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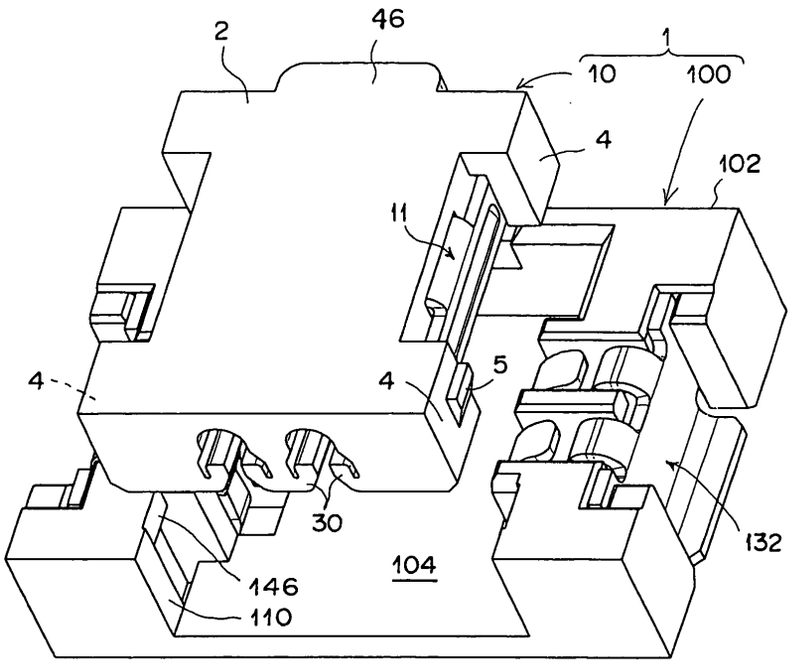
(54) Electrical connector assembly, plug connector and receptacle connector

(57) A plug connector (10) and/or a receptacle connector (100) employed therein, is miniaturized to be low in height and narrow. The plug connector (10) has two first contacts (11), which are arranged in a line and face opposite directions from each other, exposed at its side surfaces. The receptacle connector (100) has a recess (104) for receiving the plug connector (10) and two second contacts, which are exposed at positions corresponding to the first contacts (11), within the recess. When the plug connector (10) and the receptacle connector (100) engage each other, elastic contact pieces of the second contacts contact a side of the first contacts (11) to electrically connect thereto at the side of the plug connector.

FIG.4



EP 1 385 232 A2

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to an electrical connector assembly suitable for use in miniature electric/electronic equipment such as cellular telephones, as well as a plug connector and a receptacle connector utilized in the electrical connector assembly.

Description of the Related Art

[0002] It is known to electrically connect wires and printed circuit boards (printed boards) via electrical connector assemblies. An example of this type of electrical connector assembly is disclosed in Japanese Unexamined Utility Model Publication No. 8(1996)-6368. This connector assembly is constructed by a first connector (plug connector) which is connected to a wire, and a second connector (receptacle connector) which is fixed to a printed board.

[0003] An insulation displacement contact that connects with the core of the wire is connected at the tip of the wire. In addition, a crimp contact is crimped onto the shielded outer covering of the wire. The tip of the wire is housed within a first housing to constitute the plug connector. Meanwhile, the receptacle connector has a second housing for housing the plug connector, and two second contacts, for respectively contacting the insulation displacement contact and the crimp contact of the plug connector, are provided within the second housing.

[0004] This connector assembly is configured to connect a single wire. Each of the second contacts has a pair of arms for contacting the insulation displacement contact or the crimp contact from both exterior sides.

[0005] According to the aforementioned known connector assembly, when the contacts of the plug connector and the receptacle connector engage each other, the connectors are arranged along a plane parallel to the circuit board. Therefore, the connectors do not protrude from the circuit board, and the assembly is low in height. However, the contacts of the receptacle connector have flexible arms on both sides of each of the contacts of the plug connector, giving rise to the following problem. That is, the arms require a predetermined range of motion in the width direction of the connector, which is parallel to the circuit board, to secure necessary contact pressure. As a result, the width of the connector becomes large. In the case that the number of terminals of the connector is increased to two, the contacts will require further space in the horizontal direction. Therefore, there is a possibility that such connectors will be difficult to utilize in miniature electric/electronic equipment, in which there are limitations in mounting area.

SUMMARY OF THE INVENTION

[0006] The present invention has been developed in view of the points described above. It is an object of the present invention to provide a miniature electrical connector assembly which is low in height as well as narrow, and a plug connector and a receptacle connector to be employed in the connector assembly.

[0007] The electrical connector assembly of the present invention comprises:

a plug connector having first contacts for being connected to wires;
a receptacle connector having second contacts for contacting the first contacts, mounted on a circuit board; wherein
the plug connector has side surfaces that face opposite directions from each other;
the first contacts are provided with contact surfaces which contact and hold the wires to be attached to the plug connector so that the wires are substantially parallel to the circuit board, the contact surfaces being exposed on one of the side surfaces of the plug connector;
the receptacle connector has a recess for receiving the plug connector, the recess being open at its top and open to the side toward the wires;
the second contacts have contact portions which are exposed at the recess for contacting the contact surfaces of the first contacts when the plug connector is received in the recess and circuit board connection portions for being electrically connected to the circuit board;
the first contacts are provided as a pair, arranged along a line and facing opposite directions from each other; and
the second contacts are provided as a pair, arranged along a line and facing opposite directions from each other, corresponding to the first contacts.

