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(54) **CONNECTOR**

(57) An upper contact 15 includes a straight section L1 extending from a contacting portion 15A to a bending portion 15D in a fitting direction, and in the straight section L1, a press-fitted portion 15B press-fitted into a press-fitting hole 12E in the housing body 12A, an exposed portion 15C exposed outside the housing 12 and extending in the fitting direction, and a press-fitting shoulder portion 15G formed on the border between the exposed portion

15C and the bending portion 15D are sequentially arranged. The housing 12 includes a resin wall 12F extending throughout an entire length of the exposed portion 15C in the fitting direction and facing a side surface of the exposed portion 15C via an air layer, and an overhanging portion 12G connected to the resin wall 12F and overhanging the exposed portion 15C throughout the entire length of the exposed portion 15C.

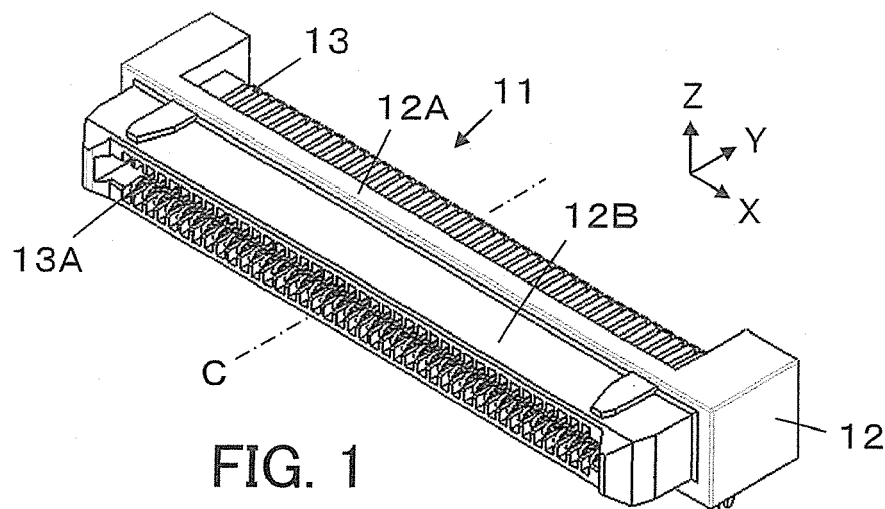


FIG. 1

Description

TECHNICAL FIELD

[0001] The present invention relates to a connector, particularly to a connector having a plurality of contacts for high-speed signal transmission.

BACKGROUND ART

[0002] As a connector of this type, for example, Patent Literature 1 discloses a multipolar connector in which a plurality of upper contacts 2 and a plurality of lower contacts 3 are held by a housing 1 made from an insulating resin and the lower contacts 3 include at least a pair of high-speed differential signal transmitting contacts 3A and 3B that are adjacent to each other, as shown in FIG. 18.

[0003] The high-speed differential signal transmitting contacts 3A and 3B each include a press-fitted portion 4 press-fitted and fixed in the housing 1, a contacting portion 5 extending in a fitting direction of the connector, being exposed in front of the housing 1 and being brought in contact with a contact of a counter connector, and an exposed portion 7 being exposed behind the housing 1 and extending in a direction perpendicular to the fitting direction via a bending portion 6. Ends of the exposed portions 7 of the high-speed differential signal transmitting contacts 3A and 3B are connected to board connecting portions 8 that bend to be spaced apart from each other in the fitting direction and therefore have a staggered arrangement.

CITATION LIST

PATENT LITERATURE

[0004] Patent Literature 1: JP 2011-9151 A

SUMMARY OF INVENTION

TECHNICAL PROBLEMS

[0005] In order to efficiently transmit high-speed differential signals, the impedances of the high-speed differential signal transmitting contacts 3A and 3B need to match with a predetermined value set in advance.

[0006] In impedance matching, however, when the length of the press-fitted portion 4 tightly adhered to the housing 1 made from an insulating resin is increased, the dielectric loss increases while the impedance of the contact decreases, and accordingly, it is difficult to achieve the efficient transmission.

[0007] On the other hand, when the length of the press-fitted portion 4 is decreased and the length of the exposed portion 7 which is not enclosed by the housing 1 is increased, although the dielectric loss decreases, the impedance increases and cannot match with the predeter-

mined value, accordingly. If the exposed portion 7 has an increased width to have a large capacity, the increase in impedance between the high-speed differential signal transmitting contacts 3A and 3B is suppressed, thus facilitating impedance matching. However, because of the increased length of the exposed portion 7 extending from the bending portion 6 in the direction perpendicular to the fitting direction, the height of the connector is increased, disadvantageously.

[0008] When, to cope with it, a modified contact is assumed in which the exposed portion 7 not enclosed by the housing 1 is located between the press-fitted portion 4 and the bending portion 6 to extend along the fitting direction and the exposed portion 7 is larger in width than the press-fitted portion 4, the dielectric loss decreases and also impedance matching is achieved without increasing the height of the connector. In such a contact, shoulders of the exposed portion 7 are formed because the wide exposed portion 7 joins the bending portion 6, and the shoulders are pressed by a jig to press-fit the press-fitted portion 4 into the housing 1. At this time, since the exposed portion 7 is located between the press-fitted portion 4 and the bending portion 6 and this increases the distance from the shoulders of the exposed portion 7 to be pressed by the jig to the press-fitted portion 4, the buckling of the contact easily occurs in press-fitting. Even after the contact has been press-fitted, when an external force acts on the board connecting portion 8 toward the bending portion 6 in, for example, connecting the board connecting portion 8 to a board, the exposed portion 7 may deviate from the fitting direction and this prompts the contact to come off.

[0009] Such problems arise not only in paired contacts as described in Patent Literature 1 but also in a contact for use in transmitting a signal other than a differential signal if impedance of the contact needs to match with a predetermined value set in advance and the contact is press-fitted in a housing made from a resin. Such a contact whose impedance needs to match with a predetermined value set in advance is hereinafter called "high-speed signal transmitting contact."

[0010] The present invention has been made to solve the conventional problems described above and is aimed at providing a connector with which impedance matching is achieved with the dielectric loss remaining low and which is capable of preventing a contact from buckling in press-fitting and from coming off after press-fitting.

SOLUTION TO PROBLEMS

[0011] The present inventions provides a connector, comprising: a housing made from an insulating resin; and high-speed signal transmitting contacts arranged at and held by the housing, wherein each of all the high-speed signal transmitting contacts has at its one end a contacting portion to be brought in contact with a contact of a counter connector, at its another end a board connecting portion to be connected to a board, and a bending portion

being located between the contacting portion and the board connecting portion, wherein a straight section extending from the contacting portion to the bending portion in a fitting direction with the counter connector is formed, the straight section having a press-fitted portion being adjacent to the contacting portion and being press-fitted into and fixed to the housing, an exposed portion being adjacent to the press-fitted portion, being exposed outside the housing and extending in the fitting direction, and a press-fitting shoulder portion being located between the exposed portion and the bending portion, wherein the board connecting portion extends from the bending portion in a direction intersecting the fitting direction, wherein the contacting portion has a width smaller than a width of the press-fitted portion, wherein the exposed portion has a width equal to or smaller than the width of the press-fitted portion, wherein the bending portion has a width smaller than a width of the press-fitting shoulder portion, and wherein the housing includes a resin wall extending throughout an entire length of the exposed portion in the fitting direction and facing a side surface of the exposed portion via an air layer, and an overhanging portion being connected to the resin wall and overhanging the exposed portion throughout the entire length of the exposed portion at an opposite side from a side facing in a direction in which the board connecting portion extends.

[0012] Preferably, the resin wall is disposed between the exposed portions of a pair of the high-speed signal transmitting contacts adjacent to each other and has a height size larger than a thickness size of the exposed portion.

[0013] The overhanging portion may overhang each of the exposed portions of the pair of high-speed signal transmitting contacts from an upper end of the resin wall.

[0014] Preferably, the press-fitted portion has a projection projecting in a width direction.

[0015] Preferably, the exposed portion has a width equal to or smaller than the width of the press-fitting shoulder portion.

