

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
2 October 2008 (02.10.2008)

PCT

(10) International Publication Number
WO 2008/117136 A1

(51) International Patent Classification:
H01R 12/18 (2006.01) **H01R 13/652** (2006.01)

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(21) International Application Number:
PCT/IB2007/051448

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(22) International Filing Date: 28 March 2007 (28.03.2007)

(25) Filing Language: English

(26) Publication Language: English

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(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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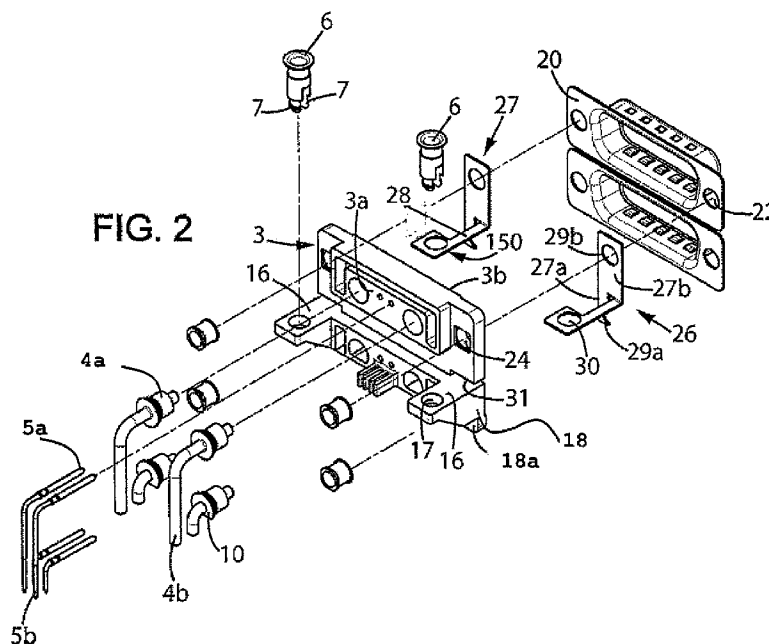
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Published:

— with international search report

(54) Title: CONNECTOR COMPRISING A PLURALITY OF CONNECTION STAGES



(57) Abstract: The connector comprises a plurality of connection stages (9a, 9b) stacked over a support (2). The stages comprise a shielding surface (20, 21) surrounding a contact, to be connected with a shielding surface (32) of a mating connector. The connector comprises a shielding device (26, 6) connected to the shielding surface (20, 21) of the upper and lower connection stages, and to a grounded surface of the support. The secondary shielding portion (150) is electrically connected to the main shielding portion between the upper (27b) and lower (27a) portions of the shielding device.

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CONNECTOR COMPRISING A PLURALITY OF CONNECTION STAGES

FIELD OF THE INVENTION

The instant invention relates to connectors
5 comprising a plurality of connection stages.

BACKGROUND OF THE INVENTION

For some connectors, such as described in US
5,865,645, a bent metallic ground connecting plate is used
for establishing the grounding connection between the
10 shielding surface of the connector and the Printed Circuit
Board (PCB). It also assists the mechanical integrity of
the connector.

Yet, a problem remains when connectors with
multiple connection stages are to be provided since the
15 vertical stacking of the mono-stage connectors of US
5,865,645 will not provide a grounding connection to the
Printed circuit board for the upper connectors.

This has been partly addressed by solutions whereby
the shielding plate extends vertically between the
20 plurality of connectors, and further extends backwards
horizontally from the bottom portion of the bottom
connector for establishing a grounding connection.
However, these solutions also have the inconvenience of
being bulky in their transition zones from the vertical
25 portion to the horizontal portion, and thus prevent closer
mounting of such connectors to the support.

In addition, such solutions are often
inconvenienced by requiring important cutaways in the PCB
sections to physically accommodate such connectors, and to
30 prevent short circuits of the Printed Circuit Board tracks
by contact with the shielding portions providing grounding
from the connectors.

