

ELECTRICAL CONNECTOR

BACKGROUND OF THE INVENTION

5 Field of the Invention

The present invention relates to an electrical connector comprising a plate-like base, a resilient contact arm extending from the base and having a contact portion in contact with a circuit board at its free end, and a plurality of contacts
10 each having a connection portion extending from the base and connected to a separate circuit board from said circuit board.

Description of the Related Art

As a conventional electrical connector of this kind, one
15 as shown in FIG. 5 is known, for example (see Japanese Patent Laid-Open No. 10-340750).

This electrical connector 101 comprises a plurality of contacts 110 and an insulative housing 120 that accommodates these contacts 110.

20 Among them, each of the contacts 110 is formed only by stamping a sheet metal and has a plate-like base 111, a resilient contact arm 112 extending from the base 111 on the right side in a horizontal direction (the right side in FIG. 5 (B)) and having a contact portion 113 in contact with a circuit board
25 (not shown) at its free end, and a connection portion 114 extending from the base 111 on the left side and soldered to a separate circuit board (not shown) from said circuit board.

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Then, a contact press-fit portion 115 extends upward at an upper end of the base 111 between a starting point of the resilient contact arm 112 and a starting point of the connection portion 114.

5 Also, a plurality of contact accommodating passageways 121 in which the contacts 110 are accommodated are provided in the housing 120 in parallel to each other at a predetermined pitch in a transverse direction (a vertical direction in FIG. 5 (A)). Each contact accommodating passageway 121 is open
10 at the lower side while its upper wall exists at the upper side. Then, a press-fit opening 122 into which the contact press-fit portion 115 is press-fitted and a slit 123 from which the contact portion 113 projects are provided in this upper wall. The press-fit opening 122 and the slit 123 are
15 alternately provided in the transverse direction of the housing 120.

Then, when the contact press-fit portion 115 of each contact 110 is press-fitted into the press-fit opening 122 of the housing 120 in sequence from downward so that the contact
20 portion 113 passes through the slit 123, the plurality of contacts 110 are secured to the housing 120 to complete an electrical connector 101. When the connection portion 114 of this completed electrical connector 101 is soldered on said separate circuit board, the electrical connector 101 is mounted
25 on the separate circuit board. Then, when the circuit board arranged on the connector is made contact with the contact portion 113 from above the electrical connector 101 and the

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two circuit boards are fixed each other by a fixing means such as screwing, the two circuit boards are electrically connected to each other.

However, this conventional electrical connector 101
5 includes the following problems.

That is, when the circuit board arranged on the connector is made contact with the contact portion 113 from above the electrical connector 101, the contact portion 113 provided on the single resilient contact arm 112 makes contact with
10 the circuit board, contact reliability of the resilient contact arm 112 with the circuit board is low. Thus, if the circuit board arranged on the connector may be warped when the two circuit boards are fixed each other by a fixing means such as screwing, then no contact by the resilient contact arm 112
15 would be occurred.

Also, since the contact press-fit portion 115 extends upward at an upper end of the base 111 of the contact 110 between the starting point of the resilient contact arm 112 and the starting point of the connection portion 114, an arm length
20 of the resilient contact arm 112 cannot be taken sufficiently long for a length along a horizontal direction of the housing 120. Thus, a resilient region of the resilient contact arm 112 is small so that the resilient contact arm 112 may be plastically deformed even if a displacement of the contact
25 portion 113 is small.

SUMMARY OF THE INVENTION

Therefore, the present invention is made in view of the above problems and its embodiment may provide an electrical connector comprising a plurality of contacts wherein it offers improved reliability of contact between a resilient contact arm with a circuit board.

Also, another embodiment of the present invention may provide an electrical connector comprising a plurality of contacts wherein it allows for an increased arm length of a resilient contact arm for a length along a horizontal direction of the housing.

