



(51) International Patent Classification:  
*H01R 13/6594* (2011.01) *H01R 12/71* (2011.01)

(21) International Application Number:  
PCT/US2011/042098

(22) International Filing Date:  
28 June 2011 (28.06.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
2010-161782 16 July 2010 (16.07.2010) JP

(71) Applicant (for all designated States except US): **3M INNOVATIVE PROPERTIES COMPANY** [US/US]; 3M Center, Post Office Box 33427, Saint Paul, MN 55133-3427 (US).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **SHIMIZU, Tatsuyoshi** [JP/JP]; 33, 1 Tamagawadai 2-chome, Setagaya, Tokyo 158-8583 (JP).

(74) Agents: **MILLER, William D.** et al.; 3M Center Office of Intellectual Property Counsel, Post Office Box 33427, Saint Paul, MN 55133-3427 (US).

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

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: ELECTRICAL CONNECTOR FOR CIRCUIT SUBSTRATE

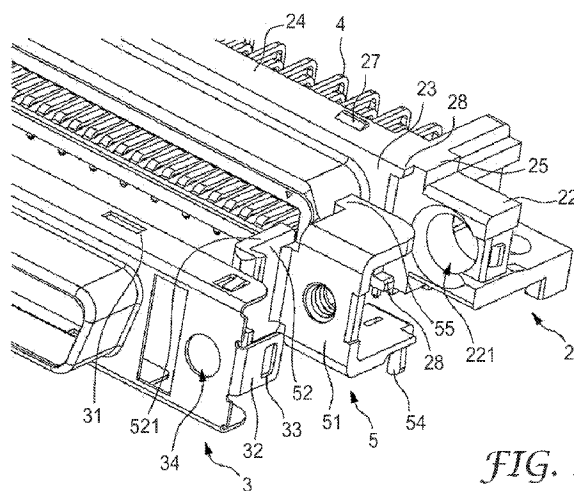


FIG. 2

(57) Abstract: To provide an electrical connector having a structure by which a counter-fitting force cannot displace components of the connector, and damage or deform a fixing portion of the connector, which is fixed to the substrate. Between contact supporting portion (24) and end portion (22), a shoulder portion (25), extending in the direction opposite to attachment direction D2 and configured to contact protruding portion (55) of engaging member (5), is arranged. As engaging member (5) is moved relative to body 2 along attachment direction D2, protruding portion (55) and shoulder portion (25) abut each other. Due to the engagement between shoulder portion (25) and protruding portion (55), displacement of engaging member (5) relative to body (2) is prevented.

## ELECTRICAL CONNECTOR FOR CIRCUIT SUBSTRATE

5

### Technical Field

The present invention relates to an electrical connector for a circuit substrate, in particular, an electrical connector for a circuit substrate having an engaging member by which a body of the connector is engaged with another electronic component so that a contact of the connector is maintained contacted to a conductive portion of the electronic component.

10

### Background

An electrical connector, having a pair of connectors for electrically connecting independent components (for example, a cable and a circuit board; or circuit boards) normally having a plurality of conductive portions, is known, wherein each of the pair of connectors has an engaging means for releasably engaging the connectors with each other.

15

Patent Literature 1 describes, in relation to one type of electrical connectors, that "each lock block 10 has attachment part 10a integrally formed with attachment piece 5 arranged both sides of conductive shell 4, first engaging piece 10b which functions as means which projects from attachment part 10a and is adapted to engage with another connector 19, and second engaging piece 10c which functions as means which projects from attachment part 10a and is adapted to be fixed to circuit board 21."

20

Patent Literature 2 describes, in relation to another type of electrical connectors, that "body 24 is made from insulating material such as plastic, and has surface 30 positioned on a circuit board (not shown) and surface 32 facing another connector, wherein surfaces 30 and 32 are parallel to each other."

25

### Patent Literature

[PTL1] Japanese Unexamined Patent Publication (Kokai) No. 7-192813

30

[PTL2] Japanese Unexamined Patent Publication (Kokai) No. 7-335333

### Summary

In the connector of PTL1, when another connector fitted with insertion hole 2 of connector body 1 is withdrawn from the insertion hole, due to a force in a counter-fitting direction applied to the connector body, lock block 10 may be displaced in the counter-fitting direction relative to connector body 1, resulting in backlash between the lock block and the connector body. Further, due to the displacement, a stress is be applied to second engaging piece 10c of lock block 10 which functions as means to fix the connector to circuit board 21, whereby second engaging piece 10c may be damaged or deformed.

Thus, the invention provides an electrical connector having a structure by which the counter-fitting force cannot displace components of the connector, and damage or deform a fixing portion of the connector, which is fixed to the substrate.

According to one aspect of the invention, there is provided an electrical connector for a circuit board, comprising: a conductive shield member; an insulative body, at least a part of which is covered by the shield member; a plurality of electrical contacts supported by the body; and

an engaging member disposed at each longitudinal end of the body, the engaging member being electrically connected to the shield member and adapted for electrical connection to a circuit board, wherein the engaging member has an engaging portion adapted to engage the longitudinal end of the body, an arm portion extending from the engaging portion, a latch portion extending from a front end of the arm portion in the direction generally perpendicular to the extending direction of the arm portion, and a protruding portion extending from the engaging portion in an attachment direction along which the engaging member is attached to the body, wherein the body has a shoulder portion for stopping the protruding portion of the engaging member when the engaging member is attached to the body.