The instant invention has notably for object to
mitigate those drawbacks.

SUMMARY OF THE INVENTION

To this aim, according to the invention, it is provided a connector comprising at least a first and a second connection stage each for mating with a respective mating connector having a shielding surface, the first connection stage being stacked, along a stacking direction, above the second connection stage which is disposed over a circuit board to which the connector is adapted to be secured, each connection stage comprising:

- 10 - at least one contact having a first connection end for connection to a complementary contact of the respective mating connector, and a second connection end for connection to the circuit board;
- 15 - a shielding member surrounding at least partly said contact, for electrical connection with the complementary shielding member of the respective mating connector;
- 20 - an insulator portion supporting the shielding member and the at least one contact of the relative connection stage;

wherein the connector further comprises a shielding device including:

- 25 - a main shielding portion for electrically connecting together the respective shielding members of each connection stage;
- 30 - a secondary shielding portion connected to the main shielding portion located between the first and the second connection stages and adapted to be electrically connected to a grounding track of the circuit board.

With these features, both the upper and the lower stages of the connector will be simultaneously grounded by connection to a grounded part of the support. Furthermore since the secondary shielding portion is positioned between the first and the second stacked stages, it therefore

raises above the circuit board when the connector is put in place on said circuit board. As a consequence, any risk of short circuit between the secondary shielding portion and any conductive tracks of the circuit board is avoided. This is achieved without necessarily requiring a large cut-out of the circuit board; the smaller cut-out area of the circuit board, the greater track density is available for connection.

In some embodiments, one might also use one or more of the features claimed in the sub-claims.

According to another aspect, the invention relates to a connector assembly comprising a circuit board and such a connector.

BRIEF DESCRIPTION OF THE DRAWINGS

Other characteristics and advantages of the invention will readily appear from the following description of one of its embodiments, provided as a non-limitative examples, and of the accompanying drawings.

On the drawings:

- Fig. 1 is a partial schematic perspective front view of an electronic device comprising a connector according to a first embodiment,

- Fig. 2 is an exploded perspective rear view of the connector of Fig. 1,

- Fig. 3 is a planar front view of a sheet plate for the connector of Fig. 1 and 2 at an intermediate manufacturing step,

- Fig. 4 is a schematic perspective back view of a connector according to a second embodiment,

- Fig. 5a is a planar front view of a shielding device according to a variant of the first embodiment, at an intermediate manufacturing step, and

- Fig. 5b is a perspective view of the shielding device of Fig 5a after manufacturing.

On the different Figures, the same reference signs designate like or similar elements.

DETAILED DESCRIPTION

Figure 1 shows a connector 1 for connection to a support 2 which, in the present example, is a printed circuit board. The connector 1 is for example of the D-subminiature type. As described, it is made of two stages stacked along a stacking direction (Arrow S on Fig. 1). The upper stage 1b is for connection to an upper mating connector 100b. The lower stage 1a is for connection to a lower mating connector (not shown) which can be independent of the upper connector. For example, the upper and lower connectors are of similar design.

The connector comprises an insulating block 3 made of an electrically insulative material. As shown on Fig. 2, the block 3 comprises a body 18 and two back legs 16 extending perpendicularly to the body 18 and behind it. The body 18 is pierced with through holes for insertion therein of electrical contacts.

These electrical contacts can for example be of two different types: electrical power contacts 4 and electrical signal contacts 5. Electrical power contacts are of large dimension, over 8 millimetres (mm) in diameter and for example of diameter about 10 mm, for transmitting electrical power to and/or from the printed circuit board to a complementary contact of a mating connector. Electrical signal contacts are of smaller diameter for transmitting signal to and/or from the printed circuit board to a complementary contact of a mating connector.

The number of electrical power and signal contacts on the drawings is purely by way of example.

Each of the contact extends through an aperture of the housing from a first end portion 4a, 5a, on the back face side 3a of the insulating body and a second end portion 4b, 5b for connection to the printed circuit board 2 on the front face side 3b of the insulating body.

