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ELECTRICAL CONNECTOR

DETAILED DESCRIPTION OF INVENTION

(Field of Invention)

The present invention relates to an electrical connector comprising contacts having engaging protrusions to be engaged and secured in a housing.

(Prior Art)

One example of this type of conventional electrical connectors is shown in FIG. 4 (see U.S. patent No. 5,064,391).

This electrical connector 100 comprises a housing 101, a plurality of contacts 103 to be engaged and secured in the housing 101, and an electrically conductive shell 102 provided on the housing 101 so as to cover the contacts 103.

Each contact 103 is formed with a pair of engaging protrusions 104,105 projecting from the both sides thereof to be engaged and secured in a contact receiving groove 106 as shown in FIG. 4 (B). Also, positions of engaging protrusions 104,105 separate apart by distance H from each other along the insertion direction of the contacts 103 and are asymmetrical with respect to a center line CL of the contact 103. The positions of the engaging protrusions 104,105 are asymmetrical in order to increase the pitch between the neighboring contacts 103,103.

On the other hand, the contact receiving grooves 106 of the housing 101 in which the contacts 103 are engaged and secured have contact insertion

entrances 107 widening toward contact insertion edges to ease the insertion of contacts 103.

Also, another example of conventional electrical connectors is shown in FIG. 5 (see JP-U-3-95584).

This electrical connector 300 comprises a housing 310 having a plurality of parallel contact securing holes 311, a plurality of contacts 320 to be engaged and secured in the contact securing holes 311 of the housing 310, and a slider 330 for pressing a flat cable 340 inserted into the housing 310 against contact portions 325 of the contacts 320.

Each contact 320 has a base portion 321, a solder tine 326 extending from one side of the base portion 321 to be soldered to a circuit board 350, a cantilever shaped spring portion 324 extending from the other side of the base portion 321 to have a contact portion 325 for making contact with a bottom surface of the flat cable 340 at the tip thereof, and a contact securing portion 322 extending upwardly from the base portion 321 between the solder tine 326 and the spring portion 324 to be engaged and secured in the contact securing hole 311. Also, a side edge of the contact securing portion 322 facing the solder tine 326 is provided with two engaging protrusions 323 to be engaged and secured in said contact securing hole 311, and a side edge of the contact securing portion 322 facing the spring portion 324 is a straight side edge along a straight side wall of the contact securing hole 311.

(Problems to be Solved by the Invention)

Unfortunately, the conventional electrical connector 100 as shown in FIG. 4 has a disadvantage in that the contacts 103 tend to rotate in the direction as shown by an arrow A in FIG. 4 (B) and thus are difficult to insert because the engaging protrusions 105 located ahead of the other engaging protrusions 104 by a distance H hit the side walls of the contact insertion entrances 107 earlier

than the other engaging protrusions 104 as the contacts 103 are inserted into the respective contact receiving grooves 106 of the housing 101.

While in the conventional electrical connector 300 as shown in FIG. 5, the engaging protrusions 323 to be inserted and secured in the contact securing holes 311 are formed along one side edge of each solder tine 326 of the contact securing portion 322 rather than the side edge proximity to the spring portion 324 formed with the contact portion 325 which engages the bottom surface of the flat cable 340. This means that rotary moment develops in such a manner to deflect the spring portion 324 downwardly and rotate the contact securing portion 322 toward the spring portion 324 as the slider 330 is inserted into the housing 310 to urge the flat cable 340 onto the contact portions 325 of the contacts 320. The rotary moment acts to reduce the engaging force of the engaging protrusions 323 with the contact securing hole 311, thereby resulting in slanting the contact securing portion 322 with respect to the contact securing hole 311. This causes a problem of difficulty in maintaining a necessary normal contact force because the contact points between the contact portions 325 at the tips of spring portions 324 and the flat cable 340 tend to shift down.

It is an object of the present invention to provide an electrical connector including contacts each having at least a pair of engaging protrusions at asymmetrical locations with respect to the center line of the contact for securing it in the housing, thereby enabling the contact to be easily inserted into the housing.

It is another object of the present invention to provide an electrical connector capable of maintaining proper alignment of the contact securing portion of each contact with the contact securing hole, thereby maintaining contact points between the contact portions and the matable substrate and also maintaining the necessary normal contact force.