[0016] The press-fitting shoulder portion may have a pair of projections projecting separately on opposite sides in a width direction of the bending portion.

[0017] Preferably, the board connecting portion extends in a direction perpendicular to the fitting direction.

[0018] Each of all the high-speed signal transmitting contacts may have a wide portion being located between the bending portion and the board connecting portion, being exposed outside the housing and having a width larger than the width of the bending portion.

[0019] It is preferable to further comprise a locator being fixed to the housing and serving to hold the board connecting portion of each of the high-speed signal transmitting contacts.

[0020] The high-speed signal transmitting contacts may include at least a pair of differential signal contacts adjacent to each other for use in transmitting a high-speed differential signal, and the pair of differential signal

contacts may be formed by bending metal plates of a same shape at the bending portions in a same direction and then bending the metal plates such that the board connecting portions are spaced apart from each other in the fitting direction so as to have a staggered arrangement.

[0021] The contacting portion may or may not have spring properties.

10 ADVANTAGEOUS EFFECTS OF INVENTION

[0022] According to the present invention, the straight section extending in the fitting direction in the high-speed signal transmitting contact has the press-fitted portion being press-fitted into and fixed to the housing, the exposed portion being exposed outside the housing and extending in the fitting direction, and the press-fitting shoulder portion, the contacting portion has a width smaller than the width of the press-fitted portion, the exposed portion has a width equal to or smaller than the width of the press-fitted portion, the bending portion has a width smaller than the width of the press-fitting shoulder portion, and the housing includes the resin wall extending throughout the entire length of the exposed portion and facing a side surface of the exposed portion via the air layer, and an overhanging portion being connected to the resin wall and overhanging over the exposed portion throughout the entire length of the exposed portion at the opposite side from the side facing in the direction in which the board connecting portion extends. Owing to this configuration, impedance matching can be achieved with the dielectric loss remaining low, and a contact is prevented from buckling in press-fitting and from coming off after press-fitting.

35 BRIEF DESCRIPTION OF DRAWINGS

[0023]

[FIG. 1] FIG. 1 is a perspective view showing a receptacle connector according to Embodiment 1 of the invention, when viewed from an obliquely front upper position.

[FIG. 2] FIG. 2 is a perspective view showing the receptacle connector according to Embodiment 1, when viewed from an obliquely rear upper position.

[FIG. 3] FIG. 3 is a perspective view showing the receptacle connector according to Embodiment 1, when viewed from an obliquely front lower position.

[FIG. 4] FIG. 4 is a perspective view showing the receptacle connector according to Embodiment 1, when viewed from an obliquely rear lower position.

[FIG. 5] FIG. 5 is a plan view showing the receptacle connector according to Embodiment 1.

[FIG. 6] FIG. 6 is a cross-sectional view taken along line A-A of FIG. 5.

[FIGS. 7] FIGS. 7A to FIG. 7D are respectively a perspective view, a plan view, a side view and a back

view, all showing a pair of high-speed signal transmitting contacts used in the receptacle connector according to Embodiment 1.

[FIG. 8] FIG. 8 is an enlarged perspective view showing an important part of the receptacle connector according to Embodiment 1.

[FIG. 9] FIG. 9 is a partial enlarged cross-sectional view showing a region including an exposed portion, as well as its vicinity, of a high-speed signal transmitting contact in the receptacle connector according to Embodiment 1.

[FIG. 10] FIG. 10 is a perspective view showing a plug connector according to Embodiment 2, when viewed from an obliquely front upper position.

[FIG. 11] FIG. 11 is a perspective view showing the plug connector according to Embodiment 2, when viewed from an obliquely rear upper position.

[FIG. 12] FIG. 12 is a perspective view showing the plug connector according to Embodiment 2, when viewed from an obliquely front lower position.

[FIG. 13] FIG. 13 is a perspective view showing the plug connector according to Embodiment 2, when viewed from an obliquely rear lower position.

[FIG. 14] FIG. 14 is a plan view showing the plug connector according to Embodiment 2.

[FIG. 15] FIG. 15 is a cross-sectional view taken along line B-B of FIG. 14.

[FIG. 16] FIG. 16 is a perspective view showing a pair of high-speed signal transmitting contacts used in the plug connector according to Embodiment 2.

[FIG. 17] FIG. 17 is a partial enlarged cross-sectional view showing a region including an exposed portion, as well as its vicinity, of a high-speed signal transmitting contact in the plug connector according to Embodiment 2.

[FIG. 18] FIG. 18 is a cross-sectional view of a conventional connector.

DESCRIPTION OF EMBODIMENTS

[0024] Embodiments of the present invention are described below based on the appended drawings.

Embodiment 1

[0025] FIGS. 1 to 4 each show the structure of a receptacle connector 11 according to Embodiment 1.

[0026] The receptacle connector 11 includes a housing 12 extending in a direction perpendicular to a fitting axis C and made from an insulating resin, and a plurality of contacts 13 are arranged at and held by the housing 12.

[0027] The housing 12 includes a housing body 12A and a hollow frame-shaped portion 12B which extends forward from the housing body 12A along the fitting axis C and which is to be inserted into a counter connector (not shown). In each of the contacts 13, one end 13A protrudes in the frame-shaped portion 12B along the fitting axis C, the middle part is fixed to the housing body

12A, and the other end 13B is exposed outside the housing body 12A.

[0028] The other ends 13B of the contacts 13 extend in a direction perpendicular to the fitting axis C and also perpendicular to a direction in which the housing 12 extends. A locator 14 having a flat plate shape and serving to hold the other ends 13B of the contacts 13 is fixed to the housing 12.

[0029] For convenience, the direction in which the contacts 13 are aligned and the housing 12 extends is called "X direction," the direction along the fitting direction C from the front to the back of the housing 12 "+Y direction," and the direction in which the other ends 13B of the contacts 13 extend "-Z direction."

[0030] As shown in FIG. 5, the frame-shaped portion 12B of the housing 12 protrudes from the housing body 12A in the -Y direction, and the contacts 13 are aligned in the X direction.

[0031] FIG. 6 shows the cross-sectional structure of the receptacle connector 11 as cut in a YZ plane passing through one contact 13. The housing 12 includes a contact support portion 12C of flat plate shape extending along a XY plane at a Z direction position in the middle of the frame-shaped portion 12B in the Z direction at the +Y direction side with respect to the housing body 12A, and the contacts 13 are divided into two groups of a plurality of upper contacts 15 which are aligned at the +Z direction side of the contact support portion 12C and a plurality of lower contacts 16 which are aligned at the -Z direction side of the contact support portion 12C.

[0032] The upper contacts 15 are high-speed signal transmitting contacts, and for instance, each pair of contacts adjacent to each other constitutes a high-speed differential signal transmitting contact pair, so that a plurality of the high-speed differential signal transmitting contact pairs are provided. On the other hand, the lower contacts 16 are contacts for transmitting electric signals that are not high-speed signals (i.e., contacts whose impedances need not match with a predetermined value set in advance).

[0033] The upper contacts 15 each include a contacting portion 15A positioned at the -Y direction-side end, a press-fitted portion 15B adjacent to the contacting portion 15A at the +Y direction side, an exposed portion 15C adjacent to the press-fitted portion 15B, a bending portion 15D adjacent to the exposed portion 15C, a wide portion 15E adjacent to the bending portion 15D, and a board connecting portion 15F adjacent to the wide portion 15E. The upper contacts 15 are each provided with a straight section L1 extending from the contacting portion 15A to the bending portion 15D in the Y direction that is the fitting direction.

[0034] The contacting portion 15A is brought into contact with a contact of a counter connector (not shown) to establish the electric connection, has spring properties, and is exposed outside the housing 12 and located in a hollow portion 12D of the frame-shaped portion 12B.

[0035] The press-fitted portion 15B is press-fitted into

a press-fitting hole 12E extending through the housing body 12A in the Y direction to fix the upper contact 15 to the housing 12.

[0036] The exposed portion 15C is exposed outside the housing 12 at the +Y direction side of the housing body 12A and extends in the +Y direction that is the fitting direction.