In the provided example, the connector is a right angle connector in that the contacts form a 90° angle

between the respective first and second end portions. The lower and upper stages of the connector are therefore stacked over the printed circuit board 2 along the stacking direction S.

5 In the provided example, the insulating block is fixed on the printed circuit board using two mechanical fixation device 6: each back leg 16 cooperates with a snap-fit mechanical fixation device 6 which is suitable for being inserted each through a hole 17 of the back leg and
10 into a hole 8 of the printed circuit board, complementary to the fixation device 6. Such a fixation device is, by way of example, provided as a pair of parallel elastic tongues 7 extending vertically downward for snapping into complementary holes 8 forming complementary retention
15 features provided in the printed circuit board.

The body 18 is sufficiently thick for enabling a proper insertion of the contacts therein by crimping. For example, the body 18 has a thickness of about 2.4 mm.

20 In the detailed description, the electrical contacts are provided in a lower stage 9a and an upper stage 9b above said lower stage. In the present example, the distance between the upper face of the printed circuit board and the longitudinal axis of the power contacts 4 of the lower stage 9a is about 2.51 mm.

25 The power contacts 4 of the upper stage 9b extend according to a sensibly cylindrical shape inside the body 18. The longitudinal axis of this cylindrical portion is sensibly parallel to the upper face of the printed circuit board 2. An annular flange 10 contacts the back face 3a of
30 the body 18.

35 The power contacts 4 in the lower stage 9a are shaped similarly to the electrical power contact of the upper stage 2, described above, with the following differences. In the portion of the electrical power contacts extending parallel to the upper face of the printed circuit board, the lowermost part of the contact is

removed to provide a truncated shape, which corresponds for example, in section, to the shape of a cylinder intersected by a plane running parallel to the longitudinal axis 15 of the cylinder. This provides for example a flat face of the electrical power contact which extends parallel to the upper face of the printed circuit board 2, and facing this upper face.

Further, the flange 10 in the lower stage is cut-out, for example in a similar way, as shown on Fig. 2.

This cut-out shape of the electrical contact and of the flange provides a contact surface 18a in the front face 3b of the body 18, which extends below the electrical power contacts of the lower stage 9a.

As shown in Fig. 1, the connector 1 is assembled with the printed circuit board 2 such that the first fixation devices 6 cooperate with the complementary retention features 8 of the printed circuit board. Electrical power contacts 4 and signal contacts 5 are to be inserted into corresponding parts 12, 13, respectively of the printed circuit board 2. The contact surface 18a of the front face 3b of the body 18 comes into contact with the edge 14 of the printed circuit board 2, for better retention thereto. It should be noted that it is only sufficient to design a cut out in the printed circuit board of a width corresponding to the width of the connector and of depth sensibly corresponding to the thickness of the front face 3b of the body 18, i.e. in the present example: 2.4 mm. Thus, more surface area can be provided on the printed circuit board 2 for electrical tracks.

Each of the upper 9b and lower stage 9a is provided with a shielding surface which comprises a metallic plate 20 and a metallic plug 21 which, in the described example, surrounds the contacts of the respective stage. The plug 21 corresponds to a corresponding metallic surface 11 forming a shielding surface for the mating connector. The metallic plate 20 is provided with holes 22 which correspond both to

corresponding holes 23 formed in a metallic plate 32 of the mating connector 100b, and to holes 24 in the insulator block for fixation of the mating connector 100b to the connector with suitable fixation devices such as metallic screws and bolts (not shown). This fixation ensures an electrical connection between the shielding surface of the mating connector 100a and that of that stage of the connector.

Thus, each stage of the connector extends from an upper level Z_u measured along the stacking direction S to a lower level Z_l , below the upper level. The levels are defined for example by the uppermost and lowermost portions of the shielding surface of the stage with respect to the stacking direction S . At each stage, a medial level Z_m can be defined as an average of the upper and the lower level.

