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Lee et al.

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(54) **BOARD TO BOARD MALE CONNECTOR AND BOARD TO BOARD FEMALE CONNECTOR**

(71) Applicant: **ADVANCED-CONNECTEK INC.**, New Taipei (TW)

(72) Inventors: **Kuo-Ching Lee**, New Taipei (TW); **Jin Wei Wang**, New Taipei (TW); **Mei Shi**, New Taipei (TW); **Sheng-Ho Yang**, New Taipei (TW); **Wang-Jie Luo**, New Taipei (TW); **Ta-Teh Meng**, New Taipei (TW)

(73) Assignee: **ADVANCED-CONNECTEK INC.**, New Taipai (TW)

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H01R 12/70	(2011.01)
H01R 12/71	(2011.01)
H01R 13/20	(2006.01)
H01R 13/03	(2006.01)

(52) **U.S. Cl.**
CPC ***H01R 12/73*** (2013.01); ***H01R 12/7029*** (2013.01); ***H01R 12/716*** (2013.01); *H01R 12/707* (2013.01); *H01R 13/03* (2013.01); *H01R 13/20* (2013.01)

(58) **Field of Classification Search**
CPC H01R 12/52; H01R 12/716; H01R 9/096
USPC 439/74, 495, 660
See application file for complete search history.

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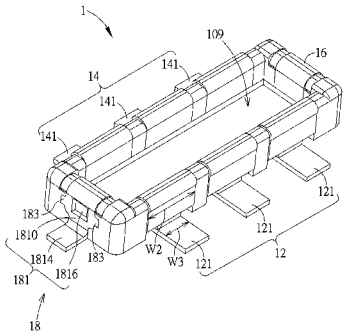
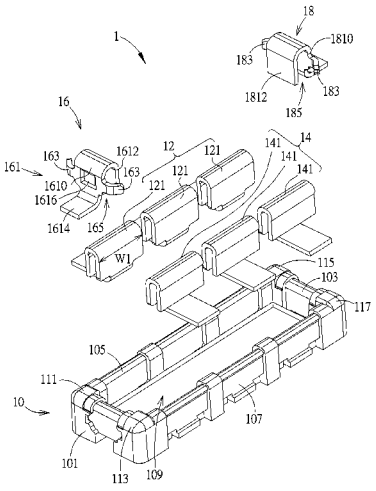
Primary Examiner — Abdullah Riyami
Assistant Examiner — Thang Nguyen
(74) *Attorney, Agent, or Firm* — Winston Hsu

(57) **ABSTRACT**

A board to board male connector includes a male insulator, a first male signal contact set, a second male signal contact set, and a first male holding contact. The male insulator includes a first side wall, a second side wall, a first erect wall, and second erect wall. The first side wall is opposite to the second side wall. The first erect wall is opposite to the second erect wall. The first male signal contact set is disposed on the first erect wall. The second male signal contact set is disposed on the second erect wall. The first male holding contact includes a first male holding body disposed on the first side wall, and at least one first embedding wing extending from at least one side of the first male holding body and embedding into the first side wall.

20 Claims, 10 Drawing Sheets





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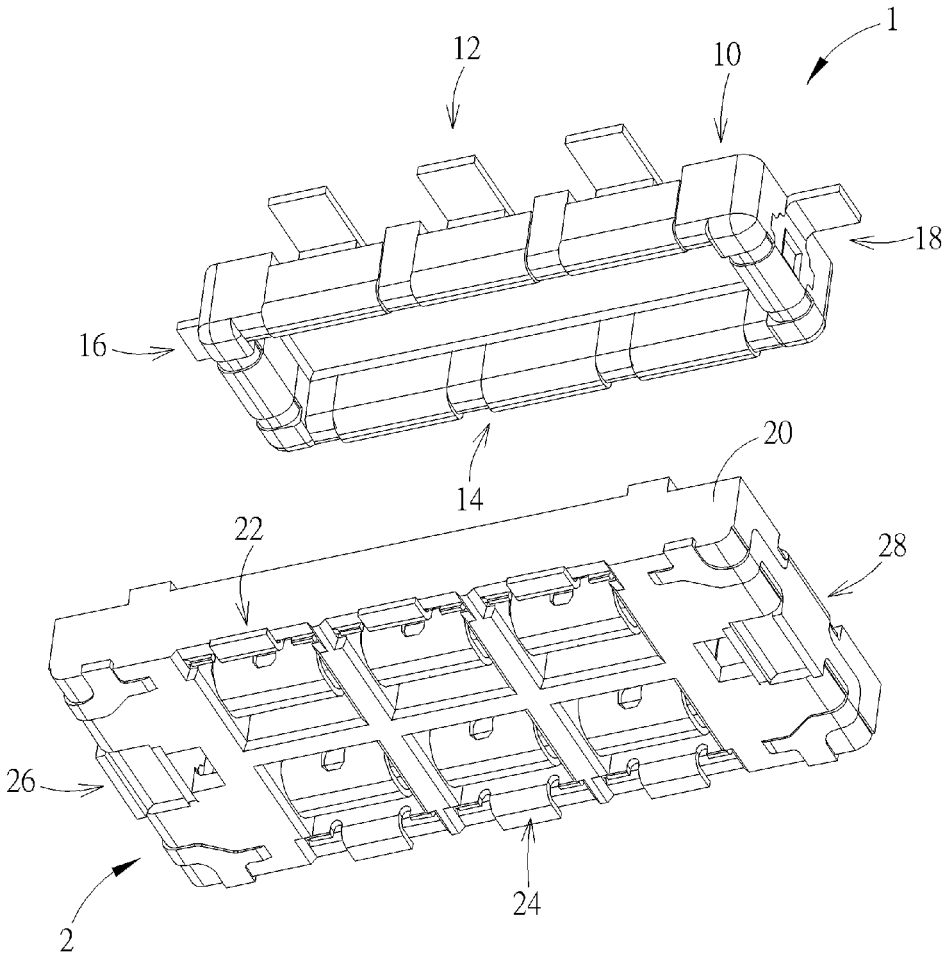


