

CONTACT AND ELECTRICAL CONNECTOR

TECHNICAL FIELD

The present invention relates to a contact and an electrical connector having such
5 contacts.

BACKGROUND ART

In the field of an electrical connector having a plurality of contacts for connecting
circuit boards to each other, various kinds of electrical connectors are known, for example,
10 an electrical connector disclosed in Patent Literature 1, as described below.

In Patent Literature 1, there is a description that "in an electrical connector 1
comprising a housing 2 and a plurality of terminals mounted side by side at a
predetermined pitch P along the longitudinal direction of the housing 2, wherein, by
connecting a conductor of one printed circuit board to a contact portion of said terminal, it
15 is electrically connected to a conductor of the other printed circuit board connected to the
solder tail portion of said terminal, said terminals are divided into left-side terminals 3
having left-side contact beam 3b with left-side contact portion 3a and right-side terminals
4 having right-side contact beam 4b with right-side contact portion 4a, each of said left-
side terminals 3 having left-side contact beam 3b with left-side contact portion 3a and
20 right-side terminals 4 having right-side contact beam 4b with right-side contact portion 4a
being formed with the left-side and right-side contact beams 3b, 4b of the left-side and
right-side terminals 3, 4 themselves supported by a horizontal beam 10, and said left-side
terminals 3 having left-side contact beam 3b with left-side contact portion 3a and right-
side terminals 4 having right-side contact beam 4b with right-side contact portion 4a are
25 inserted through the contact beam mounting port 18 of said housing 2, and are mounted
with the horizontal beam 10 in contact with the floor surface 22 of the housing 2, such
that, in the mounted state in the housing 2, the left-side and the right-side terminals 3, 4
are arranged so as to be staggered with each other in a zigzag pattern in the housing 2, --".

Citation List

[Patent Literature 1] Japanese Unexamined Patent Publication (Kokai) No. H05-
299144

SUMMARY OF THE INVENTION

In recent years, increase of number of signals used in electric products and devices together with size reduction of electric products gives rise to an ever-increasing need for an electrical connector capable of arranging a large number of contacts at narrow pitch. In order to realize such an electrical connector, insertion stress experienced by a contact when a circuit board or the like is inserted into the electrical connector needs to be reduced sufficiently. However, the contact of the electrical connector as disclosed in above Patent Literature 1 is formed generally in the shape of a circular arc from the base portion to the contact portion (contact) at the distal end, so that the insertion stress exerted to the contact cannot be reduced sufficiently, and it is difficult to use the contact within the range of elastic characteristics.

It is an object of the present invention to provide a contact and an electrical connector capable of reducing stress exerted to the contact and being used within the range of elastic characteristics.

One aspect of the present invention provides a contact comprising a base portion, a resilient portion connected to the base portion, and a contact portion provided at an end of the resilient portion, wherein the resilient portion comprises a plurality of straight segments and a plurality of curved segments, and wherein the base portion extends so as to face the contact portion.

Another aspect of the present invention provides an electrical connector comprising contacts as described above, and a housing for arranging a plurality of said contacts.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view showing contacts and an electrical connector according to an embodiment of the present invention;

Fig. 2 is a perspective view showing a first board to be connected to the electrical connector of Fig. 1;

Fig. 3 is an enlarged view showing an essential part of Fig. 1;

Fig. 4 is a longitudinal sectional view showing the electrical connector of Fig. 1 at the press-fitting part of the upper contact;

Fig. 5 is a longitudinal sectional view showing the electrical connector of Fig. 1 at the press-fitting part of the lower contact;

Fig. 6 is a schematic view showing the positional relation of the contacts of Fig. 1 to the terminal portions of the first board;

5 Fig. 7A is a longitudinal sectional view showing the electrical connector according to the embodiment of the present invention before insertion of the first board;

Fig. 7B is a longitudinal sectional view showing the electrical connector according to the embodiment of the present invention after insertion of the first board;

10 Fig. 8A is an enlarged view showing an essential part of the contact portion at the start of insertion of the first board;

Fig. 8B is an enlarged view showing an essential part of the contact portion after insertion of the first board;

Fig. 9A is a view showing a variant of the embodiment of Figs. 8A and 8B;

Fig. 9B is a view showing a variant of the embodiment of Figs. 8A and 8B; and

15 Fig. 9C is a view showing a variant of the embodiment of Figs. 8A and 8B.

DETAILED DESCRIPTION

The embodiments of the present invention are described below, with reference to Figs. 1 to 9C. Fig. 1 is a perspective view showing an electrical connector 100 having
20 contacts according to this embodiment of the present invention, and Fig. 2 is a perspective view showing a board 200 (hereinafter referred to as first board) to be inserted into this electrical connector (card edge connector) 100. The electrical connector 100 is mounted to a board 300 (Fig. 4, hereinafter referred to as second board) for installing the connector, and electrically connects the first board 100 to the second board 300.

25 The electrical connector 100 of Fig. 1 comprises a housing 10 and a plurality of contacts 50, 60 arranged in the housing 10. Fig. 1 also shows perspective views of the contacts 50, 60 before being incorporated into the housing 10. The contact 50 on the upper side of the Figure is referred to as an upper contact, and the contact 60 on the lower side of the Figure is referred to as a lower contact. In the following, for convenience, up-
30 down direction and forward-rearward and left-right directions are defined as illustrated in the Figure, and the construction of various parts is described with reference to this definition.

The housing 10 has a shape of generally rectangular parallelepiped that is elongate in left-right direction, and is formed, for example, by resin molding from an electrically insulating resin material. Slot hole (fitting port) 11 is formed on the upper surface of the housing 10, and slot wall 11a is formed inside the housing 10 to define the slot hole 11. A first board 200 is attached detachably to the slot hole 11.