The connector further comprises a shielding device for connecting the shielding surface of each mating connector to the ground of the printed circuit board. In this embodiment, the shielding device comprises the already described metallic fixation device 6, which is electrically connected to a grounded track 25 of the printed circuit board.

The shielding device further comprises a pair of metallic sheet plates 26 shown in detail on Fig. 2. These sheet plates comprise a substantially flat main shielding portion 27 and a secondary shielding portion 150 comprising a substantially flat intermediate portion 28 which extends therefrom perpendicularly to the main shielding portion 27 and to the rear. The main shielding portion 27 comprises an upper portion 27b which is fixed between the front face of the insulator body 18 and the back face of the metallic plate 20 of the shielding surface of the upper stage, and is therefore electrically connected to this shielding surface. The main shielding portion 27 comprises a lower portion 27a which is fixed between the front face of the insulator body 18 and the back face of the metallic plate

20 of the shielding surface of the lower stage, and is therefore electrically connected to this shielding surface. As shown on Fig. 2, the upper portion 27b comprises a hole 29b which is in line with the corresponding hole 24 of the insulator body, with the hole 22 in the metallic plate of the shielding surface of the upper stage and the hole 23 of the upper mating connector 100b. The lower portion 27a comprises a partial hole 29a which is in line with the corresponding hole 24 of the insulator body, with the hole 22 in the metallic plate of the shielding surface of the lower stage and the hole 23 of the lower mating connector.

The intermediate portion 28 extends from the main shielding portion between its upper and lower portions. In particular, it is connected to the main shielding portion 27 at a level, with respect to the stacking direction, which is intermediate between the medial level of the upper and lower stages. It comprises a hole 30 which faces the hole 17 of the back leg 16 of the insulating block, for insertion therein of the fixation device 6.

When mounting the connector, the intermediate portion 28 of the metallic sheet plate 26 will be inserted through a specific slot 31 performed in the housing until the hole 30 comes into correspondence with the hole 17 of the back leg, and the main shielding portion 27 is brought onto the front face of the body. The metal sheet plate is therefore supported on the back leg 16. The plate 20 of each stage is fixed on the insulator block, in electrical connection with the metallic sheet plate as previously explained. The assembled connector is snap-fitted into the printed circuit board. The fixation device 6 thus forms a part of the secondary shielding portion 150.

Hence, continuous electrical connection of each of the shielding surface of the mating connectors to a grounded track of the printed circuit board is ensured. It is contemplated that, for a connector with more stages, a metallic sheet plate similar to the one of Fig. 2 extending

through all stages could be provided, the intermediate portion 28 extending between the lowermost and the next-to-lowermost stages with respect to the stacking direction.

Further, the metallic sheet plate 26 could be
5 provided sufficiently thick for ensuring the mechanical integrity of the connector, in addition to the electrical function of the metallic sheet plate 26.

As shown on Fig. 3, the metallic sheet plate could be obtained by forming, for example by stamping and bending
10 an originally substantially flat metallic plate, in a very simple row of operations. Fig. 3 shows this plate after stamping, and before bending.

As shown on Fig. 4, according to a second embodiment, the fixation device 6 of the connector is not
15 necessarily snap-fitted through the printed-circuit board but could for example be soldered to a grounded track at the surface of the printed circuit board.

According to variant of the first and second embodiments, and as illustrated in Figs. 5a and 5b, the
20 shielding device 26 may alternatively comprise an integrated fixation device 66, in the form of an extension of the intermediate portion 28 extending vertically downwards to be electrically connected to a grounded track of the support 2.

25 In this embodiment, the fixation device 66, consisting in an integrated connection portion, is disposed with a pair of parallel elastic tongues 7 extending vertically downwards for snapping into the complementary holes 8 in the printed circuit board. It would, however,
30 be conceivable to adapt such a fixation device for it to be soldered to a grounded track on the surface of the printed circuit board.

Such a shielding device could be manufactured in the same manner as that described for the first embodiment.

