



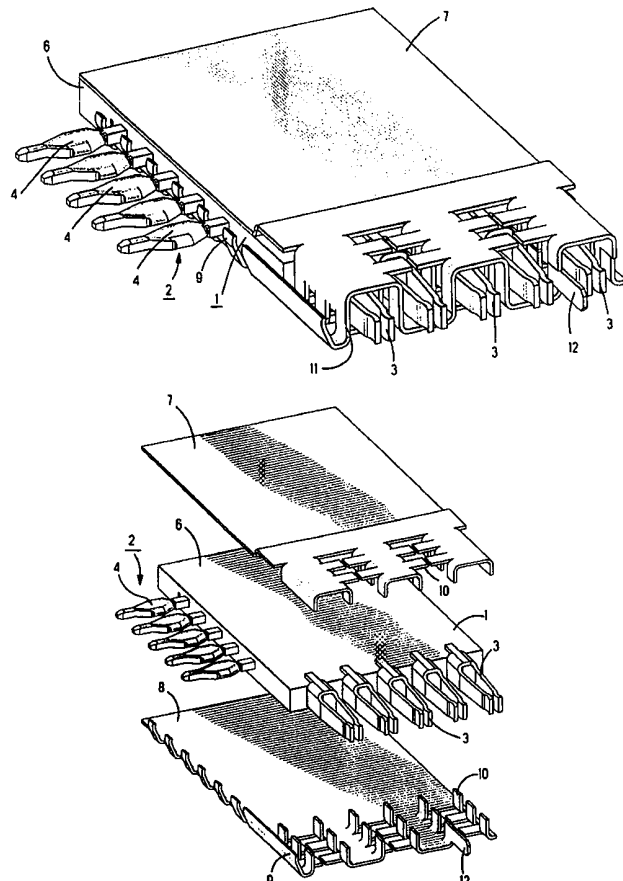
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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| <p>(51) International Patent Classification <sup>6</sup> :<br/><b>H01R 13/658, 23/68 // 13/648, 9/09</b></p>  | <p><b>A1</b></p>  | <p>(11) International Publication Number: <b>WO 99/26321</b><br/>(43) International Publication Date: 27 May 1999 (27.05.99)</p> |
| <p>(21) International Application Number: PCT/IB98/01823<br/>(22) International Filing Date: 13 November 1998 (13.11.98)<br/>(30) Priority Data:<br/>97120256.9 19 November 1997 (19.11.97) EP<br/>(71) Applicant (for all designated States except US): THE WHITAKER CORPORATION [US/US]; Suite 450, 4550 New Linden Hill Road, Wilmington, DE 19808 (US).<br/>(72) Inventors; and<br/>(75) Inventors/Applicants (for US only): DE BLIECK, Roland, Tristan [NL/NL]; Purperbeer 30, NL-5345 ET Oss (NL). WIEKAMP, Jan, Hendrik, Ate [NL/NL]; Hinthamereinde 45, NL-5211 PM 's-Hertogenbosch (NL).<br/>(74) Agents: HEINZ-SCHAEFER, Marion et al.; AMP International Enterprises Ltd., AMPèrestrasse 3, CH-9323 Steinach (CH).</p> | <p>(81) Designated States: AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p><b>Published</b><br/>With international search report.</p> |  |

(54) Title: SHIELDED ELECTRICAL CONNECTOR

(57) Abstract

The invention relates to an electrical plug-in connector with electrical terminal elements (2) which have contact portions (3) for the contacting of complementary contacts which have terminal portions (4) for connection with an electrical conductor, for example on a printed circuit board, and which have intermediate portions which connect the contact portions (3) to the terminal portions (4). The terminal elements (2) are combined in columns to form terminal subassemblies (1). The intermediate portions are fastened in or on an insulating rib (6) and the contact portions protrude out of the rib (6). The connector also has a shielding element (7, 8) which shields the individual terminal subassemblies (1) from one another. A cage-like shield (11) which surrounds at least one contact portion (2) and is connected to the shielding element (7, 8) between the terminal subassemblies (1) is provided.



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SHIELDED ELECTRICAL CONNECTOR

The invention relates to a shielded electrical plug connector with electrical terminal elements which have  
5 contact portions for the contacting of complementary contacts, the contact portions protruding out of an insulating housing.

The invention also relates to an electrical plug connector with electrical terminal elements which have  
10 contact portions for the contacting of complementary contacts, which have terminal portions for connection with an electrical conductor, for example on a printed circuit board, and which have intermediate portions which connect the contact portions to the terminal portions,  
15 the terminal elements are combined in columns to form terminal subassemblies, the intermediate portions are fastened in or on an insulating rib and the contact portions protrude out of the rib, and with a shield which shields the individual terminal subassemblies from one  
20 another.

EP 422 785 B1 discloses an impedance-matched rear-panel plug connector. This is a rectangular electrical connector with an insulating housing with pin-receiving openings in a front contact side of the housing, for  
25 receiving contact pins of a complementary connector. The pin-receiving openings are in connection with pin-receiving passages which extend to a rear side of the housing. The openings and the passages are arranged in a group of columns and rows. Furthermore, the electrical  
30 connector has electrical terminals with contact portions arranged in the pin-receiving passages, terminal portions for connection with a printed circuit board and intermediate portions which connect the contact portions and the terminal portions. The electrical terminals are

combined in columns to form terminal subassemblies. The intermediate portions of one terminal subassembly are enclosed within a moulded insulating rib. The terminal subassemblies are arranged against the insulating housing in a position in which they lie next to one another with the contact portions in the pin-receiving passages of the insulating housing. Shielding elements may be arranged between the terminal subassemblies or between the insulating ribs in order to prevent crosstalk between neighbouring columns of terminals.

In order to minimize crosstalk in the plug connector, however, further measures may be of use. It is the object of the invention to indicate such further measures.

The object is achieved by an electrical connector with the features of Patent Claim 1 or 2. Advantageous developments are specified in the subclaims.