[0037] The bending portion 15D bends at a substantially right angle. Due to the bending portion 15D present between the exposed portion 15C and the wide portion 15E, the wide portion 15E extends from the bending portion 15D in the -Z direction.

[0038] The -Z direction-side end of the wide portion 15E bends in the Y direction and is connected to the board connecting portion 15F, and consequently, the board connecting portion 15F extends in the -Z direction at a position where it is deviated from the +Z direction-side end of the wide portion 15E in the Y direction by a predetermined distance.

[0039] The upper contacts 15 aligned in the X direction are configured so that the -Z direction-side ends of the wide portions 15E bend alternately toward the -Y direction and +Y direction and are then connected to the corresponding board connecting portions 15F, and the +Z direction-side ends of the board connecting portions 15F configured as above are inserted in through-holes 14A of the locator 14, whereby the board connecting portions 15F of the upper contacts 15 are held in a staggered arrangement.

[0040] FIGS. 7A to 7D each show a pair of upper contacts 15 constituting a high-speed differential signal transmitting contact pair. The pair of upper contacts 15 are formed of two metal plates cut in the same shape. The two metal plates are curved in the same direction at the contacting portions 15A, bent in the same direction at the bending portions 15D, bent in the opposite directions at the wide portions 15E and bent in the opposite directions at the board connecting portions 15F, thereby forming the pair of upper contacts 15 of the same shape except that the two board connecting portions 15F are shaped to be spaced apart in the Y direction that is the fitting direction.

[0041] In each of the upper contacts 15, a press-fitting shoulder portion 15G having a pair of projections which project on the opposite sides in the width direction of the bending portion 15D, namely, in the X direction is formed on the border between the exposed portion 15C and the bending portion 15D.

[0042] The press-fitted portion 15B has press-fitting projections which project on the opposite sides in the width direction, namely, in the X direction.

[0043] As shown in FIG. 7B, when the widths of the contacting portion 15A, the press-fitted portion 15B including the press-fitting projections, the exposed portion 15C, the press-fitting shoulder portion 15G, the bending portion 15D and the wide portion 15E are denoted by W1, W2, W3, W4, W5 and W6, respectively, the width W1 of the contacting portion 15A is set to be smaller than

the width W2 of the press-fitted portion 15B including the press-fitting projections, and the width W5 of the bending portion 15D is set to be smaller than the width W4 of the press-fitting shoulder portion 15G.

[0044] The width W3 of the exposed portion 15C is set to be equal to or smaller than both of the width W2 of the press-fitted portion 15B and the width W4 of the press-fitting shoulder portion 15G, and the width W6 of the wide portion 15E is set to be larger than the width W5 of the bending portion 15D.

[0045] As shown in FIG. 8, a plurality of resin walls 12F are formed on the surface of the contact support portion 12C of the housing 12 at the +Z direction side so as to be each located between adjacent exposed portions 15C of the upper contacts 15. The resin walls 12F each extend in the Y direction throughout the entire length of the exposed portion 15C of the upper contact 15. As shown in FIG. 9, each wall surface of the resin wall 12F faces a side surface S1 of the exposed portion 15C via an air layer A1. Owing to the setting in which the width W3 of the exposed portion 15C is equal to or smaller than the width W2 of the press-fitted portion 15B, the resin wall 12F and the air layers A1 described above are allowed to be present between the exposed portions 15C of two upper contacts 15 adjacent to each other.

[0046] In addition, an overhanging portion 12G is formed at the +Z direction-side end of each resin wall 12F to overhang the exposed portions 15C of two upper contacts 15 located at both sides of the resin wall 12F and extend throughout the entire length of the exposed portion 15C at the +Z direction side of the exposed portions 15C, i.e., at the opposite side from the side facing in the -Z direction in which the board connecting portions 15F extend.

[0047] The resin wall 12F has a height size larger than the thickness size of the exposed portion 15C of the upper contact 15. As shown in FIG. 9, the surface of the exposed portion 15C at the +Z direction side is in contact with the corresponding overhanging portions 12G, while the surface of the exposed portion 15C at the -Z direction side is away from the surface of the contact support portion 12C at the +Z direction side so that an air layer B1 is formed between those surfaces. The degree of overhanging of each overhanging portion 12G in the X direction is set to a value which allows the overhanging portion 12G partially to overlap the exposed portion 15C of the relevant upper contact 15 in the Z direction, and a gap K1 is formed on the exposed portion 15C between a pair of overhanging portions 12G facing each other.

[0048] With the contacting portion 15A being positioned at the +Y direction side of the press-fitting hole 12E of the housing body 12A, the press-fitting shoulder portion 15G is pressed with a jig (not shown) in the -Y direction, and as a consequence, the upper contact 15 can be held in the housing 12. At this time, owing to the setting in which the width W1 of the contacting portion 15A is smaller than the width W2 of the press-fitted portion 15B, the press-fitted portion 15B is press-fitted into

the press-fitting hole 12E after the contacting portion 15A has been inserted into the press-fitting hole 12E, and consequently, the upper contact 15 is fixed to the housing 12.

[0049] The exposed portion 15C extending in the Y direction is present between the press-fitted portion 15B and the press-fitting shoulder portion 15G and therefore, the distance from the press-fitting shoulder portion 15G to be pressed by the jig to the press-fitted portion 15B to be press-fitted into the press-fitting hole 12E is long. However, since the overhanging portion 12G is formed at the +Z direction side of the exposed portion 15C throughout the entire length of the exposed portion 15C and the surface of the contact support portion 12C is positioned at the -Z direction side of the exposed portion 15C via the air layer B1, the buckling of the upper contact 15 can be prevented.

[0050] In addition, the exposed portion 15C of the upper contact 15 extending in the Y direction has the side surfaces S1 each of which faces the corresponding resin wall 12F via the air layer A1, the surface at the -Z direction side which faces the surface of the contact support portion 12C via the air layer B1, and the surface at the +Z direction side on which the gap K1 is formed. Owing to this configuration, impedance matching of the upper contact 15 can be achieved with the dielectric loss remaining low.

[0051] The width W6 of the wide portion 15E which is exposed outside the housing 12 is set to be larger than the width W5 of the bending portion 15D, and impedance matching can be achieved by adjusting the width W6 of the wide portion 15E.

[0052] As shown in FIG. 6, together with the thus configured upper contacts 15, the lower contacts 16 are aligned at the -Z direction side of the contact support portion 12C.

[0053] The lower contacts 16 each include a contacting portion 16A that has spring properties and is positioned at the -Y direction-side end, a press-fitted portion 16B that is adjacent to the contacting portion 16A at the +Y direction side and is press-fitted into the press-fitting hole 12E of the housing body 12A, a bending portion 16C adjacent to the press-fitted portion 16B, and a board connecting portion 16D adjacent to the bending portion 16C, as with the upper contacts 15.

[0054] The lower contacts 16 aligned in the X direction are each configured so that the length from the press-fitted portion 16B to the bending portion 16C is set alternately to either of two different values, and the board connecting portions 16D of the lower contacts 16 as configured above are inserted in through-holes 14A of the locator 14, whereby the board connecting portions 16D of the lower contacts 16 are held in a staggered arrangement.

[0055] The thus configured receptacle connector 11 is mounted on a board (not shown) and used with the board connecting portions 15F of the upper contacts 15 and the board connecting portions 16D of the lower contacts

16 being connected to the corresponding interconnects in the board.

[0056] At this time, although the exposed portion 15C extending in the Y direction is provided adjacent to the press-fitted portion 15B in each of the upper contacts 15 and this increases the length from the bending portion 15D to the press-fitted portion 15B press-fitted into the press-fitting hole 12E, since the overhanging portion 12G is formed throughout the entire length of the exposed portion 15C at the +Z direction side of the exposed portion 15C, i.e., at the opposite side from the side facing in the -Z direction in which the board connecting portion 15F extends, even if an external force acts in the +Z direction on the board connecting portion 15F of the upper contact 15 in mounting of the receptacle connector 11, the exposed portion 15C and the bending portion 15D are prevented from deviating from the fitting direction, so that the contact will not come off.