[0008] The plug connector of the present invention comprises:

an insulative plug housing having side surfaces that face opposite directions from each other; and
contacts having wire connection portions for contacting and holding wires within the plug housing, and contact surfaces that are exposed on the side surfaces; wherein
the contacts are arranged along a line in the housing, facing opposite directions from each other.

[0009] The receptacle connector of the present invention comprises:

a receptacle housing having a recess for receiving a plug connector formed therein, the recess being open at its top and open to a side toward wires

which are connected to the plug connector; and
contacts having contact portions which are exposed at the recess for contacting contacts of the plug connector when the plug connector is received in the recess, and circuit board connection portions for being connected to the circuit board; wherein
the contacts are provided as a pair, arranged along a line and facing opposite directions from each other, corresponding to the contacts of the plug connector.

[0010] A construction may be adopted wherein:

the receptacle connector is provided with a cutout on a side wall opposite from the side at which the recess is open; and
the plug connector is provided with a protrusion complementary to the cutout, that fits in the cutout during complete engagement with the receptacle connector.

[0011] Further, a construction may be adopted wherein:

the plug connector and the receptacle connector are provided with locking portions that engage each other during engagement of the plug connector and the receptacle connector, the locking portions being formed further toward the side at which the wires are led out than the contact surface and the contact portion.

[0012] A construction may be adopted wherein:

two parallel contact receiving grooves are provided in the plug housing of the plug connector, which are open toward the top thereof;
the first contacts (contacts of the plug connector) are insulation displacement type contacts;
the first contacts are provided in the contact receiving grooves; and
wires are insulation displacement contacted to the first contacts. It is preferable that the plug connector engage the receptacle connector with the contact receiving grooves facing the receptacle connector. It is also preferable that bends (arrowheads) for preventing extraction of the wires be formed at the ends of the contact receiving grooves toward the side at which the wires are led out.

[0013] The contact portions of the second contacts may be constructed as a plurality of elastic contact pieces which are separated in the axial direction (lengthwise direction) of the wires.

[0014] According to the electrical connector assembly of the present invention, the plug connector comprises side surfaces that face opposite directions from each other; and first contacts of the plug connector having wire connection portions for connecting and holding wires, and contact surfaces which are exposed to one of the side surfaces of the plug connector. On the other hand, the receptacle connector comprises a recess for receiving the plug connector, the recess being open at its top and open to the side toward the wires. The second contacts of the receptacle connector have contact portions which are exposed at the recess for contacting the contact surfaces of the first contacts when the plug connector is received in the recess, and circuit board connection portions for being electrically connected to the circuit board. The first contacts are provided as a pair arranged along a line and facing opposite directions from each other, and the second contacts are provided as a pair, arranged along a line and facing opposite directions from each other, corresponding to the first contacts. Therefore, the following effects are exhibited.

[0015] The contacts of the receptacle connector contact one side of the contacts of the plug connector; therefore the space required for the contacts in the width direction is decreased. Accordingly, miniaturization of the connector assembly is possible, due to the connector assembly being low in height as well as small in width.

[0016] In addition, the plug connector of the present invention comprises: an insulative plug housing having side surfaces that face opposite directions from each other; and contacts having wire connection portions for contacting and holding wires within the plug housing, and contact surfaces that are exposed on the side surfaces; wherein the contacts are arranged along a line in the housing, facing opposite directions from each other. Therefore, the contact portions of the contacts are provided on the side surfaces of the plug connector, enabling it to be low in height.

[0017] The receptacle connector of the present invention comprises a receptacle housing having a recess for receiving a plug connector formed therein, the recess being open at its top and open to a side toward wires which are connected to the plug connector; and contacts having contact portions which are exposed at the recess for contacting contacts of the plug connector when the plug connector is received in the recess, and circuit board connection portions for being connected to the circuit board; wherein the contacts are provided as a pair, arranged along a line and facing opposite directions from each other, corresponding to the contacts of the plug connector. Therefore, the connector assembly is enabled to be low in height when the plug connector and the receptacle connector are assembled together.

[0018] In addition, in the case that the receptacle connector is provided with a cutout on a side wall opposite from the side at which the recess is open; and the plug connector is provided with a protrusion complementary to the cutout, that fits in the cutout during complete engagement with the receptacle connector, complete engagement between the receptacle connector and the plug connector can be visually confirmed. In other words, if the plug connector is mounted upside down,

the protrusion and the cutout engage during initial engagement. The plug connector will be in a state in which it protrudes from the recess, and cannot be pressed in any further. Therefore, improper engagement can be confirmed visually, thereby preventing erroneous engagement.

[0019] Further, in the case that the plug connector and the receptacle connector are provided with locking portions that engage each other during engagement of the plug connector and the receptacle connector, the locking portions being formed further toward the side at which the wires are led out than the contact surface and the contact portion, the plug connector becomes more resistant to disengagement when a prying force is applied to the wires.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

Figure 1 is a perspective view of the plug connector of the present invention,

Figure 2A is a plan view of the plug connector shown in Figure 1,

Figure 2B is a side view of the plug connector shown in Figure 1,

Figure 3 is a perspective view of the receptacle connector of the present invention,

Figure 4 is a perspective view showing a state immediately prior to engagement of the plug connector of Figure 1 and the receptacle connector of Figure 3,

Figure 5 is a perspective view showing the electrical connector assembly of the present invention, with the plug connector and the receptacle connector following engagement, and

Figure 6 is a sectional view taken along the line VI-VI of Figure 5.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] Hereinafter, preferred embodiments of the electrical connector assembly (hereinafter, simply referred to as "assembly"), the plug connector, and the receptacle connector of the present invention will be described in detail with reference to the attached drawings. Figure 1 is a perspective view of the plug connector of the present invention. Figure 2A is a plan view of the plug connector shown in Figure 1. Figure 2B is a side view of the plug connector shown in Figure 1.