According to another aspect of the invention, there is provided a method for manufacturing an electrical connector for a circuit board, the electrical connector comprising an electromagnetic shield member having electrical conductivity; a body made from insulating material, at least a part of which is covered by the electromagnetic shield member; a plurality of contacts having electrical conductivity, supported by the body in a row; and an engaging member attached to each longitudinal end of the body, the engaging

member being electrically connected to the electromagnetic shield member and adapted to electrically connected to a circuit board, the method comprising the steps of: moving the engaging member in a direction generally perpendicular to a fitting direction along which another electrical component is fitted with the electrical connector so that a engaging  
5 portion of the engaging member is engaged with each longitudinal end of the body and a protruding portion, extending from the engaging portion in an attachment direction along which the engaging member is attached to the body, comes into contact with a shoulder portion formed on the body; and attaching the electromagnetic shield member to the body by moving the electromagnetic shield member relative to the body in the fitting direction.

10 In an electrical connector according to an embodiment of the present invention, by attaching the engaging member to the body in the direction generally perpendicular to the fitting direction of the connector, and engaging the protruding portion of the engaging member with the shoulder portion of the body, the positional displacement of the engaging member relative to the body may be avoided, and damage and/or deformation of the fixing  
15 portion of the engaging member may be avoided.

In an embodiment of the present invention, the engaging member is attached to the body in the direction generally perpendicular to the fitting direction, whereby the engaging member may be attached to the body with no or low force.

### 20 **Brief Description of the Drawings**

Fig. 1 is a perspective view of an electrical connector for a circuit board according to an exemplary embodiment of the present invention.

Fig. 2 is an enlarged exploded perspective view around an engaging member of the connector of Fig. 1.

25 Fig. 3 is a perspective view showing an example of the configuration of the engaging member of the connector.

Fig. 4 is a perspective view of the engaging member, viewed in a direction different from that of Fig. 3.

Fig. 5 is a perspective view showing the state before the engaging member is  
30 attached to the connector body.

Fig. 6 is a perspective view showing the state after the engaging member is attached to the connector body.

Fig. 7 is a perspective view showing the state after the engaging member is attached to the connector body, viewed in a direction different from that of Fig. 6.

5

### Detailed Description

Fig. 1 is a perspective view of an electrical connector for a circuit board (hereinafter, referred to as "a connector") 1 according to a first embodiment of the present invention, and Fig. 2 is an enlarged exploded perspective view around an engaging member of the connector of Fig. 1. Connector 1 has a body 2 made from insulating material such as insulating resin and having a fitting opening 21 with which another electric component (not shown) may be fitted; an electromagnetic shield member 3 made from conductive material such as metal and configured to cover at least part of body 2; and a plurality of contacts 4 made from conductive material such as metal and supported by body 2 in a row. Each contact 4 is electrically connected to a conductive portion on a circuit board (not shown) at one end 41 of the contact (see Fig. 7), and is electrically connected to a conductive portion of the electric component fitted with opening 21 of body 2 at the other end 42 the contact. At each longitudinal end of body 2, an engaging member 5 is arranged. Engaging member 5 is configured to maintain connector 1 and the electric component in the connected state, and electrically connect electromagnetic shield member 3 to the grounded circuit board.

Fig. 3 shows an example of the configuration of engaging member 5, and Fig. 4 shows engaging member 5 viewed in a direction different from that of Fig. 3. Engaging member 5 has an engaging portion 51 adapted to engage longitudinal end 22 of body 2 (see Fig. 2), an arm portion 52 extending from engaging portion 51, a latch portion 53 extending from a front end of arm portion 52 in the direction generally perpendicular to the extending direction of arm portion 52, and a fixing portion 54 projecting from engaging portion 51. In one exemplary embodiment, engaging member 5 is formed as substantially one unitary member made from sheet-metal process or die-cast process. In the illustrated embodiment, two engaging members 5 are positioned at respective both longitudinal ends

30

of body 2, and each engaging member 5 has one arm portion 52 and two latch portions 53 formed at the front end of the arm portion.

Engaging portion 51 of engaging member 5 represents generally a C- or U-shape when viewed in an attachment direction D2 along which engaging member 5 is attached to body 2. Concretely, engaging portion 51 has opposing portions 511 and 512 forming opposing sides of the C- or U-shape, and a base portion 513 to which opposing portions 511 and 512 are connected. Opposing portions 511 and 512 are configured to at least partially surround and hole end 22 of body 2 having generally a rectangular body shape. It is not necessary to apply a strong force in order to attach engaging portion 51 to end portion 22, in other words, engaging portion 51 can be attached to end portion 22 by a weak force. Otherwise, engaging member 51 may be engaged with end portion 22 by so-called clearance-fit, whereby substantially no force is necessary to engage them with each other. In the illustrated embodiment, arm portion 52 extends from base portion 513 of engaging member 51, and fixing portion 54 extends from the front end of opposing portion 512.