According to an aspect, the electrical connector of the present invention comprises a plate-like base, a resilient contact arm extending from the base and having a contact portion in contact with a circuit board at its free end, a plurality of contacts each having a connection portion extending from said base and connected to a separate circuit board from said circuit board, each contact being formed only by stamping a sheet metal, and an insulative housing that accommodates the contacts and has in its upper wall a slit from which said contact portion projects, wherein said resilient contact arm comprises first and second resilient contact arms having said contact portion at their respective free ends and extending in parallel to each other substantially obliquely from near one end toward above the other end in a horizontal direction of said base, and starting positions of said first and second resilient contact arms are shifted in horizontal and vertical directions.

According to the above aspect, the resilient contact arm may comprise first and second resilient contact arms having the contact portion at their respective free ends and extending in parallel to each other substantially obliquely from near one end toward above the other end in a horizontal direction of said base so that the circuit board makes contact with the contact portions of the first and second resilient contact arms that are flexible independently from above the electrical connector, offering improved contact reliability of the resilient contact arm with the circuit board.

Also, the first and second resilient contact arms may extend in parallel to each other substantially obliquely from near one end toward above the other end in a horizontal direction of said base, and positions of the starting points of said first and second resilient contact arms are shifted in horizontal and vertical directions, allowing for an increased arm length of the two resilient contact arms for a length along a horizontal direction of the housing.

Furthermore, if a horizontal length of the housing is fixed while the positions of the starting points of the first and second resilient contact arms may be shifted only in a horizontal direction, then a distance between the two resilient contact arms is shortened so that a sufficient clearance cannot be taken between the two resilient contact arms during stamping of a sheet metal. Thus, by shifting the positions of the

starting points of the first and second resilient contact arms not only in a horizontal direction but also in a vertical direction, a clearance may be taken large between the two resilient contact arms during stamping of a sheet metal.

Also, the electrical connector of the above aspect may have the position of the starting point of said first resilient contact arm positioned on said other end side in a horizontal direction among said first and second resilient contact arms is located downward with respect to the position of the starting point of said second resilient contact arm positioned on said one end side in a horizontal direction, and a vertical length of the contact portion of the first resilient contact arm is longer than a vertical length of the contact portion of the second resilient contact arm.

This electrical connector ensures that the contact portions of the first and second resilient contact arms make contact with the circuit board without making a horizontal dimension of the housing excessive.

Furthermore, according to the above embodiment, the electrical connector said housing has on an upper portion of its side wall a second slit communicating with the slit formed in said upper wall, and said contact portion of the first resilient contact arm enters said second slit when said first resilient contact arm is flexed downwardly.

According to a further embodiment, when the first resilient contact arm having the vertically long contact portion is flexed downward, the contact portion may enter the

second slit, avoiding any collision of the contact portion of the first resilient contact arm with the side wall of the housing, allowing a horizontal dimension of the housing to be utilized fully effectively. Also, when the first resilient contact arm is flexed downward, the contact portion may be guided by the second slit, avoiding any damage to the first resilient contact arm due to the disengagement of the contact portion from the second slit.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of an embodiment of an electrical connector according to the present invention;

FIG. 2 is a front view of the electrical connector as shown in FIG. 1;

FIG. 3 is a cross-sectional view taken along line 3-3 in FIG. 1;

FIG. 4 is a front view of a circuit board and a separate circuit board interconnected by the electrical connector as shown in FIG. 1; and

FIGS. 5 (A) and (B) show a conventional exemplary electrical connector, (A) being a plan view and (B) being a cross-sectional view taken along line 5B-5B in (A).

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of the present invention will now be described with reference to the drawings. FIG. 1 is a plane view of an embodiment of the electrical connector according to the present invention. FIG. 2 is a front view of the electrical
5 connector as shown in FIG. 1. FIG. 3 is a cross-sectional view taken along line 3-3 in FIG. 1. FIG. 4 is a front view of a circuit board and a separate circuit board interconnected by the electrical connector as shown in FIG. 1.