As shown in Fig. 2, the first board 200 is a plate member of generally rectangular shape with IC devices or the like mounted thereon, and on the front and rear surfaces (only one surface is shown), terminal portions 201 are provided at equal interval in left-right direction in number corresponding to the number of respective contacts 50, 60. Width of the slot hole 11 of Fig. 1 in forward-rearward direction and length of the slot hole 11 in left-right direction are set somewhat larger than the thickness in forward-rearward direction and the length in left-right direction of the first board 200 so that the electrical connector 100 and the board 200 can be attached to and detached from each other even if there are dimensional error and assembling error between the electrical connector 100 and the board 200 to some extent (see Figs. 7A and 7B).

Fig. 3 is an enlarged view showing an essential part (upper left corner) of the electrical connector 100. As shown in Fig. 3, on the front and rear side walls 12, 13 of the housing 10, slits 14, 15 for press-fitting the upper contacts 50 are formed respectively at equal interval in left-right direction on a surface intersecting the housing 10 in up-down and forward-rearward directions. Further, on the front wall 12 of the housing 10, slits 16 for press-fitting of the lower contacts 60 are formed at equal interval in left-right direction on a surface intersecting the housing 10 in up-down and forward-rearward directions and alternately with the slits 14. Width (length in left-right direction) of these slits 14 ~ 16 is approximately equal to the thickness of the contacts 50, 60.

As shown in Fig. 1, the contacts 50, 60 are formed in the shape of thin plate of a constant thickness, and the upper contacts 50 are press fitted from above into the slits 14, 15, and the lower contacts 60 are press-fitted from below into the slits 17. In this way, a plurality of upper contacts 50 and lower contacts 60 are arranged so as to be staggered with each other along the slot hole 11 in left-right direction (in a zigzag pattern) (see Fig. 6). By forming the contacts 50, 60 in the shape of thin plate and press-fitting them from above and from below into the slits, a large number of contacts 50, 60 can be easily arranged at narrow pitch on the housing 10, and the number of pins on the electrical

connector 100 can be easily increased.

Fig. 4 is a longitudinal sectional view showing the electrical connector 100 at the portion for press-fitting upper contacts 50. In the section for press-fitting, the above-described slits 14, 15 are formed in the front and the rear of the slot wall 11a, and the slits 14, 15 continue to the slit 17 that is formed in lower part of the slot wall 11a. The slit 14 penetrates the upper part of the front wall 12 in the forward direction, and the upper end portion 12a of the front wall 12 has a tapered shape rising rearward. On the other hand, the slit 17 penetrates the front portion of the bottom wall 18 along the rear surface of the front wall 12 of the housing 10, and a through hole 19 is formed between the front wall 12 and the low wall 18. As described below, the base portion 51 of the upper contact 50 is securely fixed to the housing 10 by the upper end portion 12a of the front wall 12 of the housing 10 and the through hole 19, and the step portion 51a and protrusion portion 51d provided on the base portion 51 of the upper contact 50. An opening 20 is formed on the upper part of the rear wall 13 to continue from the slit 15 and to penetrate the rear wall 13 in rearward direction. The opening 20 is provided to ensure sufficient space for rearward displacement of the contact portion 53 of the upper contact 50.

Fig. 5 is a longitudinal sectional view showing the electrical connector 100 at the portion for press-fitting lower contacts 60. In this section for press-fitting, the above-described slit 16 is formed in the front of the slot wall 11a, and the slit 16 continues to a slit 21 that is formed in the lower part of the slot wall 11a. The range of the slit 16 is enlarged in upward direction, and a taper portion 12b is formed in the rear end surface of the front wall 12. The taper portion 12b is provided to ensure sufficient space for the contact portion 63 of the lower contact 60 to be displaced in the forward direction. On the other hand, the slit 21 penetrates the entire bottom wall 18 from the front wall 12 to the rear wall 13. Between the slot wall 11a and the rear wall 13, a through hole 22 is formed to continue from the slit 21 upward, and the through hole 22 is in communication with the opening 20 of Fig. 4. As described below, the base portion 61 of the lower contact 60 is securely fixed to the housing 10 by the slit 21 and the through hole 22 in the bottom portion of the housing 10, and protrusion portions 61e, 61f provided in the base portion 61 of the lower contact 60.

The construction of the upper contact 50 is described below. As shown in Figs. 1 and 4, the upper contact 50 comprises a base portion 51 disposed in up-down direction

along the front wall 12, a terminal portion 52 connected to the base portion 51, a contact portion 53 disposed behind the base portion 51, and a resilient portion 54 with one end connected to the base portion 51 and with contact portion 53 provided at the other end.

The base portion 51 is opposed to the contact portion 53, and extends in up-down direction. Thus, the base portion 51 is generally in parallel to the contact portion 53, and extends upward up to the height of the contact portion 53. A step portion 51a is provided in the front surface of the base portion 51, and width (length in forward-rearward direction) of the base portion 51 becomes narrower with the step portion 51a as a boundary. The base portion 51 comprises a first base portion 51b of broad width above the step portion 51a and a second base portion 51c of narrow width below the step portion 51a, and extends in the slits 14, 17. On the rear surface of the lower end of the second base portion 51c, there is provided a protrusion portion 51d projecting rearward.

As shown in Fig. 4, the upper contact 50 is press-fitted along the slits 14, 15, 17 until the step portion 51a engages with the upper end portion 12a of the front wall 12. At this time, the front surface of the second base portion 51c is brought into close contact with the rear surface of the front wall 12, and while the protrusion portion 51d bears against the wall surface of the through hole 19, the lower end portion of the second base portion 51c is inserted into the through hole 19 and the second base portion 51c is locked to the through hole 19. By locking the second base portion 51c to the through hole 19 via the step portion 51d with the second base portion 51c in close contact with the front wall 12 while the protrusion portion 51d bears against the wall surface of the through hole 19, the elongate base portion 51 can be firmly fixed in close contact to the housing 10. Thus, with the upper contact 50 formed in miniature size in the shape of thin plate suitable for being arranged in a large number at narrow pitch, the base portion 51 can be supported stably in the housing 10 with no deformation. As a result, position of the connection portion 55 connecting the base portion 51 to the resilient portion 54 is fixed, and the contact portion 53 opposed to the base portion 51 can be stably swayed in forward-rearward direction with the connection portion 55 as a supporting point.