As shown in Figs. 1 and 2, arm portion 52 of engaging member 5 is configured to project from a fitting opening side surface 23 of body 2 when attached to end portion 22 of body 2. Latch portion 53 is configured to outwardly extend from the front end of arm portion 52 in the longitudinal direction and engage with the electric component fitted with connector 1. Fixing portion 54 is configured to electrically connected to a grounded through hole formed in a circuit board (not shown) by soldering etc., when connector 1 is mounted on the circuit board. On the other hand, engaging member 5 contacts or is electrically connected to electromagnetic shield member 3 when they are assembled as shown in Fig. 1. Therefore, electromagnetic shield member 3 may be electrically grounded, whereby the shield member may have the shield effect against the extrinsic noise or the like. Electromagnetic shield member 3 has a function for shielding inner elements of the connector from the extrinsic noise or the like.

A thread 514 is formed in base portion 513 of engaging portion 51, a through hole 34 is formed at a portion of electromagnetic shield member 3 where corresponds to the position of thread 514 when assembled, and a through hole 221 is formed at a portion of end 22 of body 2 where corresponds to the position of thread 514 when assembled (see

Fig. 2). Due to this, a screw for preventing another electric component or connector from disengaging from connector 1, or a screw for fixing connector 1 to a circuit board (not shown), may be used.

As shown in Figs. 3 and 4, engaging member 5 further has a protruding or step portion 55 extending from engaging portion 51 in attachment direction D2. Attachment direction D2 is generally perpendicular to a fitting direction (D1 in Fig. 1) along which another electric component is fitted with connector 1. Although protruding portion 55 may be any place of engaging portion 51 as long as protruding portion 55 extends in attachment direction D2, in one exemplary embodiment, protruding portion 55 extends from the front end of one opposing portion (portion 511 in the illustrated embodiment), as shown in Figs. 3 and 4. In one exemplary embodiment, the dimensions of opposing portions 511 and 512 along fitting direction D1 are determined based on the thickness of end portion 22 of body 2 along the fitting direction. Further, the thickness of end portion 22 of body along fitting direction D1 is determined based on the strength required for body 2.

As shown in Figs. 3 and 4, in one exemplary embodiment, engaging member 5 further has a protruding or step portion 57 extending from opposing portion 512 of engaging portion 51 (the opposing portion where protruding portion 55 is not formed) in attachment direction D2. Although protruding portion 57 may be any place of portion 512 of engaging portion 51 as long as protruding portion 57 extends in attachment direction D2, in one exemplary embodiment, protruding portion 57 is positioned where is equivalent to the position of protruding portion 55 in fitting direction D1 (or separated from base portion 513 by the same distance as protruding portion 55). Due to this, when a force in the counter-fitting direction applied to the connector, the same magnitude of force is applied to the two protruding portions, whereby the force may be properly supported.

Next, a method of assembling (manufacturing) connector 1 will be explained below, with reference to Fig. 5. As shown in Figs. 2 and 5, end portion 22 of body 2 is formed at both ends of a contact supporting portion 24 adapted to support contacts 4. First, engaging member 5 is moved toward end portion 22 of body 2 along attachment direction D2 generally perpendicular to fitting direction D1, so that engaging portion 51 surrounds end portion 22. In this regard, between contact supporting portion 24 and end portion 22, a shoulder portion 25, extending in the direction opposite to attachment direction D2 and

configured to contact protruding portion 55 of engaging member 5, is arranged. Therefore, as engaging member 5 is moved relative to body 2 along attachment direction D2, protruding portion 55 of engaging member 5 and shoulder portion 25 of body 2 abut each other, as shown in Fig. 6. In moving engaging member 5 in attachment direction D2, a relatively strong force, required for normal press fitting, is not necessary.

Shoulder portion 25 is configured to at least partially support a force applied to engaging member 5 in the direction opposite to fitting direction D1 (or the counter-fitting direction). Concretely, a boundary surface 61 between protruding portion 55 and shoulder portion 25 extends generally perpendicular to fitting direction D1. When another electric component fitted with connector 1 is withdrawn from connector 1, a force in the counter-fitting direction is applied to body 2, and a force in the counter-fitting direction is also applied to fixing portion 54 of engaging member 5. The force applied to engaging member 5 may be supported by shoulder portion 25 and distributed throughout the connector. Generally, a force of 100N - 200N may be applied to the connector when the electric component is withdrawn from the connector, and thus, in the conventional connector, a member corresponding to the engaging member may be displaced relative to a member corresponding to the body. On the other hand, in the invention, due to the engagement between the protruding portion and the shoulder portion, the displacement of engaging member 5 relative to body 2 is prevented, and a strong force is not applied to fixing portion 54 of engaging member 5 fixed to the board, whereby the damage and/or deformation of fixing portion 54 may be prevented.

In one exemplary embodiment, shoulder portion 25 of body 2 is formed at a thickness direction edge of body 2, in view of the facility of manufacturing the body. In this case, when protruding portion 55 is formed at the front end of opposing portion 51, engaging portion 51 may cover or surround across end portion 22 in the thickness direction thereof, whereby the engagement between engaging portion 51 and end portion 22 may be stable.

Although engaging member 5 may have one protruding portion, engaging member 5 may have another protruding portion 57, as shown in Figs. 3 and 4. In this case, body 2 has a shoulder or step portion 26 configured to contact protruding portion 57, and a boundary surface 62 between protruding portion 57 and shoulder portion 26 extends

generally perpendicular to fitting direction D1. Due to such a configuration, shoulder portion 26 may have a similar function to shoulder portion 25 as described above, whereby a considerably strong force in the counter-fitting direction may be supported and distributed throughout the connector.