[0022] First, a plug connector 10 will be described with reference to Figure 1, Figure 2A and Figure 2B. The plug connector 10 is constructed by an insulative plug housing 2 (hereinafter, simply referred to as "housing"), and is shaped substantially as a thin rectangular parallelepiped. The housing 2 is constructed to be horizontally symmetrical. Recesses 6 are formed in side walls 4 that constitute the exterior side surfaces of the housing 2 at the centers thereof in the longitudinal direction 3 of the housing 2. A pair of contact receiving grooves 8 (hereinafter, simply referred to as "receiving grooves") are formed in the interior sides of the recesses 6. The receiving grooves 8 extend along the longitudinal direction 3 of the housing, that is, the longitudinal direction of wires W, and are open toward an upper surface 12 of the housing 2. An insulation displacement contact 11 (first contact) is provided in each of the two receiving grooves 8.

[0023] The shape of the housing 2 will be described in further detail. Note that regarding the description, as the structure of the housing 2 is horizontally symmetrical, a single side thereof will be described. In addition, for the sake of convenience, the surface of the plug connector 10 that faces upward in Figure 1 will be referred to as the upper surface 12, and the side wall on the side of the housing 2 where the wires W are led out will be referred to as a front wall 22. The recess 6 extends from the upper surface 12 to a lower surface 14 (Figure 2B) of the housing 2, and are formed toward the interior of the housing 2, to open to the side of the housing 2. A narrow groove 16 which is open at the upper surface 12 and extends in the longitudinal direction 3 is formed toward the interior of the recess 6. The groove 16 and the receiving groove 8 communicate with each other via a channel 18 which is open to the upper surface 12. The channel 18 is formed at the approximate center of the recess 6 in the longitudinal direction 3.

[0024] The receiving groove 8 is formed to be longer and wider than the groove 16. The rear portion thereof is closed by a wall 20 which is a portion of a rear wall 44, and the receiving groove 8 is open toward the front wall 22. A wide portion 24 which is wide in the width direction of the wire W and extends from the upper surface 12 to a bottom wall 26 of the housing 2 is formed at the approximate center of the receiving groove 8 in the longitudinal direction 3. In addition, a wire placement groove 28 is formed in the front wall 22, corresponding to the receiving groove 8. The wire placement groove 28 has elastically deformable bends 30 (arrowheads) that extend into the wire placement groove 28 from both sides of the upper surface 12. A gap 31 for the wire W to pass through is formed between the pair of bends 30. Arcuate tapers 30a for guiding the wires W are formed on the side of the bends 30 toward the upper surface 12, to facilitate insertion of the wires W.

[0025] Next, the contacts 11 which are received in the receiving groove 8 will be described. The contacts 11, of which one is shown separated from the housing 2 in Figure 1, are each formed by punching and bending a single metal plate. Each contact 11 comprises a substantially rectangular base portion 32; insulation displacement plates 34 (wire connecting portion) formed by bending both ends of the base portion 32 in the longitudinal direction 3; and a contact plate 36 which is bent upward from the base portion 32 via a connecting por-

tion 35. The outer surface of the contact plate 36 is the contact surface 36a that electrically contacts contacts 132 (second contacts) of a receptacle connector 100, to be described later.

[0026] The pair of insulation displacement plates 34, which are separated in the longitudinal direction 3 of the wire W, each has an upwardly open slot 38. The two slots 38 are aligned in the longitudinal direction 3 of the wire W, and are configured to electrically connect with the wires W pressed thereinto. Barbs, that is, protrusions 40, are formed on both sides at the lower ends of the insulation displacement plates 34.

[0027] The contact plate 36 is a vertical plate that extends along the longitudinal direction 3. An outwardly protruding bead 42 is formed along the longitudinal direction 3 at the center of the contact plate 36. The operation of the bead 42 will be described later. In addition, protrusions 43, which are of the same thickness as the plate thickness of the contact plate 36, are formed at both edges in the longitudinal direction 3 of the contact plate 36.

[0028] To mount the contact 11 into the housing 2, the contact 11 is pressed into the receiving groove 8 from the side of the upper surface 12. During insertion, the base portion 32 and the contact plate 36 are press fit into the wide portion 24 and the groove 16, respectively. At this time, the connecting portion 3 is arranged in the channel 18. The protrusions 40 and 43 frictionally engage with the inner surfaces of the wide portion 24 and the groove 16, respectively, to prevent extraction of the contact from the housing 2.

[0029] The contacts 11 are placed within the receiving grooves 8 of the housing 2. Then, the wires W are placed above each contact 11 and pressed into the slots 38 of the insulation displacement plates 34, by a method known to those skilled in the art. The walls 20 serve to position the tips 21 of the wires W during placement of the wires W. When the wires W are pressed into the slots 38, outer coverings of the wires W are torn by the edges of the slot 38, and cores (not shown) of the wires W and the contact plate 36 are electrically connected. The ends of the wires W toward the side at which they are led out of the plug connector 10 are pressed through the gap 31 into the wire placement grooves 28 while deforming the bends 30. The wires W which have been pressed into the wire placement grooves 28 are prevented from being extracted from above by free ends of the bends 30.