FIG. 1

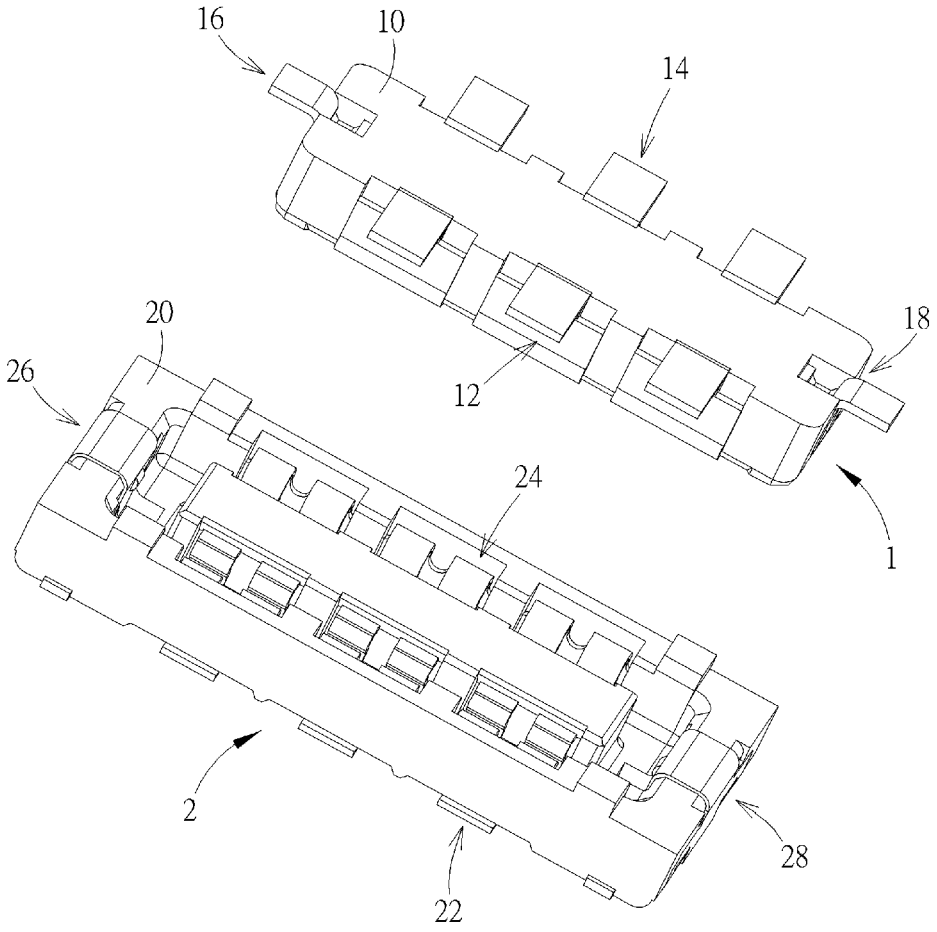


FIG. 2

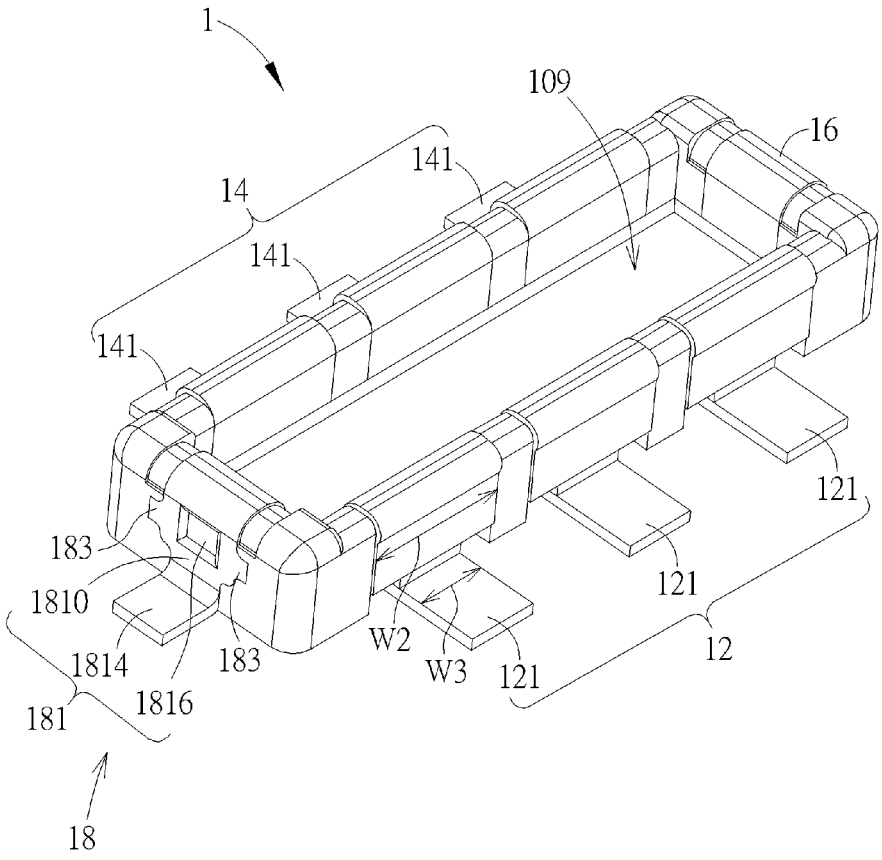

1
109
16
141
14
141
141
121
183
121
1810
W2
W3
121
12
1814
183
1816
181
18

FIG. 3

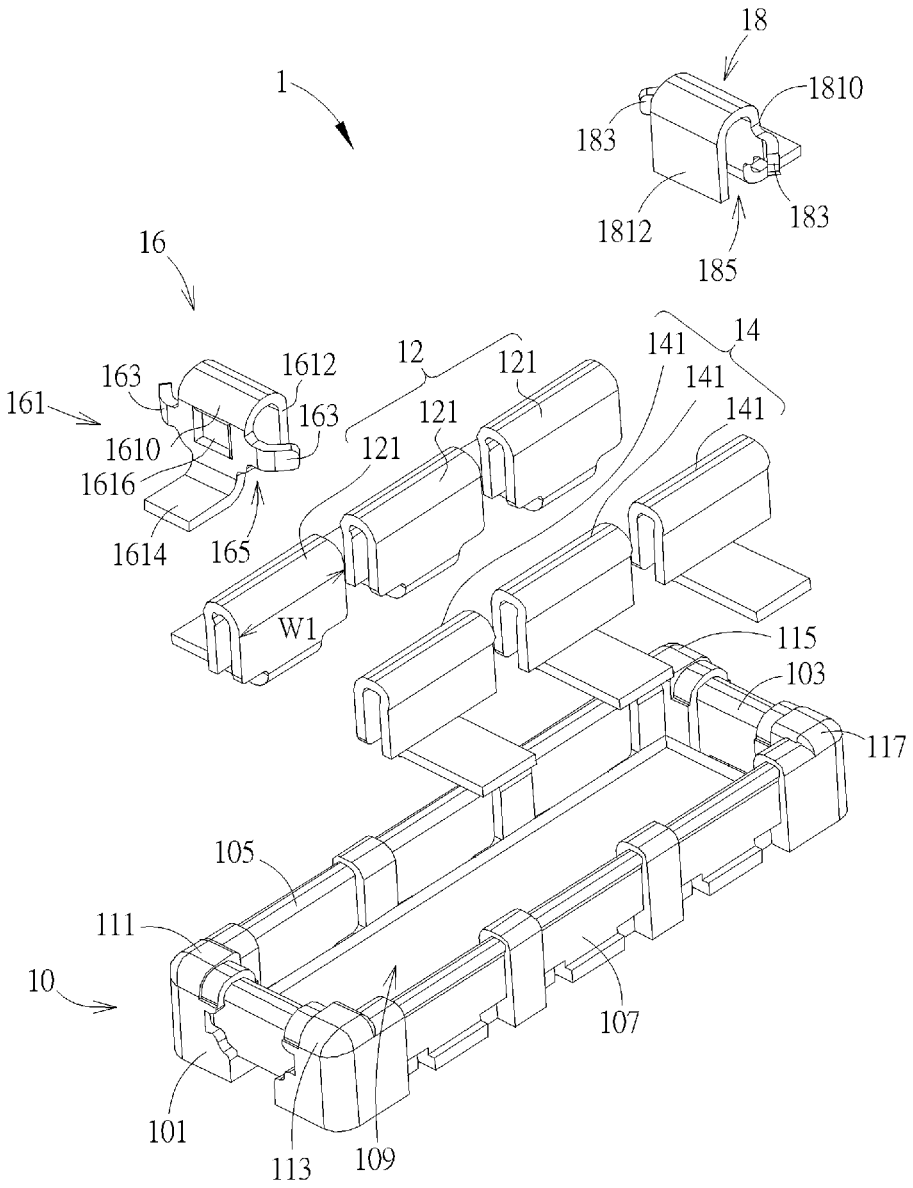

18
1
1810
183
1812
183
185
16
14
12
141
141
141
121
121
121
163
1612
161
163
1610
1616
1614
165
W1
115
103
117
105
111
10
107
101
113
109