5           After engaging member 5 is attached to body 2, electromagnetic shield member 3 is pushed toward body 2 in the fitting direction so as to attach electromagnetic shield member 3 to body 2, and then the assembling of connector 1 is completed. In addition, when a projection 27 is formed on the upper part of body 2 and an engaging hole 31 is formed at a portion of electromagnetic shield member 3 where corresponds to the position  
10 of projection 27, electromagnetic shield member 3 may be prevented from disengaging from body 2.

          Electromagnetic shield member 3 may have a disengage-preventing portion adapted to prevent engaging member 5 from disengaging from the body in a counter-attachment direction opposite to the attachment direction. In the illustrated embodiment,  
15 the disengaging preventing portion is a tab-like member 32 extending from the longitudinal end of electromagnetic shield member 3 in the direction generally perpendicular to attachment direction D2. Tab-like member 32 is configured to contact or be adjacent a counter-attachment direction side of engaging member 5, so as to prevent engaging member 5 from disengaging or dropping from body 2. Further, when an engaging  
20 hole 33 is formed on tab-like member 32 and a projection 221 is formed at a site of end portion 22 where corresponds to the position of engaging hole 33, electromagnetic shield member 3 may be assuredly prevented from disengaging from body 2.

          As shown in Figs. 2 and 6, body 2 may have one or more (two in the illustrated embodiment) canopy portion 28 configured to contact or be adjacent a lateral side 521 of  
25 arm portion 52. Due to this, engaging member 5 is prevented from rotating relative to body 2 about an axis parallel to attachment direction D2.

          In the above embodiment, although fixing portion 54 of engaging member 5 is exemplified to be connected to the board (not shown) in a through-hole manner, fixing portion 54 may be modified so as to be connected to the board in a surface-mount manner.

**Reference Signs List**

|    |                                 |
|----|---------------------------------|
|    | 1 electrical connector          |
|    | 2 body                          |
|    | 21 fitting opening              |
| 5  | 22 end portion                  |
|    | 25, 26 shoulder portion         |
|    | 3 electromagnetic shield member |
|    | 32 tab-like member              |
|    | 4 contact                       |
| 10 | 5 engaging member               |
|    | 51 engaging portion             |
|    | 52 arm portion                  |
|    | 53 latch portion                |
|    | 54 fixing portion               |
| 15 | 55, 57 protruding portion       |

Following are exemplary items of an electrical connector, according to exemplary aspects of the present invention.

Item 1 is an electrical connector for a circuit board, comprising:

20 a conductive shield member;

an insulative body, at least a part of which is covered by the shield member;

a plurality of electrical contacts supported by the body; and

an engaging member disposed at each longitudinal end of the body, the engaging member being electrically connected to the shield member and adapted for electrical

25 connection to a circuit board,

wherein the engaging member has an engaging portion adapted to engage the longitudinal end of the body, an arm portion extending from the engaging portion, a latch portion extending from a front end of the arm portion in the direction generally perpendicular to the extending direction of the arm portion, and a protruding portion

30 extending from the engaging portion in an attachment direction along which the engaging member is attached to the body,

wherein the body has a shoulder portion for stopping the protruding portion of the engaging member when the engaging member is attached to the body.

5 Item 2 is the connector according to item 1, wherein the attachment direction of the engaging member is generally perpendicular to a fitting direction along which another electrical component is fitted with the electrical connector.

10 Item 3 is the connector according to item 1, wherein the engaging member has a fixing portion projecting from the engaging portion and adapted to be fixed to the circuit board.

15 Item 4 is the connector according to any one of preceding items, wherein a boundary surface between the protruding portion and the shoulder portion generally extends in a direction generally perpendicular to the fitting direction.

Item 5 is the connector according to any one of preceding items, wherein the shield member has a disengage-preventing portion adapted to prevent the engaging member from disengaging from the body in a counter-attachment direction opposite to the attachment direction.

20

Item 6 is the connector according to any one of preceding items, wherein the disengage-preventing portion is a tab-like member extending from the longitudinal end of the shield member in the direction generally perpendicular to the attachment direction.

25

Item 7 is a method for manufacturing an electrical connector for a circuit board, the electrical connector comprising an electromagnetic shield member having electrical conductivity; a body made from insulating material, at least a part of which is covered by the electromagnetic shield member; a plurality of contacts having electrical conductivity, supported by the body in a row; and an engaging member attached to each longitudinal end of the body, the engaging member being electrically connected to the electromagnetic

30

shield member and adapted to electrically connected to a circuit board, the method comprising the steps of:

moving the engaging member in a direction generally perpendicular to a fitting direction along which another electrical component is fitted with the electrical connector so that a engaging portion of the engaging member is engaged with each longitudinal end of the body and a protruding portion, extending from the engaging portion in an attachment direction along which the engaging member is attached to the body, comes into contact with a shoulder portion formed on the body; and

attaching the electromagnetic shield member to the body by moving the electromagnetic shield member relative to the body in the fitting direction.