In order to reduce crosstalk within a plug connector, it is necessary to shield the terminals from one another, at least in certain regions. In the case of the present invention, for example, a terminal subassembly is shielded on two sides by a shielding element in the region of the rib, the shielding elements merge with cage-like shields that surround the terminal portions of the terminals. Therefore, a closed shield, which can be connected by means of resilient elements to earth potential on a printed circuit board, is produced around the terminal portions.

Depending on the application, it may be necessary to surround a single terminal with a cage-like shield or enclose terminals in pairs with a common cage-like shield. These pairs may either be formed within one terminal subassembly or between neighbouring terminal subassemblies. Also, if the intermediate portions of the

terminals of one terminal subassembly are surrounded by an insulating rib, it is possible that this rib has, alongside the intermediate portions, grooves into which may be received further shielding parts, which are  
5 connected to the cage-like shield to shield the intermediate portions of the neighbouring terminals from one another.

Exemplary embodiments of the invention are now to be explained with reference to the figures, in which:

10 Figure 1 shows a perspective view of a terminal subassembly according to the present invention;

Figure 2 shows another perspective view of the same terminal subassembly;

15 Figure 3 shows an exploded representation of the terminal subassembly with the shielding elements;

Figure 4 shows an assembled perspective view of an alternative embodiment of the present invention;

Figure 5 shows a partially assembled perspective view of the pair of subassemblies shown in Figure 4;

20 Figure 6 shows a perspective view of a cage-like shield portion for a pair of contact portions of the assembly of Figure 4;

Figure 7 shows a perspective view of a cage-like shield portion for one contact portion of the assembly of  
25 Figure 4;

Figure 8 shows a perspective view of a cage-like shield portion for two contact portions of the assembly of Figure 4;

Figure 9 shows a partially exploded representation  
30 of another embodiment of a terminal subassembly according to the present invention with alternative shielding elements;

Figure 10 shows the assembled arrangement of the terminal subassembly of Figure 9;

Figure 11 shows yet another embodiment of a terminal subassembly according to the present invention in an exploded representation with an alternative cage-like shield and a further shielding part; and

5 Figure 12 shows the assembled arrangement corresponding to Figure 11.

Figures 1 to 3 illustrate a terminal subassembly 1 which has five terminals 2, that each have a contact portion 3, a terminal portion 4 and an intermediate  
10 portion (which cannot be seen in the drawings) that connects the contact portion 3 to the terminal portion 4. The contact portions 3 have, in the present example, two opposite contact spring arms for the contacting of a contact pin or contact blade. A different design of  
15 contact portions 3 is conceivable. The terminal portions 4 have a press-in region 5, for pressing into a plated through hole in a circuit board. A different design of the terminal portions 4 is also quite possible.

The intermediate portions are surrounded in the  
20 present example by an insulating rib 6. The insulating rib 6 keeps the terminal elements 2 in the prescribed arrangement. The rib 6 may be produced, for example, by encapsulating the terminals 2 by injection moulding. The terminals 2 may, however, also be located in  
25 corresponding channels in a prefabricated moulded part, which the rib 6 represents.

Associated with the terminal subassembly 1 are two shielding elements 7 and 8. One such shielding element  
7, 8 is arranged on each side of the rib 6. The  
30 shielding element 8 has, along a side which corresponds to the terminal portions 4, resilient elements 9 for contacting corresponding regions on the circuit board. On the side of the shielding elements 7, 8 corresponding to the contact portions 3, the shielding elements 7, 8

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have punched-out lugs 10, some of which have been bent out of the plane of the shielding element 7, 8 by 90°. On an alternate basis, the next lug is located in the plane of the shielding element 7, 8. This achieves the effect that, when shielding elements 7, 8 are joined together, around each contact portion 3 there is produced a cage-like shield 11, which is formed by the lugs 10.

By means of the cage-like shields 11, each individual contact portion 3 can be shielded from the next. As a result, the crosstalk between the individual terminals 2 of a terminal subassembly 1 can be reduced. In order to establish particularly good contacting of the shielding with shielding of a complementary connector (not shown), it is possible to provide on a lug 10 a contact blade 12 which would contact the corresponding shielding of the complementary connector.

In the exemplary embodiment of Figures 1 to 3, the shielding elements 7, 8 are produced as punched parts from a metal sheet. The cage-like shields 11 for the contact portions 3 are formed as one part with the shielding elements 7, 8. This makes the production of the cage-like shield particularly easy.

A further exemplary embodiment of the invention is represented in Figures 4 to 8. Here, two terminal subassemblies 1' and 1'', which are arranged next to one another, are represented. The terminal subassemblies 1' and 1'' have terminals with contact portions 3 and terminal portions 4, as in the case of the previous exemplary embodiment. However, here the shielding elements are in the form of a metallized coating 7' on the rib 6. The rib 6 may, for example, be made in the form of a circuit board on which the intermediate portions of the terminals are in the form of a metallized coating thereupon as circuit traces on which the contact

portions 3 and terminal portions 4 are fastened by soldering processes. The rib 6 thus corresponds in this case to a printed circuit board which, for shielding, is coated with a metallized coating 7' which acts as a shielding element.

In this embodiment, the cage-like shields 11, 11', 11'' are made of punched parts, as represented in Figures 6 to 8. These punched parts have contact prongs 13, which would be soldered to the metallized surface 7'. This may take place, for example, by the SMD (Surface Mounted Device) technique. As can be seen particularly clearly in Figure 4, it is then possible to surround individual contact portions with a cage-like shield 11, to surround two contact portions of one terminal subassembly 1'' with a cage-like shield 11' or to surround two contact portions 3 of two terminal subassemblies 1', 1'' with a cage-like shield 11''.

A further exemplary embodiment, similar to the exemplary embodiment of Figures 1 to 3, is represented in Figures 9 and 10. There can again be seen a terminal subassembly 1 with terminals with contact portions 3 and terminal portions 4, the intermediate portion of which is surrounded by an insulating rib 6. Provided on two sides of the insulating rib 6 are shielding elements 7 and 8, which have on the side with the contact portions further shields 11 surrounding each a pair of contact portions 3.