FIG. 4

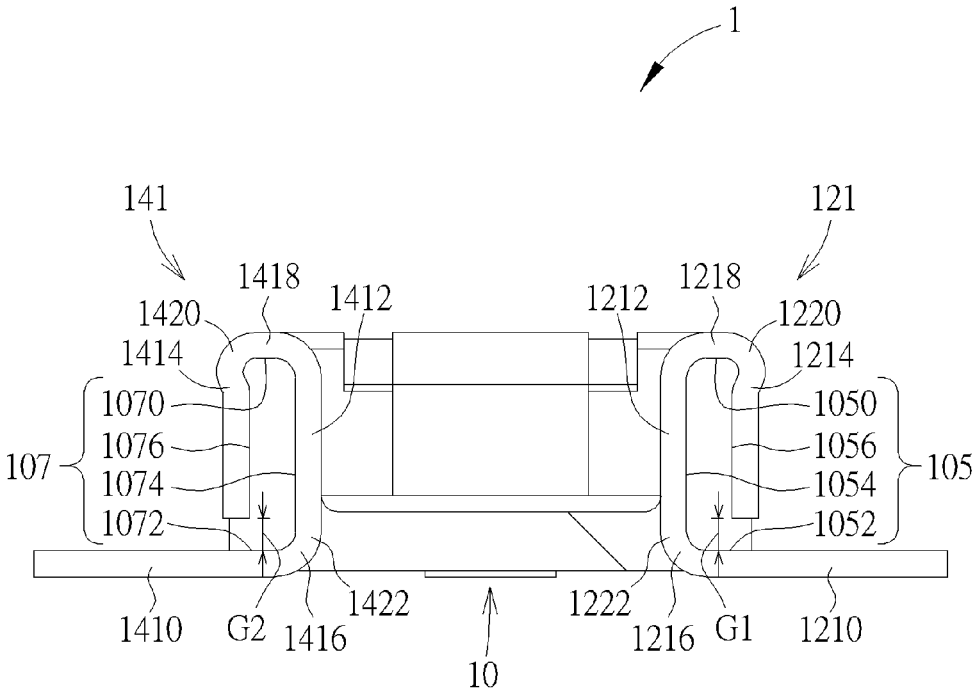
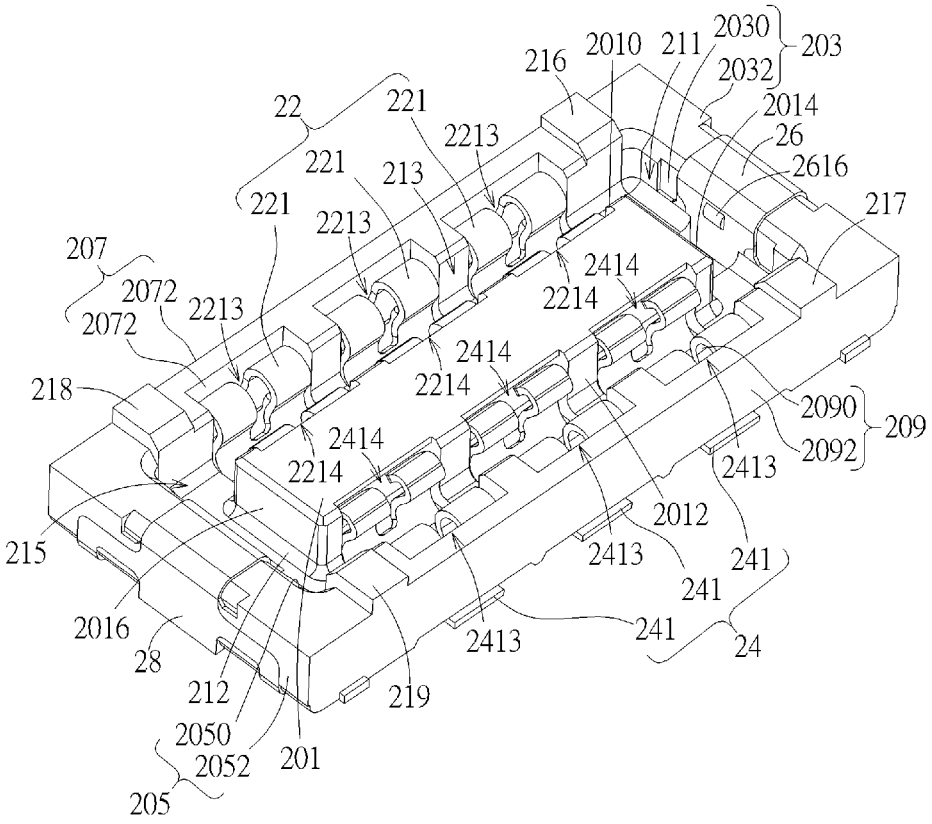

1
141
121
1418
1412
1212
1218
1420
1220
1414
1214
1070
1050
1076
1056
107
105
1074
1054
1072
1052
1410
G2
1422
1222
G1
1210
1416
1216
10

FIG. 5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203
2010
211
216
2032
2014
26
2616
217
22
221
2213
213
207
2072
2214
2414
218
2090
209
2092
2413
2012
241
24
215
2016
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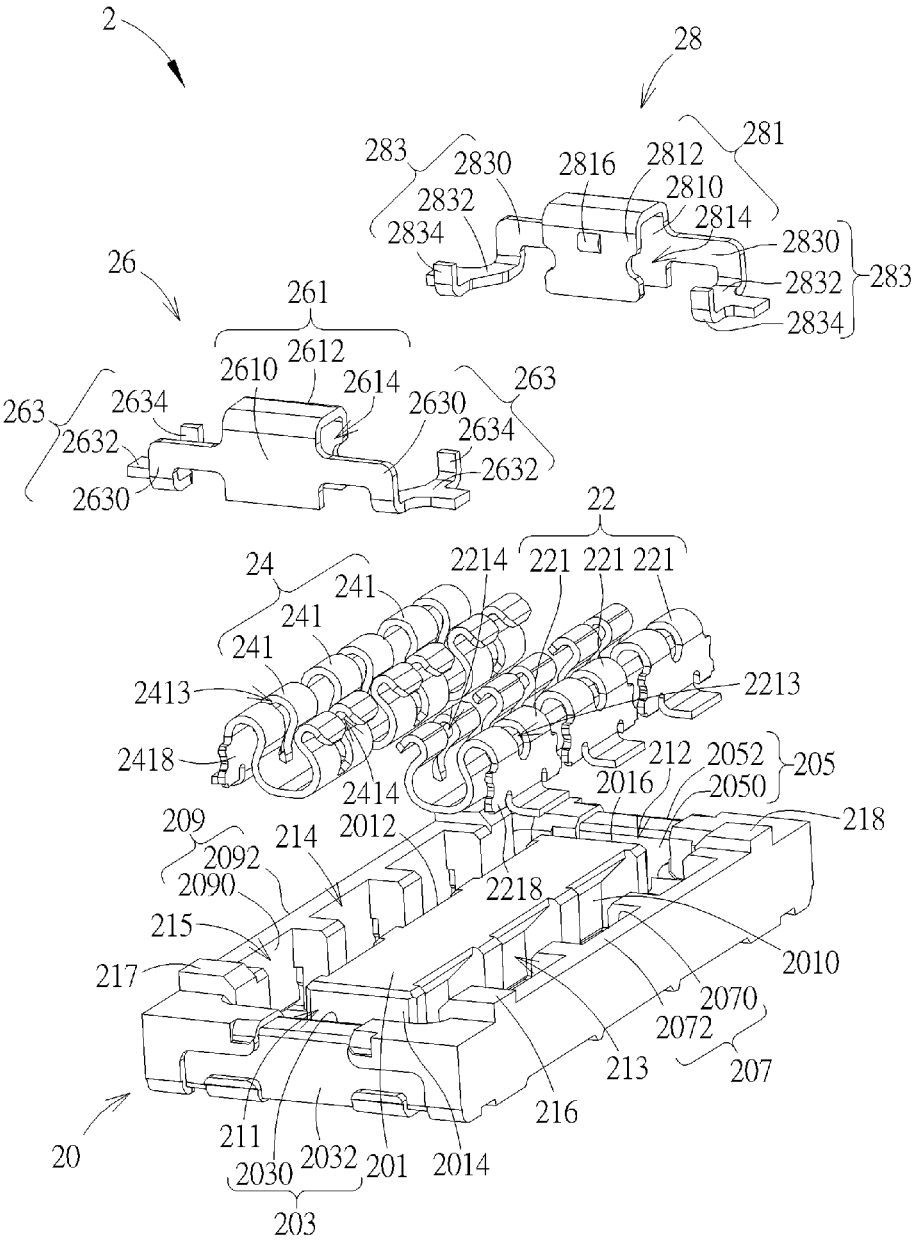
212
2050
2052
205
201
219

FIG. 6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2610
2614
263
263
2634
2630
2634
2632
2632
2630
22
24
2214
221 221 221
241
241
241
2413
2213
2418
212
2052
205
2414
2016
2050
209
2012
218
2092
214
2090
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215
2010
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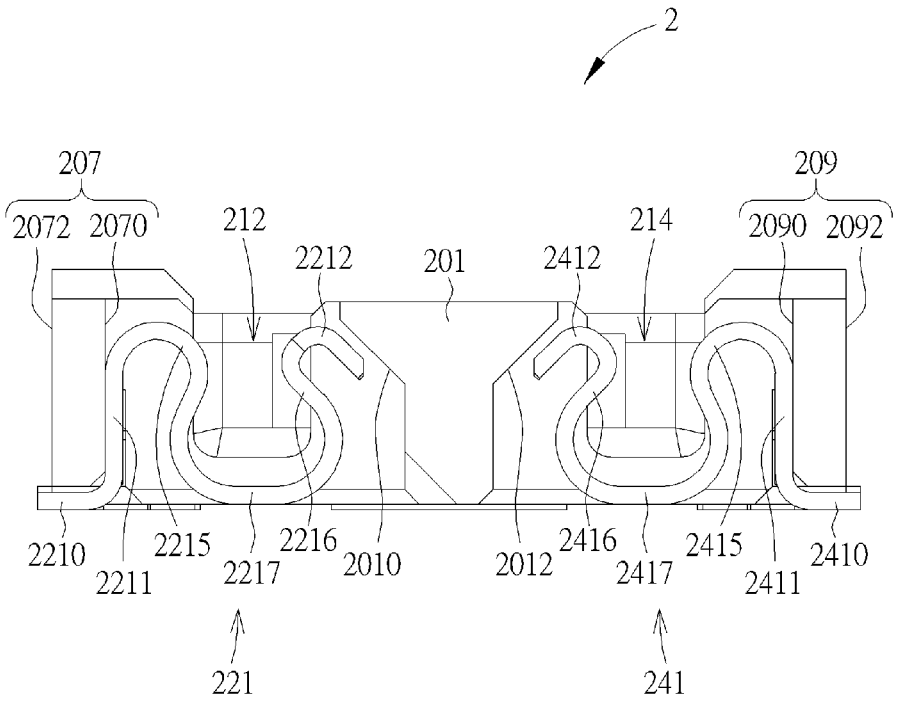
2070
2072
213
207
216
211
20
2030
2032
201
2014
203