What is claimed is:

1. An electrical connector for a circuit board, comprising:  
a conductive shield member;  
an insulative body, at least a part of which is covered by the shield member;  
5 a plurality of electrical contacts supported by the body; and  
an engaging member disposed at each longitudinal end of the body, the  
engaging member being electrically connected to the shield member and adapted for  
electrical connection to a circuit board,  
wherein the engaging member has an engaging portion adapted to engage  
10 the longitudinal end of the body, an arm portion extending from the engaging portion, a  
latch portion extending from a front end of the arm portion in the direction generally  
perpendicular to the extending direction of the arm portion, and a protruding portion  
extending from the engaging portion in an attachment direction along which the engaging  
member is attached to the body,  
15 wherein the body has a shoulder portion for stopping the protruding portion  
of the engaging member when the engaging member is attached to the body.
2. The connector according to claim 1, wherein the attachment direction of the  
engaging member is generally perpendicular to a fitting direction along which another  
20 electrical component is fitted with the electrical connector.
3. The connector according to claim 1, wherein the engaging member has a  
fixing portion projecting from the engaging portion and adapted to be fixed to the circuit  
board.  
25
4. The connector according to any one of preceding claims, wherein a  
boundary surface between the protruding portion and the shoulder portion generally  
extends in a direction generally perpendicular to the fitting direction.
- 30 5. The connector according to any one of preceding claims, wherein the shield  
member has a disengage-preventing portion adapted to prevent the engaging member from

disengaging from the body in a counter-attachment direction opposite to the attachment direction.

6. The connector according to any one of preceding claims, wherein the  
5 disengage-preventing portion is a tab-like member extending from the longitudinal end of the shield member in the direction generally perpendicular to the attachment direction.

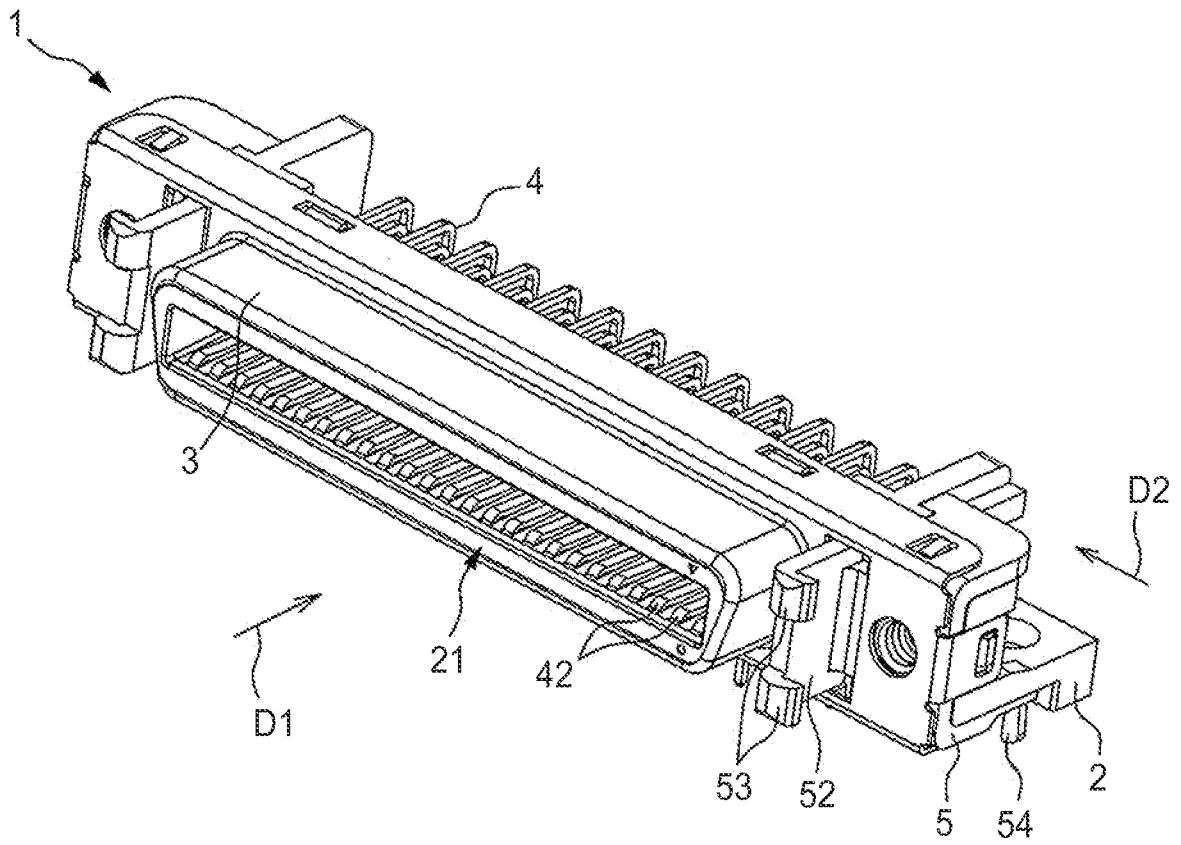
7. A method for manufacturing an electrical connector for a circuit board, the  
electrical connector comprising an electromagnetic shield member having electrical  
10 conductivity; a body made from insulating material, at least a part of which is covered by the electromagnetic shield member; a plurality of contacts having electrical conductivity, supported by the body in a row; and an engaging member attached to each longitudinal end of the body, the engaging member being electrically connected to the electromagnetic shield member and adapted to electrically connected to a circuit board, the method  
15 comprising the steps of:

moving the engaging member in a direction generally perpendicular to a  
fitting direction along which another electrical component is fitted with the electrical  
connector so that a engaging portion of the engaging member is engaged with each  
longitudinal end of the body and a protruding portion, extending from the engaging portion  
20 in an attachment direction along which the engaging member is attached to the body, comes into contact with a shoulder portion formed on the body; and

attaching the electromagnetic shield member to the body by moving the  
electromagnetic shield member relative to the body in the fitting direction.