The terminal portion 52 is directly above the step portion 51a, and projects forward from the first base portion 51b. The electrical connector 100 is mounted to the board 300 with the end surface of the front wall 12 facing the board 300, and with the terminal portion 52 penetrating the board 300.

The resilient portion 54 has a plurality of curved segments 54a and a plurality of straight segments 54b in a folded zigzag shape, and extends from inside the slits 17 to inside the slit 15. Thus, the resilient portion 54 is connected to the second base portion 51c at the connection portion 55 above the protrusion portion 51d, and projects from the connection portion 55 vertically upward, and then is bent alternately obliquely downward and vertically upward, and is finally connected to the lower end portion of the contact portion 53. Width of the resilient portion 54, that is, the section perpendicular to the centerline L1 of the resilient portion 54 extending along the resilient portion 54, is generally constant at various parts of the resilient portion 54. This width is determined by considering the shape and material of the resilient portion 54 so as to impart a predetermined spring characteristics to the resilient portion 54.

By forming the resilient portion 54 so as to have a folded zigzag shape with a constant width, the amount of deflection of the resilient portion 54 can be increased within the limited range in forward-rearward direction between the front wall 12 and the rear wall 13, so that the contact portion 53 can be easily swayed to and fro (in forward-rearward direction) with the connection portion 55 as a supporting point. Here, since the base portion 51 is securely fixed to the housing 10 and the position of the connection portion 55 is fixed relative to the housing 10, the contact portion 53 can be displaced stably. As a result, nearly equal displacement of the contact portion 53 of each upper contact 50 can be realized, and stress exerted to each upper contact 50 can be made nearly equal to each other. By forming the resilient portion 54 in a folded shape, the resilient portion 54 has the structure of an extended spring, and when the first board 200 is inserted, the entire resilient portion 54 is deformed by the contact force exerted to the contact portion 53. Thus, strain produced in the upper contact 50 due to the contact force can be absorbed by the entire extended resilient portion 54. Therefore, it is possible to prevent an excessive stress from being exerted to the upper contact 50 due to local stress concentration, and to use the upper contact 50 within the range of elastic characteristics of the material. Since the opening 20 is provided behind the contact portion 53, interference of the contact 53 with the rear wall 13 at the time of rearward swaying of the contact portion 53 can be avoided.

The contact portion 53 has a generally semi-circular overall shape with the front surface 53a bulging forward in a shape of circular arc opposed to the base portion 51 and

partly projecting through the slit 15 into the slot hole 11. The rear surface 53b of the contact portion 53 lies on the extension of the rear end surface of the resilient portion 54 and is formed in the shape of straight line. Width (length in forward-rearward direction) of the contact portion 53, that is, its cross-sectional area, gradually increases from the lower end of the contact portion 53 upward until the center portion 53c in up-down direction is reached where the cross-sectional area is maximum.

The construction of the lower contact 60 is described below. As shown in Figs. 1 and 5, the lower contact 60 comprises a base portion 61, a terminal portion 62 connected to the base portion 61, a contact portion 63 disposed above the base portion 61, and a resilient portion 64 with one end connected to the base portion 61 and with contact portion 63 provided on the other end.

The base portion 61 has a first base portion 61a disposed in the slit 21 between the front wall 12 and the rear wall 13, and a second base portion 61b extending vertically upward along the rear end surface of the first base portion 61a. The second base portion 61b is opposed to the contact portion 63 and extends in up-down direction. Thus, the second base portion 61b extends upward generally in parallel to the contact portion 63 up to the height of the contact portion 53. Front end surface and rear end surface of the first base portion 61a are respectively formed in stepped form in correspondence to the lower end of the front wall 12 and the lower end of the rear wall 13 so as to form step portions 61c and 61d. A protrusion portion 61e projecting forward is provided on the front end surface of the first base portion 61, and a protrusion portion 61f projecting forward is provided on the front surface of upper end of the second base portion 61b.

As shown in Fig. 5, the lower contact 60 is press-fitted along the slits 16, 21 until the step portions 61c, 61d abut respectively against the lower end surface of the front wall 12 and the lower end surface of the rear wall 13. At this time, while the rear surface of the first base portion 61a and the rear surface of the second base portion 61b are brought into close contact with the front surface of the rear wall 13 and the protrusion portion 61e bears against the wall surface of the front wall 12, the first base portion 61a is inserted between the front wall 12 and the rear wall 13 to be locked to the front wall 12. Further, while the protrusion portion 61f bears against the wall surface of the through hole 22, the upper end of the second base portion 61b is inserted into the through hole 22, and is locked to the through hole 22. Thus, with the rear surface of the first base portion 61a and the second

base portion 61b in close contact with the rear wall 13, the entire base portion 61 can be firmly fixed in close contact to the housing 10 by locking the first base portion 61a via the protrusion 61e to the front wall 12 and by locking the second base portion 61b via the protrusion 61f to the through hole 22. Thus, with the lower contact 60 formed in
5 miniature size in the shape of thin plate suitable for being arranged in a large number at narrow pitch, the base portion 61 can be supported stably in the housing 10 with no deformation. As a result, position of the connection portion 65 connecting the base portion 61 to the resilient portion 64 is fixed, and the contact portion 63 opposed to the base portion 61 can be stably swayed to and fro in forward-rearward direction with the
10 connection portion 65 as a supporting point.

