

**PIN CONTACT AND ELECTRICAL CONNECTOR USING THE
SAME**

BACKGROUND OF THE INVENTION

1. Field of the Invention

5 The present invention relates to a pin contact, and more particularly, to a pin contact requiring less insertion force and generating larger retention force.

2. Description of the Related Art

10 Electrical connectors can use compliant pins or press-fit pins to electrically connect to associated circuitry on a printed circuit board. Typically, upon insertion of an electrical connector equipped with press-fit pins, a bulge portion of each press-fit pin mechanically and electrically engages a respective electrically conductive inner surface defining an aperture, of size smaller than that of the bulge portion, on the printed circuit
15 board. It is desirable that the press-fit pin resiliently and retentively engage the aperture without requirement of excessive installation force.

20 As a press-fit pin is inserted into a respective aperture on a printed circuit board, the bulge portion of the press-fit pin is squeezed and deformed such that a retention force between the bulge portion and the electrically conductive inner surface defining the aperture can hold the press-fit pin within the aperture. However, if the retention force is small or the bulge portion is not rigid, the press-fit pin may not be secured properly, resulting in unreliable electrical and mechanical connection; in contrast, if the bulge portion is too large or too rigid, large installation force is required
25 to overcome the engagement force, and improper insertion force risks damaging the electrically conductive inner surface and the press-fit pin. In addition, as the number of the press-fit pins of an electrical connector increases for high density requirement, the necessary insertion force becomes large, and it may be difficult to install the electrical connector to

the printed circuit board.

Normally, the bulge portion of a traditional press-fit pin has an elliptical shape. Increasing the size of the bulge portion can increase the retention force, but also significantly increases the insertion force. Moreover, the apertures usually have varied sizes due to the process variation of manufacturing. Thus, some press-fit pins of elliptical shape may be held by smaller retention forces and may result in unreliable electrical and mechanical connection.

In light of the above-mentioned problems, traditional press-fit pins of elliptical shape may not be properly held due to the size variations of apertures, and are not easily adapted to correct such variations. Therefore a pin, which can lower insertion force and increase retention force, is required.

SUMMARY OF THE INVENTION

An objective of the present invention is to provide a new and improved pin contact requiring lower insertion force and increased retention force.

In order to achieve the above objective, the present invention proposes a pin contact, which comprises a tip portion and a bulge portion. The bulge portion, widthwise defined by a pair of convex side edges, includes a first half section and a second half section. The first half section is connected to the tip portion and the second half section is disposed away from the tip portion, wherein the first half section of the bulge portion has a shape slimmer than that of the second half section of the bulge portion.

The present invention also proposes an electrical connector, which includes an insulating housing, a pair of latch-ejector assemblies, and a plurality of first and second contact pins. The insulating housing includes a pair of oppositely disposed end portions and a card-receiving slot extending between the two end portions. Each latch-ejector assembly is configured to move within a pivot manner in the respective end portion. Each of the plurality of first and second contact pins includes a contact portion, and the

plurality of first and second contact pins are arrayed along two elongated sides of the card-receiving slot with the contact portions protruding into the card-receiving slot. Each of the plurality of first and second contact pins comprises a tip portion and a bulge portion. The bulge portion, widthwise defined by a pair of convex side edges, includes a first half section and a second half section. The first half section is connected to the tip portion and the second half section is disposed away from the tip portion, wherein the first half section of the bulge portion has a shape slimmer than that of the second half section of the bulge portion.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described according to the appended drawings in which:

FIG. 1 illustrates an electrical connector mounted on a printed circuit board and receiving a printed circuit card according to one embodiment of the present invention;

FIG. 2 is a perspective exploded view of FIG. 1 according to one embodiment of the present invention;

FIG. 3 is a side view showing an electrical connector according to one embodiment of the present invention;

FIG. 4 is a perspective view of first and second pin contacts according to one embodiment of the present invention;

FIG. 5 is a side view of the bulge portion of a pin contact according to one embodiment of the present invention;

FIG. 6 is a side view showing a pin contact being inserted into a through hole according to one embodiment of the present invention; and