[0030] The plug connector 10 is provided with a tab 46 (protrusion) at the lower central portion of the rear wall 44, which is opposite from the end at which the wires are led out. The lower surface of the tab 46 and the lower surface 14 of the housing 2 are coplanar. The operation of the tab 46 will be described later. In addition, a latch protrusion 5 (locking portion) having an upwardly facing taper 5a is provided on the side walls 4 toward the side that the wires are led out. Further, tapers 4a and 44a that act as guides during engagement with the receptacle connector 100 are formed on the upper edges of the side walls 4 and the rear wall 44, respectively.

[0031] Next, the receptacle connector 100 that engages with the plug connector 10 will be described with reference to Figure 3. Figure 3 is a perspective view of the receptacle connector 100 of the present invention. The receptacle connector 100 comprises a thin parallelepiped insulative receptacle housing 102 (hereinafter, simply referred to as "housing"). The housing 102 has a recess 104 for receiving the plug connector at its approximate center. The recess 104 is open to an upper surface 102 of the housing 102, and open toward the front. The recess 104 is defined by a rear wall 108, inner walls 110, and a bottom wall 112. In addition, a cutout 114 which complements the tab 46 of the plug connector 10 is provided at the upper edge of the rear wall 108.

[0032] A single side of the housing 102 will be described, because the housing 102 is horizontally symmetrical. A recess 120 that extends from the upper surface 106 to a lower surface 118 is formed in a side wall 116 of the housing 102. A groove 124 that extends along the longitudinal direction 3 is formed toward the interior of the recess 120. Two ribs 126, 126 are provided extending toward the interior of the recess 104 from each inner wall 110. The ribs 126, 126 are provided at an interval within the length of the plug connector 10 in the longitudinal direction 3. A rib 128, which is parallel to the ribs 126, 126, is integrally molded with the housing 102 at the midpoint between the ribs 126. The ribs 126 and 128 are connected by a contact supporting wall 130 close to the recess 120. A contact 132 is mounted to the contact supporting wall 130. Rectangular openings 134 that penetrate to the lower surface 118 are provided in the bottom wall 112 between the ribs 126 and the rib 128.

[0033] Next, the contacts 132 which are mounted in the housing 102 will be described. The contacts 132, of which one is shown separated from the housing 102 in Figure 3, are each formed by punching and bending a single metal plate. Each contact 132 comprises: a plate-shaped base portion 132 having a cutout 136 at its upper edge; and contact portions, that is, elastic contact pieces 140 (hereinafter, simply referred to as "contact pieces") that extend upward from two locations within the cutout 136, are bent downward in an arcuate manner, then are bent upward again in the vicinity of the lower edge of the base portion 138, also in an arcuate manner.

[0034] The two contact pieces 140 are formed at an interval so that they may be arranged between the ribs 126 and 128. Extended portions 140a, which will be positioned most toward the interior of the recess 104 when the contact 132 is placed in the recess 104, are formed at the tips of the contact pieces 140. The extended portions 140 serve as locking portions when the contacts 11 and the contacts 132 engage each other, but the details thereof will be described later. The tips of the contact pieces 140 are bent obliquely toward the base por-

tion 138 above the extended portions 140a, to form guide surfaces. The contact pieces 140 which are constructed in this manner have elasticity as a whole, and are deformable in the direction of plate thickness of the contact pieces 140.

[0035] In addition, two protrusions 139 which are separated in the vertical direction are provided on each side edge of the base portion 138. A circuit board connection portion 141 to be surface mounted onto a circuit board (not shown) is formed by bending the end of the base portion 138, opposite from the cutout 136, in the direction opposite from the contact pieces 140.

[0036] Next, the method of mounting the contact 132 onto the housing 102 will be described. If the base portion 138 of the contact 132 is press fit into the groove 124 of the recess 120 from above, the contact pieces are arranged so as to cover the contact supporting wall 130. At this time, the lower portions of the contact pieces 140 are arranged within the openings 134. Because the bottom wall 112 does not interfere with the contact pieces 140, sufficient flexure is possible by the contact pieces 140. The contact pieces 140 are positioned between the ribs 126, 128 in a state in which the contact pieces are protected thereby. The shape of the two contact pieces 140 are appropriately maintained due to the existence of the middle rib 128, which prevents excessive deformation cause by erroneous engagement or prying forces applied from an exterior source. In addition, the contact supporting wall 130 prevents solder from entering the recess 104 toward the contact pieces 140 when the circuit board connection portion 141 is soldered onto the circuit board (not shown).

[0037] When the contact 132 is press fit into the groove 124, the protrusions 139 frictionally engage the groove 124, thereby fixing the base portion 138 therein. A pair of latch protrusions 146 having downwardly facing shoulders 144 are formed within the recess 104 of the housing 102, on the inner walls 110 close to a front wall 142. The operation of the latch protrusions 146 will be described later. Tapers 148, which act as guides during engagement with the plug connector 10, are formed on the inner sides of the upper edges of the rear wall 108 and the inner walls 110 that define the recess 104.

[0038] Next, engagement of the plug connector 10 and the receptacle connector 100 will be described with reference to Figure 4 through Figure 6. Figure 4 is a perspective view showing a state immediately prior to engagement of the plug connector 10 and the receptacle connector 100. Figure 5 is a perspective view showing the electrical connector assembly of the present invention, with the connectors 10 and 100 engaged with each other. Figure 6 is a sectional view taken along the line VI-VI of Figure 5.

[0039] First, with reference to Figure 4, the plug connector 10 is in a position corresponding to the recess 104 of the receptacle connector 100, with the bends 30 facing toward the receptacle connector 100. If the plug connector 10 is pressed downward into the recess 104 from this state, the side walls 4 of the plug connector 10 move along the inner walls 110 of the recess 104 so that the plug connector 10 is housed within the recess 104. The latch protrusions 5 of the plug connector 10 engage with the latch protrusions 146 (locking portions) of the recess 104, and thereby the connectors are fixed to each other. By the engagement of the latch protrusions 5 and 146, the plug connector 10 is prevented from being disengaged from the receptacle connector 100, even if a prying force is applied to the wires W at the ends at which they are led out.