35 The above description is given as a non limiting example, and variants of this example could also be part of

the invention as defined by the scope of the appended claims.

CLAIMS

1. A connector comprising at least a first and a second connection stage (9a, 9b) each for mating with a
5 respective mating connector (100b) having a shielding surface (32), the first connection stage being stacked, along a stacking direction (S), above the second connection stage which is disposed over a circuit board to which the connector is adapted to be secured, each connection stage
10 comprising:

- at least one contact (4, 5) having a first connection end (4a, 5a) for connection to a complementary contact of the respective mating connector (100b), and a second connection end for connection to the circuit
15 board;
- a shielding member (20, 21) surrounding at least partly said contact, for electrical connection with the complementary shielding member (32) of the respective mating connector;
- 20 - an insulator portion supporting the shielding member (20, 21) and the at least one contact (4, 5) of the relative connection stage;

wherein the connector further comprises a shielding device including:

- 25 - a main shielding portion (27) for electrically connecting together the respective shielding members (20, 21) of each connection stage;
- a secondary shielding portion (150) connected to the main shielding portion located between the first and
30 the second connection stages and adapted to be electrically connected to a grounding track of the circuit board (2).

2. Connector according to claim 1, further comprising a fixation device (6) adapted for mechanically
35 retaining the connector on the circuit board and for

electrically connecting the secondary shielding portion (150) to the circuit board.

3. Connector according to claim 1, wherein the secondary shielding portion (150) comprises:

5 - an intermediate portion (28) connected to the main shielding portion (27);

 - an integrated connection portion (66), being an extension of said intermediate portion (28), provided with retention means adapted for mechanically retaining the connector on the circuit board and for electrically
10 connecting the secondary shielding portion (150) to the circuit board.

4. Connector according to any one of claims 1 to 3, wherein the shielding device comprises a sheet plate
15 portion (26) formed from a metallic plate which is partially cut and bent to form both the main shielding portion (27) and secondary shielding portion (150) extending perpendicularly to the main shielding portion (27).

20 5. Connector according to any of the preceding claims, wherein the connector is a right-angled connector, the second connection end (4b, 5b) of each contact extending perpendicularly to the first connection end (4a, 5a) thereof.

25 6. Connector according to any one of the preceding claims, comprising a unitary insulating block (3) forming the insulator portion of each connection stage (9a, 9b).

 7. Connector according to claim 6, wherein the insulating block (3) comprises a body (18) and a back leg
30 (16) extending behind and perpendicularly to the body (18), the body (18) comprising a front face for receiving the mating connectors, and further comprising a slot (31) for insertion therethrough of the secondary shielding portion (150) of the shielding device,

35 wherein the main shielding portion (27) of the shielding device is held on the front face of the body

(18), and wherein the secondary shielding portion (150) is retained by the back leg (16) of the insulating block (3).

8. Connector according to any one of preceding claim, wherein the shielding member (20) comprises a hole
5 (22) for fixation thereto of the mating connector (100b) by means of a fixation device, wherein the main shielding portion (27) comprises a complementary hole (29a; 29b), and wherein said holes (22, 29a; 22, 29b) are in line so that said mating connector is adapted to be fixed onto said
10 connector by means of a fixation device extending through said holes.

9. Connector assembly comprising a printed circuit board (2) and a connector (1) according to any one of the preceding claims.