[0057] In addition, the exposed portion 15C of the upper contact 15 lies at the straight section L1 extending in the fitting direction, thereby obtaining the receptacle connector 11 that is kept small in height in the Z direction.

[0058] In the receptacle connector 11 according to Embodiment 1, impedance matching of the upper contact 15 can be achieved with the dielectric loss remaining low, and in addition, since the board connecting portions 15F of the upper contacts 15 are disposed in a staggered arrangement, the narrow pitch can be realized while minimizing skew which may occur in high-speed signal transmission.

Embodiment 2

[0059] FIGS. 10 to 14 each show the structure of a plug connector 21 according to Embodiment 2. The plug connector 21 is to be fitted with the receptacle connector 11 of Embodiment 1 and includes a housing 22 which extends in a direction perpendicular to the fitting axis C and which is made from an insulating resin. A plurality of contacts 23 are arranged at and held by the housing 22.

[0060] For the plug connector 21 of Embodiment 2, an X direction, a Y direction and a Z direction are defined in accordance with those defined for the receptacle connector 11 of Embodiment 1 with which the plug connector 21 is to be fitted.

[0061] The housing 22 includes a housing body 22A. The housing body 22A has formed therein a counter-connector receiving portion 22B of recess shape which opens toward the +Y direction and serves to receive the frame-shaped portion 12B of the receptacle connector 11 which is a counter connector. In each of the contacts 23, one end 23A protrudes in the counter-connector receiving portion 22B, the middle part is fixed to the housing body 22A, and the other end 23B is exposed outside the housing body 22A.

[0062] The other ends 23B of the contacts 23 extend in the -Z direction, and a locator 24 having a flat plate shape and serving to hold the other ends 23B of the con-

tacts 23 is fixed to the housing 22.

[0063] FIG. 15 shows the cross-sectional structure of the plug connector 21 as cut in a YZ plane passing through one contact 23. The housing 22 includes a contact support portion 22C of flat plate shape extending along a XY plane from the inside of the counter-connector receiving portion 22B to a point at the -Y direction side of the housing body 22A at a Z direction position in the middle of the counter-connector receiving portion 22B in the Z direction, and the contacts 23 are divided into two groups of a plurality of upper contacts 25 which are aligned at the +Z direction side of the contact support portion 22C and a plurality of lower contacts 26 which are aligned at the -Z direction side of the contact support portion 22C.

[0064] Each of the upper contacts 25 has the same configuration as the upper contact 15 used in the receptacle connector 11 of Embodiment 1 except that a contacting portion 25A has no spring properties. Specifically, the upper contacts 25 are high-speed signal transmitting contacts, and for instance, each pair of contacts adjacent to each other constitutes a high-speed differential signal transmitting contact pair, so that a plurality of the high-speed differential signal transmitting contact pairs are provided. The upper contacts 25 each include the contacting portion 25A, a press-fitted portion 25B, an exposed portion 25C, a bending portion 25D, a wide portion 25E and a board connecting portion 25F, and are each provided with a straight section L2 extending from the contacting portion 25A to the bending portion 25D in the Y direction that is the fitting direction.

[0065] The press-fitted portion 25B is press-fitted into a press-fitting hole 22E in the housing body 22A to fix the upper contact 25 to the housing 22.

[0066] In the upper contact 25, as shown in FIG. 16, a press-fitting shoulder portion 25G having a pair of projections which project on the opposite sides in the width direction of the bending portion 25D, namely, in the X direction is formed on the border between the exposed portion 25C and the bending portion 25D.

[0067] As with the upper contact 15 in Embodiment 1, the width of the contacting portion 25A is set to be smaller than that of the press-fitted portion 25B, and the width of the bending portion 25D is set to be smaller than that of the press-fitting shoulder portion 25G.

[0068] The width of the exposed portion 25C is set to be equal to or smaller than both widths of the press-fitted portion 25B and the press-fitting shoulder portion 25G, and the width of the wide portion 25E is set to be larger than that of the bending portion 25D.

[0069] As shown in FIG. 17, a plurality of resin walls 22F are formed on the surface of the contact support portion 22C of the housing 22 at the +Z direction side so as to be each located between adjacent exposed portions 25C of the upper contacts 25. The resin walls 22F each extend in the Y direction throughout the entire length of the exposed portion 25C of the upper contact 25. Each wall surface of the resin wall 22F faces a side surface S2

of the exposed portion 25C via an air layer A2. Owing to the setting in which the width of the exposed portion 25C is equal to or smaller than that of the press-fitted portion 25B, the resin wall 22F and the air layers A2 described above are allowed to be present between the exposed portions 25C of two upper contacts 25 adjacent to each other.

[0070] In addition, an overhanging portion 22G is formed at the +Z direction-side end of each resin wall 22F to overhang the exposed portions 25C of two upper contacts 25 located at both sides of the resin wall 22F and extend throughout the entire length of the exposed portions 25C at the +Z direction side of the exposed portions 25C, i.e., at the opposite side from the side facing in the -Z direction in which the board connecting portions 25F extend.

[0071] The resin wall 22F has a height size larger than the thickness size of the exposed portion 25C of the upper contact 25. The surface of the exposed portion 25C at the -Z direction side is in contact with the surface of the contact support portion 22C at the +Z direction side, while the surface of the exposed portion 25C at the +Z direction side is away from the corresponding overhanging portions 22G in the -Z direction. The degree of overhanging of each overhanging portion 22G in the X direction is set to a value which allows the overhanging portion 22G to partially overlap the exposed portion 25C of the relevant upper contact 25 in the Z direction, and a gap K2 is formed between a pair of overhanging portions 22G facing each other.

[0072] With the contacting portion 25A being positioned at the -Y direction side of the press-fitting hole 22E of the housing body 22A, the press-fitting shoulder portion 25G is pressed with a jig (not shown) in the +Y direction, and as a consequence, the upper contact 25 can be held in the housing 22. At this time, owing to the setting in which the width of the contacting portion 25A is smaller than that of the press-fitted portion 25B, the press-fitted portion 25B is press-fitted into the press-fitting hole 22E after the contacting portion 25A has been inserted into the press-fitting hole 22E, and consequently, the upper contact 25 is fixed to the housing 22.

[0073] The exposed portion 25C extending in the Y direction is present between the press-fitted portion 25B and the press-fitting shoulder portion 25G and therefore, the distance from the press-fitting shoulder portion 25G to be pressed by the jig to the press-fitted portion 25B to be press-fitted into the press-fitting hole 22E is long. However, since the surface of the contact support portion 22C extends throughout the entire length of the exposed portion 25C at the -Z direction side of the exposed portion 25C and the overhanging portion 22G is disposed at the +Z direction side of the exposed portion 25C, the buckling of the upper contact 25 can be prevented.

[0074] In addition, the exposed portion 25C of the upper contact 25 extending in the Y direction has the side surfaces S2 each of which faces the corresponding resin wall 22F via the air layer A2, and the surface at the +Z

direction side on which the gap K2 is formed. Owing to this configuration, impedance matching of the upper contact 25 can be achieved with the dielectric loss remaining low.

[0075] Furthermore, impedance matching can be achieved by adjusting the width of the wide portion 25E which is exposed outside the housing 22.

[0076] As shown in FIG. 15, together with the thus configured upper contacts 25, the lower contacts 26 are aligned at the -Z direction side of the contact support portion 22C.

[0077] The lower contacts 26 each include a contacting portion 26A having no spring properties, a press-fitted portion 26B press-fitted into the press-fitting hole 22E of the housing body 22A, a bending portion 26C, and a board connecting portion 26D, as with the upper contacts 25.

[0078] The lower contacts 26 aligned in the X direction are each configured so that the length from the press-fitted portion 26B to the bending portion 26C is set alternately to either of two different values, and the board connecting portions 26D of the lower contacts 26 are inserted in through-holes 24A of the locator 24, whereby the board connecting portions 26D of the lower contacts 26 are held in a staggered arrangement.