A further exemplary embodiment of the invention can be seen in Figures 11 and 12. Here too, a terminal subassembly 1 has terminals with contact portions 3 and terminal portions 4. One of the contact portions 3 is surrounded by a cage-like shield 11, which continues into shielding parts 14, which engage into grooves 15 on both sides of the rib 6 and surround an intermediate portion of a terminal element almost completely. This makes it

possible also to shield the individual intermediate portions of the terminals of a terminal subassembly from one another. It is even conceivable to create a coaxial line in this way.

- 5 The individual terminal subassemblies may be combined by parallel arrangements to form a plug-in connector.

CLAIMS

1. Electrical connector with electrical terminal elements (2) that have contact portions (3) for the contacting of complementary contacts, the contact portions protruding out of an insulating housing, characterized in that a cage-like shield (11) that surrounds at least one contact portion (3) and is connected to a given potential is provided.
- 10
2. Electrical connector with electrical terminal elements (2) that have contact portions (3) for the contacting of complementary contacts, that have terminal portions (4) for connection with an electrical conductor, for example on a printed circuit board, and that have intermediate portions which connect the contact portions (3) to the terminal portions (4), the terminal elements (2) being combined in columns to form terminal subassemblies (1), the intermediate portions being fastened in or on an insulating rib (6) and the contact portions protruding out of the rib (6), and with at least one shielding element (7, 8) that shields the individual terminal subassemblies (1), characterized in that a cage-like shield (11) which surrounds at least one contact portion (3) and is connected to at least one shielding element (7, 8) is provided.
- 20
3. Electrical connector according to one of Claims 1 or 2, characterized in that the cage-like shield (11) is formed as one part with the shielding element (7, 8) between the terminal subassemblies (1).
- 30
4. Electrical connector according to one of Claims 1 to 3, characterized in that a plurality of terminal

subassemblies (1, 1', 1'') are combined in the electrical plug-in connector.

5. Electrical connector according to one of Claims 1 to 4, characterized in that each contact portion (3) is surrounded by a cage-like shield (11).

6. Electrical connector according to Claim 5, characterized in that two contact portions (3) of one terminal subassembly (1, 1', 1'') are surrounded by a common cage-like shield (11).

7. Electrical connector according to one of Claims 4 or 5, characterized in that two contact portions (3) of neighbouring terminal subassemblies (1, 1', 1'') are surrounded by a common cage-like shield (11).

8. Electrical connector according to one of Claims 1 to 7, characterized in that the shielding element (7, 8) and the cage-like shield (11) are produced from a metal sheet by punching and bending.

9. Arrangement according to one of Claims 1 to 7, characterized in that the intermediate portions are formed on a printed circuit board, in that the shielding elements (7') between the individual terminal subassemblies (1', 1'') are made in the form of a corresponding conductive coating on this printed circuit board and in that the cage-like shield (11) is made in the form of parts punched and bent from metal sheet which are connected to the conductive coating.

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10. Electrical connector according to Claim 9, characterized in that the cage-like shields (11) are formed as surface-solderable parts (SMD parts).

5 11. Electrical connector according to one of Claims 1 to 8, characterized in that the intermediate portions are incorporated into an insulating rib (6), in that the insulating rib (6) has grooves (15) alongside the intermediate portions in such a way that on the cage-like  
10 shield (11') there are provided for the individual intermediate portions further shielding parts (14), which shield the intermediate portions from one another.

12. Electrical connector according to one of Claims 1 to  
15 11, characterized in that the shielding elements (7, 8, 7') between the individual terminal subassemblies (1, 1', 1'') have resilient elements (9) which engage around the insulating rib (6) and by which a given potential on a printed circuit board can be contacted.

20

13. Electrical connector according to one of Claims 1 to 12, characterized in that at least one cage-like shield (11) has a contact blade (12) for contacting the shield of a complementary plug-in connector.