FIG. 7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207
2072
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212
2212
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2412
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209
2090
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2010
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2416
2417
2415
2411
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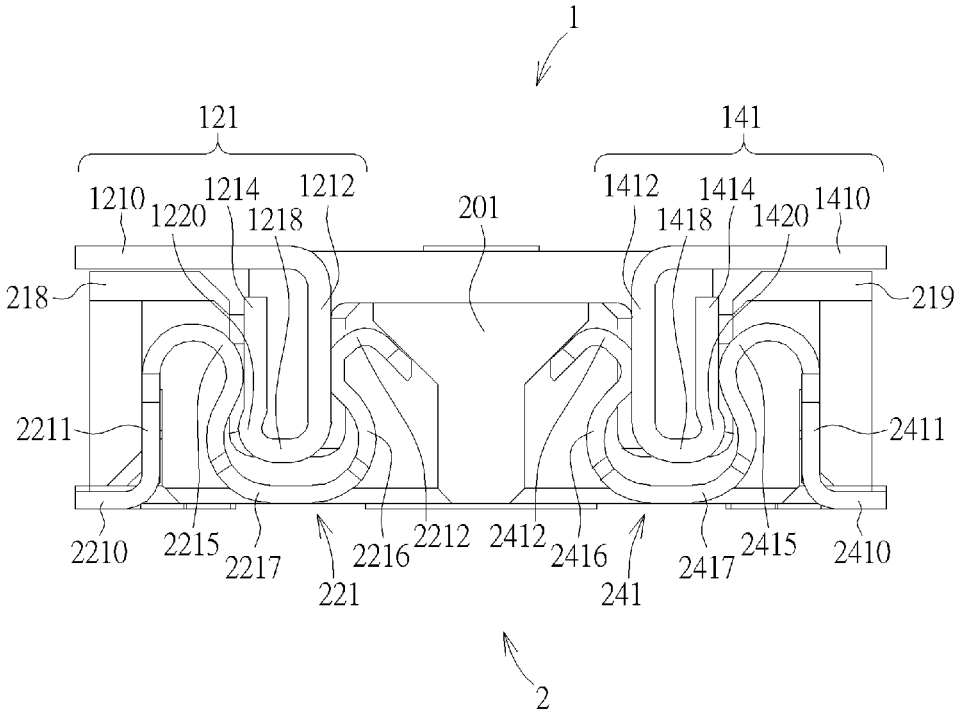
221
241

FIG. 8


1
121
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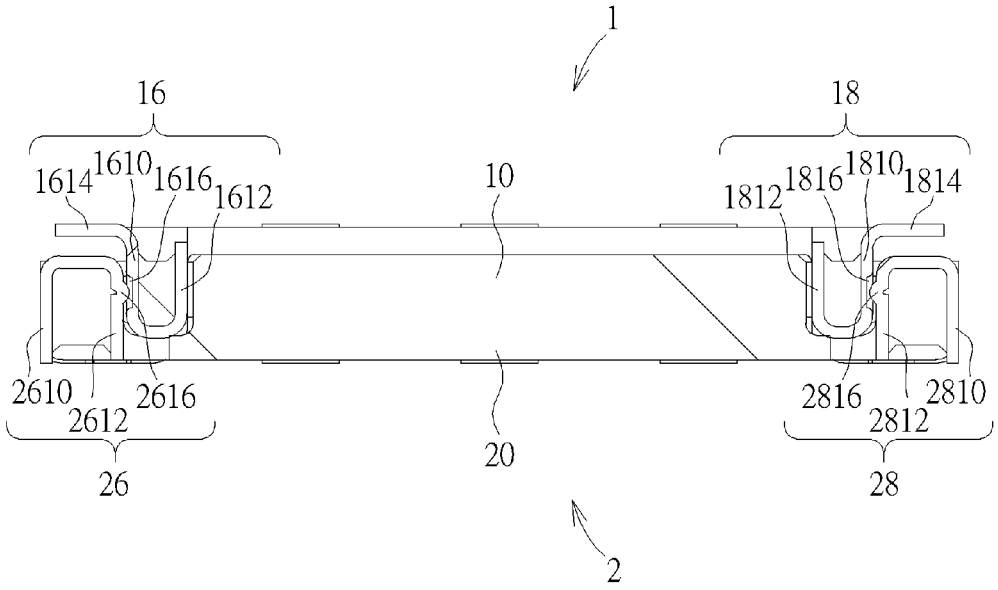
2410
2

FIG. 9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1614
1610
1616
1612
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1812
1816
1810
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2610
2612
2616
2816
2812
2810
20
26
28
2

FIG. 10

BOARD TO BOARD MALE CONNECTOR AND BOARD TO BOARD FEMALE CONNECTOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a male connector and a female connector, and more particularly, to a board to board male connector and a board to board female connector capable of enduring large current.

2. Description of the Prior Art

A board to board connector assembly enables signal transmission via engagement of a male signal contact and a female signal contact. In other words, the female contact of the board to board connector assembly is merely utilized for clamping the male signal contact, so as to fix the board to board male connector and the board to board female connector. However, when the board to board male connector or the board to board female connector is suddenly applied by an external force, the board to board male connector may disengage from the board to board female connector easily due to an insufficient clamping strength between the board to board male connector and the board to board female connector, which causes signal interruption or damage of the signal contacts.

SUMMARY OF THE INVENTION

Therefore, an objective of the present invention is to provide a board to board male connector and a board to board female connector having holding contacts for solving aforementioned drawbacks.

In order to achieve the aforementioned objective, the present invention discloses a board to board male connector. The male connector includes a male insulator, a first male signal contact, a second male signal contact, and a first male holding contact. The male insulator includes a first side wall, a second side wall, a first erect wall, and a second erect wall. The first side wall is opposite to the second side wall, and the first erect wall is opposite to the second erect wall. The first male signal contact set is disposed on the first erect wall. The second male signal contact set is disposed on the second erect wall. The first male holding contact includes a first male holding body and at least one first embedding wing. The first male holding body is disposed on the first side wall. The at least one first embedding wing extends from at least one side of the first male holding body and embeds into the first side wall.

In order to achieve the aforementioned objective, the present invention further discloses a board to board female connector. The female connector includes a female insulator, a first female signal contact set, a second female contact set, and a first female holding contact. The female insulator includes an inner lateral wall, a first outer lateral wall, a second outer lateral wall, a first outer straight wall, and a second outer straight wall. A first slot is defined between the inner lateral wall and the first outer lateral wall. A second slot is defined between the inner lateral wall and the second outer lateral wall. A first recess is defined between the inner lateral wall and the first outer straight wall, and a second recess is defined between the inner lateral wall and the second outer straight wall. The first female signal contact set is disposed in the first recess. The second female signal contact set is disposed in the second recess. The first female holding contact includes a first female holding body and at least one first embedding claw. The first female holding body is disposed on the first outer lateral wall. The at least one first embedding claw includes a first extending portion, a first bending portion, and a first claw portion. The first extending portion extends from a side of the first female holding body. The first bending portion extends from the first extending portion. The first claw portion protrudes from the first bending portion. The first extending portion and the first bending portion clamp the first outer lateral wall, and the first claw portion embeds into the first outer lateral wall.