[0079] The thus configured plug connector 21 is mounted on a board (not shown) and used with the board connecting portions 25F of the upper contacts 25 and the board connecting portions 26D of the lower contacts 26 being connected to the corresponding interconnects in the board.

[0080] At this time, although the exposed portion 25C extending in the Y direction is provided adjacent to the press-fitted portion 25B in each of the upper contacts 25 and this increases the length from the bending portion 25D to the press-fitted portion 25B press-fitted into the press-fitting hole 22E, since the overhanging portion 22G is formed throughout the entire length of the exposed portion 25C at the +Z direction side of the exposed portion 25C, i.e., at the opposite side from the side facing in the -Z direction in which the board connecting portion 25F extends, even if an external force acts in the +Z direction on the board connecting portion 25F of the upper contact 25 in mounting of the plug connector 21, the exposed portion 25C and the bending portion 25D are prevented from deviating from the fitting direction, so that the contact will not come off.

[0081] In addition, the exposed portion 25C of the upper contact 25 lies at the straight section L2 extending in the fitting direction, thereby obtaining the plug connector 21 that is kept small in height in the Z direction.

[0082] In the plug connector 21 according to Embodiment 2, impedance matching of the upper contact 25 can be achieved with the dielectric loss remaining low, and in addition, since the board connecting portions 25F of the upper contacts 25 are disposed in a staggered arrangement, the narrow pitch can be realized while minimizing skew which may occur in high-speed signal trans-

mission.

[0083] While in Embodiments 1 and 2 described above, the board connecting portions 15F and 25F of the upper contacts 15 and 25 extend in the Z direction perpendicular to the fitting direction, the invention is not limited thereto, and the board connecting portions 15F and 25F may extend in any direction intersecting the fitting direction.

[0084] While in Embodiments 1 and 2 described above, the upper contacts 15 and 25 are high-speed signal transmitting contacts and the lower contacts 16 and 26 are contacts for transmitting electric signals that are not high-speed signals, the lower contacts 16 and 26 may be high-speed signal transmitting contacts and the upper contacts 15 and 25 may be contacts for transmitting electric signals that are not high-speed signals, in the opposite manner.

[0085] Alternatively, all of the upper contacts 15 and 25 and the lower contacts 16 and 26 may be high-speed signal transmitting contacts.

[0086] The contacting portions 15A of the upper contacts 15 and the contacting portions 16A of the lower contacts 16 in the receptacle connector 11 according to Embodiment 1 have spring properties, and the contacting portions 25A of the upper contacts 25 and the contacting portions 26A of the lower contacts 26 in the plug connector 21 according to Embodiment 2 have no spring properties. However, the contacting portions 25A of the upper contacts 25 and the contacting portions 26A of the lower contacts 26 in the plug connector 21 may have spring properties, and the contacting portions 15A of the upper contacts 15 and the contacting portions 16A of the lower contacts 16 in the receptacle connector 11 may have no spring properties, in the opposite manner.

[0087] The present invention is applicable not only to a connector having contacts arranged in two arrays of upper and lower rows but also to a wide variety of connectors each having a plurality of high-speed signal transmitting contacts arranged in a housing regardless of the number of contacts.

REFERENCE SIGNS LIST

[0088]

1 housing, 2 upper contact, 3 lower contact, 3A, 3B high-speed differential signal transmitting contact, 4 press-fitted portion, 5 contacting portion, 6 bending portion, 7 exposed portion, 8 board connecting portion, 11 receptacle connector, 12, 22 housing, 13, 23 contact, 12A, 22A housing body, 12B frame-shaped portion, 12C, 22C contact support portion, 12D hollow portion, 12E, 22E press-fitting hole, 12F, 22F resin wall, 12G, 22G overhanging portion, 13A, 23A one end, 13B, 23B other end, 14, 24 locator, 14A, 24A through-hole, 15, 25 upper contact, 15A, 16A, 25A, 26A contacting portion, 15B, 16B, 25B, 26B press-fitted portion, 15C, 25C exposed portion,

15D, 16C, 25D, 26C bending portion, 15E, 25E wide portion, 15F, 16D, 25F, 26D board connecting portion, 15G, 25G press-fitting shoulder portion, 16, 26 lower contact, 21 plug connector, 22B counter-connector receiving portion, C fitting axis, L1, L2 straight section, W1 to W6 width, A1, A2, B1 air layer, S1, S2 side surface, K1, K2 gap

Claims

1. A connector, comprising:

a housing made from an insulating resin; and high-speed signal transmitting contacts arranged at and held by the housing, wherein each of all the high-speed signal transmitting contacts has at its one end a contacting portion to be brought in contact with a contact of a counter connector, at its another end a board connecting portion to be connected to a board, and a bending portion being located between the contacting portion and the board connecting portion,

wherein a straight section extending from the contacting portion to the bending portion in a fitting direction with the counter connector is formed, the straight section having a press-fitted portion being adjacent to the contacting portion and being press-fitted into and fixed to the housing, an exposed portion being adjacent to the press-fitted portion, being exposed outside the housing and extending in the fitting direction, and a press-fitting shoulder portion being located between the exposed portion and the bending portion,

wherein the board connecting portion extends from the bending portion in a direction intersecting the fitting direction, wherein the contacting portion has a width smaller than a width of the press-fitted portion, wherein the exposed portion has a width equal to or smaller than the width of the press-fitted portion, wherein the bending portion has a width smaller than a width of the press-fitting shoulder portion, and

wherein the housing includes a resin wall extending throughout an entire length of the exposed portion in the fitting direction and facing a side surface of the exposed portion via an air layer, and an overhanging portion being connected to the resin wall and overhanging the exposed portion throughout the entire length of the exposed portion at an opposite side from a side facing in a direction in which the board connecting portion extends.

2. The connector according to claim 1, wherein the resin wall is disposed between the exposed portions of a pair of the high-speed signal transmitting contacts adjacent to each other and has a height size larger than a thickness size of the exposed portion.

3. The connector according to claim 2, wherein the overhanging portion overhangs each of the exposed portions of the pair of high-speed signal transmitting contacts from an upper end of the resin wall.

4. The connector according to any one of claims 1 to 3, wherein the press-fitted portion has a projection projecting in a width direction.

5. The connector according to any one of claims 1 to 4, wherein the exposed portion has a width equal to or smaller than the width of the press-fitting shoulder portion.

6. The connector according to any one of claims 1 to 5, wherein the press-fitting shoulder portion has a pair of projections projecting separately on opposite sides in a width direction of the bending portion.

7. The connector according to any one of claims 1 to 6, wherein the board connecting portion extends in a direction perpendicular to the fitting direction.

8. The connector according to any one of claims 1 to 7, wherein each of all the high-speed signal transmitting contacts has a wide portion being located between the bending portion and the board connecting portion, being exposed outside the housing and having a width larger than the width of the bending portion.

9. The connector according to any one of claims 1 to 8, further comprising a locator being fixed to the housing and serving to hold the board connecting portion of each of the high-speed signal transmitting contacts.

10. The connector according to any one of claims 1 to 9, wherein the high-speed signal transmitting contacts include at least a pair of differential signal contacts adjacent to each other for use in transmitting a high-speed differential signal, the pair of differential signal contacts being formed by bending metal plates of a same shape at the bending portions in a same direction and then bending the metal plates such that the board connecting portions are spaced apart from each other in the fitting direction so as to have a staggered arrangement.