FIG. 7 is a side view showing a pin contact inserted into a through hole according to one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, embodiments of the card edge connector having an ejection mechanism of the present invention will be described in detail with reference to the attached drawings. As illustrated in FIGS. 1 and 2, an electrical connector 1 is mounted on a printed circuit board 2, configured for receiving a printed circuit card 3. The electrical connector 1 comprises an elongated insulating housing 12, a pair of latch-ejector assemblies 14, and a plurality of first and second pin contacts 16a and 16b. The insulating housing 12 includes two oppositely disposed end portions 121 and a card-receiving slot 122 facing upward, extending between the two end portions 121, and configured for insertion of the edge portion 32 of a printed circuit card 3. Each end portion 121 has a hollow interior, in which a latch-ejector assembly 14 is provided. Each latch-ejector assembly 14 moves in a pivoting manner within the respective end portion 121, rotating in one direction to reject the printed circuit card 3 by an ejector portion 141, and rotating in another direction to lock the printed circuit card 3 using its latch portion 142 latched into the respective notch 31 of the printed circuit card 3 as shown in FIG. 1.

As shown in FIG. 2, the electrical connector 1 also includes a plurality of cavities 123 each for receiving the respective first or second pin contact 16a or 16b. The plurality of cavities 123 are arranged in pairs and disposed along both elongated sides of the card-receiving slot 122 following the longitudinal direction of the insulating housing 12. Referring to FIGS. 2 to 4, each first or second pin contact 16a or 16b includes a contact portion 161 and a tip portion 162. Each contact portion 161 has a bow-like shape such that the contact portion 161 can protrude into the card-receiving slot 122 to electrically engage the respective contact on the edge portion 32 of a received printed circuit card 3 when the first or second pin contact 16a or 16b is received within the respective cavity 123. As shown in FIG. 3, after the first and second pin contacts 16a and 16b are assembled in the insulating housing 12, their tip portions 162 protrude from the bottom

surface of the insulating housing 12. Referring back to FIG. 2, the printed circuit board 2 includes a plurality of through holes 21 disposed with respect to the tip portions 162 of the plurality of first and second pin contacts 16a and 16b. Each through hole 21 is defined by an electrically
5 conductive inner surface connected to associated circuitry formed on the printed circuit board 2.

Referring to FIGS. 4 and 5, each first or second pin contact 16a or 16b further comprises a bulge portion 163 being substantially symmetrical about the longitudinal axis 1634 and configured to engage the electrically
10 conductive inner surface defining the through hole 21. The bulge portion 163, which is widthwise defined by a pair of oppositely disposed continuous convex side edges 1631, can be divided in half, along a direction transverse to the longitudinal axis, into two half sections: the first half section 1641 and the second half section 1642. The first half section
15 1641 includes a first end part 1632 connected to the tip portion 162, and the second half section 1642 includes a second end part 1633 away from the tip portion 162. As shown in FIG. 5, the first half section 1641 has a shape similar or analogous to the second half section 1642. However, the rate of change of the width d1 of the first end part 1632 is less than the rate of
20 change of the width D1 of the second end part 1633 in the direction along the longitudinal axis 1634. In other words, the radius of curvature of the portion of the side edge 1631 in the first end part 1632 changes more slowly than the radius of curvature of the portion of the side edge 1631 in the second end part 1633, measured with respect to distance along the
25 longitudinal axis 1634. Thus, the first half section 1641 has a shape slimmer than that of the second half section 1642.

Moreover, the difference of the value of the rate of change between the first end part 1632 and the second end part 1633 can be small, and therefore the first half section 1641 can have a shape slightly slimmer than that of the
30 second half section 1642.

As a result, when the bulge portion 163 is inserted within a respective

through hole 21, the first end part 1632 has less deformation, requiring less insertion force, and the second end part 1633 has larger deformation, generating larger retention force. Although the second end part 1633 may require larger insertion force, it is believed that the total insertion force may be reduced through proper design of the shapes of the first end part 1632 and the second end part 1633.

Additionally, referring to FIG. 6, another advantage of the design shown in FIG. 5 is that due to the slim shape of the first end part 1632, a bulge portion 163 can be inserted farther into a respective through hole 21 when the first or second pin contact 16a or 16b begins insertion such that the first or second pin contact 16a or 16b can be straighter and more properly aligned before it is inserted. As a result, the insertion of the first and second pin contacts 16a and 16b can be more reliable and produce fewer unwanted consequences.

In the present embodiment, the bulge portion 163 is designed to have convex side edges 1631, each of which is curved outward in the first end part 1632 less than in the second end part 1633, and a first or second pin contact 16a or 16b is directly manufactured by stamping based on such a design. Specifically, the bulge portion 163 of a first or second pin contact 16a or 16b is formed in a single step using a stamping process; no other processing steps are required to shape the bulge portion 163. Therefore, the bulge portion 163 of a first or second pin contact 16a or 16b can have smooth, smoothly curved or continuous convex side edges 1631 as those shown in FIG. 5, and can be more rigid, intact and resistant to breaking during insertion.