(Means to Solve the Problems)

The electrical connector according to the present invention comprises a housing formed with contact securing holes and contacts each having a contact securing portion to be inserted and secured in the respective contact securing hole of the housing and features in the following respects. The contact securing portion of each contact to be engaged and secured in the contact securing hole is formed with at least a pair of first and second engaging protrusions at both side edges thereof at mutually offset locations along the contact insertion direction, thereby making the first and second engaging protrusions asymmetrical about the center line of the contact. Each of the contact securing holes is formed with a contact insertion entrance having first and second offset chamfers against that the first and second engaging protrusions abut substantially simultaneously as the contact is inserted into the contact insertion entrance.

The electrical connector according to the present invention comprises a housing formed with contact securing holes and contacts to be inserted and secured in the contact securing holes of the housing. Each of the contacts includes a base portion , a solder tine extending from one side of the base portion , a cantilever shaped spring portion extending from the other side of the base portion to have a contact portion for making contact with a bottom surface of a complementary substrate at the tip thereof , and a contact securing portion extending from the base portion between the solder tine and the spring portion to be engaged and secured in said contact securing hole . The electrical connector features in the following respects. The side edge of the contact securing portion of each contact proximity to the spring portion is provided with at least an engaging protrusion to be engaged and secured in the contact securing hole ,and the side edge of the contact securing portion of each

contact proximity to the solder tine is a straight side edge along a straight side wall of the contact securing hole.

(Embodiments)

Embodiments of the present invention will be described in detail by reference to the accompanying drawings. FIG. 1 shows an electrical connector of a first embodiment of the present invention, wherein (A) is a top view and (B) is a front view. FIG. 2 is cross-sectional views along the line 2-2 in FIG. 1(A), wherein (A) is a cross-sectional view when the contacts started to engage the housing and (B) is a cross-sectional view when the contacts have been secured in the housing. Please note, however, that the contact is not in cross section.

In FIGs. 1 and 2, an electrical connector 1 comprises a housing 10 having a plurality of contact securing holes 12, and a plurality of contacts 20 having contact securing portions 22 to be engaged and secured in the contact securing holes 12 of the housing 10.

Each contact 20 is made by stamping a metal plate and comprises a base portion 21, a solder tine 27 extending from the left side (in FIG.2) of the base portion 21 to be soldered to a pad on a substrate, a cantilever shaped spring portion 25 extending from the right side of the base portion 21 to have a contact portion 26 for making contact with a pad provided on a complementary substrate at the tip thereof, and a contact securing portion 22 projecting upwardly from the base portion 21 between the solder tine 27 and the spring portion 25. The spring portion 25 extends upwardly from the right side of the base portion 21 and extends downwardly and obliquely through a first bent 25a and further extends upwardly and obliquely through a second bent 25b. The contact portion 26 extends upwardly from a tip 25c of the spring portion 25.

Each of the contact securing portions 22 of the contacts 20 is formed with plural pairs of first and second engaging protrusions 23,24 (2 pairs in this embodiment) at the both sides thereof to be engaged and secured in the contact securing hole 12 of the housing 10. The first and second engaging protrusions 23,24 locate spaced apart by space W from each other along the insertion direction of the contact 20 (the upper and lower direction in FIG. 2 (B)) so that the first and second engaging protrusions 23,24 are asymmetrical with respect to the center line CL of the contact 20. Front surfaces of the first and second engaging protrusions 23,24 in the contact insertion direction are slanted for ease of insertion of the contact securing portion 22 into the contact securing hole 12.

The housing 10 is provided with a plurality of contact receiving passageways 11 in parallel to one another in the lateral direction (the upper and lower direction in FIG. 1 (A)) for receiving the contacts 20. Each of the contact receiving passageways 11 is provided with a contact securing hole 12 for securing the contact securing portion 22 and an opening 16 for contact portion through which the contact portion 26 projects. The contact securing holes 12 and the openings 16 for contact portion are disposed alternately in the lateral direction of the housing 10 (see FIG. 1 (A)). The contact securing hole 12 is upwardly oriented from the contact receiving passageway 11 to the upper surface of the housing 10. The contact securing hole 12 is provided with a contact insertion entrance 13 having a pair of first and second chamfers 14, 15 against which the both first and second engaging protrusion 23, 24 abut substantially simultaneously during the insertion of the contact 20.