The terminal portion 62 projects forward from the lower end of the first base portion 61a, and penetrates the board 300. Thus, in the present embodiment, as in the terminal portion 52 of the upper contact 50, the first base portion 61a is extended in forward-rearward direction to thereby project the terminal portion 62 forward in front of
15 the front wall 12. With this construction, as shown in Fig. 1, the terminal portion 52 of the upper contact 50 and the terminal portion 62 of the lower contact 60 are arranged at positions spaced apart in up-down direction from each other and are respectively aligned in left-right direction. By providing the terminal portion 52 and the terminal portion 62 as separated in up-down direction, even if the electrical connector 100 has a large number of
20 pins at narrow pitch, it is possible to relax the crowded arrangement of the terminal portions 52, 62, and wiring of the terminal portions 52, 62 to the board 300 can be simplified.

The resilient portion 64 is formed, as the resilient portion 54 of the upper contact 50, in a folded zigzag shape, and extends from inside the slit 21 to inside the slit 16. The resilient portion 64 is connected to the second base portion 61b at the connection portion 65 in lower part of the second base portion 61b, and projects vertically forward from the connection portion 65, and then is bent obliquely upward, and then is bent obliquely downward and vertically upward alternately, to be finally connected to the lower end of the contact portion 63. Width of the resilient portion 64, that is, the section perpendicular
25 to the centerline L2 of the resilient portion 64 extending along the resilient portion 64, is generally constant at various parts of the resilient portion 64. This width is determined by considering the shape and material of the resilient portion 64 so as to impart a
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predetermined spring characteristics to the resilient portion 64.

By forming the resilient portion 64 so as to have a folded zigzag shape with a constant width, the amount of deflection of the resilient portion 64 can be increased within the limited range in forward-rearward direction between the front wall 12 and the rear wall 13, so that the contact portion 63 can be easily swayed to and fro (in forward-rearward direction) with the connection portion 65 as a supporting point. Here, since the base portion 61 is firmly fixed to the housing 10 and the position of the connection portion 65 is fixed relative to the housing 10, the contact portion 63 can be displaced stably. As a result, nearly equal displacement of the contact portion 63 of each lower contact 60 can be realized, and stress exerted to each lower contact 60 can be made nearly equal to each other. By forming the resilient portion 64 in a folded shape, the resilient portion 64 has the structure of an extended spring, and when the first board 200 is inserted, the entire resilient portion 64 is deformed by the contact force exerted to the contact portion 63. Thus, strain produced in the lower contact 60 due to the contact force can be absorbed by the entire extended resilient portion 64. Therefore, it is possible to prevent an excessive stress from being exerted to the lower contact 60 due to local stress concentration, and to use the lower contact 60 within the range of elastic characteristics of the material. Since the taper portion 12b is provided in the front wall 12 in front of the contact portion 63, and since the rear surface of the front wall 12 is retreated forward, interference of the contact 63 with the front wall 12 at the time of forward swaying of the contact portion 63 can be avoided.

The contact portion 63 has a generally semi-circular overall shape with the rear surface 63a bulging forward in a shape of circular arc opposed to the second base portion 61b and partly projecting through the slit 16 into the slot hole 11. The front surface 63b of the contact portion 63 lies on the extension of the rear end surface of the resilient portion 64 and is formed in the shape of straight line. Width (length in forward-rearward direction) of the contact portion 63, that is, its cross-sectional area, gradually increases from the lower end of the contact portion 63 upward until the center portion 63c in up-down direction is reached where the cross-sectional area is maximum.

The contacts 50, 60 as described above are formed from an electrically conductive metal, for example, by punching a metal plate of constant thickness with a press. In this way, a large number of contacts 50, 60 having resilient portions 54, 64 in folded shape can

be fabricated easily in high precision. Width of the resilient portions 54, 64 is nearly equal to thickness of the contacts 50, 60, and width of the contact portions 53, 63 is larger than thickness of the contacts 50, 60.

Fig. 6 is a schematic view showing the positional relation of the contacts 50, 60 to the terminal portion 201 of the first board 200. The upper contacts 50 and the lower contacts 60 are arranged at equal pitch in left-right direction, and are staggered with each other in a zigzag pattern. In correspondence to this arrangement, the terminal portions 201 of the first board 200 are also provided on the front and rear surfaces at positions staggered with each other in left-right direction. As an example, number of the upper contacts 50 of the electrical connector 100 is 42, and number of the lower contacts 60 of the electrical connector 100 is 43, and pitch of each of the upper and lower contacts is 0.8 mm, and thickness is 0.25 mm.

Each terminal portion 201 is formed with broad width in left-right direction, and length in left-right direction of each terminal portion 201 is longer than length (thickness) in left-right direction of each contact 50, 60. Therefore, it is possible to insert the first board 200 at somewhat displaced position in left-right direction, so that positional deviation of the first board 200 relative to the electrical connector 100 can be absorbed.

An operation of the electrical connector 100 according to the present embodiment is described below. Fig. 7A is a longitudinal sectional view showing the electrical connector 100 before the first board 200 is inserted into the electrical connector 100, and Fig. 7B is a longitudinal sectional view showing the electrical connector 100 after insertion. As shown in Fig. 7A, before insertion of the first board 200, the contact portion 53 of the upper contact 50 and the contact 63 of the lower contact 60 are positioned in planes separated from each other in left-right direction (direction normal to the plane of paper) at positions symmetric with respect to the slot hole 11 in forward-rearward direction.