[0040] Then, as shown in Figure 5, when the plug connector 10 and the receptacle connector 100 are completely engaged, the tab 46 of the plug connector 10 enters the cutout 114 of the receptacle connector 100, and the lower surface 14 of the plug connector 10 and the upper surface 106 of the receptacle connector 100 become coplanar. Thereby, complete engagement of the connectors can be visually confirmed.

[0041] In the case that the plug connector is pressed into the receptacle connector 100 upside down, the tab 46 abuts the cutout 114 in the initial stages of the engagement operation, and the plug connector 10 cannot be pressed any further into the receptacle connector 100. At this time, the plug connector 10 is in a state in which it protrudes from the receptacle connector 100, so that visual confirmation of erroneous engagement is facilitated. In addition, the tab 46 serves as a lever that may be gripped by a finger or the like to pull the plug connector 10 upward while the wires W are also pulled upward when the plug connector 10 is to be removed from the receptacle connector 100.

[0042] Next, the state of engagement between the contacts 11 and 132 during complete engagement of the connectors 10 and 100 will be described with reference to Figure 6. As the plug connector 10 and the receptacle connector 100 engage each other, the beads 42 of the contacts 11 pass the extended portions 140a of the contacts 132 and engage therewith. Thereby, the contacts 11 and 132 are electrically connected to each other, while at the same time, extraction in the direction in which they separate from each other is prevented. That is, the extended portions 140a and the beads 42 also serve as locking portions for the connectors 10 and 100.

[0043] The electrical contact portions of the contacts 11 and 132 are in the interior of the assembly 1, where contact from the exterior thereof is prevented. This, in addition to the fact that two contact pieces 140 are provided in each contact 11, increases the reliability of the electrical connection. In addition, because the beads 42 and the extended portions 140a protrude toward each other, a "click" is felt when they pass over each other. Complete engagement between the connectors 10 and 100 can also be perceptually recognized by this "click".

[0044] If the wires W which are led out from the plug connector 10 are pried upward from the position shown in Figure 5, separation of the plug connector 10 from the receptacle connector 100 is prevented by the contacts

11 and 132 being locked to each other, as well as the engagement between the latch protrusions 5 and 146. Because the latch protrusions 5 and 146 are positioned closer to the ends of the wires which are led out of the plug connector 10 than the contact portions of the contacts 11 and 132, the locking function is particularly effective.

[0045] In addition, in the case that the wires W are pried upward, upward movement of the wires W is prevented by the bottom wall 26 of the housing 2 of the plug connector 10, and there is no possibility of damage to the housing 2. In the case that the wires W are pried downward, although force is applied to the bends 30, the force is received by the bottom wall 112 of the housing 102 of the receptacle connector 100, there is no possibility that the bends 30 will be damaged.

[0046] A preferred embodiment has been described in detail above, but the present invention is not limited to the embodiment described above. Various changes and modifications are possible without departing from the scope of the invention claimed hereinafter. For example, the contacts of the plug connector 10 may be crimp type contacts.

Claims

1. A plug connector (10) comprising:

an insulative plug housing (2) having side surfaces that face opposite directions from each other; and
contacts (11) having wire connection portions for contacting and holding wires within the plug housing (102), and contact surfaces (36a) that are exposed on the side surfaces; wherein
the contacts (11) are arranged along a line in the housing, facing opposite directions from each other.

2. A plug connector (10) as claimed in claim 1 in combination with a receptacle connector (100) which comprises

a receptacle housing (102) having a recess (104) for receiving the plug connector formed therein, the recess (104) being open at its top and open to a side toward wires which are connected to the plug connector; and

second contacts (132) having contact portions (140a) which are exposed at the recess (104) for contacting contacts (11) of the plug connector (10) when the plug connector is received in the recess (104), and circuit board connection portions for connecting the circuit board; wherein

the second contacts (132) are arranged along a line and facing opposite directions from each other, corresponding to the contacts of the plug connector.

3. A receptacle connector (100) comprising:

a receptacle housing (102) having a recess (104) for receiving a plug connector formed therein, the recess (104) being open at its top and open to a side toward wires which are connected to the plug connector; and
contacts (132) having contact portions (140a) which are exposed at the recess (104) for contacting contacts of the plug connector when the plug connector is received in the recess (104), and circuit board connection portions for being connected to the circuit board; wherein
the contacts (132) are arranged along a line and facing opposite directions from each other, corresponding to the contacts of the plug connector.

4. A connector as claimed in claim 2, wherein:

the plug connector (10) and the receptacle connector (100) are provided with locking portions (5,146) that engage each other during engagement of the plug connector and the receptacle connector, the locking portions being formed further toward the side at which the wires are led out than the contact surface (36a) and the contact portion (140a).

5. The receptacle connector (100) claimed in claim 2, 3 or 4, wherein:

the receptacle connector is provided with a cutout (114) on a side wall (108) opposite from the side at which the recess (104) is open; and
the plug connector is provided with a protrusion (46) complementary to the cutout (114), that fits in the cutout during complete engagement with the receptacle connector.

6. A connector as claimed in any one of the preceding claims, wherein the contacts (11) and/or the second contacts (132) are provided as a pair.