When the contact securing protrusion 22 of the contact 20 is inserted into the contact securing hole 12 for securing therein, the first and second engaging protrusions 23,24 of the contact securing portion 22 abut against the first and second chamfers 14,15 of the contact insertion entrance 13 substantially

simultaneously as shown in FIG. 2 (A). As a result, the contact securing portion 22 does not slant with respect to the center line of the contact securing hole 12 by the first and second engaging protrusions 23,24 during the insertion of the contact 20, thereby assuring easy insertion of the contact 20. As the contact securing portion 22 is inserted further, the first and second engaging protrusions 23,24 of the contact securing portion 22 bite into opposite side walls of the contact securing hole 12 so that the contact securing portion 22 is engaged and secured in the contact securing hole 12 as shown in FIG. 2 (B). Since the contact securing portion 22 is secured in the housing 10 while maintaining proper alignment with the center line of the contact securing hole 12 during insertion of the contact securing portion 22, coplanarity of the contact portions 26 is maintained in the upper and lower direction (upper and lower direction in FIG. 2 (A)) .

Then, a second embodiment of this invention will be described by reference to FIG. 3. FIG.3 is a cross-sectional view of a second embodiment of the electrical connector according to the present invention.

In FIG.3, an electrical connector 200 comprises a housing 210 having a plurality of contact securing holes 212 and a plurality of contacts 220 to be engaged and secured in the contact securing holes 212 of the housing 210 in similar manner to the electrical connector 1 as shown in FIGs.1 and 2. The housing 210 has the substantially same construction as the housing 10 in FIGs. 1 and 2 and comprises a plurality of contact receiving passageways 211 provided in parallel with one another in the lateral direction (perpendicular to the surface of the sheet of drawing of FIG. 3) to receive the contacts 220. Each contact receiving passageway 211 is provided with a contact securing hole 212 for securing a contact securing portion 222 and an opening 213 for contact portion through which a contact portion 225 projects. Also, the contact securing holes 212 and the openings 213 for contact portion are disposed

alternately in the lateral direction of the housing 210.

Each contact 220 is made by stamping a metal plate and comprises a base portion 221, a solder tine 226 extending from the left side (in FIG.3) of the base portion 221 to be soldered to a pad on a circuit board (not shown), a cantilever shaped spring portion 224 extending from the right side of the base portion 221 having a contact portion 225 for making contact with the bottom surface of a complementary substrate (not shown) at the tip thereof, and a contact securing portion 222 projecting upwardly from the base portion 221 between the solder tine 226 and the spring portion 224 similar to the contact 20 of the electrical connector 1 in FIGs. 1 and 2. The spring portion 224 extends upwardly from the right upper side of the base portion 221 and extends downwardly and obliquely through a first bent 224a and further extends upwardly and obliquely through a second bent 224b. The contact portion 225 extends upwardly from a tip 224c of the spring portion 224.

The construction of the contact securing portion 222 in the contact 220 is different from that of the contact securing portion 22 in the contact 20 of the electrical connector 1 in FIGs. 1 and 2. That is, a side edge 212a of the contact securing portion 222 facing the spring portion 224 is provided with two engaging protrusions 223a, 223b to be engaged and secured in the contact securing hole 212, and a side edge 212b of the contact securing portion 222 facing the solder tine 226 is a straight side edge along a straight side wall of the contact securing hole 212. Since the side edge 212a of the contact securing portion 222 facing the spring portion 224 is provided with two engaging protrusions 223a, 223b to be engaged and secured in the contact securing hole 212, the engaging protrusions 223 bite into the side wall 212a of the contact securing hole 212 by the rotary moment toward the spring portion 224 acting on the contact securing portion 222, thereby maintaining proper orientation of the contact securing portion 222 with respect to the contact securing hole 212

without reducing the engaging force of the engaging portions 223 with the side wall 212a of the contact securing hole 212 when the complementary substrate is made contact with the contact portions 225 of the contacts 200. Therefore, the position of the contact point of the contact portion 225 at the tip of the spring portion 224 and the complementary substrate does not shift downwardly and a given contact force is maintained. On the other hand, since the side edge 212b of the contact securing portion 222 facing the solder tine 226 is a straight side edge along a straight side wall of the contact securing hole 212, the side edge 212b of the contact securing portion 222 facing the solder tine 226 is guided along the straight side wall of the contact securing hole 212 during the insertion of the contact securing portion 222 into the contact securing hole 212, thereby maintaining the orientation of the side edge 212b after insertion. That is, since the side edge 212b of the contact securing portion 222 facing the solder tine 226 has no engaging protrusion, no rotary moment is produced by contacting of the engaging protrusion to the contact securing hole 212 during insertion of the contact securing portion 222.

