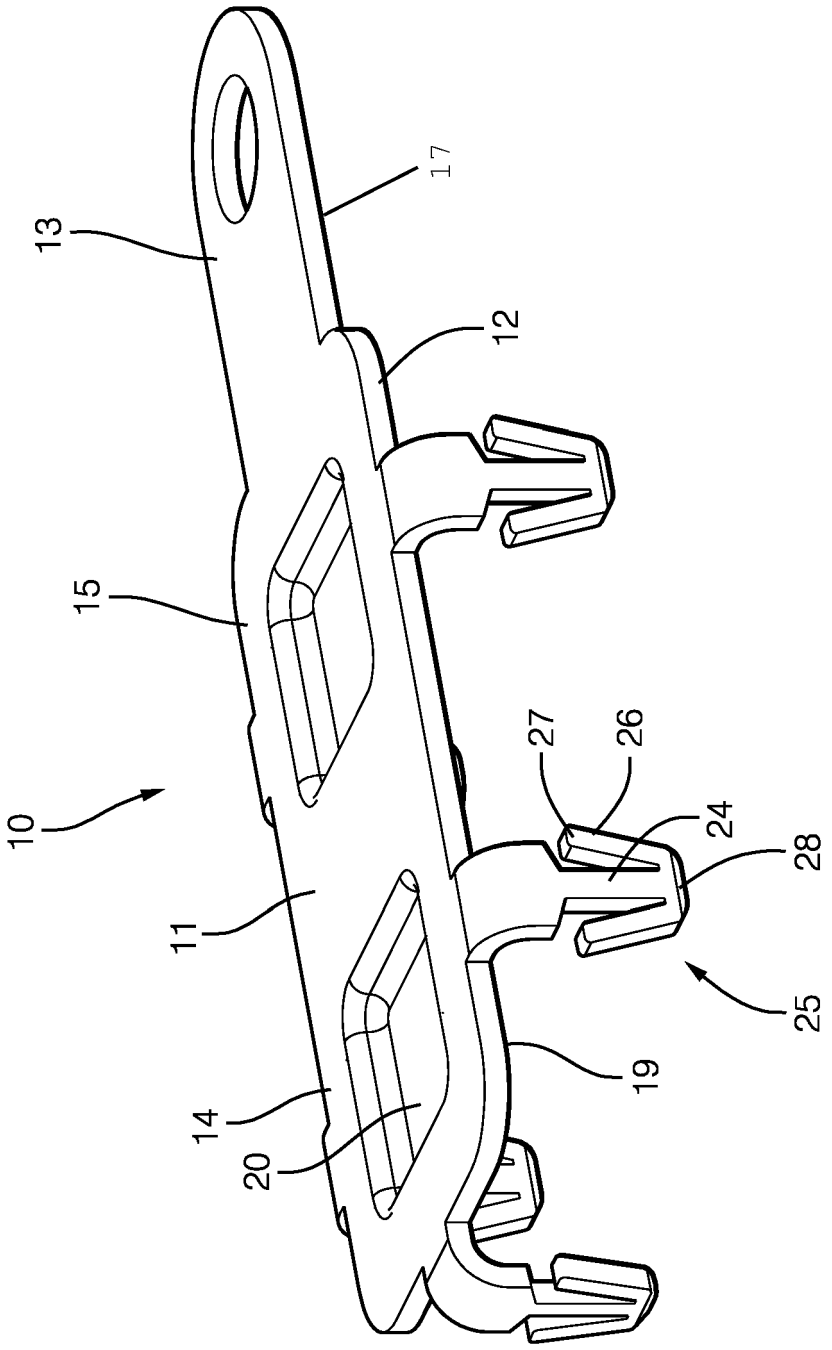

FIG. 1

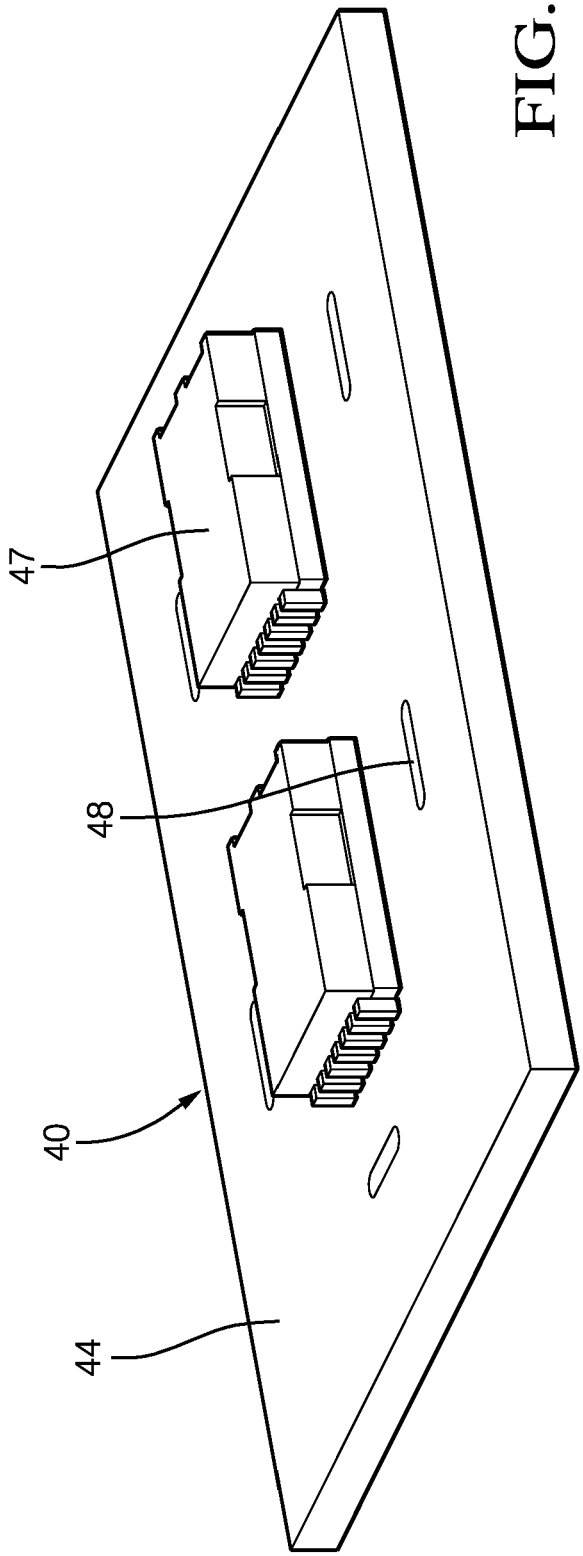

FIG. 2

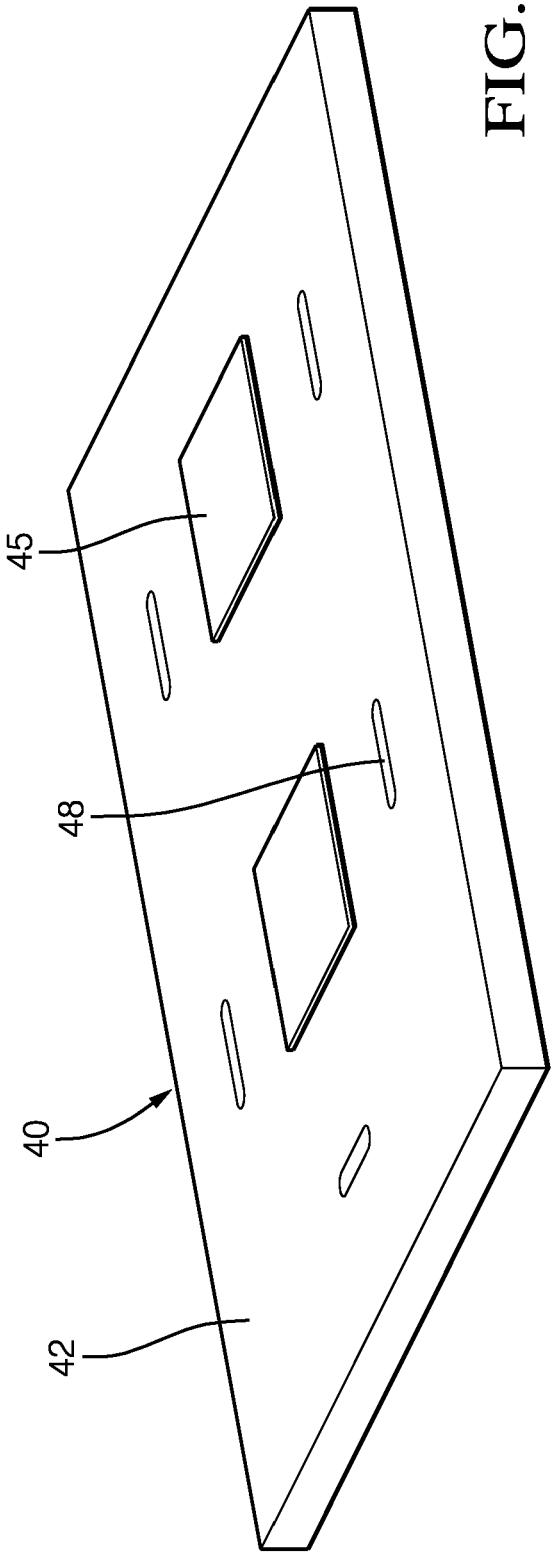

FIG. 3

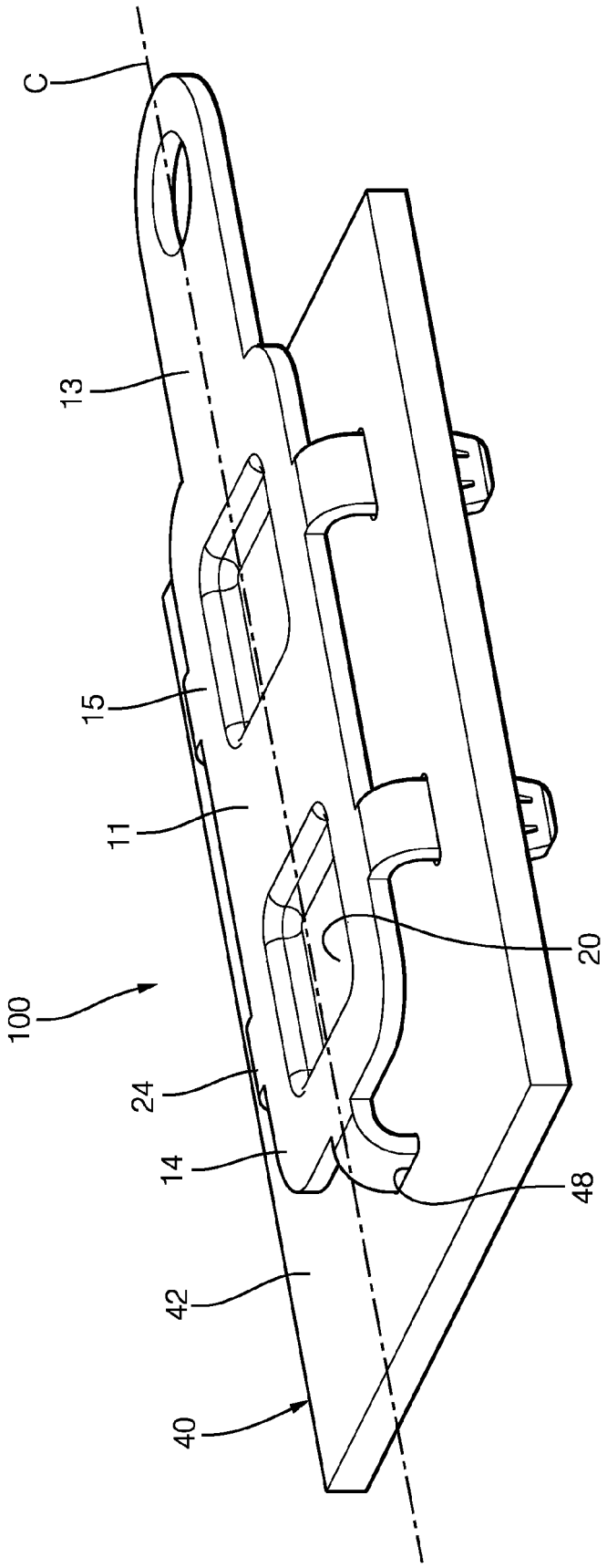