As shown in Fig. 7B, when the first board 200 is inserted from above into the electrical connector 100, an external force (contact force) is exerted to each contact portion 53, 63 in forward-rearward direction by the first board 200 due to pushing force (fitting force) applied to the first board 200. By this external force, the contact portion 53 is swayed rearward with the connection portion 55 as a supporting point, and the contact portion 63 is swayed forward with the connection portion 65 as a supporting point. The

contact portions 53, 63 are thereby separated and opened in forward-rearward direction so as to hold the first board 200 between the contact portions 53 and 63, and the contact portions 53 and 63 come into contact with the terminal portion 201 of the first board 200 at center portions 53c, 63c or nearby contact points 53d, 63d of the contact portions 53, 63.

At this time, the contact pressure between the contact portions 53, 63 and the terminal portion 201 varies in accordance with spring characteristics of the contact portions 53, 63, that is, the amount of displacement the amount of displacement of the contact portions 53, 63 per unit load imposed on the contacts 50, 60, and stress is exerted to the contacts 50, 60 in accordance with the amount of displacement of the contact portions 53, 63. In the present embodiment, the resilient portions 54, 64 have a folded structure having a plurality of curved segments 54a, 64a and a plurality of straight segments 54b, 64b, so that excessive stress can be prevented from being produced in any part of the contacts 50, 60 due to local stress concentration. As a result, the contacts 50, 60 can be used within the range of elastic characteristics without giving rise to permanent strain in the contacts 50, 60.

Further, since the end surface of the contact portions 53, 63 is bulged in the shape of a curved surface so as to obtain cross-sectional area larger than the resilient portions 54, 64, rigidity of the contact portions 53, 63 is increased, and deformation of the contact portions 53, 63 themselves due to contact force exerted to the contact portions 53, 63 can be avoided. In addition, the contacts 50, 60 can be prevented from being twisted, so that the contacts 50, 60 can be stably swayed in forward-rearward direction in accordance with insertion of the first board 200. The connection portions 55, 65 connecting the base portions 51, 61 to the resilient portions 54, 64 are not displaced, and since the position of the supporting point for swaying the contacts 50, 60 is fixed, a large number of contacts 50, 60 can be swayed evenly, and desired contact pressure can be produced between the contact portions 53, 63 of the contacts 50, 60 and the terminal portion 201.

In a state as shown in Fig. 7B, if electric current flows between the contacts 50, 60 and the terminal portion 201, heat is generated in the contacts 50, 60. Since, the greater the electrical resistance, the greater is the amount of heat generated, the heat generated is particularly large at the contact points 53d, 63d. In the present embodiment, by bulging out the contact portions 53, 63 in the form of a convex curved surface, the cross-sectional

area of the contact portions 53, 63 is gradually increased toward the center portion 53c, 63c, so that electrical resistance of the contacts 50, 60 themselves at the contact points 53d, 63d can be reduced, and heat discharge for the heat generated at the contact points 53d, 63d can be improved. Heat generation in the contacts 50, 60 can be thereby suppressed, and required electric current can be easily flown in the electrical connector 100 having the contacts 50, 60 in the shape of thin plate. In this Example, the radius of curvature of the part containing the contact points 53d, 63d is preferably 3 to~ 10 times the width of the resilient portions 54, 64.

On the contrary, if the contacts 50, 60 are formed in same width from the connection portion 55, 65 to the contact points 53d, 63d, not only electrical resistance of the contacts 50, 60 is increased, but also heat discharge is deteriorated. Thus, the amount of heat generated becomes larger, and it may become difficult to flow required electric current through the electrical connector 100.

Further, in the present embodiment, at the time of insertion of the first board 200 into the electrical connector 100, the first board 200 can exhibit so-called wiping action by sliding on the surface of the contact portion 53, 63 to remove non-conductive material formed or attached on the contact portions 53, 63. Figs. 8A and 8B are enlarged views showing essential part of the contact portions 53, 63 at the start of insertion and after insertion of the first board 200, respectively. As shown in Fig. 8A, the contact portion 53, 63 and the first board 200 come into contact at the contact points 53e, 63e. Then, as the first board 200 is inserted, the contact points move downward, and when the first board 200 is completely inserted, the contact points are 53d, 63d as in Fig. 7B. In this way, wiping effect of the contacts 50, 60 can be obtained.

Figs. 9A to 9C are views showing an Example in which the positions of the contact portion 53, 63 of the upper contact 50 and the lower contact 60 are different in up-down direction, and showing the course of event that occurs when the first board 200 is inserted from above. By adjusting the length of the curved segment of the resilient portions 54, 64, the electrical connector 100 can be constructed as shown in Figs. 9A to 9C, without requiring large change in spring design condition of the contacts 50, 60. In this way, the contact starting time for the upper contact group and lower contact group with the first board 200 can be shifted relative to each other, and total insertion force for inserting the first board 200 into the electrical connector 100 can be reduced.

The contacts 50, 60 according to the above-described embodiment comprise the base portions 51, 61, the resilient portions 54, 64 connected to the base portions 51, 61, and the contact portions 53, 63 provided at an end of the resilient portions 54, 64, the resilient portions 54, 64 having a plurality of straight segments 54b, 64b and a plurality of curved segments 54a, 64a, so that, although the contacts 50, 60 are of small size in the shape of thin plate suitable for arranging in a large number at narrow pitch, it can prevent excessive stress from being exerted to the contacts 50, 60 at the time of insertion of the first board 200 and can be used within the range of elastic characteristics. Since the base portions 51, 61, the resilient portions 54, 64 and the contact portions 53, 63 are constructed so as to extend in the same plane, the contacts 50, 60 can be fabricated by simple punching with a press, and same products can be fabricated easily and in high precision in mass production.