11. The connector according to any one of claims 1 to 10, wherein the contacting portion has spring properties.

12. The connector according to any one of claims 1 to 10, wherein the contacting portion has no spring properties.

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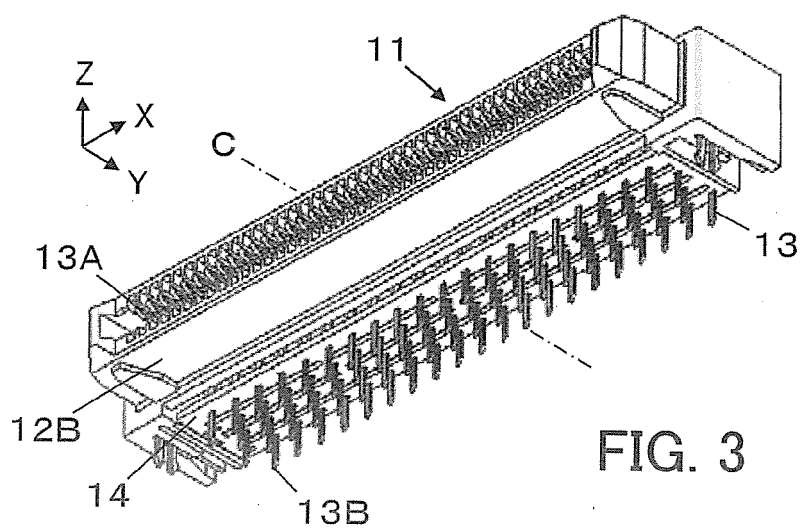
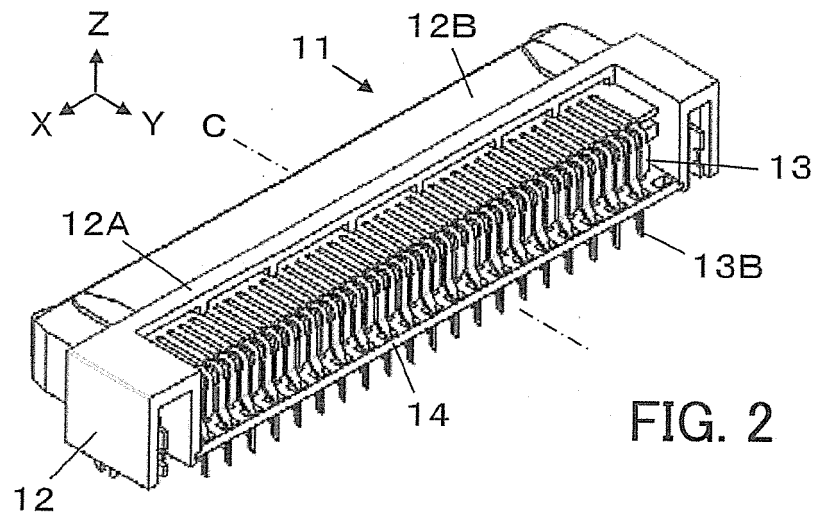
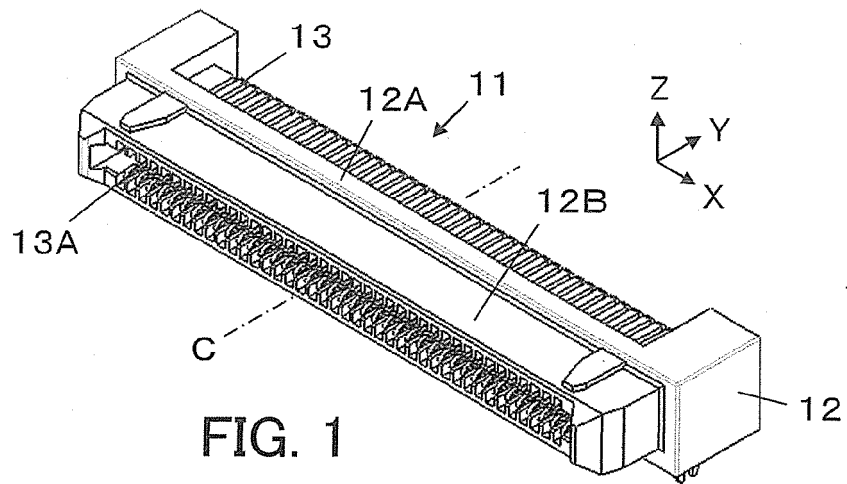
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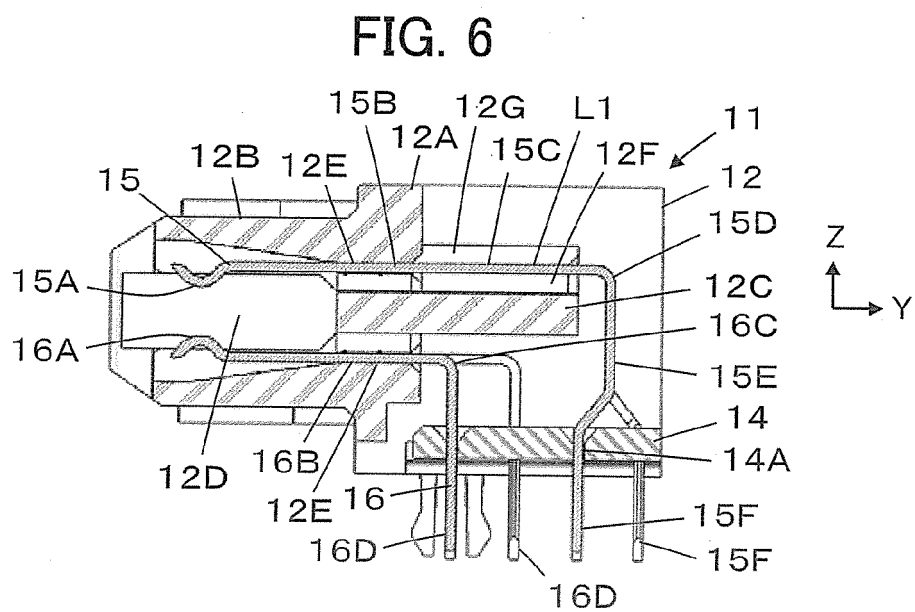
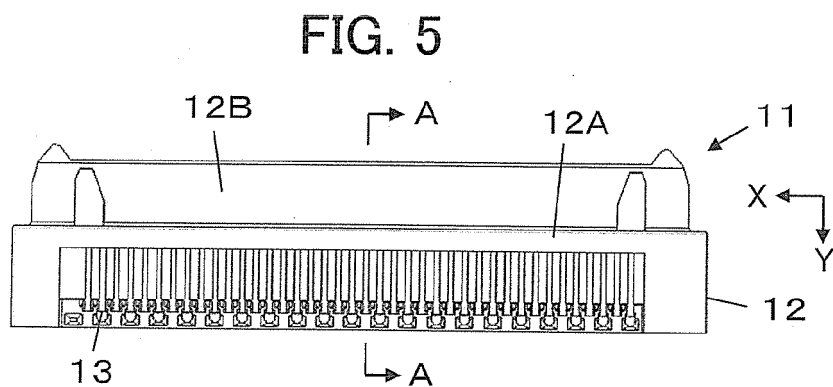
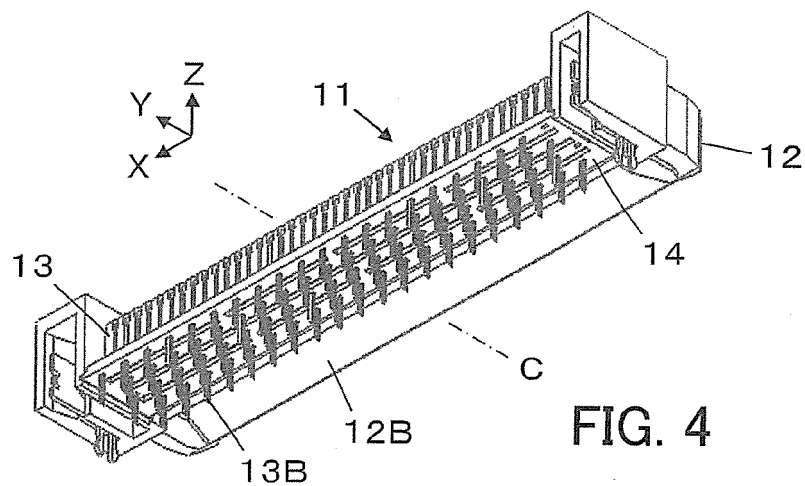
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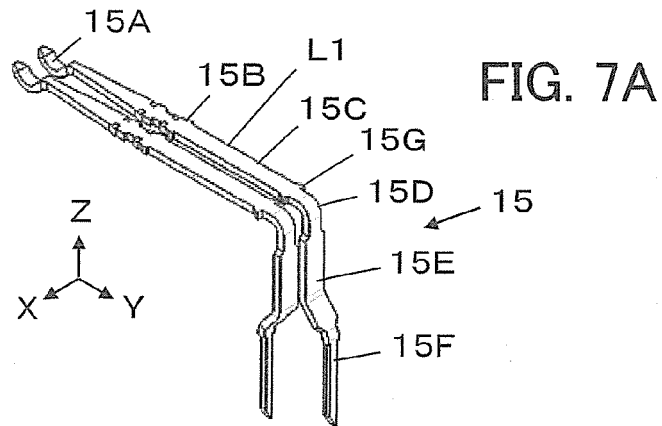