FIG. 4

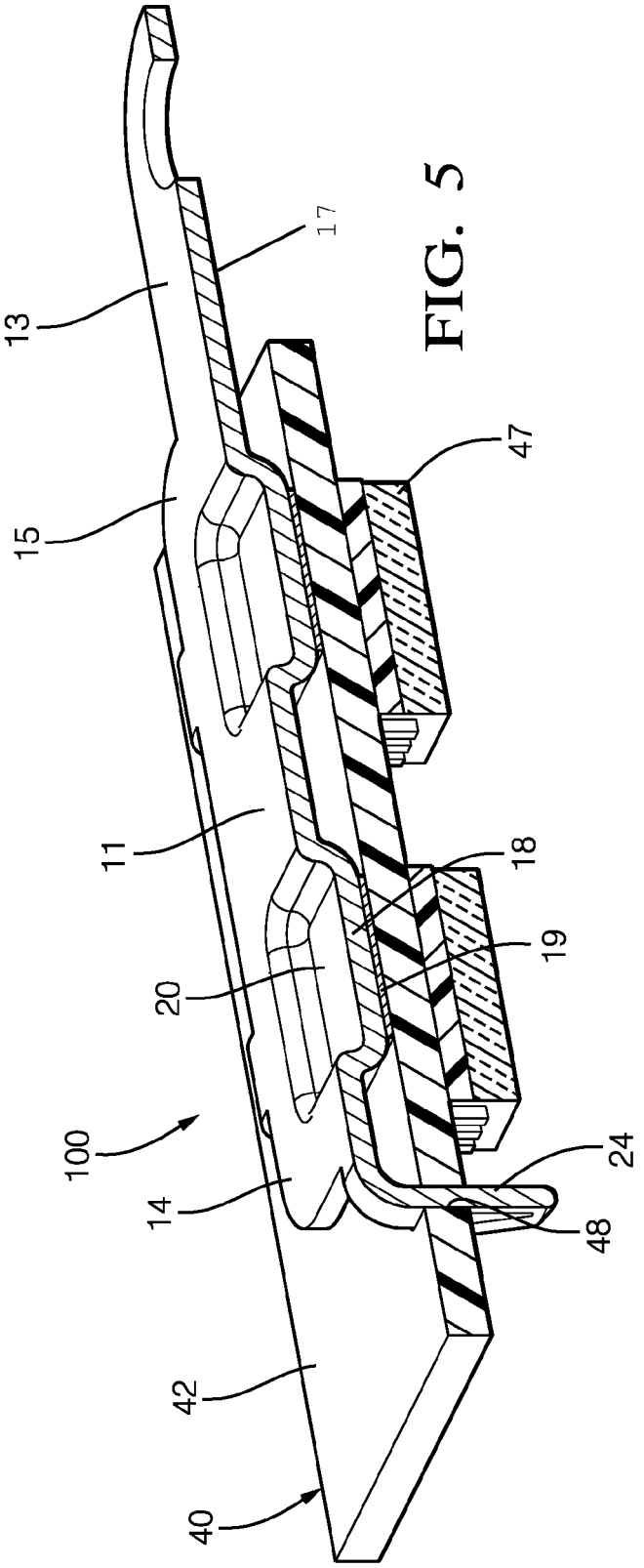

FIG. 5

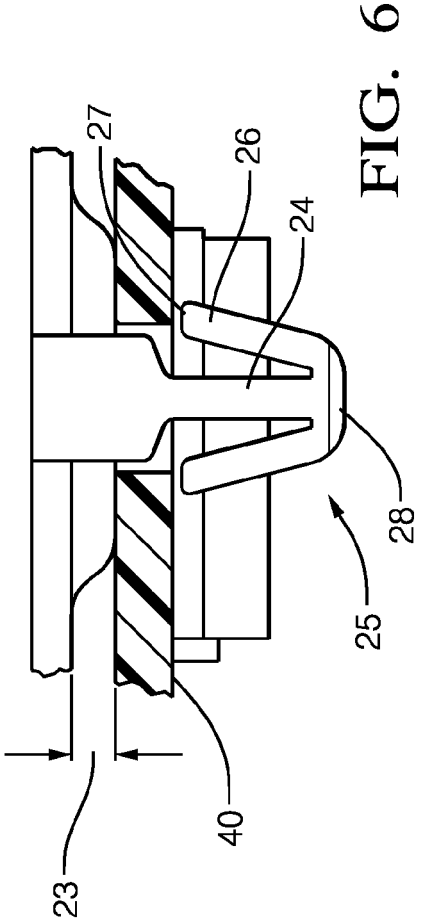

FIG. 6

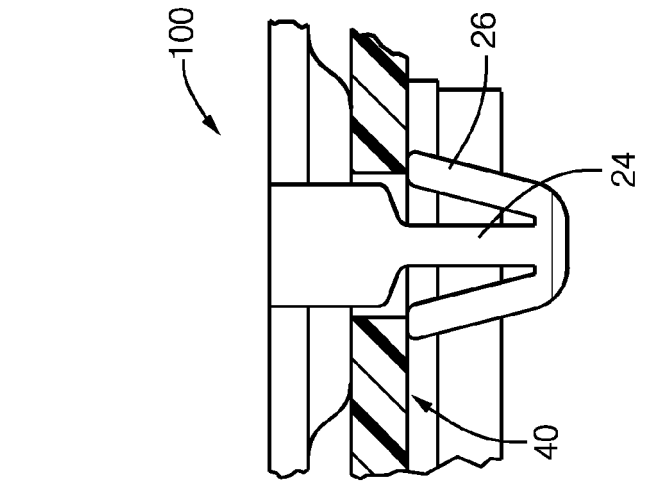

FIG. 7c