In summary, in the present invention, the first male holding contact of the male connector is fixed on the male insulator by the first embedding wing, and the first female holding contact of the second female connector is fixed on the female insulator by the first embedding claw. Therefore, the first male holding contact and the first female holding contact are able to respectively provide the male insulator and the female insulator with an additional holding force, so as to increasing a mating force between the male connector and the female connector.

These and other objectives of the present invention will no doubt become obvious to those of ordinary skill in the art after reading the following detailed description of the preferred embodiment that is illustrated in the various figures and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** and FIG. **2** are schematic diagrams of a male connector and a female connector at different views according to an embodiment of the present invention.

FIG. **3** is a schematic diagram of the male connector according to the embodiment of the present invention.

FIG. **4** is an exploded diagram of the male connector according to the embodiment of the present invention.

FIG. **5** is a sectional diagram of the male connector according to the embodiment of the present invention.

FIG. **6** is a schematic diagram of the female connector according to the embodiment of the present invention.

FIG. **7** is an exploded diagram of the female connector according to the embodiment of the present invention.

FIG. **8** is a sectional diagram of the female connector according to the embodiment of the present invention.

FIG. **9** and FIG. **10** are diagrams illustrating the male connector combined with the female connector at different views according to an embodiment of the present invention.

DETAILED DESCRIPTION

Please refer to FIG. **1** to FIG. **4**. FIG. **1** and FIG. **2** are schematic diagrams of a male connector **1** and a female connector **2** at different views according to an embodiment of the present invention. FIG. **3** is a schematic diagram of the male connector **1** according to the embodiment of the present invention. FIG. **4** is an exploded diagram of the male connector **1** according to the embodiment of the present invention. As shown in FIG. **1** to FIG. **4**, the male connector **1** includes a male insulator **10**, a first male signal contact set **12**, a second male signal contact set **14**, a first male holding contact **16**, and a second male holding contact **18**. The male insulator **10** includes a first side wall **101**, a second side wall **103**, a first erect wall **105**, and a second erect wall **107**. The first side wall **101** is opposite to the second side wall **103**. The first erect wall **105** is opposite to the second erect wall **107**. The first side wall **101**, the first erect wall **105**, the second side wall **103**, and the second erect wall **107** communicate with one another and cooperatively define a male mating space **109** for mating the female connector **2**.

Furthermore, a first male guiding block **111** is disposed at a conjunction where the first side wall **101** and the first erect wall **105** are connected. A second male guiding block **113** is disposed at a conjunction where the first side wall **101** and the second erect wall **107** are connected. A third male guiding block **115** is disposed at a conjunction where the second side wall **103** and the first erect wall **105** are connected, and a fourth male guiding block **117** is disposed at a conjunction where the second side wall **103** and the second erect wall **107** are connected. The first male guiding block **111**, the second male guiding block **113**, the third male guiding block **115**, and the fourth male guiding block **117** are for guiding the male connector **1** to be aligned with the female connector **2** during the male connector **1** is mated with the female connector **2**.

Please refer to FIG. **3** to FIG. **5**. FIG. **5** is a sectional diagram of the male connector **1** according to the embodiment of the present invention. As shown in FIG. **3** to FIG. **5**, the first male signal contact set **12** includes three first male signal contacts **121** disposed on the first erect wall **105**. It should be noticed that the quantity of the first male signal contact **121** is not limited thereto. Furthermore, the first erect wall **105** has a first upper side **1050**, a first lower side **1052**, a first inner side **1054**, and a first outer side **1056**. The second erect wall **107** has a second upper side **1070**, a second lower side **1072**, a second inner side **1074**, and a second outer side **1076**. The first lower side **1052** and the second lower side **1072** face a circuit board, which is not shown in figures. The first inner side **1054** faces the second inner side **1074**.

Each of the first male signal contacts **121** includes a first male welding portion **1210**, a first male inner abutting portion **1212**, a first male outer abutting portion **1214**, a first male lower connecting portion **1216**, a first male upper connecting portion **1218**, and a first male bending portion **1220**. The first male welding portion **1210** is welded on the circuit board. The first male lower connecting portion **1216** is connected to the first male welding portion **1210** and the first male inner abutting portion **1212**, so that the first male inner abutting portion **1212** extends from the first male welding portion **1210** and is combined with the first inner side **1054**. The first male outer abutting portion **1214** extends from the first male inner abutting portion **1212** and is combined with the first outer side **1056**. The first male upper connecting portion **1218** extends from the first male inner abutting portion **1212** and is combined with the first upper side **1050**. The first male bending portion **1220** is connected to the first male upper connecting portion **1218** and the first male outer abutting portion **1214**, so that the first male outer abutting portion **1214** extends from the first male inner abutting portion **1212** and is combined with the first outer side **1056**.

A gap G**1** is formed between an edge of the first male outer abutting portion **1214** and an upper surface of the first male welding portion **1210**, i.e., the edge of the first male outer abutting portion **1214** is not connected to the upper surface of the first male welding portion **1210**. Therefore, it prevents solder from climbing up on the first male outer abutting portion **1214** via the first male welding portion **1210** during a Surface Mount Technology (SMT) process. Furthermore, the first male lower connecting portion **1216** has an exposed Nickel-plated layer **1222**. Since solder cannot climb up on the exposed Nickel-plated layer **1222**, the exposed Nickel-plated layer **1222** prevents solder from climbing up on the first male inner abutting portion **1212** via the first male welding portion **1210** during a Surface Mount Technology (SMT) process. Therefore, the gap G**1** and the exposed Nickel-plated layer **1222** prevent a climbing effect of solder during a Surface Mount Technology (SMT) process. In a practical application, the Nickel-plated layer **1222** of the first male lower connecting portion **1216** can be exposed by stripping a gold layer over the Nickel-plated layer **1222** via a gold stripping process.

As shown in FIG. **4**, there is a width difference between the first male outer abutting portion **1214** and the first male welding portion **1210**, i.e., a width W**1** of the first male inner abutting portion **1212** and a width W**2** of the first male outer abutting portion **1214** are greater than a width W**3** of the first male welding portion **1210**. Therefore, a contacting area between the first male inner abutting portion **1212** and the female connector **2** or a contacting area between the first male outer abutting portion **1214** and the female connector **2** can be increased, so as to reduce impedance between the first male signal contact **121** and the female connector **2**, which allows the first male signal contact **121** to endure a larger current. Furthermore, the first male bending portion **1220** can be a mushroom-shaped structure. In other words, the first male bending portion **1220** can be an arc-shaped structure and protrude from the first male outer abutting portion **1214** along a direction from the first male inner abutting portion **1212** toward the first male outer abutting portion **1214** for increasing an insertion and withdrawal force between the first male signal contact **121** and the female connector **2**. Besides, since the first male signal contact **121** is a structure bent from the first inner side **1054** toward the first outer side **1056**, a climbing length of solder is longer during a Surface Mount Technology (SMT) process of the first male welding portion **1210**, which effectively prevents the first male signal contact **121** from the climbing effect of solder.

Similarly, the second male signal contact set **14** includes three second male signal contacts **141** disposed on the second erect wall **107**. It should be noticed that the quantity of the second male signal contact **141** is not limited thereto. Furthermore, each of the second male signal contacts **141** includes a second male welding portion **1410**, a second male inner abutting portion **1412**, a second male outer abutting portion **1414**, a second male lower connecting portion **1416**, a second male upper connecting portion **1418**, and a second male bending portion **1420**. A gap G**2** is formed between an edge of the second male outer abutting portion **1414** and an upper surface of the second male welding portion **1410**, i.e., the edge of the second male outer abutting portion **1414** is not connected to the upper surface of the second male welding portion **1410**. The second male lower connecting portion **1416** has an exposed Nickel-plated layer **1422**. Structures of the second male welding portion **1410**, the second male inner abutting portion **1412**, the second male outer abutting portion **1414**, the second male lower connecting portion **1416**, the second male upper connecting portion **1418**, and the second male bending portion **1420** are similar to structures of the first male welding portion **1210**, the first male inner abutting portion **1212**, the first male outer abutting portion **1214**, the first male lower connecting portion **1216**, the first male upper connecting portion **1218**, and the first male bending portion **1220**, and descriptions are omitted herein for simplicity.