7. A connector as claimed in any one of the preceding claims, wherein the contact surfaces (36a) of the first contacts (11) contact and hold wires to be attached to the plug connector (10) so that the wires are substantially parallel to the circuit board, the contact surfaces being exposed on one of the side surfaces of the plug connector.

FIG.1

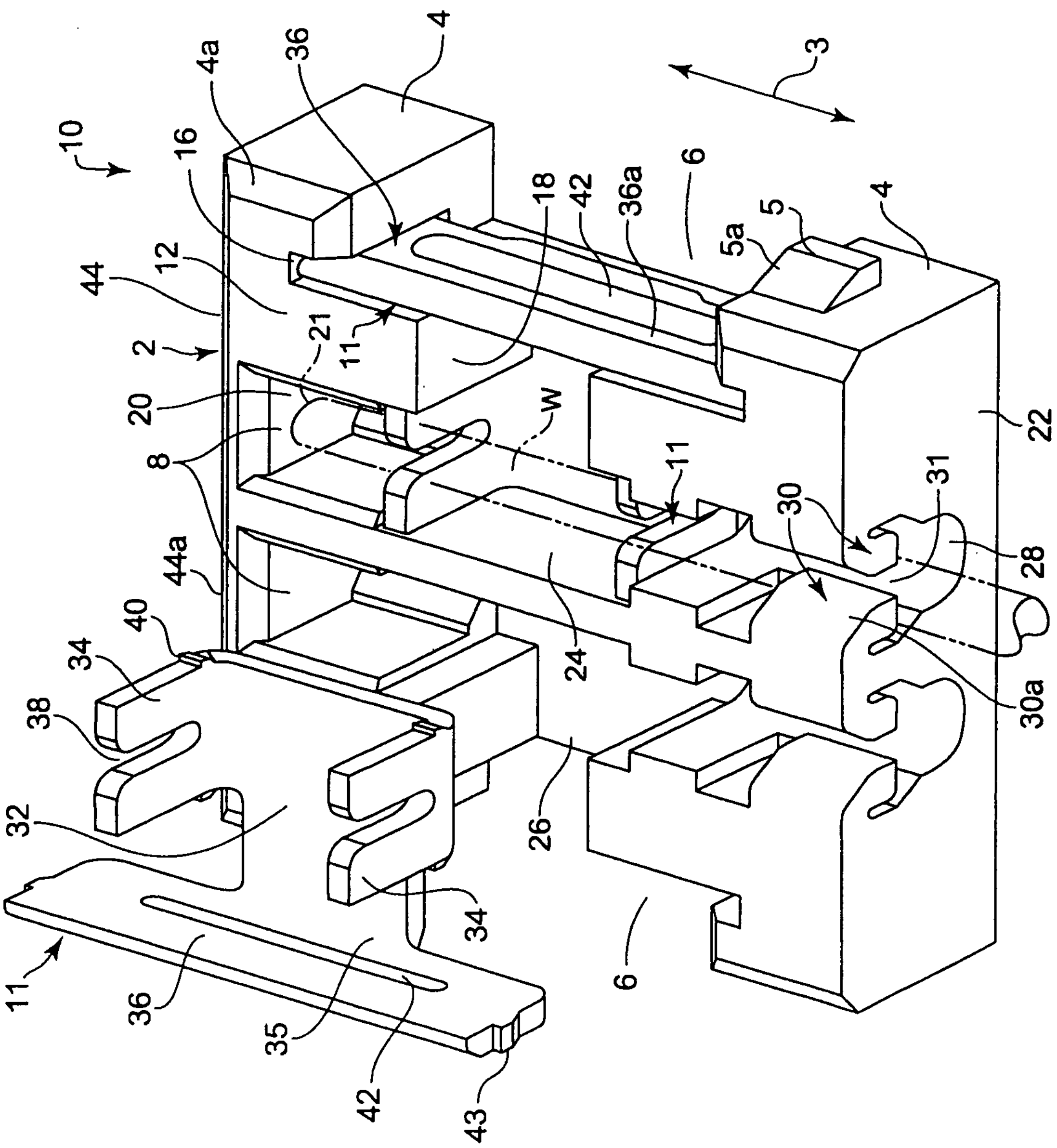

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FIG.2A

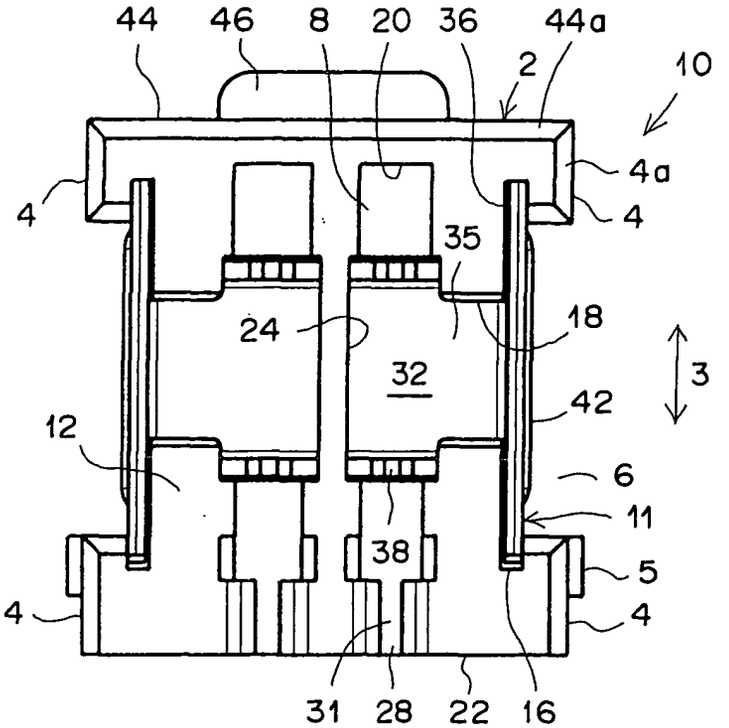
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FIG.2B