25

1/4

*FIG. 1*

2/4

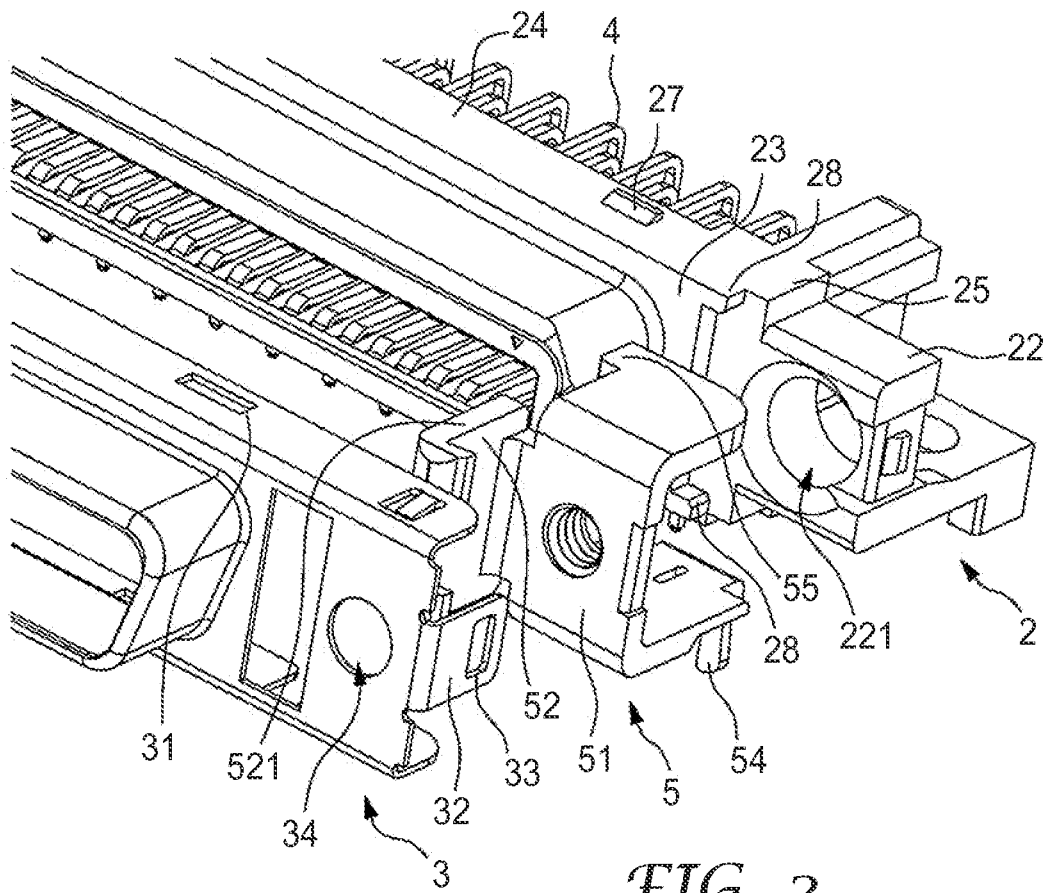


FIG. 2

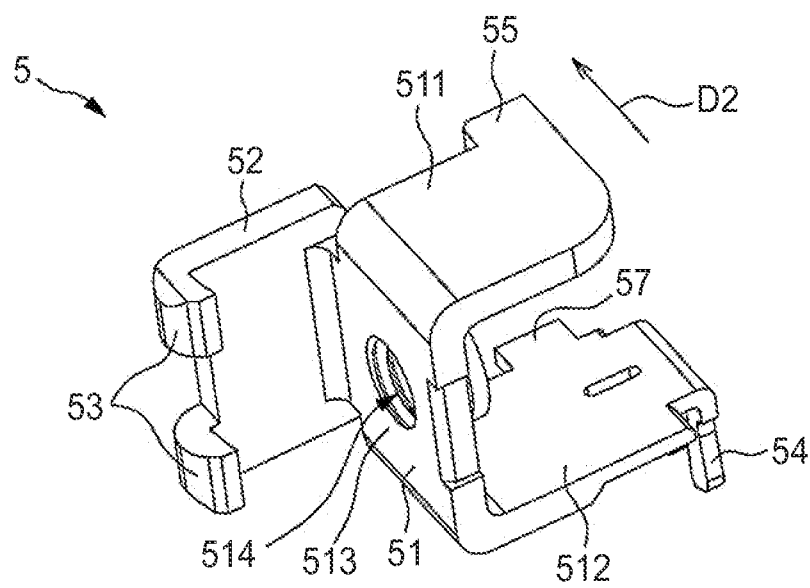


FIG. 3

3/4

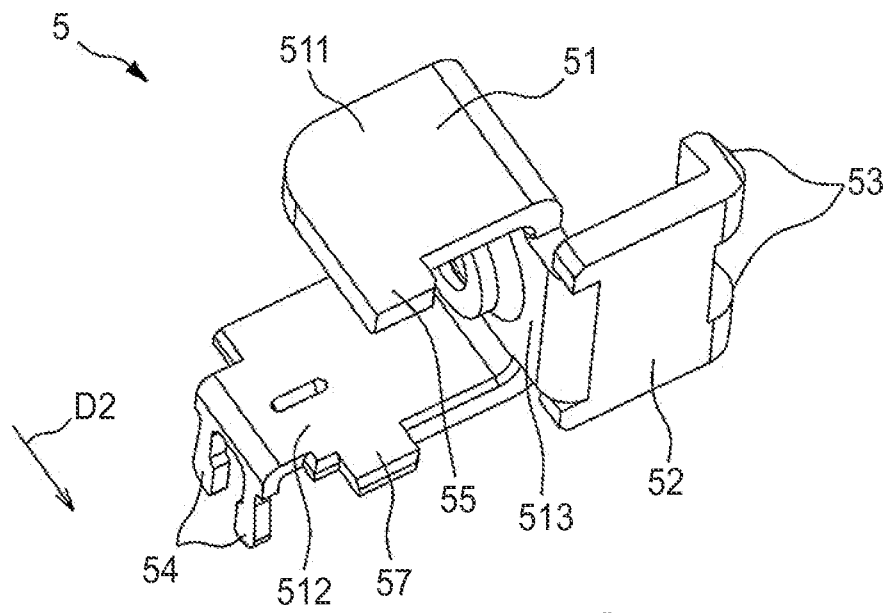