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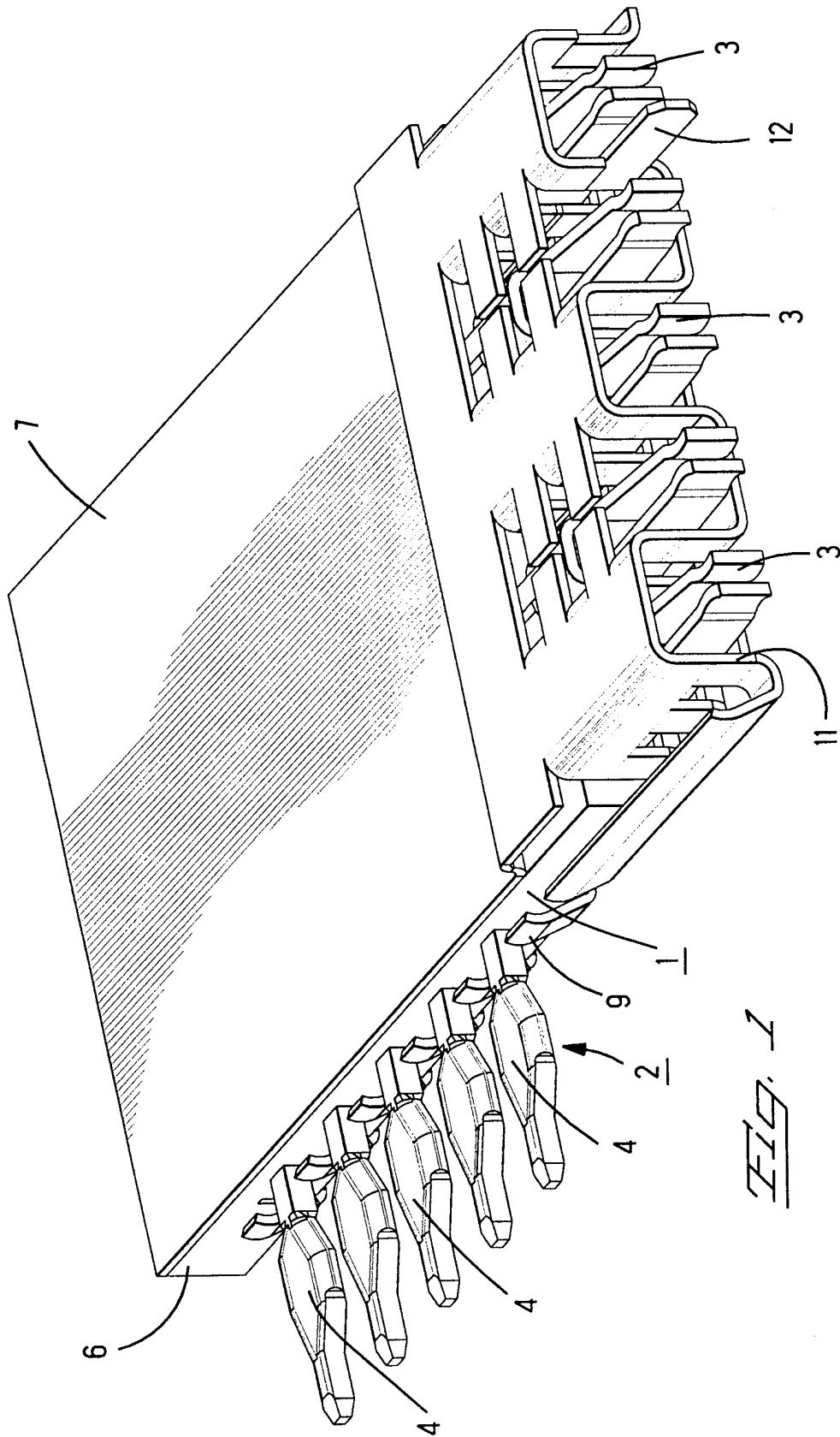
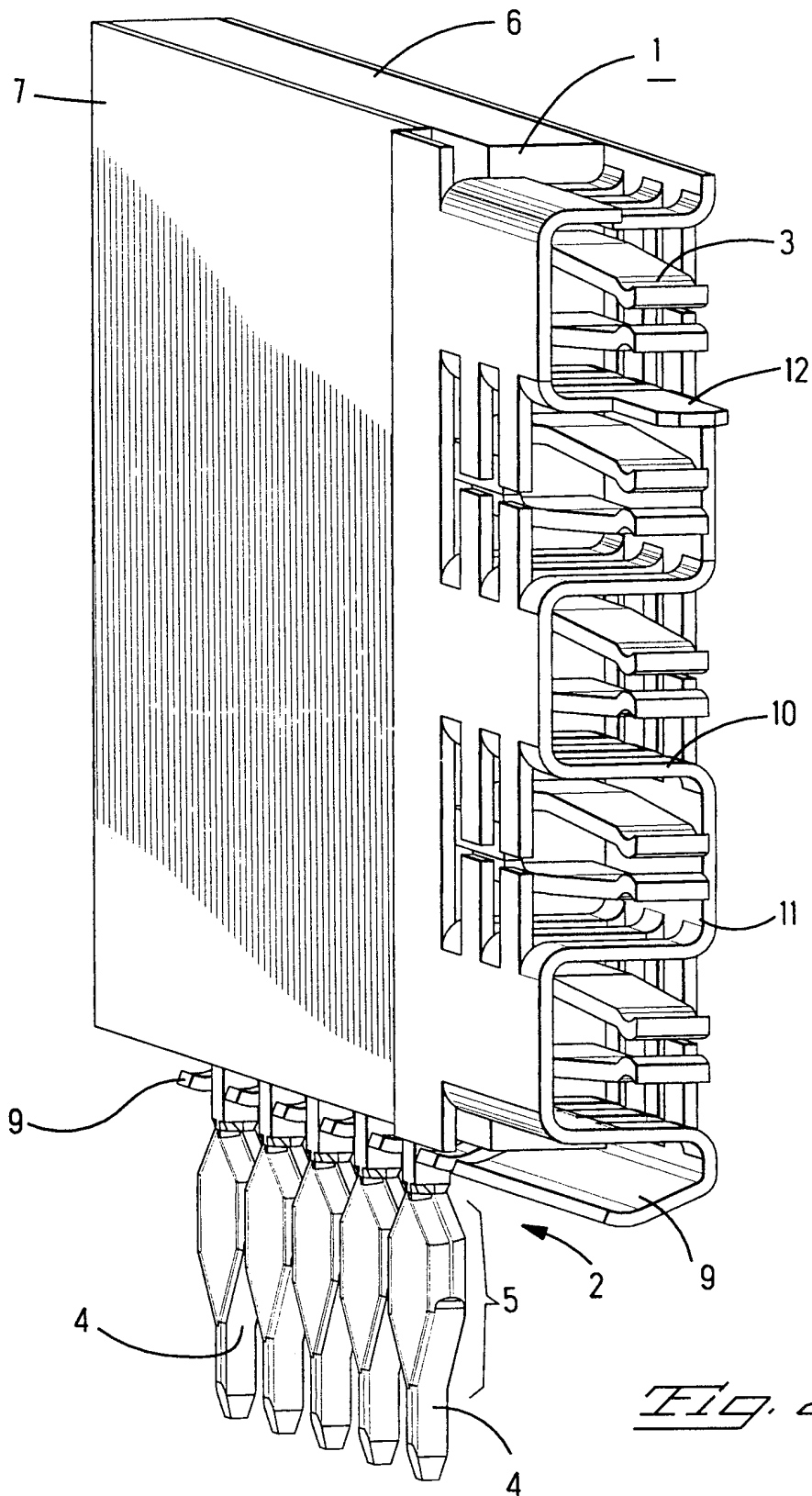