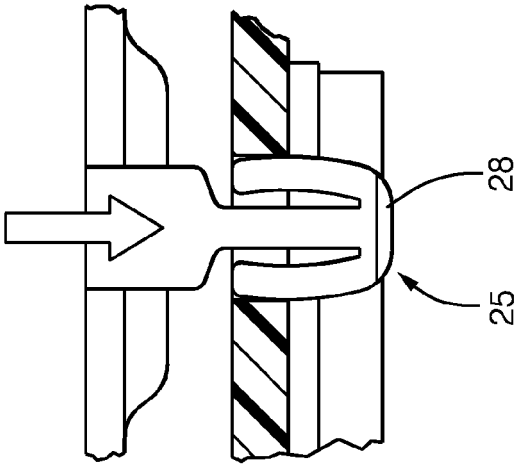

FIG. 7b

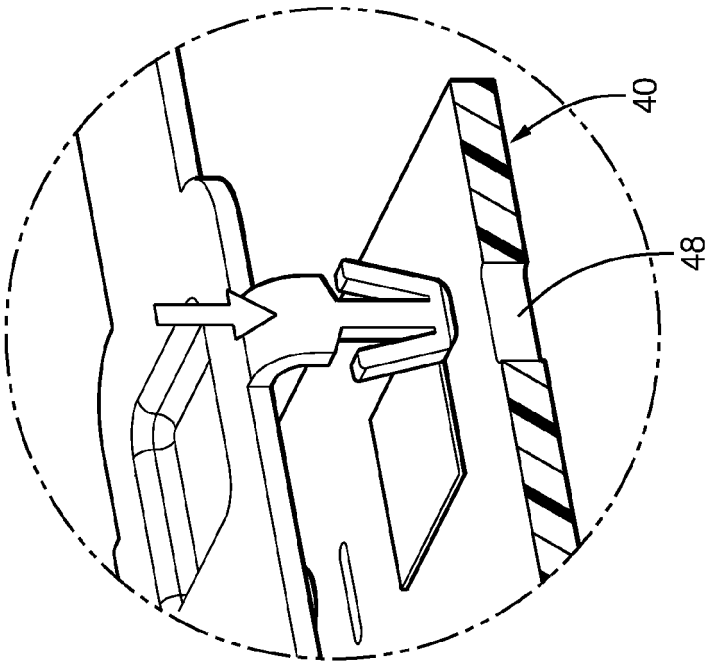

FIG. 7a

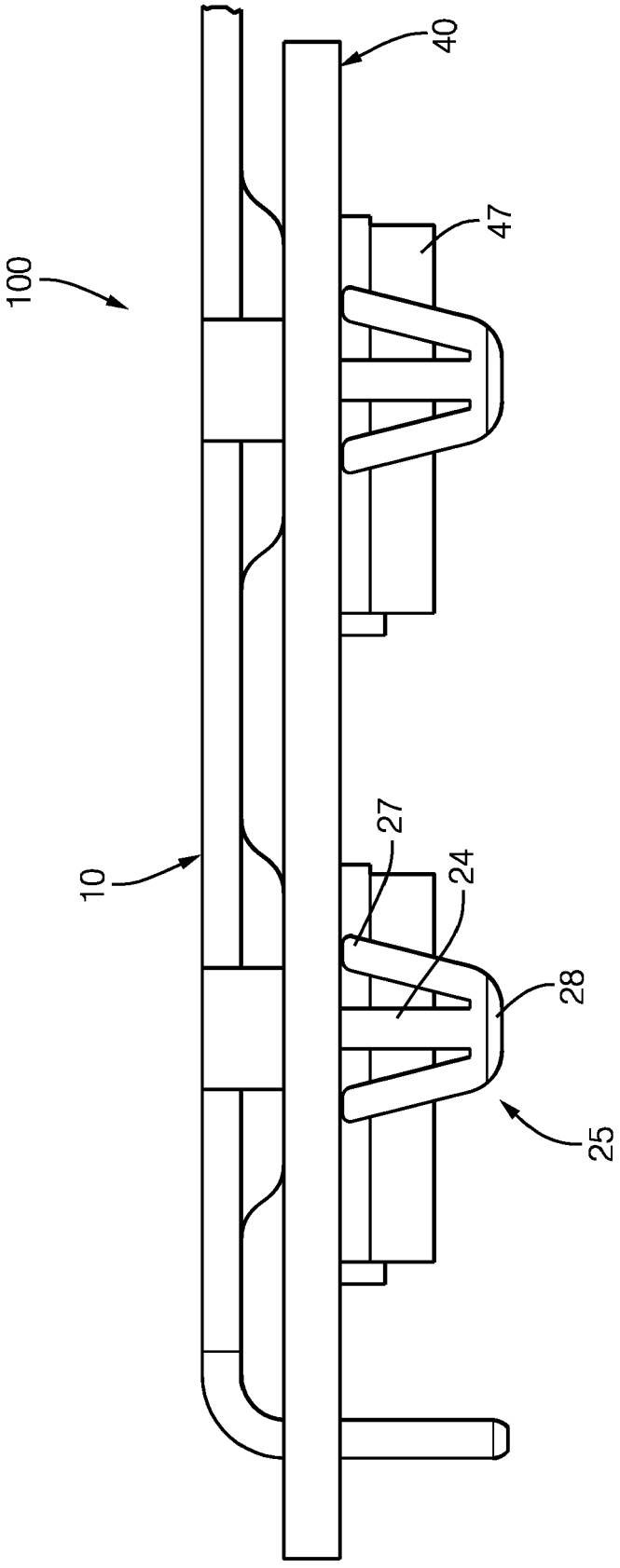

FIG. 8

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EUROPEAN SEARCH REPORT

Application Number
EP 16 18 9267

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	US 4 037 898 A (GUYETTE EDWARD L) 26 July 1977 (1977-07-26) * column 2, lines 7-64, column 3, lines 13-16; figures 1-7 *	1,3-15 2	INV. H01R12/57 H01R12/58 H01R12/71
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TECHNICAL FIELDS SEARCHED (IPC)

H01R
H05K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	15 March 2017	López García, Raquel

CATEGORY OF CITED DOCUMENTS

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