FIG. 4

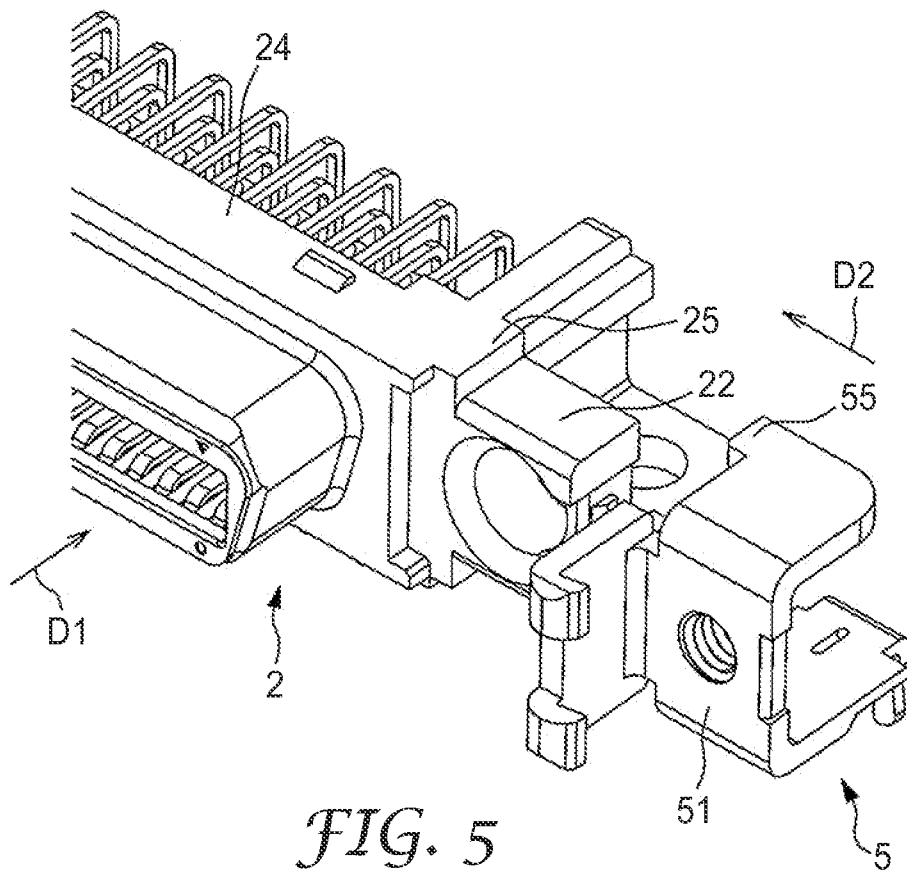
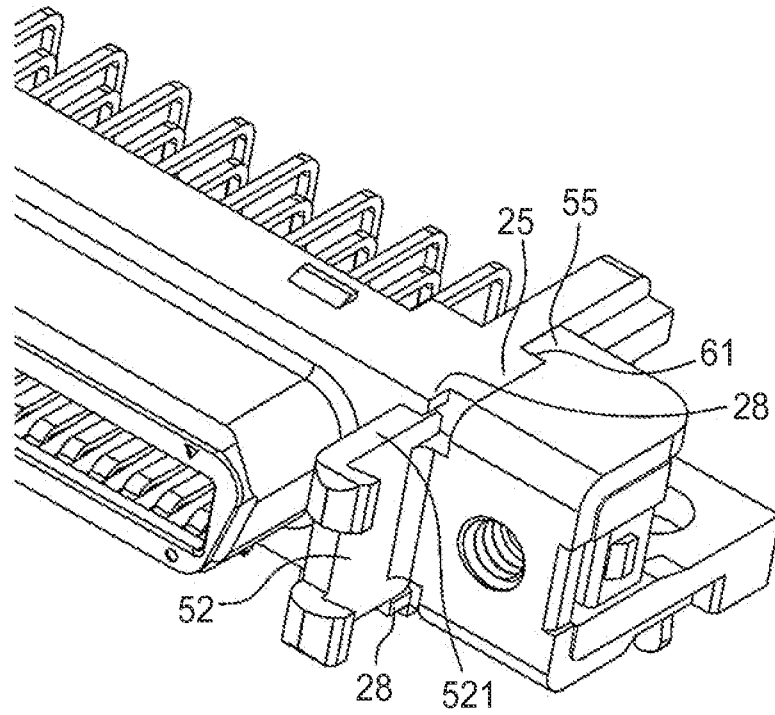
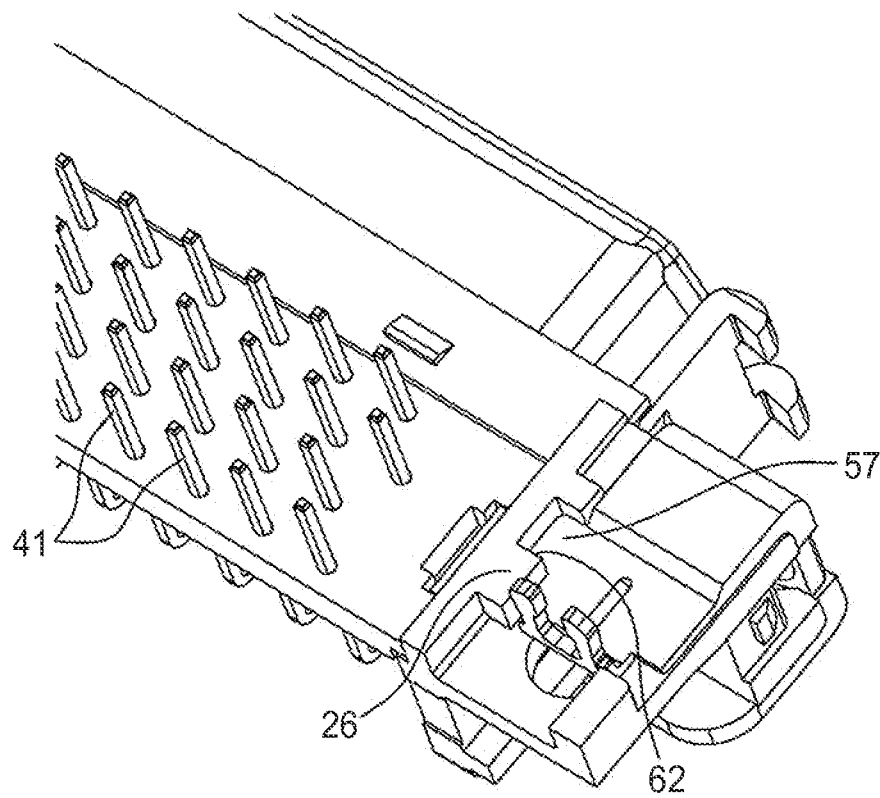