FIG. 1

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*Fig. 2*

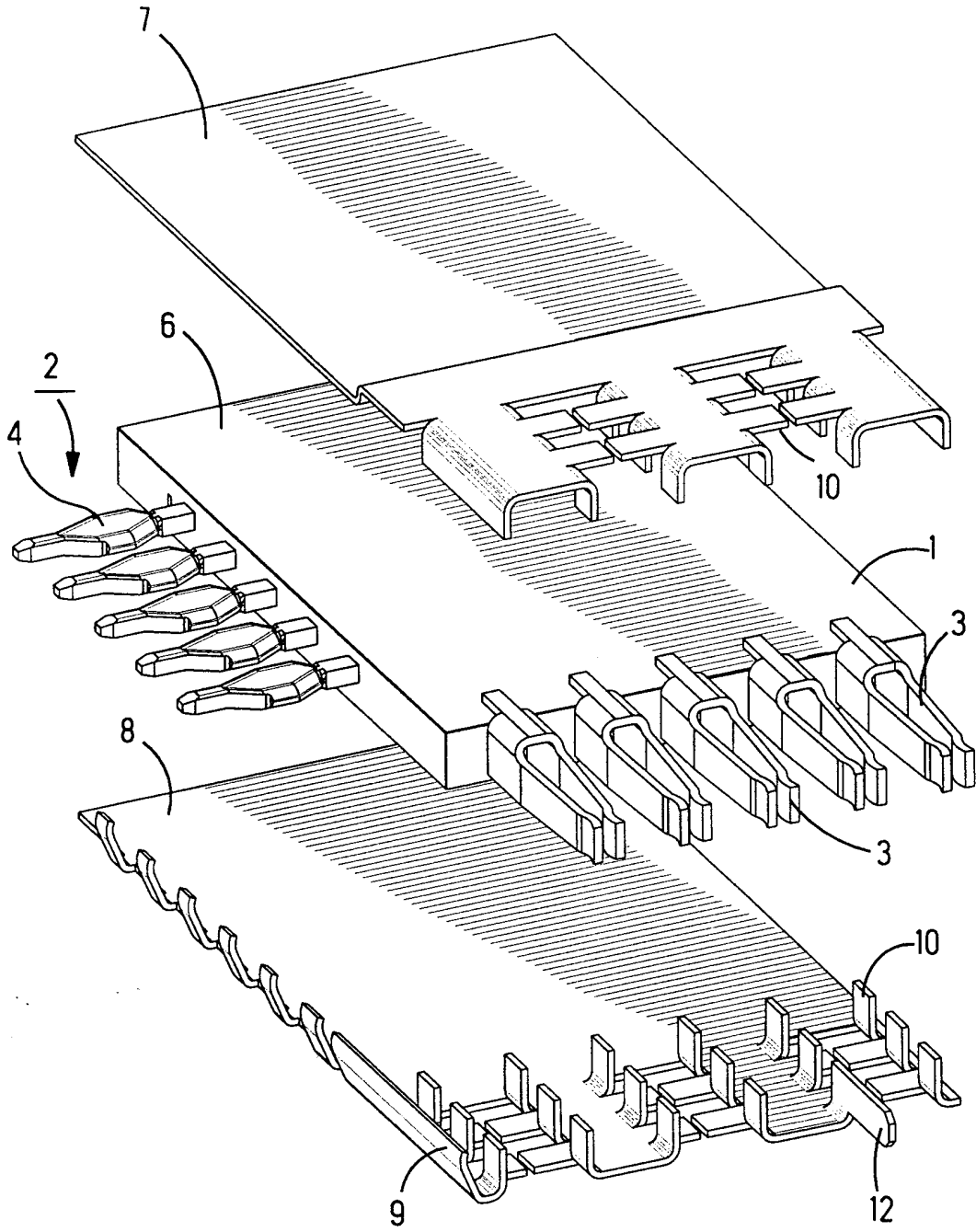


Fig. 3