In the contacts 50, 60, when the first board 200 is inserted into the gap (slot hole 11) between the base portions 51, 61 and the contact portions 53, 63 opposed to each other, the entire resilient portions 54, 64 are deformed as a whole by the contact force exerted to the contact portions 53, 63 by the first board 200, so that it is suitable to be used as a card edge connector. The contact portions 53, 63 are bulged in the shape of a convex curved surface on the side facing the base portions 51, 61 so as to have larger cross-sectional area than the resilient portions 54, 64, so that, while deformation of the contact portions 53, 63 is suppressed, amount of heat generated in the contacts 50, 60 can be reduced and required electric current can be easily flown. Since the slot hole 11 is provided in the housing 10 of the electrical connector 100 for the first board 200 in the form of a card to be fitted, and a plurality of contacts 50, 60 are arranged on one side and on the other side of the slot hole 11, respectively, so as to be staggered with each other, the electrical connector 100 can be easily used with a large number of pins.

In the embodiment described above, the resilient portion 54, 64 is formed in a folded shape that is bent from down to up, then from up to down, and then from down to up. However, the resilient portion is not limited to this construction as long as a plurality of straight segments and a plurality of curved segments are included. The contacts 50, 60 are formed of thin plate of constant thickness with width of the contact portions 53, 63 larger than the thickness. However, as long as the cross-sectional area of the contact portions 53, 63 is larger than cross-sectional area of the resilient portions 54, 64, the

contact portions 53, 63 may be formed in any shape. For example, thickness of the contact portions 53, 63 may be larger than thickness of the resilient portions 54, 64.

Shape of the housing 10 is not limited to that described above. The taper portion 12b and the opening 20 are provided in the front wall 12 and the rear wall 13 of the housing, respectively, in order to avoid interference with the contact portions 53, 63. However, as long as a retreat from the contact portions 53, 63 is provided, the retreat may be of any shape. A plurality of upper contacts 50 (a first set of contacts) and a plurality of lower contacts 60 (a second set of contacts) are arranged so as to be staggered with each other with the slot hole 11 interposed in between. However, arrangement of the contacts 50, 60 is not limited to this arrangement. The upper contacts 50 and the lower contacts 60 are press-fitted from directions opposite to each other. However, they may be press-fitted from same direction. The contacts 50, 60 need not be press-fitted after forming the housing 10, but may be formed integrally with the housing 10 as one unit.

In the above-described embodiment, the terminal portions 52 and the terminal portions 62 project from same side of the housing 10. However, they may project from different sides of the housing 10. The terminal portions 52, 62 project from direction perpendicular to the insertion direction of the card edge connector 200. However, they may project from direction parallel to the insertion direction. Thus, the structure for mounting the electrical connector 100 to the second board 300 is not limited to that shown in Fig. 4.

In the above-described embodiment, an elongate slot hole 11 is provided in the housing 10 for fitting a card edge connector 200 into the electrical connector 100. However, it may also be constructed so as to fit other connector therein. The contacts 50, 60 and the electrical connector 100 of the present invention can be used for various other applications. For example, it can be applied as a connector for connecting circuit boards in an ink jet printer. Thus, the present invention is not limited to the contacts and the electrical connector according to the above-described embodiment, as long as features and functions of the present invention can be achieved.

In accordance with the present invention, since the contact portion is provided at an end of the resilient portion having a plurality of straight segments and a plurality of curved segments, the contact can be used within the range of elastic characteristics.

What is claimed is:

1. A contact, comprising:

a base portion;

a resilient portion connected to the base portion; and

a contact portion provided at an end of the resilient portion,

wherein the resilient portion comprises a plurality of straight segments and a plurality of curved segments, and wherein the base portion extends so as to face the contact portion.

2. The contact of claim 1, wherein the base portion, the resilient portion and the

contact portion extend in a same plane.

3. The contact of claim 1 or 2, wherein the resilient portion is configured so as to

be deformed as a whole by a contact force applied from a board to the contact portion, when the board is inserted into a gap between the base portion and the contact portion facing each other.

4. The contact of any one of claims 1 to 3, wherein the contact portion bulges at a

side opposite to the base portion to have a convexly curved surface, and a cross-sectional area of the contact portion is larger than a cross-sectional area of the resilient portion.