FIG. 5

4/4



*FIG. 6*



*FIG. 7*

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2011/042098

A. CLASSIFICATION OF SUBJECT MATTER  
INV. H01R13/6594 H01R12/71  
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)  
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)

EP0-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 5 603 639 A (LAI CHIN-TE [TW] ET AL)<br>18 February 1997 (1997-02-18)                                                                        | 1-4,7                 |
| Y         | column 4, line 6 - line 53<br>column 5, line 31 - column 6, line 62;<br>figure 2<br>column 7, line 59 - column 8, line 49;<br>figure 3<br>----- | 5,6                   |
| Y         | DE 10 2006 049070 A1 (ERNI ELECTRONICS<br>GMBH [DE]) 17 April 2008 (2008-04-17)<br>paragraph [0007] - paragraph [0014]<br>-----                 | 5,6                   |
| A         | US 5 975 917 A (WANG KUO-CHENG [TW] ET AL)<br>2 November 1999 (1999-11-02)<br>paragraph [0030] - paragraph [0036];<br>figure 1<br>-----         | 1                     |

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

☒ See patent family annex.

\* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"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

25 August 2011

Date of mailing of the international search report

01/09/2011

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040,  
Fax: (+31-70) 340-3016

Authorized officer

Knack, Steffen

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2011/042098

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |            |
|-------------------------------------------|---------------------|----------------------------|---------------------|------------|
| US 5603639                                | A                   | 18-02-1997                 | NONE                |            |
| -----                                     |                     |                            |                     |            |
| DE 102006049070 A1                        | 17-04-2008          | JP 2008098165 A            | 24-04-2008          |            |
|                                           |                     | US 2008090463 A1           | 17-04-2008          |            |
| -----                                     |                     |                            |                     |            |
| US 5975917                                | A                   | 02-11-1999                 | CN 1238583 A        | 15-12-1999 |
|                                           |                     |                            | TW 400667 B         | 01-08-2000 |
| -----                                     |                     |                            |                     |            |