Referring to FIG. 5 again, the bulge portion 163 comprises a slot 1635 located within and extending along the longitudinal direction of the bulge portion 163. The slot 1635 can also be divided, along a direction transverse to the longitudinal axis, in half into a first half slot section 1643 close to the tip portion 162 and a second half slot section 1644 away from the tip portion 162. In the present embodiment, the first half slot section 1643 can

have a shape different from that of the second half slot section 1644.

Specifically, the slot 1635 can be defined by a first curved corner 1636 located close to the tip portion 162, a second curved corner 1637 away from the tip portion 162, and two concave inner side edges 1638 facing each other. In the present embodiment, the radius of the first curved corner 1636 is different from the radius of the second curved corner 1637. Similarly, the rate of change in width $d2$ of a portion of the slot 1635 adjacent to the first curved corner 1636 is not equal to the rate of change in width $D2$ of a portion of the slot 1635 adjacent to the second curved corner 1637 in the direction along the longitudinal axis 1634 so that the first half slot section 1643 has a shape different from that of the second half slot section 1644.

In another aspect, the bulge portion 163 includes a pair of side arms 1639 embracing the slot 1635. Each side arm 1639 extends from the tip portion 162 toward the interconnect portion 167, while increasing in width. Therefore, the first half section 1641 can be more flexible and the second half section 1642 can be more rigid so that the first and second pin contacts 16a and 16b can be inserted with lower insertion force and be held with higher retention force.

As shown in FIG. 5, in another embodiment, the slot 1635 can be elliptical, and the center of the slot 1635 is closer to the tip portion 162 than to the interconnect portion 167 such that the width of each side arm 1639 can increase in a direction facing away from the tip portion 162.

As shown in FIGS. 6 and 7, compared to traditional press-fit pins, the first half section 1641 of the bulge portion 163 of the first or second pin contact 16a or 16b is thinner so that the first half section 1641 deforms less, creating less resistance when it is inserted into the respective through hole 21. Therefore, the first or second pin contact 16a or 16b requires less insertion force. Additionally, the second half section 1642 of the bulge portion 163 is thicker compared to the counterpart of a traditional press-fit pin so that the second half section 1642 of the bulge portion 163 creates

larger retention force as it engages the inner surface defining the through hole 21. Consequently, the first or second pin contact 16a or 16b can be inserted using less insertion force and has larger retention force when it is inserted.

5 Referring to FIG. 4 again, each of the first and second pin contacts 16a and 16b further comprises a retention portion 165 having a plurality of barbs 1651 for insertion interfering engagement and stabilizers 1652 for stabilizing the inserted first or second pin contact 16a or 16b, and an extension portion 166a or 166b disposed between the retention portion 165
10 and the interconnect portion 167. The extension portion 166a of the first pin contact 16a and the extension portion 166b of the first pin contact 16b extend in opposite directions so that when the first and second pin contacts 16a and 16b are in an alternate arrangement, the tip portions 162 are in a zigzag arrangement along the lengthwise direction and the widthwise
15 direction of the insulating housing 12.

In summary, the present invention proposes a contact pin having a tip portion and a bulge portion, wherein the bulge portion is divided in half into a first half section connected to the tip portion and a second half section away from the tip portion, and the first half section of the bulge portion has
20 a shape slimmer than that of the second half section of the bulge portion so that the first half section requires less insertion force and the second half section increases the retention force. In addition, the bulge portion includes a slot embraced by two side arms, each extending away from the tip portion, while increasing in width. Therefore, the first half section can be more
25 flexible and the second half section can be more rigid. As a result, the contact pin of the present invention can be precisely and easily inserted using less insertion force and be held firmly by larger retention force.

The above-described embodiments of the present invention are intended to be illustrative only. Numerous alternative embodiments may be
30 devised by persons skilled in the art without departing from the scope of the following claims.

What is claimed is:

1. A pin contact, comprising:

a tip portion; and

5 a bulge portion having a first half section connected to the tip portion, a second half section away from the tip portion, and a pair of convex side edges widthwise defining the bulge portion, wherein the first half section of the bulge portion has a shape slimmer than that of the second half section of the bulge portion.