5. An electrical connector, comprising:

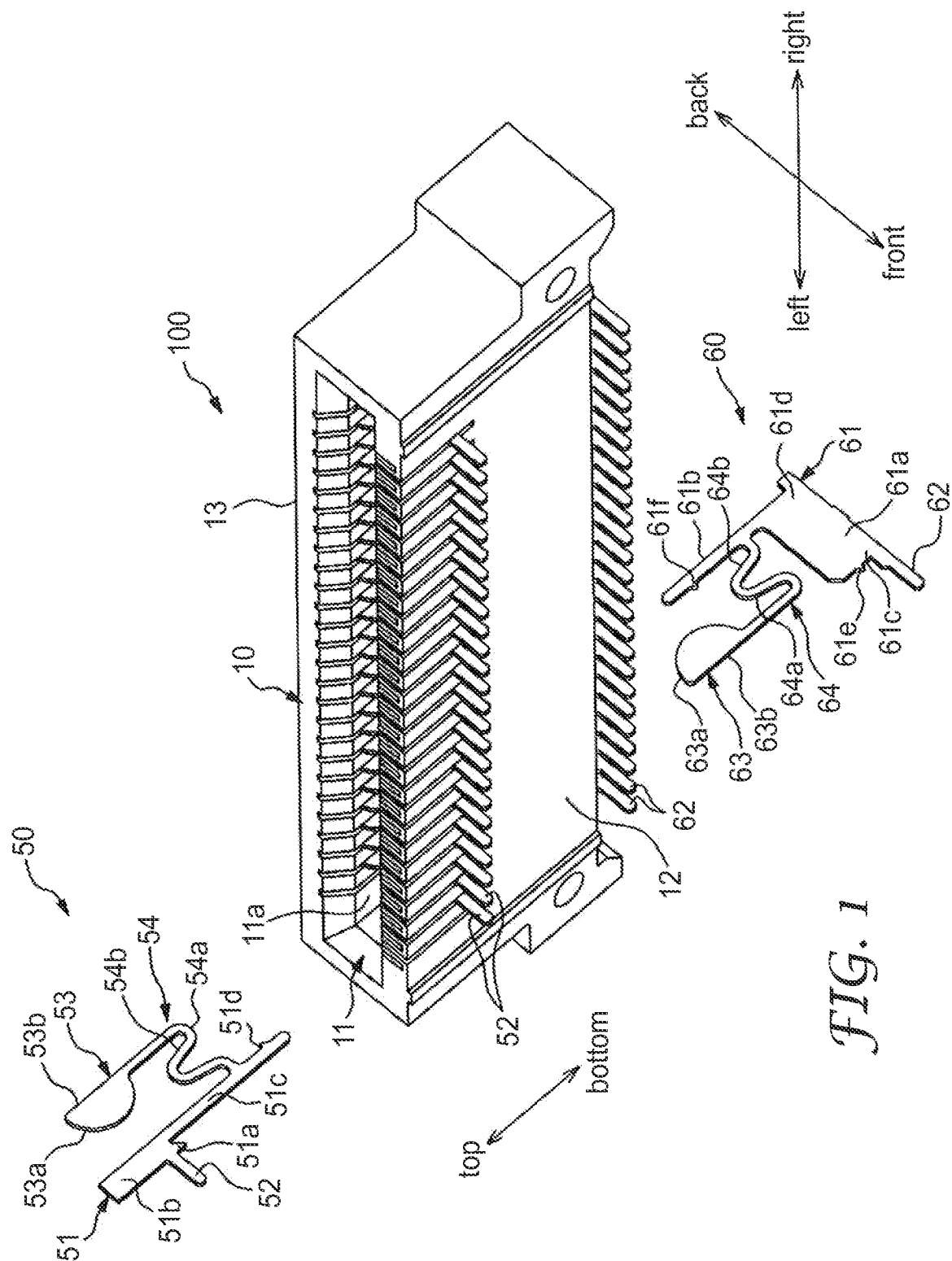
a plurality of contacts, each of which is set forth in any one of claims 1 to 4,

and

a housing for arranging the contacts.

6. The electrical connector of claim 5, wherein the housing is provided with a slot

to which a card-shaped board is fitted, and the plurality of contacts comprise a first set of contacts arranged at one side of the slot and a second set of contacts arranged at another side of the slot, the first and second sets of contacts being staggered with each other.



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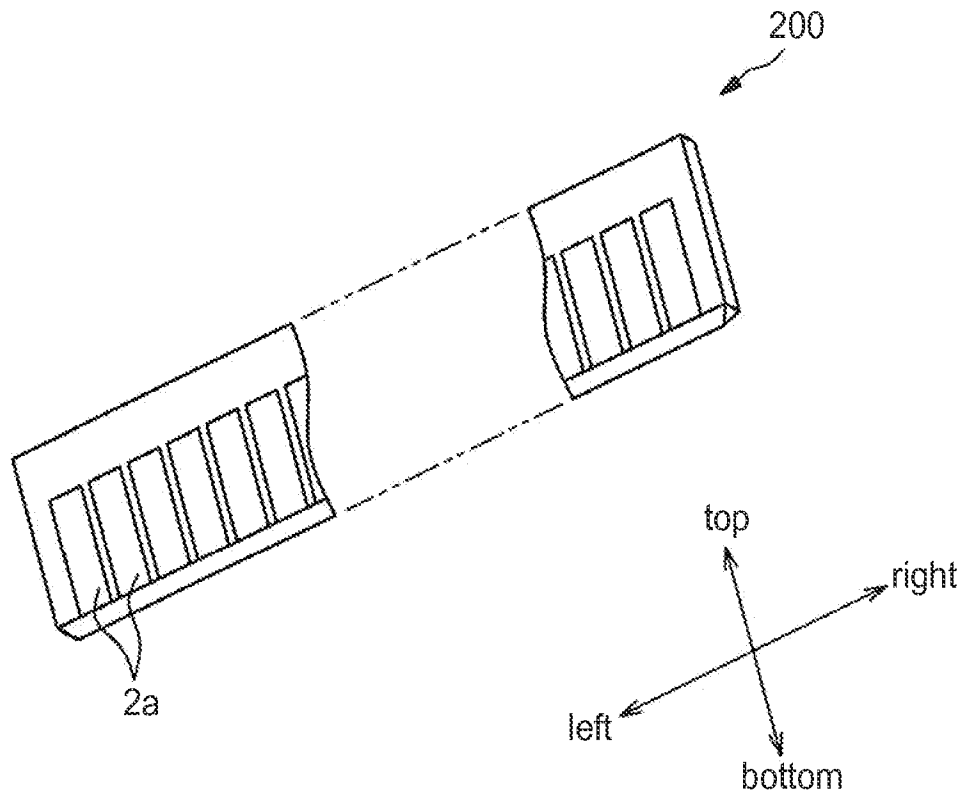
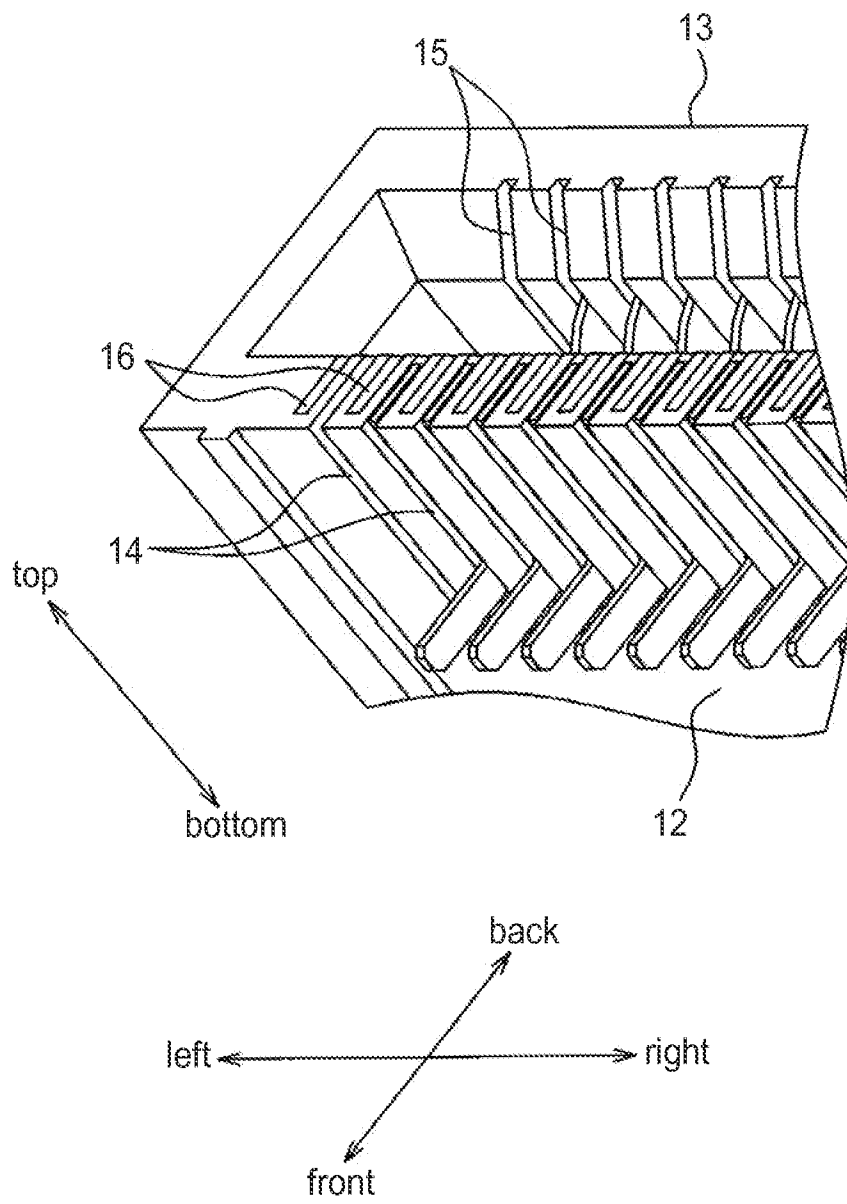