FIG. 7A

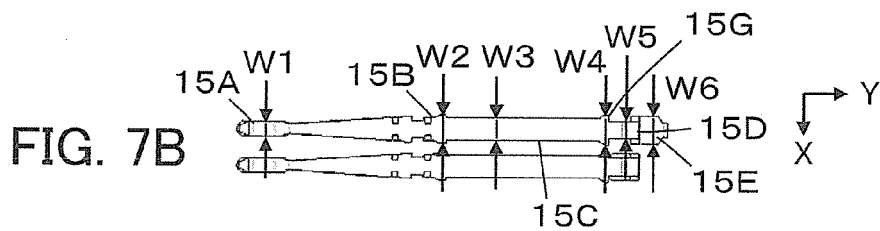


FIG. 7B

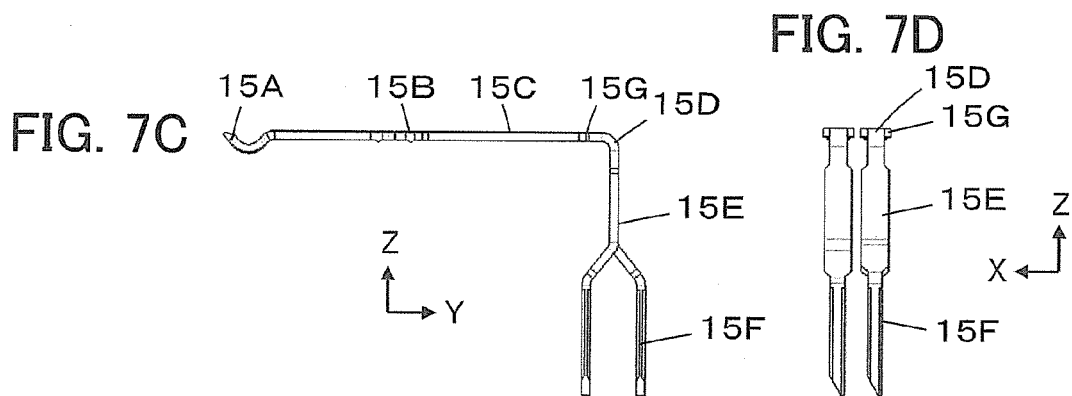


FIG. 7D

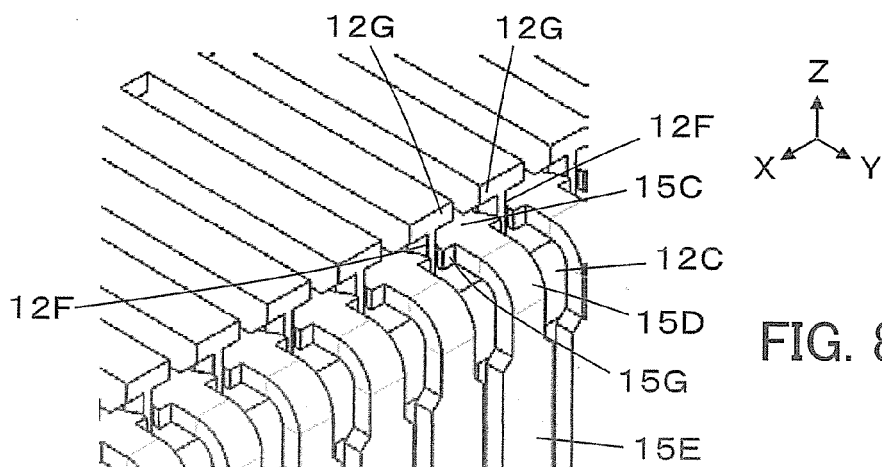


FIG. 8

FIG. 9

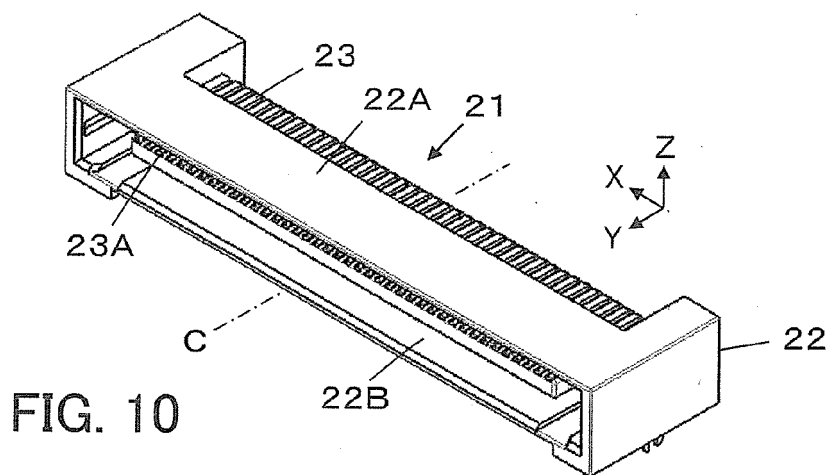
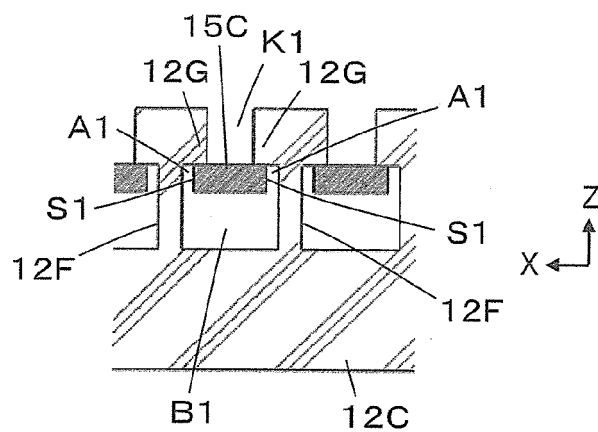