10 2. The pin contact of Claim 1, wherein the bulge portion comprises a slot located within and extending along the longitudinal direction of the bulge portion, and the slot has a first half slot section close to the tip portion and a second half slot section away from the tip portion, wherein the first half slot section has a shape different from that of the second half slot section.

15 3. The pin contact of Claim 2, wherein the first half section includes a first end part connected to the tip portion and the second half section includes a second end part away from the tip portion, wherein the rate of change of width of the first end part is less than the rate of change of width of the second end part along a longitudinal direction of the bulge portion.

20 4. The pin contact of Claim 3, wherein the slot comprises a first curved corner close to the tip portion and a second curved corner away from the tip portion, wherein the rate of change in width of a portion of the slot adjacent to the first curved corner is not equal to the rate of change in width of a portion of the slot adjacent to the second curved corner in the longitudinal direction.

25 5. The pin contact of Claim 4, wherein a radius of the first curved corner is different from a radius of the second curved corner.

6. The pin contact of Claim 2, wherein the bulge portion comprises a pair of side arms embracing the slot, wherein the width of each side arm increases in a direction away from the tip portion.

5 7. The pin contact of Claim 1, wherein the bulge portion comprises an elliptical slot extending along a longitudinal direction of the bulge portion.

8. The pin contact of Claim 7, further comprising an interconnect portion connecting to the second end part, wherein the center of the elliptical slot is closer to the tip portion than to the interconnect portion.

10 9. The pin contact of any one of Claims 1, 5, 6 and 8, wherein the bulge portion is formed in one step using a stamping process.

10. The pin contact of Claim 9, further comprising a retention portion having a plurality of barbs for insertion interfering engagement and stabilizers for stabilizing, and an extension portion connecting between the
15 retention portion and the interconnect portion.

11. An electrical connector, comprising:

an insulating housing including a pair of oppositely disposed end portions and a card-receiving slot extending between the two end portions;

20 a pair of latch-ejector assemblies each configured to move in a pivoting manner in the respective end portion;

a plurality of first and second contact pins each having a contact portion, the plurality of first and second contact pins being arrayed along two elongated sides of the card-receiving slot with the contact portions protruding into the card-receiving slot, each of first and second contact pins
25 further comprising:

a tip portion; and

5 a bulge portion having a first half section connected to the tip portion, a second half section away from the tip portion, and a pair of oppositely disposed convex side edges widthwise defining the bulge portion, wherein the first half section of the bulge portion has a shape slimmer than that of the second half section of the bulge portion.

12. The electrical connector of Claim 11, wherein the bulge portion comprises a slot located within and extending along the longitudinal direction of the bulge portion, and the slot has a first half slot section close to the tip portion and a second half slot section away from the tip portion, 10 wherein the first half slot section has a shape different from that of the second half slot section.

13. The electrical connector of Claim 12, wherein the first half section includes a first end part connected to the tip portion and the second half section includes a second end part away from the tip portion, wherein 15 the rate of change in width of the first end part is less than the rate of change in width of the second end part along a longitudinal direction of the bulge portion.

14. The electrical connector of Claim 13, wherein the slot comprises a first curved corner close to the tip portion and a second curved corner away from the tip portion, wherein the rate of change in width of a 20 portion of the slot adjacent to the first curved corner is not equal to the rate of change in width of a portion of the slot adjacent to the second curved corner in the longitudinal direction.

15. The electrical connector of Claim 14, wherein a radius of the first curved corner is different from a radius of the second curved corner. 25

16. The electrical connector of Claim 12, wherein the bulge portion comprises a pair of side arms embracing the slot, wherein the width of each side arm increases in a direction away from the tip portion.

17. The electrical connector of Claim 11, wherein the bulge portion comprises an elliptical slot extending along a longitudinal direction of the bulge portion.

5 18. The electrical connector of Claim 17, further comprising an interconnect portion connecting to the second end part, wherein the center of the elliptical slot is closer to the tip portion than to the interconnect portion.

10 19. The electrical connector of any one of Claims 11, 15, 16 and 18, wherein the bulge portion is formed in one step using a stamping process.

15 20. The electrical connector of Claim 19, wherein each of the first and second contact pins comprises a retention portion having a plurality of barbs for insertion interfering engagement and stabilizers for stabilizing; and the first contact pin comprises a first extension portion connecting between the retention portion and the interconnect portion, and the second contact pin comprises a second extension portion connecting between the retention portion and the interconnect portion, wherein the first and second extension portions extend in opposite directions.