As shown in FIG. **3** and FIG. **4**, the first male holding contact **16** includes a first male holding body **161** and two first embedding wings **163**. The first male holding body **161** is disposed on the first side wall **101**. The two first embedding wings **163** extend from two sides of the first male holding body **161**. Furthermore, the first male holding body **161** includes a first base **1610**, a first engaging plate **1612**, and a first holding welding portion **1614**. The first engaging

plate **1612** extends from the first base **1610**. A first engaging slot **165** is defined between the first engaging plate **1612** and the first base **1610** and for engaging with the first side wall **101**. The first holding welding portion **1614** extends from the first base **1610** and is welded on the circuit board. The two first embedding wings **163** embed into the first side wall **101**, so that the first male holding contact **16** can be firmly combined with the first side wall **101** by the two first embedding wings **163** and the first engaging slot **165**, which improves a holding effect between the first male holding contact **16** and the male insulator **10**. Furthermore, the first base **1610** includes a first male engaging structure **1616**. In this embodiment, the first male engaging structure **1616** can be an engaging slot structure. However, it is not limited to this embodiment.

Similarly, the second male holding contact **18** includes a second male holding body **181** and two second embedding wings **183**. The second male holding body **181** is disposed on the second side wall **103**. The two second embedding wings **183** extend from two sides of the second male holding body **181**. The second male holding body **181** includes a second base **1810**, a second engaging plate **1812**, and a second holding welding portion **1814**. The second engaging plate **1812** extends from the second base **1810**. A second engaging slot **185** is defined between the second engaging plate **1812** and the second base **1810** and for engaging with the second side wall **103**. The second holding welding portion **1814** extends from the second base **1810** and is welded on the circuit board. The two second embedding wings **183** embed into the second side wall **103**, so that the second male holding contact **18** can be firmly combined with the second side wall **103** by the two second embedding wings **183** and the second engaging slot **185**, which improves a holding effect between the second male holding contact **18** and the male insulator **10**. Furthermore, the second base **1810** includes a second male engaging structure **1816**. In this embodiment, the second male engaging structure **1816** can be an engaging slot structure. However, it is not limited to this embodiment.

Please refer to FIG. **1**, FIG. **2**, FIG. **6**, and FIG. **7**. FIG. **6** is a schematic diagram of the female connector **2** according to the embodiment of the present invention. FIG. **7** is an exploded diagram of the female connector **2** according to the embodiment of the present invention. As shown in FIG. **1**, FIG. **2**, FIG. **6**, and FIG. **7**, the female connector **2** includes a female insulator **20**, a first female signal contact set **22**, a second female signal contact set **24**, a first female holding contact **26**, and a second female holding contact **28**. The female insulator **20** includes an inner lateral wall **201**, a first outer lateral wall **203**, a second outer lateral wall **205**, a first outer straight wall **207**, and a second outer straight wall **209**. A first slot **211** is defined between the inner lateral wall **201** and the first outer lateral wall **203** and corresponding to the first side wall **101** of the male insulator **10**. A second slot **212** is defined between the inner lateral wall **201** and the second outer lateral wall **205** and corresponding to the second side wall **103** of the male insulator **10**. A first recess **213** is defined between the inner lateral wall **201** and the first outer straight wall **207** and corresponding to the first erect wall **105** of the male insulator **10**. A second recess **214** is defined between the inner lateral wall **201** and the second outer straight wall **209** and corresponding to the second erect wall **107** of the male insulator **10**. The first slot **211**, the first recess **213**, the second slot **212**, and the second recess **214** communicate with one another and cooperatively define a female mating space **215**.

Furthermore, a first female guiding block **216** is disposed on a conjunction where the first outer lateral wall **203** and the first outer straight wall **207** are connected. A second female guiding block **217** is disposed on a conjunction where the first outer lateral wall **203** and the second outer straight wall **209** are connected. A third female guiding block **218** is disposed on a conjunction where the second outer lateral wall **205** and the first outer straight wall **207** are connected, and a fourth female guiding block **219** is disposed on conjunction where the second outer lateral wall **205** and the second outer straight wall **209** are connected. The first female guiding block **216** is corresponding to the first male guiding block **111**. The second female guiding block **217** is corresponding to the second male guiding block **113**. The third female guiding block **218** is corresponding to the third male guiding block **115**. The fourth female guiding block **219** is corresponding to the fourth male guiding block **117**. In this embodiment, the first female guiding block **216**, the second female guiding block **217**, the third female guiding block **218**, and the fourth female guiding block **219** are trapezoid-shaped structures, as shown in FIG. **5** and FIG. **6**. It should be noticed that the structure and the quantity of the guiding block are not limited to those illustrated in figures in this embodiment, and it depends on practical demands.

Please refer to FIG. **6** to FIG. **8**. FIG. **8** is a sectional diagram of the female connector **2** according to the embodiment of the present invention. As shown in FIG. **6** to FIG. **8**, the first female signal contact set **22** includes three first female signal contacts **221** disposed in the first recess **213**. Furthermore, the inner lateral wall **201** includes a first inner surface **2010**, a second inner surface **2012**, a third inner surface **2014**, and a fourth inner surface **2016**. The first outer lateral wall **203** includes a first inside surface **2030** and a first outside surface **2032**. The second outer lateral wall **205** includes a second inside surface **2050** and a second outside surface **2052**. The first outer straight wall **207** includes a first inner erect surface **2070** and a first outer erect surface **2072**. The second outer straight wall **209** includes a second inner erect surface **2090** and a second outer erect surface **2092**. The first recess **213** is formed between the first inner surface **2010** and the first inner erect surface **2070**. The second recess **214** is formed between the second inner surface **2012** and the second inner erect surface **2090**. The first slot **211** is formed between the third inner surface **2014** and the first inside surface **2030**. The second slot **212** is formed between the fourth inner surface **2016** and the second inside surface **2050**.

Each of the first female signal contacts **221** includes a first female welding portion **2210**, a first female holding portion **2211**, a first female moving portion **2212**, a first female opening **2213**, a first female notch **2214**, a first female resilient arm **2215**, a first female clamping arm **2216**, and a first female lower connecting portion **2217**. The first female welding portion **2210** is welded on another circuit board, not shown in figures. The first female holding portion **2211** is connected to the first female resilient arm **2215** and the first female welding portion **2210**, so that the first female resilient arm **2215** extends from the first female welding portion **2210** and protrudes into the first recess **213**. The first female holding portion **2211** includes a first female holding stab **2218** embedding into the first outer straight wall **207**, so that first female holding portion **2211** is fixed on the first outer straight wall **207**. The first female lower connecting portion **2217** is connected to the first female resilient arm **2215** and the first female clamping arm **2216**, so that the first female clamping arm **2216** is opposite to the first female resilient

arm **2215** and protrudes into the first recess **213**. The first female moving portion **2212** extends from an end of the first female clamping arm **2216** away from the first female lower connecting portion **2217** and is movably disposed in the inner lateral wall **201**.

In this embodiment, the female lower connecting portion **2217** can be an arc-shaped structure, so that an accommodating space is formed between the first female resilient arm **2215**, the first female lower connecting portion **2217**, and the first female clamping arm **2216** cooperatively for receiving the first male signal contact **121**. However, structure of the first female signal contact **221** is not limited to the figures in this embodiment. Furthermore, the first female opening **2213** is formed on the first female resilient arm **2215**. The first female notch **2214** is formed on the first female clamping arm **2216**, and the first female notch **2214** does not communicate with the first female opening **2213**. The first female opening **2213** is for increasing resilience of the first female resilient arm **2215**. The first female notch **2214** is for increasing resilience of the first female clamping arm **2216**. Widths and depths of the first female opening **2213** and the first female notch **2214** are adjustable according to practical demands.

Similarly, the second female signal contact set **24** includes three second female signal contacts **241** disposed in the second recess **214**. Each of the second female signal contacts **241** includes a second female welding portion **2410**, a second female holding portion **2411**, a second female moving portion **2412**, a second female opening **2413**, a second female notch **2414**, a second female resilient arm **2415**, a second female clamping arm **2416**, and a second female lower connecting portion **2417**. The second female holding portion **2411** includes a second female holding stab **2418**. Structures and operation principles of the second female welding portion **2410**, the second female holding portion **2411**, the second female moving portion **2412**, the second female opening **2413**, the second female notch **2414**, the second female resilient arm **2415**, the second female clamping arm **2416**, the second female lower connecting portion **2417**, and the second female holding stab **2418** of the second female signal contact **214** are similar to those of the first female welding portion **2210**, the first female holding portion **2211**, the first female moving portion **2212**, the first female opening **2213**, the first female notch **2214**, the first female resilient arm **2215**, the first female clamping arm **2216**, the first female lower connecting portion **2217**, and the first female holding stab **2218** of the first female signal contact **221**, and related descriptions are omitted herein for simplicity.