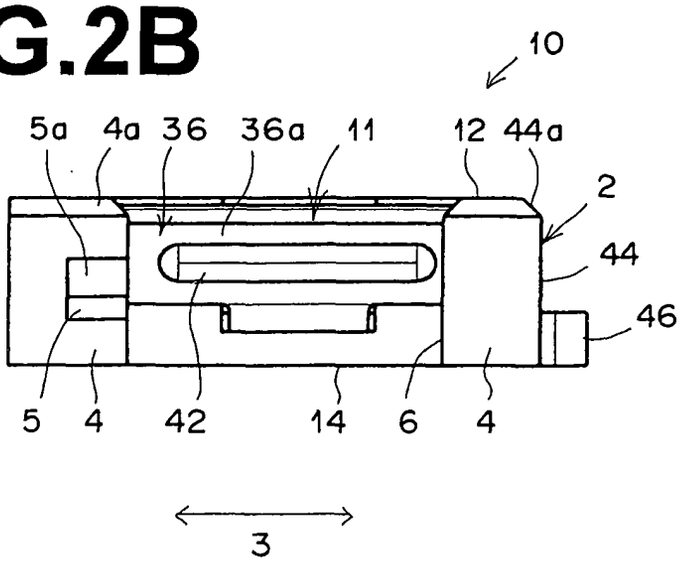
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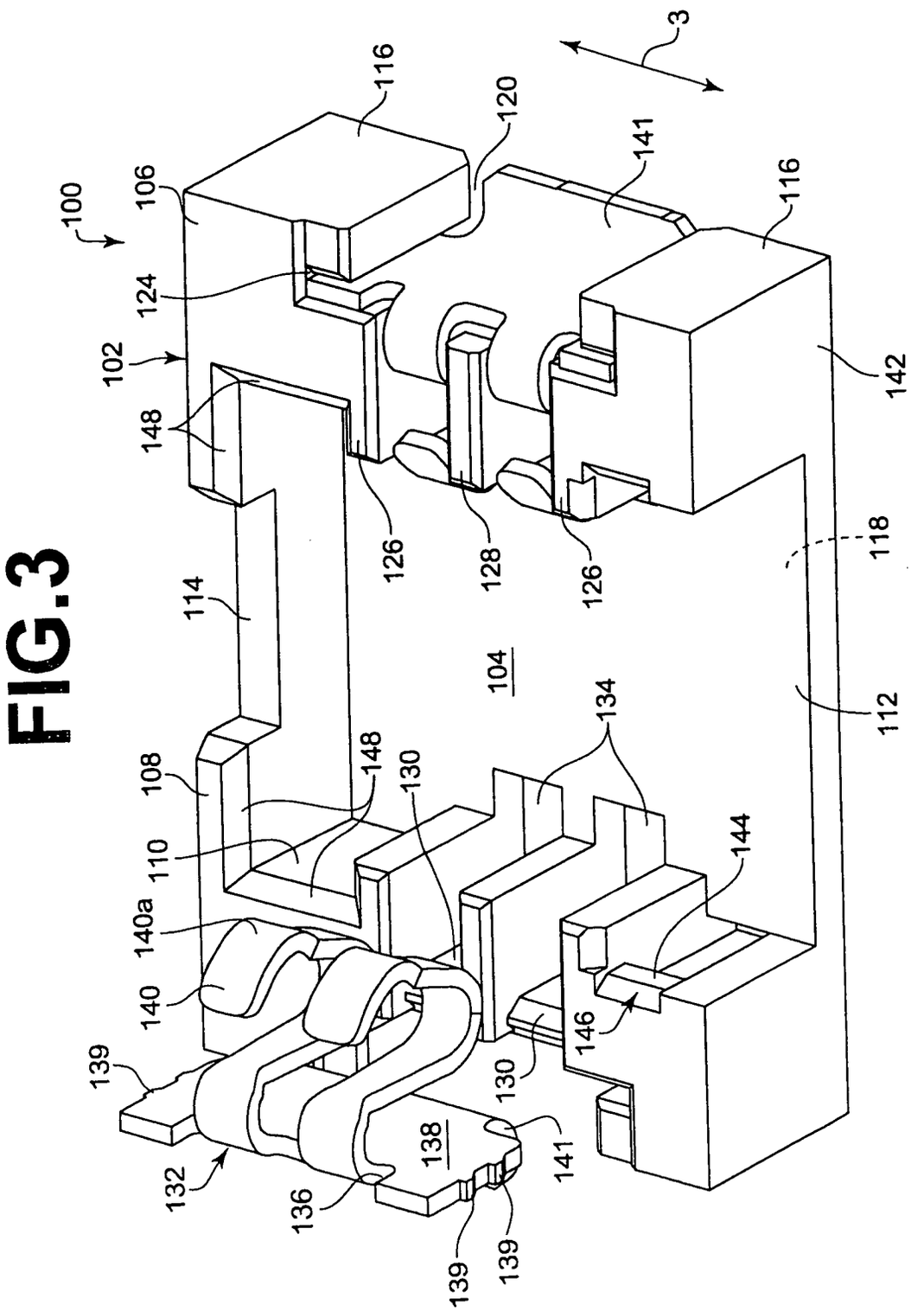
FIG.3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3