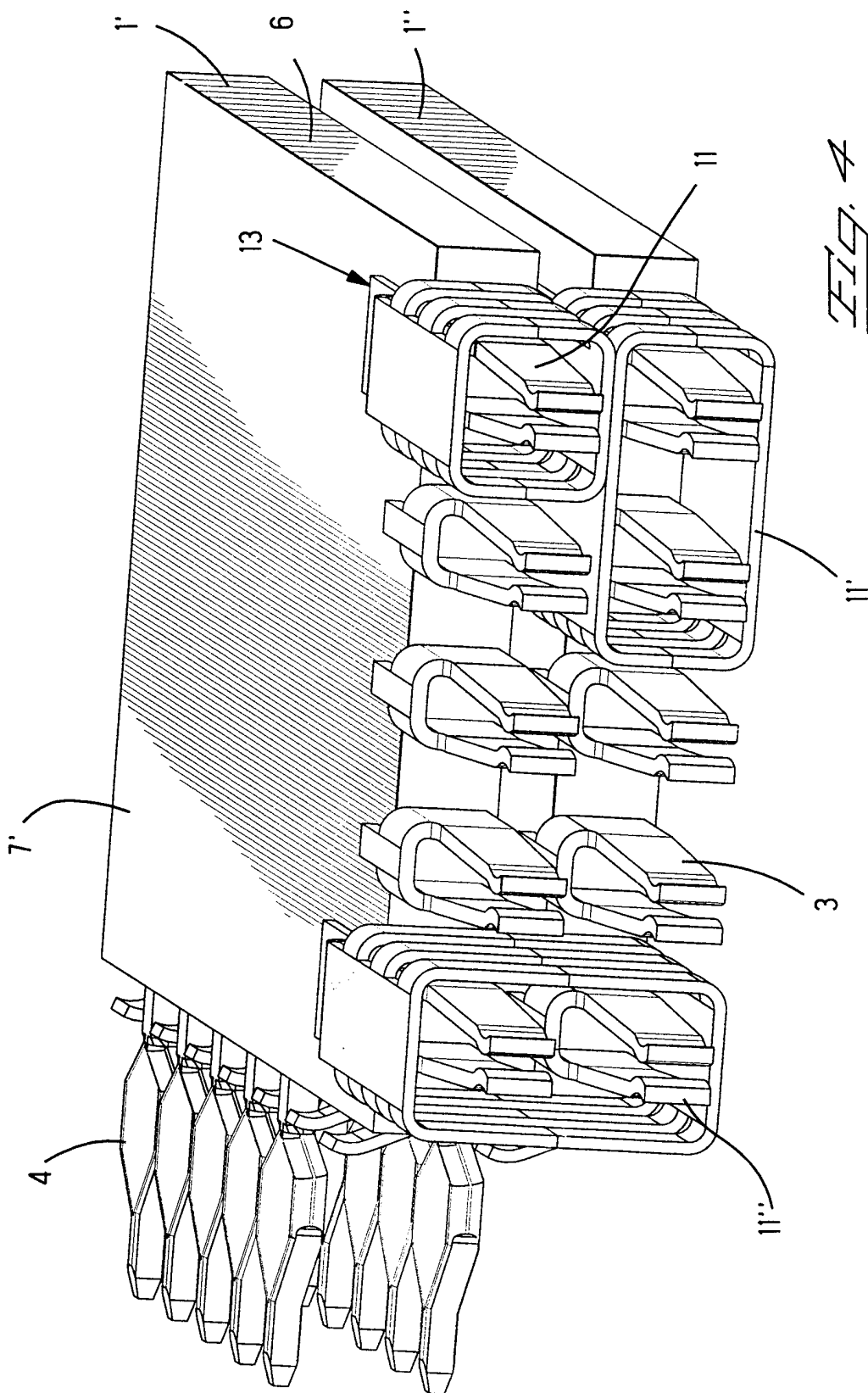
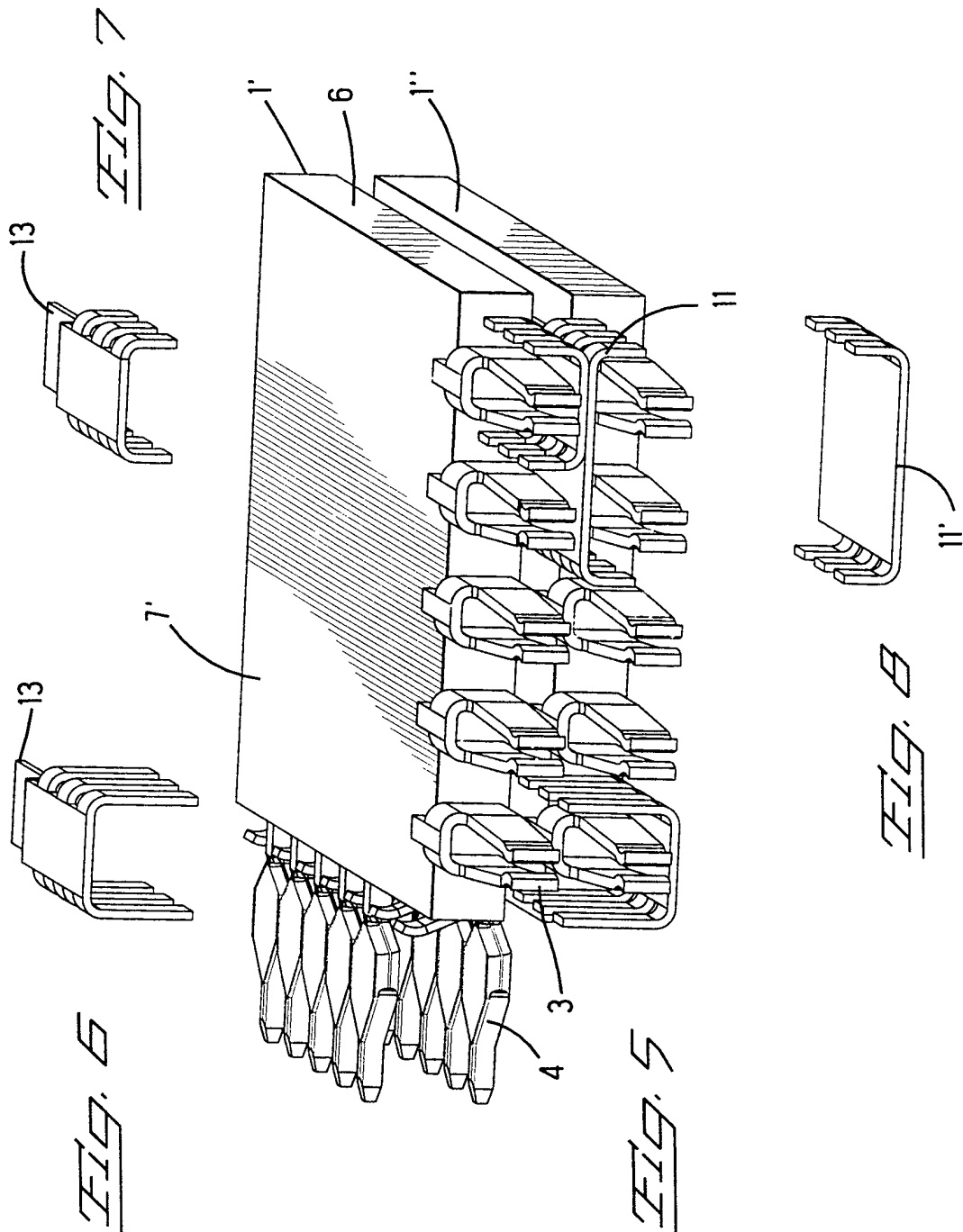
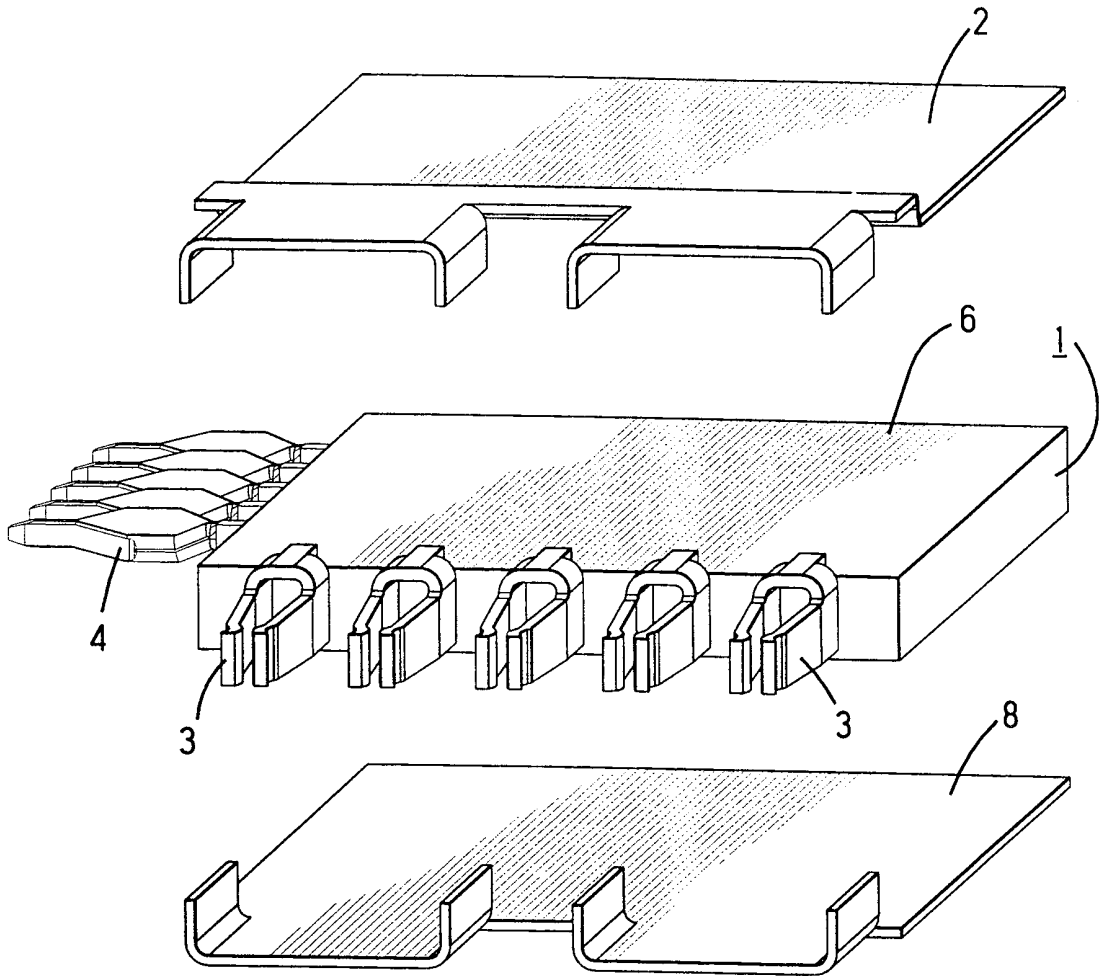