In FIGS. 1 to 4, an electrical connector 1 comprises a
10 plurality of contacts 10 and an insulative housing 20 that accommodates these contacts 10 in a staggered arrangement.

Among them, each of the contacts 10 is formed only by stamping a sheet metal and comprises a plate-like rectangular base 11, a resilient contact arm 12 extending from an upper
15 edge of the base 11, and a connection portion 15 extending from one edge in a horizontal direction of the base 11 (the left edge in FIG. 3).

Then, the base 11 is a rectangular plate having a horizontal length substantially equal to the horizontal length
20 of a contact housing passageway 21 and a plurality of engagement projections 11a to be engaged a side wall of the housing 20 are projected at opposite edges in a horizontal direction of the base 11.

Also, the resilient contact arm 12 comprises first and
25 second resilient contact arms 12A, 12B extending in parallel to each other substantially obliquely from near one end toward above the other end in a horizontal direction of the base 11,

and the positions of the starting points of the first and second resilient contact arms 12A, 12B are shifted in horizontal and vertical directions and the first resilient contact arm 12A is positioned on the other end side in a horizontal direction
5 (the right side in FIG. 3) and the second resilient contact arm 12B is positioned on one end side in a horizontal direction (the left side in FIG. 3).

The configuration of each of the first and second resilient contact arms 12A, 12B is specifically described. The first
10 resilient contact arm 12A has a first extension portion 13a at the upper edge near one end of the base 11 in a horizontal direction and upward extending from the position of the starting point located downward with respect to the position of the starting point of the second resilient contact arm 12B,
15 a second extension portion 13b extending substantially obliquely from the tip of the first extension portion 13a toward above the other end and formed taper, and a contact portion 13c extending upward from the tip of the second extension portion 13b and formed wider than the second extension portion
20 13b. Also, the second resilient contact arm 12B has a first extension portion 14a at the upper edge near one end of the base 11 in a horizontal direction and upward extending from the position of the starting point positioned on the one end side in a horizontal direction with respect to the position
25 of the starting point of the first resilient contact arm 12A, a second extension portion 14b extending substantially obliquely from the tip of the first extension portion 14a toward

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above the other end and formed taper, and a contact portion 14c extending upward from the tip of the second extension portion 14b and formed wider than the second extension portion 14b. Then, these the first extension portions 13a, 14a, the
5 second extension portions 13b, 14b and contact portion 13c, 14c extend in parallel to each other with their center lines spaced at a predetermined interval.

Also, a vertical length of the contact portion 13c of the first resilient contact arm 12A is longer than a vertical
10 length of the contact portion 14c of the second resilient contact arm 12B and positions of the tips of the contact portions 13c, 14c in a free state are the same in a vertical direction. Upper ends of these contact portions 13c, 14c make contact with the bottom face of a circuit board A mounted from upward
15 with respect to the electrical connector 1, as shown FIG. 4.

Then, a connection portion 15 extending from one edge in a horizontal direction of the base 11 is soldered on a separate circuit board B from the circuit board A, as shown FIG. 4.

On the other hand, a plurality of contact accommodating
20 passageways 21 in which the contacts 10 are accommodated are provided in the housing 20 in parallel to each other at a predetermined pitch in the transverse direction (a vertical direction in FIG. 1). Each contact accommodating passageway 21 is open at the lower side as shown in FIG. 3 while the upper
25 side is closed by its upper wall and the opposite sides in a horizontal direction are closed by its side wall. Then, a first slit 22 from which the contact portions 13c, 14c of

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the first and second resilient contact arms 12A, 12B project is provided in the upper wall of the housing 20. The first slit 22 is provided in a staggered arrangement in the transverse direction of the housing 20 as shown in FIG. 1.

5 Also, the housing 20 has on an upper portion of its side wall a second slit 23 communicating with the first slit 22 formed in the upper wall. The contact portion 13c of the first resilient contact arm 12A enters the second slit 23 when the first resilient contact arm 12A is flexed downward.