(Advantages of the Invention)

According to the electrical connector of the present invention, the contact securing portion is formed with at least a pair of first and second engaging protrusions at the both sides thereof and located spaced apart or offset from each other along the contact insertion direction. In other words, the pair of first and second engaging protrusions are asymmetrical with respect to the center line of the contact, and the contact securing hole is provided with a contact insertion entrance having a pair of first and second chamfers against which the both first and second engaging protrusions abut substantially simultaneously during the insertion of the contacts. Therefore, as the contact securing portion is inserted into the contact securing hole, the contact securing

portion does not slant with respect to the center line of the contact securing hole by the first and second engaging protrusions thereby making insertion of the contact easily and maintaining coplanarity of the contact portions of the contacts.

Also, according to the electrical connector of the present invention, the side edge of the contact securing portion facing the spring portion is provided with at least one engaging protrusion to be engaged and secured in the contact securing hole. When the complementary substrate is made contact with the contact portions of the contacts, the engaging protrusion bites into the side wall of the contact securing hole by the rotary moment toward the spring portion acting on the contact securing portion, thereby maintaining proper orientation of the contact securing portion with respect to the contact securing hole without reducing the engaging force of the engaging portion with the side wall of the contact securing hole. Therefore, the position of the contact point of the contact portion at the tip of the spring portion and the complementary substrate is not shifted downwardly and a given contact force is maintained. Also, since the side edge of the contact securing portion facing the solder tine is a straight side edge along a straight side wall of the contact securing hole, the side edge of the contact securing portion facing the solder tines is guided along the straight side wall of the contact securing hole during the insertion of the contact securing portion into the contact securing hole, thereby maintaining the orientation of the side edge after insertion.

BRIEF DESCRIPTION OF DRAWINGS

(FIG. 1)

A first embodiment of the electrical connector according to the present invention, wherein (A) is a top view and (B) is a front view.

(FIG. 2)

Cross-sectional views along the line 2-2 in FIG. 1(A), wherein (A) is a cross-sectional view showing the initial condition of the contact in engagement with the housing and (B) is a cross-sectional view after securing the contact in the housing.

(FIG. 3)

A cross-sectional view of a second embodiment of the electrical connector according to the present invention.

(FIG. 4)

A conventional electrical connector, wherein (A) is a perspective view and (B) is a cross-sectional view of a main part of the contact.

(FIG. 5)

A cross-sectional view of another conventional electrical connector.

(Description of Reference Numerals)

1,200	electrical connector
10,210	housing
12,212	contact securing hole
13	contact inserting entrance
14	first chamfer
15	second chamfer
20,220	contact
22,222	contact securing portion
23	first engaging protrusion
24	second engaging protrusion



CLAIM FOR PATENT

(1) An electrical connector comprising a housing having contact securing holes , and contacts to be engaged and secured in said contact securing holes of said housing, each of said contacts including a base portion , a solder tine extending from one side of said base portion, a cantilever shaped spring portion extending from the other side of said base portion to have a contact portion for making contact with a bottom surface of a complementary substrate at the tip thereof , and a contact securing portion extending upwardly from said base portion between said solder tine and said spring portion to be engaged and secured in said contact securing hole , characterized in that:

a side edge of said contact securing portion facing said spring portion is provided with at least a second engaging protrusion to be engaged and secured in said contact securing hole.

(2) The electrical connector of Claim 1, wherein a side edge of said contact securing portion facing said solder tine is a straight side edge along a straight side wall of said contact securing hole.

(3) The electrical connector of Claim 1, wherein a side edge of said contact securing portion facing said solder tine is provided with at least a first engaging protrusion to be engaged and secured in said contact securing hole.

(4) The electrical connector of Claim 3, wherein said first and second engaging protrusions locate spaced apart from each other along the insertion direction of said contact securing portion so that the first and second engaging protrusions are asymmetrical with respect to the centerline of said contact securing portion, and said each contact securing hole is provided with a contact insertion entrance having a pair of first and second chamfers against which said both first and second engaging protrusions abut substantially simultaneously during insertion of said contact securing portion.