FIG.4

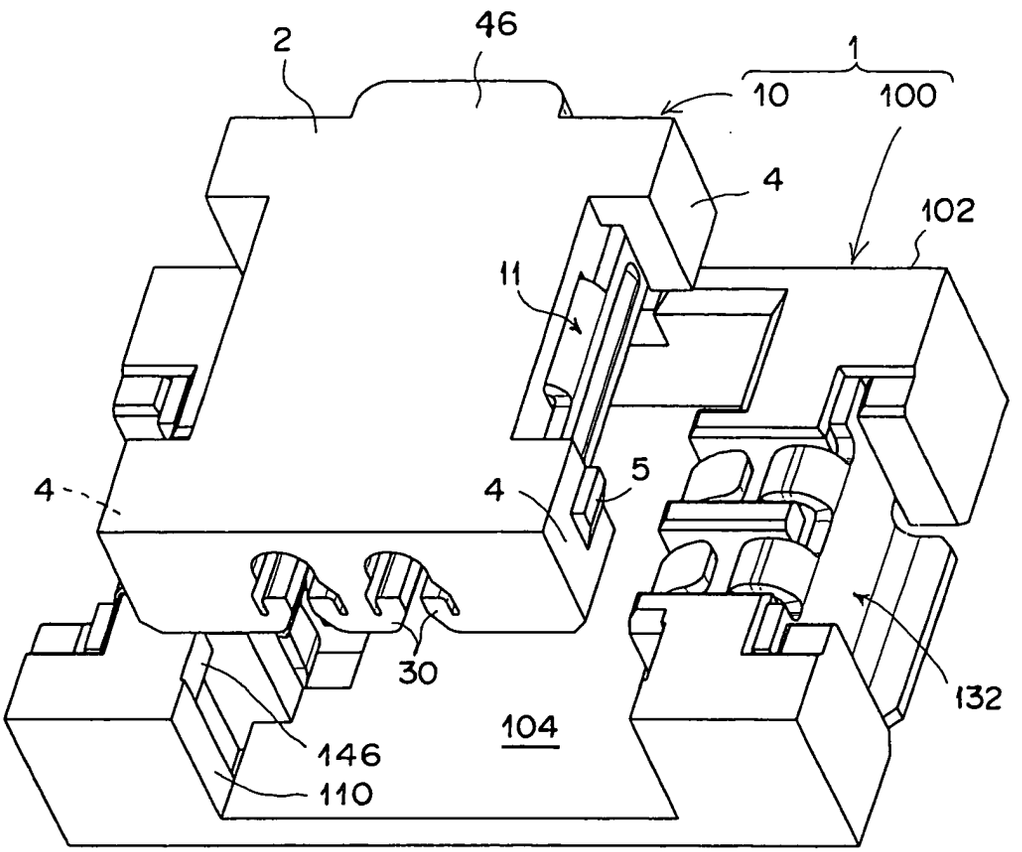

FIG.5

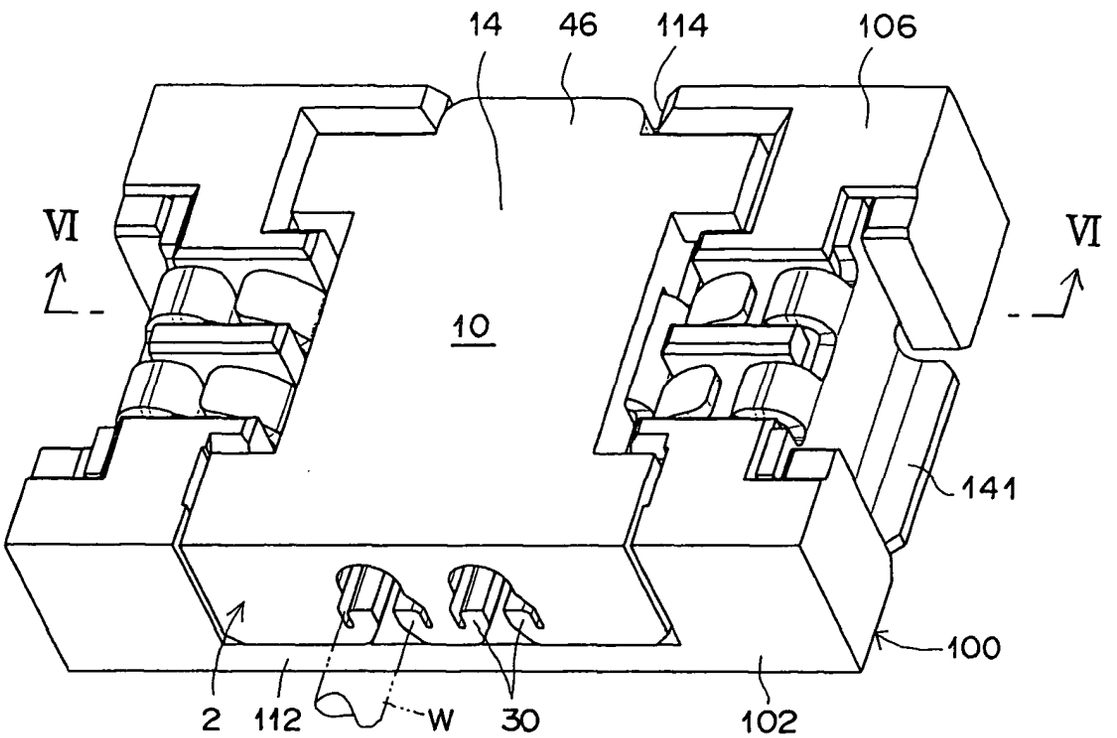

FIG.6