As shown in FIG. **6** and FIG. **7**, the first female holding contact **26** includes a first female holding body **261** and two first embedding claws **263**. The quantity of the first embedding claw **263** is not limited thereto. In another embodiment, the first female holding contact **26** can include only one first embedding claw **263**. The first female holding body **261** is disposed on the first outer lateral wall **203**. Each of the first embedding claws **263** includes a first extending portion **2630**, a first bending portion **2632**, and a first claw portion **2634**. The first extending portion **2630** extends from a side of the first female holding body **261**. The first bending portion **2632** extends from the first extending portion **2630**. The first claw portion **2634** protrudes from the first bending portion **2632**. The first female holding body **261** includes a first plate **2610** and a first edge plate **2612**. The first edge plate **2612** extends from the first plate **2610**. A first clamping slot **2614** is defined between the first edge plate **2612** and the first plate **2610** for clamping the first outer lateral wall **203**. The first extending portions **2630** and the first bending portions **2632** of the two first embedding claws **263** clamp the first outer lateral wall **203**, and the first claw portions **2634** embed into the first outer lateral wall **203**. As a result, the first female holding contact **26** can be combined with the first outer lateral wall **203** firmly. Furthermore, the first edge plate **2612** has a first female engaging structure **2616**. In this embodiment, the first female engaging structure **2616** can be an arc-shaped protruding structure. However, it is not limited to this embodiment.

Similarly, the second female holding contact **28** includes a second female holding body **281** and two second embedding claws **283**. The quantity of the second embedding claw **283** is not limited thereto. In another embodiment, the second female holding contact **28** can include only one second embedding claw **283**. The second female holding body **281** is disposed on the second outer lateral wall **205**. Each of the second embedding claws **283** includes a second extending portion **2830**, a second bending portion **2832**, and a second claw portion **2834**. The second extending portion **2830** extends from a side of the second female holding body **281**. The second bending portion **2832** extends from the second extending portion **2830**. The second claw portion **2834** protrudes from the second bending portion **2832**. The second female holding body **281** includes a second plate **2810** and a second edge plate **2812**. The second edge plate **2812** extends from the second plate **2810**. A second clamping slot **2814** is defined between the second edge plate **2812** and the second plate **2810** for clamping the second outer lateral wall **205**. The second extending portions **2830** and the second bending portions **2832** of the two second embedding claws **283** clamp the second outer lateral wall **205**, and the second claw portions **2834** embed into the second outer lateral wall **205**. As a result, the second female holding contact **28** can be combined with the second outer lateral wall **205** firmly. Furthermore, the second edge plate **2812** has a second female engaging structure **2816**. In this embodiment, the second female engaging structure **2816** can be an arc-shaped protruding structure. However, it is not limited to this embodiment.

Please refer to FIG. **1**, FIG. **2**, FIG. **9** and FIG. **10**. FIG. **9** and FIG. **10** are diagrams illustrating the male connector **1** combined with the female connector **2** at different views according to an embodiment of the present invention. When it is desired to combine the male connector **1** and the female connector **2**, the first female guiding block **216**, the second female guiding block **217**, the third female guiding block **218**, and the fourth female guiding block **219** of the female connector **2** cooperates with the first male guiding block **111**, the second male guiding block **113**, the third male guiding block **115**, and the fourth male guiding block **117** of the male connector **1**, respectively, so as to guide the male mating space **109** to be aligned with the inner lateral wall **201** and guide the first side wall **101**, the second side wall **103**, the first erect wall **105**, and the second erect wall **107** of the male connector **1** to be aligned with the first slot **211**, the second slot **212**, the first recess **213**, and the second recess **214** of the female mating space **215** of the female connector **2**, respectively. Furthermore, each of the first male signal contacts **121**, each of the second male signal contacts **141**, the first male holding contact **16**, and the second male holding contact **18** are aligned with each of the first female signal contacts **221**, each of the second female signal contacts **241**, the first female holding contact **26**, and the second female holding contact **28**, respectively.

When the male connector **1** and the female connector **2** are combined with each other, the first male outer abutting

portion **1214** of the first male signal contact **121** abuts against the first female resilient arm **2215**, and the first male inner abutting portion **1212** of the first male signal contact **121** contacts with the first female clamping arm **2216**. Furthermore, the first female lower connecting portion **2217** and the first male upper connecting portion **1218** are spaced from each other, as shown in FIG. **9**. In other words, the first female signal contact **221** merely utilizes the first female clamping arm **2216** and the first female resilient arm **2215** for contacting with the first male inner abutting portion **1212** and the first male outer abutting portion **1214** of the first male signal contact **121**, so as to improve a guiding effect and reliability during combination of the first male signal contact **121** and the first female signal contact **221**. Similarly, the second male outer abutting portion **1414** of the second male signal contact **141** abuts against the second female resilient arm **2415**, and the second male inner abutting portion **1412** of the second male signal contact **141** contacts with the second female clamping arm **2416**. Furthermore, the second female lower connecting portion **2417** and the second male upper connecting portion **1418** are spaced from each other, as shown in FIG. **9**. In other words, the second female signal contact **241** merely utilizes the second female clamping arm **2416** and the second female resilient arm **2415** for contacting with the second male inner abutting portion **1412** and the second male outer abutting portion **1414** of the second male signal contact **141**, so as to enhance guiding effect and reliability during mating of the second male signal contact **141** and the second female signal contact **241**.

Furthermore, when the male connector **1** and the female connector **2** are combined with each other, the first male engaging structure **1616** of the first base **1610** engages with the first female engaging structure **2616** of the first edge plate **2612**. The second male engaging structure **1816** of the second base **1810** engages with the second female engaging structure **2816** of the second edge plate **2812**. Therefore, an additional holding force is generated between the male connector **1** and the female connector **2**, which increase an insertion and withdrawal force between the male connector **1** and the female connector **2**.

In contrast to the prior art, the gap is formed between the edge of the male outer abutting portion and the upper surface of the male welding portion, and the male lower connecting portion has the exposed Nickel-plated layer. Therefore, when a Surface Mount Technology (SMT) process of the male welding portion is performed, the gap prevents solder from climbing up on the male outer abutting portion via the male welding portion, and the exposed Nickel-plated layer prevents the solder from climbing up on the male inner abutting portion via the male welding portion, which effectively prevents climbing of solder of the male signal contact. Furthermore, the width of the male inner abutting portion and the width of the male outer abutting portion are greater than the width of the male lower connecting portion, so that the contacting area between the male inner abutting portion and the female signal contact or the contacting area between the male outer abutting portion and the female signal contact increases, so as to reduce impedance between the male signal contact and the female signal contact. It allows the male signal contact to endure a larger current. Besides, when the male connector and the female connector are mated with each other, the first male engaging structure engages with the first female engaging structure, and the second male engaging structure engages with the second female engaging structure. It increases a mating force and enhances reliability. In addition, the male holding contact is fixed on the male connector by the engaging slot and the embedding wing, and the female holding contact is fixed on the female connector by the clamping slot and the embedding claw. Therefore, it provides an additional holding force when the male connector is mated with the female connector, and achieves better effects of positioning and holding.

Those skilled in the art will readily observe that numerous modifications and alterations of the device and method may be made while retaining the teachings of the invention. Accordingly, the above disclosure should be construed as limited only by the metes and bounds of the appended claims.

What is claimed is:

1. A board to board male connector, comprising:

a male insulator comprising a first side wall, a second side wall, a first erect wall, and a second erect wall, the first side wall being opposite to the second side wall, and the first erect wall being opposite to the second erect wall;

a first male signal contact set disposed on the first erect wall;

a second male signal contact set disposed on the second erect wall; and

a first male holding contact comprising:

a first male holding body disposed on the first side wall; and

at least one first embedding wing extending from at least one side of the first male holding body and embedding into the first side wall, the at least one first embedding wing being partially hidden inside the first side wall and partially exposed out of the first side wall.

2. The male connector of claim **1**, wherein the first male holding body comprises a first base and a first engaging plate, the first base comprises a first male engaging structure, the first engaging plate extends from the first base, a first engaging slot is defined between the first engaging plate and the first base and for engaging with the first side wall, and the first male holding contact further comprises a first holding welding portion extending from the first base and being welded on a circuit board.

3. The male connector of claim **1**, further comprising a second male holding contact, the second male holding contact comprising:

a second male holding body disposed on the second side wall; and

at least one second embedding wing extending from the second male holding body, the at least one second embedding wing embedding into the second side wall for fixing the second male holding body onto the second side wall.