FIG. 10

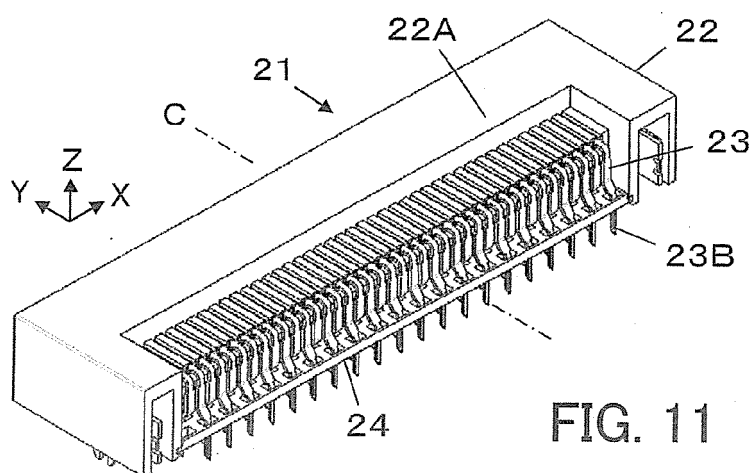


FIG. 11

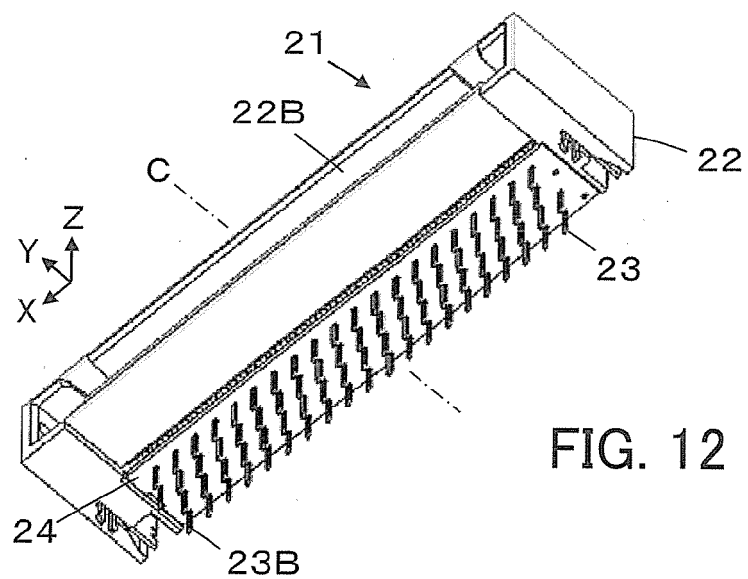


FIG. 12

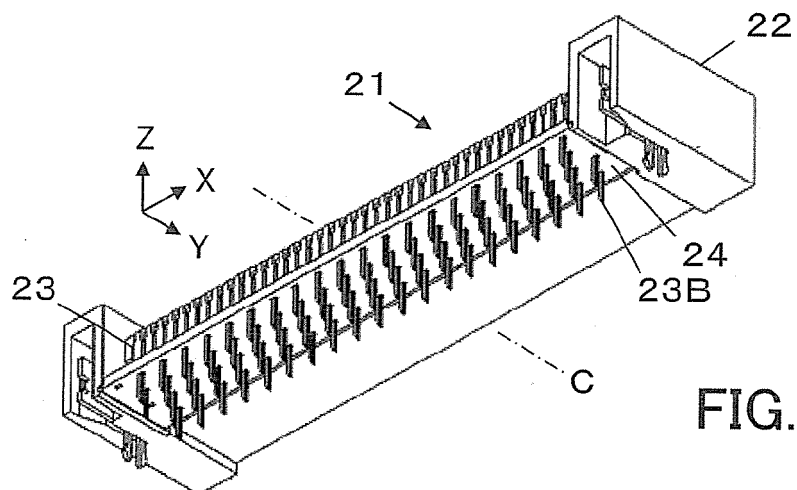


FIG. 13

FIG. 14

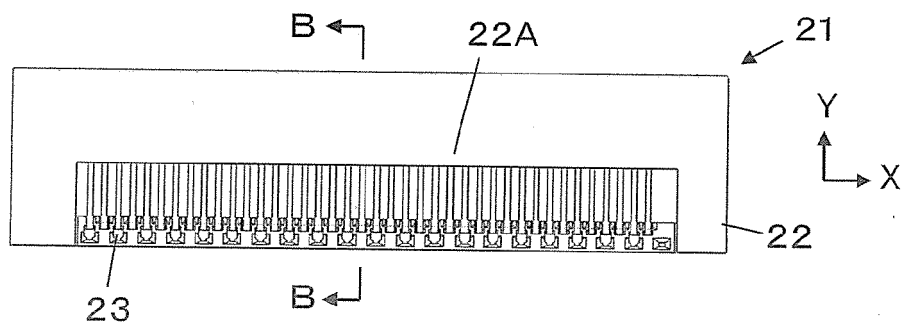


FIG. 15

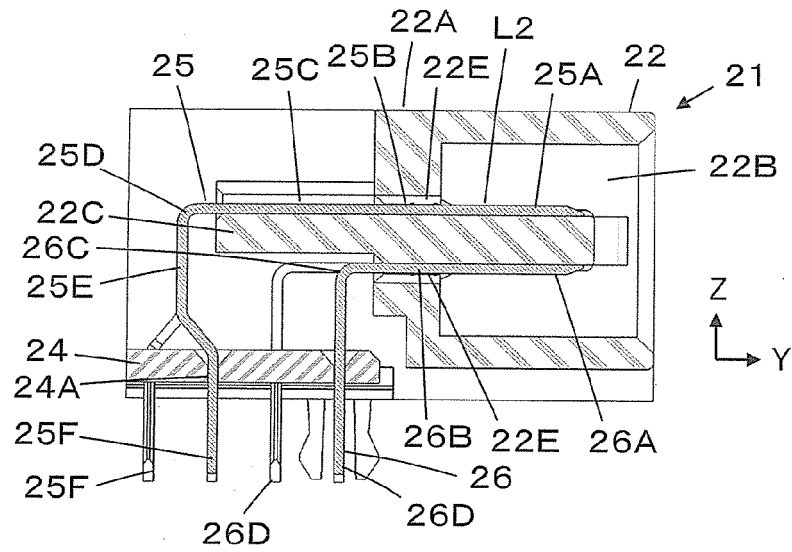


FIG. 16

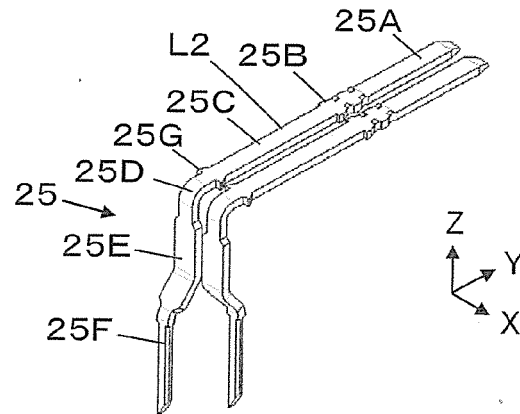


FIG. 17

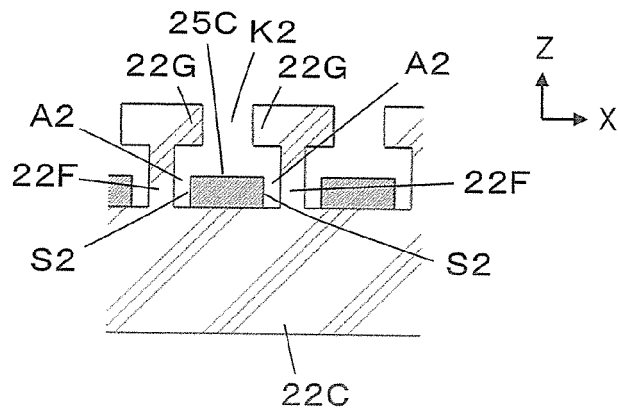
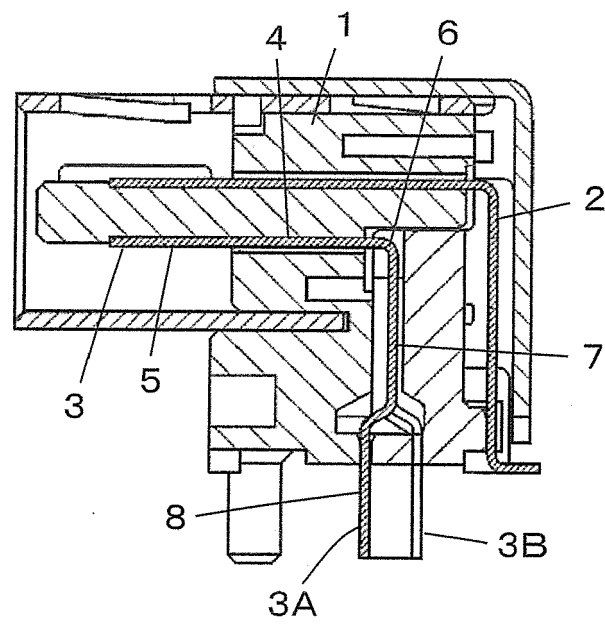


FIG. 18





EUROPEAN SEARCH REPORT

Application Number
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A	EP 1 950 841 A2 (SUMITOMO WIRING SYSTEMS [JP]) 30 July 2008 (2008-07-30) * paragraph [0024] - paragraph [0040] * * figures 1-4 *	1-12	
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			H01R
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 14 September 2016	Examiner Henrich, Jean-Pascal
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