10 To assemble the electrical connector 1, the base 11 of each contact 10 is press-fitted into the contact accommodating passageways 21 of the housing 20 in sequence from downward so that the contact portions 13c, 14c project from the first slit 22. Thus, the plurality of contacts 10 are secured to
15 the housing 20 to complete the electrical connector 1.

Then, as shown FIG. 4, when the connection portion 15 of the contact 10 of the completed electrical connector 1 is soldered on the separate circuit board B, the electrical connector 1 is mounted on the separate circuit board B. In
20 this state, the circuit board A is made contact with the contact portions 13c, 14c of the first and second resilient contact arms 12A, 12B from above the electrical connector 1 to push the circuit board A into downward and the two circuit boards A, B are fixed each other by a fixing means such as screwing,
25 the two circuit boards A, B are electrically connected each other.

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When the circuit board A is made contact with the contact portions 13c, 14c of the first and second resilient contact arms 12A, 12B from above the electrical connector 1 to push the circuit board A downward, the first and second resilient
5 contact arms 12A, 12B are flexed downward to rotate substantially about the positions of their starting points, and the contact portion 13c of the first resilient contact arms 12A enters the second slit 23 formed on the upper portion of the side wall of the housing 20. This avoids any collision
10 of the contact portion 13c of the first resilient contact arm 12A with the side wall of the housing 20, allowing a horizontal dimension of the housing 20 to be utilized fully effectively. Also, when the first resilient contact arm 12A is flexed downward, the contact portion 13c is guided by the second slit
15 23, avoiding any damage to the first resilient contact arm 12A due to the disengagement of the contact portion 13c from the second slit 23.

In making contact of the circuit board A with the contact portions 13c, 14c of the first and second resilient contact
20 arms 12A, 12B, the circuit board A makes contact with the contact portions 13c, 14c of the first and second resilient contact arms 12A, 12B that are flexible independently from above the electrical connector 1, offering improved contact reliability of the resilient contact arm 12 with the circuit board A as
25 compared to contact with a conventional single arm. Thus, any possibility of no contact by the resilient contact arm 12 can be suppressed even if the circuit board A arranged on

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the connector may be warped when the two circuit boards A, B are fixed to each other by a fixing means such as screwing. Then, an amount of projection of the contact portions 13c, 14c formed on the first and second resilient contact arms 12A, 12B from the top face of the housing 20 may be increased to further suppress any possibility of no contact by the resilient contact arm 12.

Also, the first and second resilient contact arms 12A, 12B extend in parallel to each other substantially obliquely from near one end toward above the other end in a horizontal direction of the base 11, and the positions of the starting points of the first and second resilient contact arms 12A, 12B are shifted in horizontal and vertical directions. Thus, an arm length of the resilient contact arms 12A, 12B for a length along a horizontal direction of the housing 20 can be taken longer as compared to a conventional contact in which a press-fit portion is provided in the middle of a base.

Furthermore, if a horizontal length of the housing 20 is fixed while the positions of the starting points of the first and second resilient contact arms 12A, 12B are shifted only in a horizontal direction, then a distance between the two resilient contact arms 12A, 12B is shortened so that a sufficient clearance cannot be taken between the two resilient contact arms 12A, 12B during stamping of a sheet metal. Thus, by shifting the positions of the starting points of the first and second resilient contact arms 12A, 12B not only in a horizontal direction but also in a vertical direction, a

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clearance can be taken large between the two resilient contact arms 12A, 12B during stamping of a sheet metal.

Also, the position of the starting point of the first resilient contact arm 12A among the first and second resilient contact arms 12A, 12B is located downward with respect to the position of the starting point of the second resilient contact arm 12B, and a vertical length of the contact portion 13c of the first resilient contact arm 12A is longer than a vertical length of the contact portion 14c of the second resilient contact arm 12B so that the tip positions of the contact portions 13c, 14c in a free state are the same in a vertical direction. This ensures that the contact portions 13c, 14c of the first and second resilient contact arms 12A, 12B make contact with the circuit board A without making a horizontal dimension of the housing 20 excessive.