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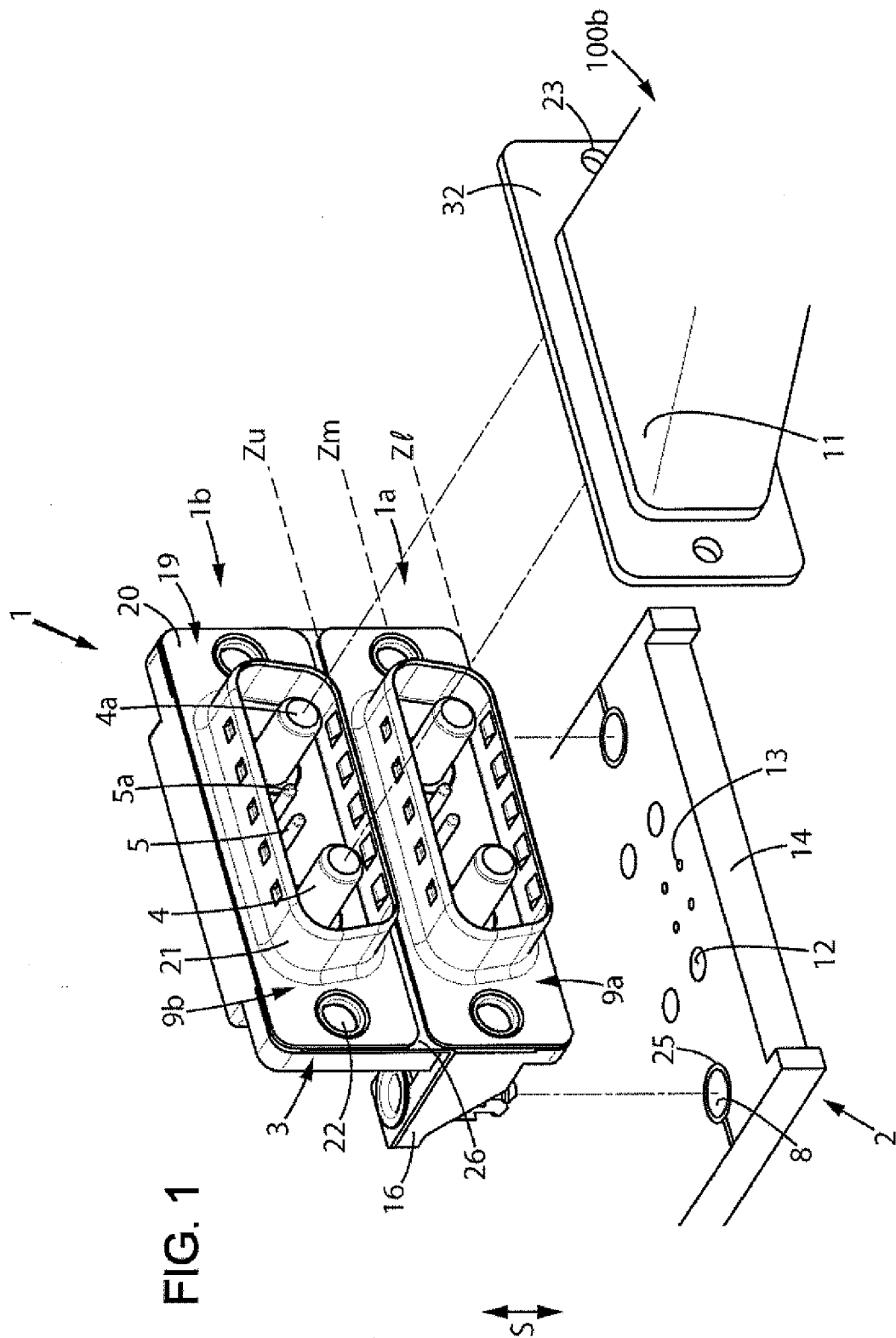
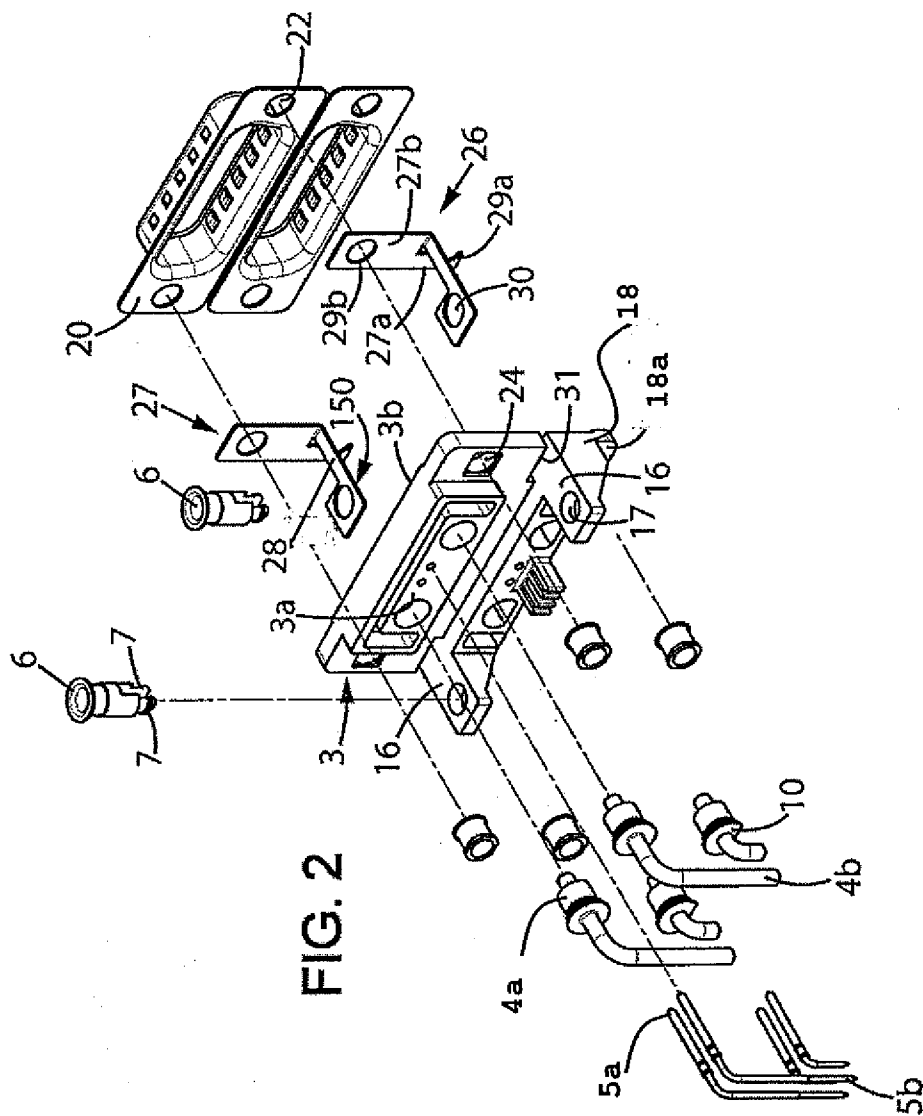