4. The male connector of claim **3**, wherein the second male holding body comprises a second base and a second engaging plate, the second base comprises a second male engaging structure, the second engaging plate extends from the second base, a second engaging slot is defined between the second engaging plate and the second base and for engaging with the second side wall, and the second male holding contact further comprises a second holding welding portion extending from the second base and being welded on a circuit board.

5. The male connector of claim **1**, wherein the first erect wall has a first upper side, a first lower side, a first inner side, and a first outer side, the second erect wall has a second upper side, a second lower side, a second inner side, and a second outer side, the first lower side and the second lower side face a circuit board, the first inner side faces the second inner side, the first male signal contact set comprises a

plurality of first male signal contacts, and each of the plurality of first male signal contacts comprises:

a first male welding portion welded on the circuit board;

a first male inner abutting portion extending from the first male welding portion and being combined with the first inner side; and

a first male outer abutting portion extending from the first male inner abutting portion and being combined with the first outer side, a gap being formed between an edge of the first male outer abutting portion and an upper surface of the first male welding portion, a width of the first male inner abutting portion and a width of the first male outer abutting portion being greater than a width of the first male welding portion.

6. The male connector of claim **5**, wherein each of the plurality of first male signal contacts further comprising:

a first male lower connecting portion connected to the first male welding portion and the first male inner abutting portion, the first male lower connecting portion having an exposed Nickel-plated layer;

a first male upper connecting portion extending from the first male inner abutting portion and being combined with the first upper side; and

a first male bending portion connected to the first male upper connecting portion and the first male outer abutting portion, the first male bending portion being an arc-shaped structure, the first male bending portion protruding from the first male outer abutting portion along a direction from the first male inner abutting portion toward the first male outer abutting portion.

7. The male connector of claim **5**, wherein the second male signal contact set comprises a plurality of second male signal contacts, and each of the plurality of second male signal contacts comprises:

a second male welding portion welded on the circuit board;

a second male inner abutting portion extending from the second male welding portion and being combined with the second inner side; and

a second male outer abutting portion extending from the second male inner abutting portion and being combined with the second outer side, a gap being formed between an edge of the second male outer abutting portion and an upper surface of the second male welding portion, a width of the second male inner abutting portion and a width of the second male outer abutting portion being greater than a width of the second male welding portion.

8. The male connector of claim **7**, wherein each of the plurality of second male signal contacts further comprising:

a second male lower connecting portion connected to the second male welding portion and the second male inner abutting portion, the second male lower connecting portion having an exposed Nickel-plated layer;

a second male upper connecting portion extending from the second male inner abutting portion and being combined with the second upper side; and

a second male bending portion connected to the second male upper connecting portion and the second male outer abutting portion, the second male bending portion being an arc-shaped structure, the second male bending portion protruding from the second male outer abutting portion along a direction from the second male inner abutting portion.

9. The male connector of claim **1**, wherein the first side wall, the first erect wall, the second side wall, and the second erect wall communicate with one another and cooperatively define a male mating space, a first male guiding block is disposed at a conjunction where the first side wall and the first erect wall are connected, a second male guiding block is disposed at a conjunction where the first side wall and the second erect wall are connected, a third male guiding block is disposed at a conjunction where the second side wall and the first erect wall are connected, and a fourth male guiding block is disposed at a conjunction where the second side wall and the second erect wall are connected.

10. A board to board female connector, comprising:

a female insulator comprising an inner lateral wall, a first outer lateral wall, a second outer lateral wall, a first outer straight wall, and a second outer straight wall, a first slot being defined between the inner lateral wall and the first outer lateral wall, a second slot being defined between the inner lateral wall and the second outer lateral wall, a first recess being defined between the inner lateral wall and the first outer straight wall, and a second recess being defined between the inner lateral wall and the second outer straight wall;

a first female signal contact set disposed in the first recess;

a second female signal contact set disposed in the second recess; and

a first female holding contact comprising:

a first female holding body disposed on the first outer lateral wall; and

at least one first embedding claw comprising a first extending portion, a first bending portion, and a first claw portion, the first extending portion extending from a side of the first female holding body, the first bending portion extending from the first extending portion, the first claw portion protruding from the first bending portion, the first extending portion and the first bending portion clamping the first outer lateral wall, and the first claw portion embedding into the first outer lateral wall.

11. The female connector of claim **10**, wherein the first female holding body comprises a first plate and a first edge plate, the first edge plate comprises a first female engaging structure, the first edge plate extends from the first plate, a first clamping slot is defined between the first edge plate and the first plate for clamping the first outer lateral wall.

12. The female connector of claim **10**, further comprising a second female holding contact, the second female holding contact comprising:

a second female holding body disposed on the second outer lateral wall; and

at least one second embedding claw comprising a second extending portion, a second bending portion, and a second claw portion, the second extending portion extending from a side of the second female holding body, the second bending portion extending from the second extending portion, the second claw portion protruding from the second bending portion, the second extending portion and the second bending portion clamping the second outer lateral wall, and the second claw portion embedding into the second outer lateral wall.

13. The female connector of claim **12**, wherein the second female holding body comprises a second plate and a second edge plate, the second edge plate comprises a second female engaging structure, the second edge plate extends from the second plate, a second clamping slot is defined between the second edge plate and the second plate for clamping the second outer lateral wall.

14. The female connector of claim **10**, wherein the inner lateral wall comprises a first inner surface, a second inner

surface, a third inner surface, and a fourth inner surface, the first outer lateral wall comprises a first inside surface and a first outside surface, the second outer lateral wall comprises a second inside surface and a second outside surface, the first outer straight wall comprises a first inner erect surface and a first outer erect surface, the second outer straight wall comprises a second inner erect surface and a second outer erect surface, the first recess is formed between the first inner surface and the first inner erect surface, the second recess is formed between the second inner surface and the second inner erect surface, the first slot is formed between the third inner surface and the first inside surface, the second slot is formed between the fourth inner surface and the second inside surface, the first female signal contact set comprises a plurality of first female signal contacts, each of the plurality of first female signal contacts comprises:

a first female welding portion welded on a circuit board;

a first female resilient arm extending from the first female welding portion and protruding into the first recess; and

a first female clamping arm opposite to the first female resilient arm and protruding into the first recess.

15. The female connector of claim **14**, wherein each of the plurality of first female signal contacts further comprises:

a first female holding portion connected to the first female resilient arm and the first female welding portion, the first female holding portion comprising a first female holding stab embedding into the first outer straight wall;

a first female lower connecting portion connected to the first female resilient arm and the first female clamping arm; and

a first female moving portion extending from an end of the first female clamping arm away from the first female lower connecting portion, the first female moving portion being movably disposed in the inner lateral wall.

16. The female connector of claim **14**, wherein each of the plurality of first female signal contacts further comprises:

a first female opening formed on the first female resilient arm; and

a first female notch formed on the first female clamping arm, the first female notch not communicates with the first female opening.

17. The female connector of claim **14**, wherein the second female signal contact set comprises a plurality of second female signal contacts, each of the plurality of second female signal contacts comprises:

a second female welding portion welded on the circuit board;

a second female resilient arm extending from the second female welding portion and protruding into the second recess; and

a second female clamping arm opposite to the second female resilient arm and protruding into the second recess.

18. The female connector of claim **17**, wherein each of the plurality of second female signal contacts further comprises:

a second female holding portion connected to the second female resilient arm and the second female welding portion, the second female holding portion comprising a second female holding stab embedding into the second outer straight wall;

a second female lower connecting portion connected to the second female resilient arm and the second female clamping arm; and

a second female moving portion extending from an end of the second female clamping arm away from the second female lower connecting portion, the second female moving portion being movably disposed in the inner lateral wall.

19. The female connector of claim **17**, wherein each of the plurality of second female signal contacts further comprises:

a second female opening formed on the second female resilient arm; and

a second female notch formed on the second female clamping arm, the second female notch not communicates with the second female opening.

20. The female connector of claim **10**, wherein the first slot, the first recess, the second slot, and the second recess communicate with one another and cooperatively define a female mating space, a first female guiding block is disposed on a conjunction where the first outer lateral wall and the first outer straight wall are connected, a second female guiding block is disposed on a conjunction where the first outer lateral wall and the second outer straight wall are connected, a third female guiding block is disposed on a conjunction where the second outer lateral wall and the first outer straight wall are connected, and a fourth female guiding block is disposed on conjunction where the second outer lateral wall and the second outer straight wall are connected.

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