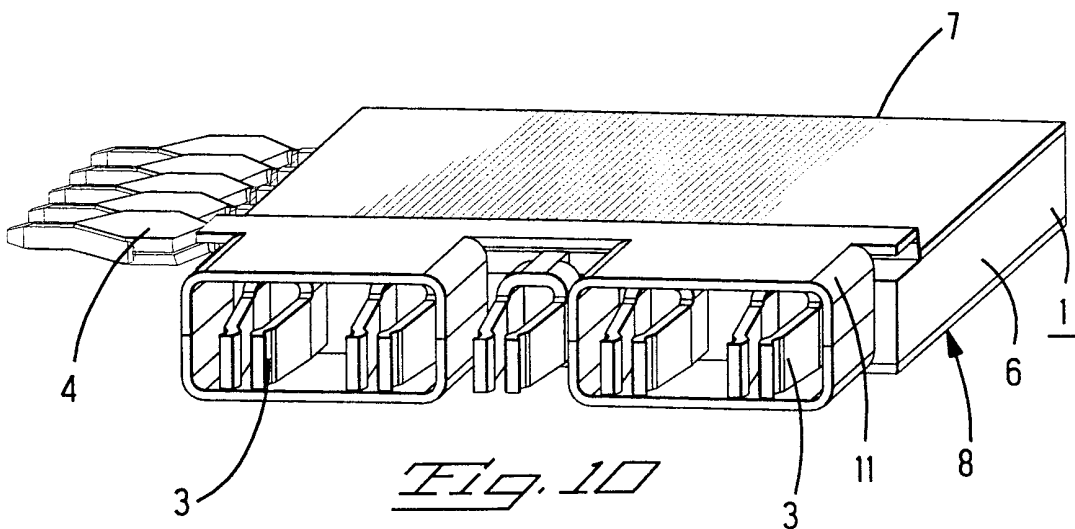
FIG. 4



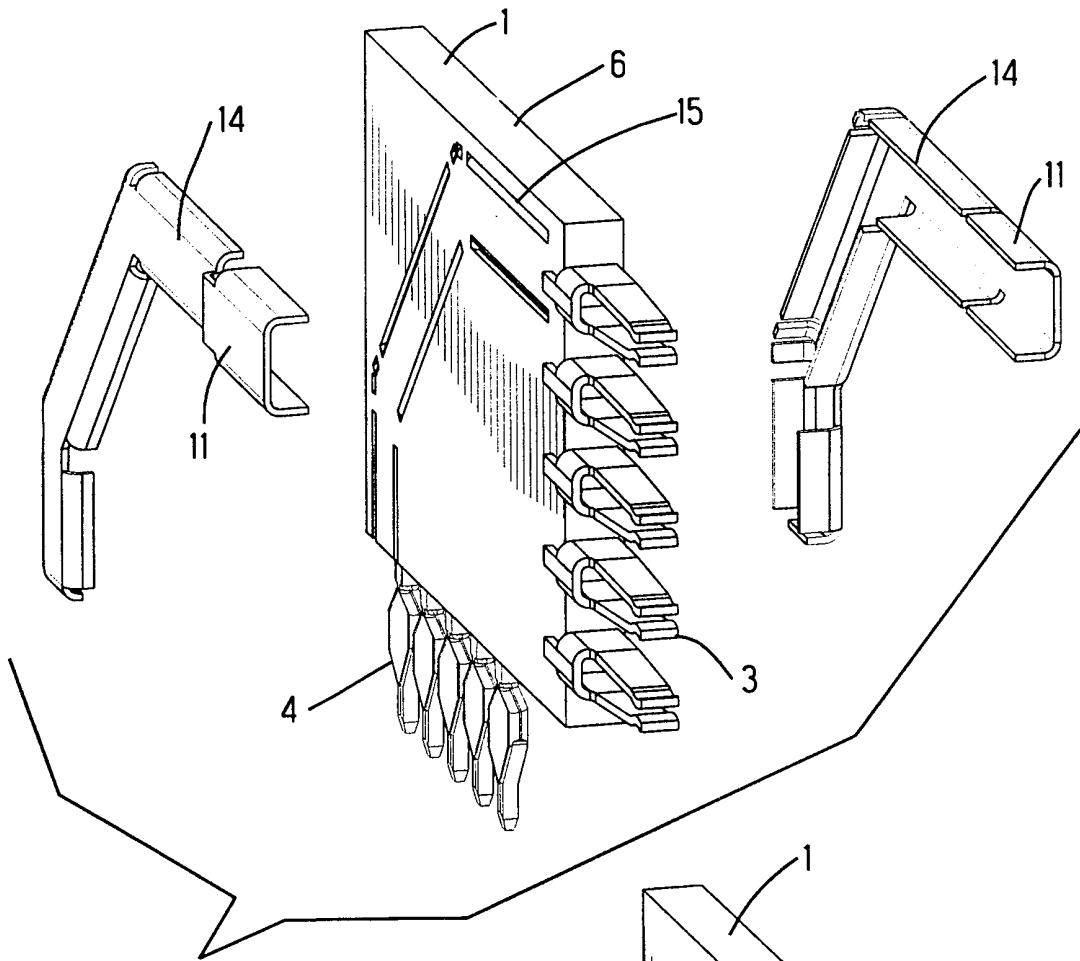
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*Fig. 9*

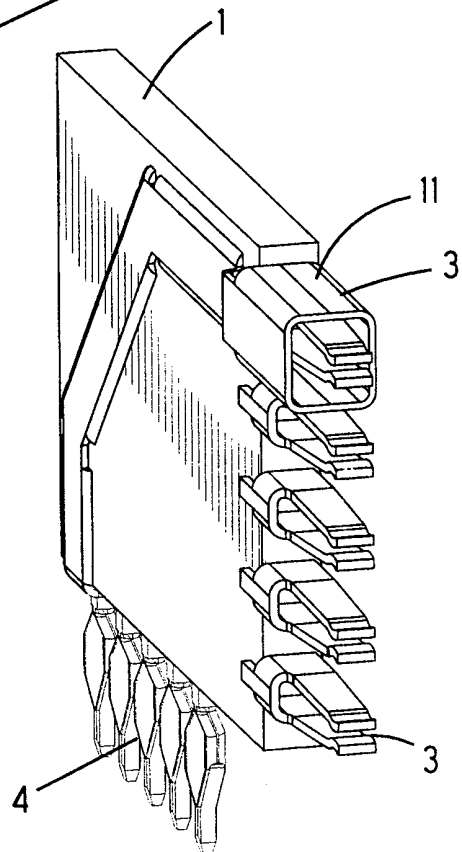


*Fig. 10*



*Fig. 11*

*Fig. 12*



## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/IB 98/01823

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H01R 13/658, H01R 23/68 // H01R 13/648, H01R 9/09  
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)

IPC6: H01R

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

WPI, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages   | Relevant to claim No. |
|-----------|--|-----------------------|
| X         | US 5620340 A (D. ANDREWS), 15 April 1997<br>(15.04.97), column 2, line 10 - line 55,<br>figures, claims, abstract<br>--  | 1-13                  |
| X         | US 5518422 A (K. ZELL ET AL), 21 May 1996<br>(21.05.96), column 1, line 30 - column 2, line 40,<br>figures 3,4,6, abstract<br>--   | 1-13                  |
| X         | US 5664968 A (S.K. MICKIEVICZ), 9 Sept 1997<br>(09.09.97), column 1, line 56 - column 2, line 29;<br>column 4, line 49 - column 6, line 20, figures 1-5,<br>abstract<br>-- | 1-13                  |

 Further documents are listed in the continuation of Box C. See patent family annex.

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Date of the actual completion of the international search

27 January 1999

Date of mailing of the international search report

12.02.99

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International application No.