FIG. 1

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3/3

FIG. 3

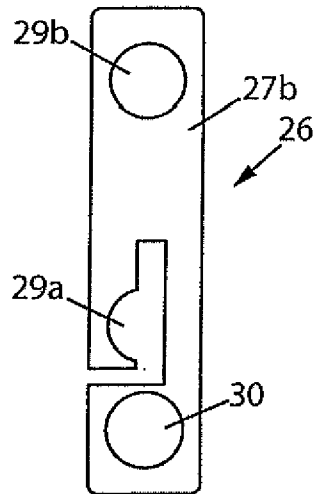


FIG. 4

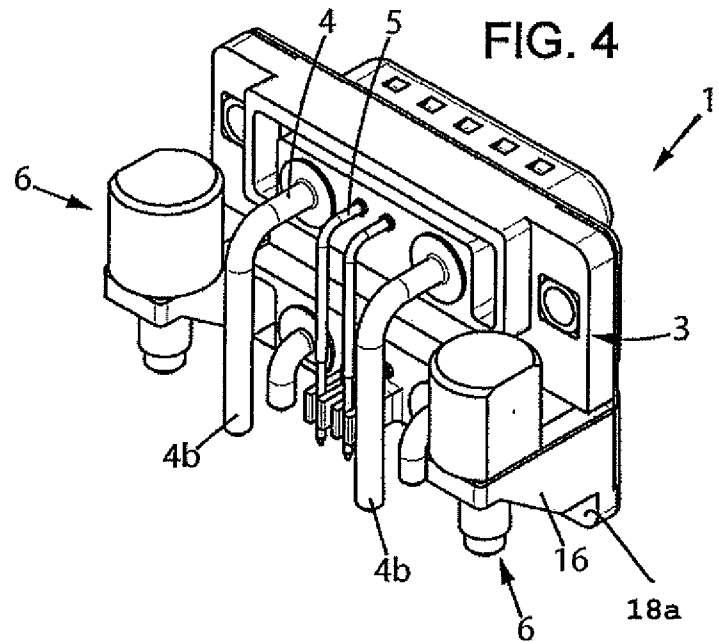


FIG. 5a

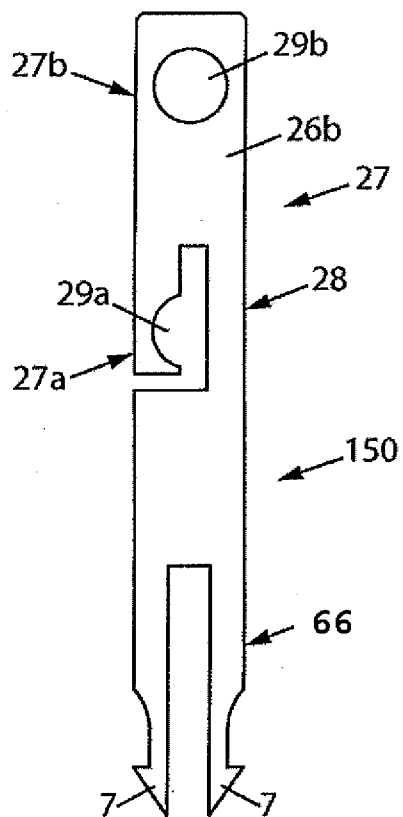
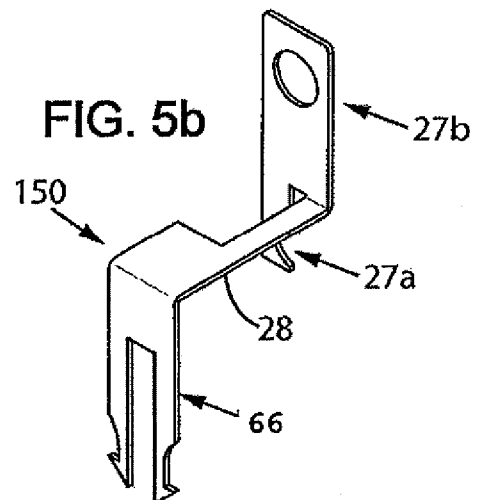


FIG. 5b



INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2007/051448

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01R12/18 H01R13/652

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

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 practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 085 590 A (GALLOWAY MICHAEL D [US]) 4 February 1992 (1992-02-04) abstract; figures 1-3 column 1, line 64 - column 3, line 22 -----	1-6,8,9
X	US 6 099 351 A (WU KUN-TSAN [TW]) 8 August 2000 (2000-08-08) abstract; figures 1-3 column 2, line 16 - column 3, line 33 -----	1,2,4-6, 9
A	US 5 599 207 A (LAI CHIN T [US]) 4 February 1997 (1997-02-04) abstract; figures 1,2 column 3, line 3 - column 4, line 67 -----	1,9
A	US 5 161 999 A (BROSCHARD III JOHN L [US] ET AL) 10 November 1992 (1992-11-10) abstract; figures 1-10 column 3, line 4 - column 5, line 53 -----	1,9

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

☒ See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

4 October 2007

Date of mailing of the international search report

15/10/2007

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SERRANO FUNCIA, J

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2007/051448

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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US 6099351	A	08-08-2000	TW 392982 Y	01-06-2000
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