Also, since the contacts 10 are formed only by stamping a sheet metal, an attachment pitch in the transverse direction of the contact 10 (a vertical direction in FIG. 1) can be made small.

While the embodiment of the present invention has been described, the present invention is not limited to it and various changes can be made as necessary. For example, the position of the starting point of the first resilient contact arm 12A among the first and second resilient contact arms 12A, 12B is located upward with respect to the position of the starting point of the second resilient contact arm 12B.

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As described above, in the electrical connector according to claim 1 of the present invention, a resilient contact arm comprises first and second resilient contact arms having contact portion at their respective free ends and extending
5 in parallel to each other substantially obliquely from near one end toward above the other end in a horizontal direction of the base so that the circuit board makes contact with the contact portions of the first and second resilient contact arms that are flexible independently from above the electrical
10 connector, offering improved contact reliability of the resilient contact arm with the circuit board as compared to contact with a conventional single arm. Also, the first and second resilient contact arms extend in parallel to each other substantially obliquely from near one end toward above the
15 other end in a horizontal direction of said base, and the positions of the starting points of said first and second resilient contact arms are shifted in horizontal and vertical directions. Thus, an arm length of the resilient contact arms for a length along a horizontal direction of the housing can
20 be taken longer as compared to a conventional contact in which the press-fit portion is provided in the middle of the base.

Also, in the electrical connector according to claim 2 of the present invention, the position of the starting point of the first resilient contact arm among the first and second
25 resilient contact arms is located downward with respect to the position of the starting point of the second resilient contact arm, and a vertical length of the contact portion of

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the first resilient contact arm is longer than a vertical length of the contact portion of the second resilient contact arm in the invention according to claim 1, ensuring that the contact portions of the first and second resilient contact arms make
5 contact with the circuit board without making a horizontal dimension of the housing excessive.

Further, in the electrical connector according to claim 3 of the present invention, the housing has on an upper portion of its side wall a second slit communicating with the slit
10 formed in said upper wall, and the contact portion of the first resilient contact arm enters the second slit when the first resilient contact arm is flexed downward, avoiding any collision of the contact portion of the first resilient contact arm with the side wall of the housing in the invention according
15 to claim 2, allowing a horizontal dimension of the housing to be utilized fully effectively. Also, when the first resilient contact arm is flexed downward, the contact portion is guided by the second slit, avoiding any damage to the first resilient contact arm due to the disengagement of the contact
20 portion from the second slit.

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What is claimed is:

1. An electrical connector comprising:

a plate-like base;

a resilient contact arm extending from the base and having
5 a contact portion in contact with a circuit board at its free
end;

a plurality of contacts each having a connection portion
extending from the base and connected to a separate circuit
board from said circuit board, each contact being formed only
10 by stamping a sheet metal; and

an insulative housing that accommodates the contacts and
has in its upper wall a slit from which the contact portion
projects,

wherein said resilient contact arm comprises first and
15 second resilient contact arms extending in parallel to each
other substantially obliquely from near one end toward above
the other end in a horizontal direction of said base and having
said contact portion at their respective free ends and the
positions of starting points of the first and second resilient
20 contact arms are shifted in horizontal and vertical directions.

2. The electrical connector according to claim 1, wherein
the position of the starting point of the first resilient
contact arm positioned on said other end side in a horizontal
25 direction among said first and second resilient contact arms
is located downward with respect to the position of the starting

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point of the second resilient contact arm positioned on said one end side in a horizontal direction, and a vertical length of said contact portion of said first resilient contact arm is longer than a vertical length of said contact portion of
5 said second resilient contact arm.

3. The electrical connector according to claim 1 or 2, wherein said housing has on an upper portion of its side wall a second slit communicating with the slit formed in said upper wall,
10 and said contact portion of said first resilient contact arm enters said second slit when said first resilient contact arm is flexed downward.