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| C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT |  |                       |
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| Category*   | Citation of document, with indication, where appropriate, of the relevant passages   | Relevant to claim No. |
| X   | US 5507655 A (R. GOERLICH), 16 April 1996<br>(16.04.96), column 2, line 30 - column 3, line 6,<br>figures 1,2, abstract<br><br>--<br>----- | 1-13                  |

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Information on patent family members

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| Patent document cited in search report | Publication date | Patent family member(s)  | Publication date   |
|--|------------------|--|--|
| US 5620340 A                           | 15/04/97         | US 5842887 A<br>EP 0677215 A<br>JP 8505732 T<br>NL 9202301 A<br>SG 47908 A<br>WO 9416477 A | 01/12/98<br>18/10/95<br>18/06/96<br>18/07/94<br>17/04/98<br>21/07/94 |
| US 5518422 A                           | 21/05/96         | DE 59401765 D<br>EP 0670615 A,B<br>FI 951008 A<br>JP 2739871 B<br>JP 8037059 A             | 00/00/00<br>06/09/95<br>04/09/95<br>15/04/98<br>06/02/96             |
| US 5664968 A                           | 09/09/97         | WO 9737404 A   | 09/10/97   |
| US 5507655 A                           | 16/04/96         | DE 4313771 A,C<br>DE 4414393 A<br>FR 2704696 A,B<br>JP 7006824 A                           | 03/11/94<br>02/11/95<br>04/11/94<br>10/01/95                         |