FIG. 2

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*FIG. 3*

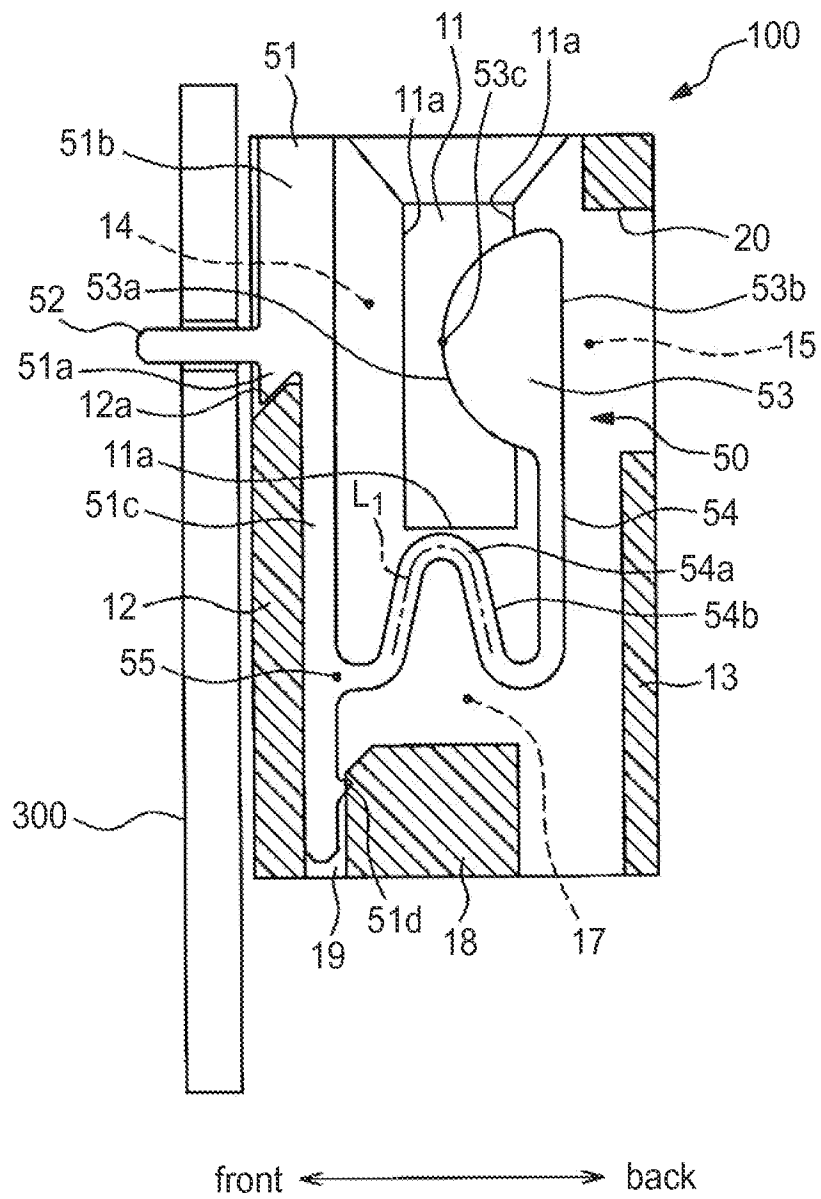


FIG. 4

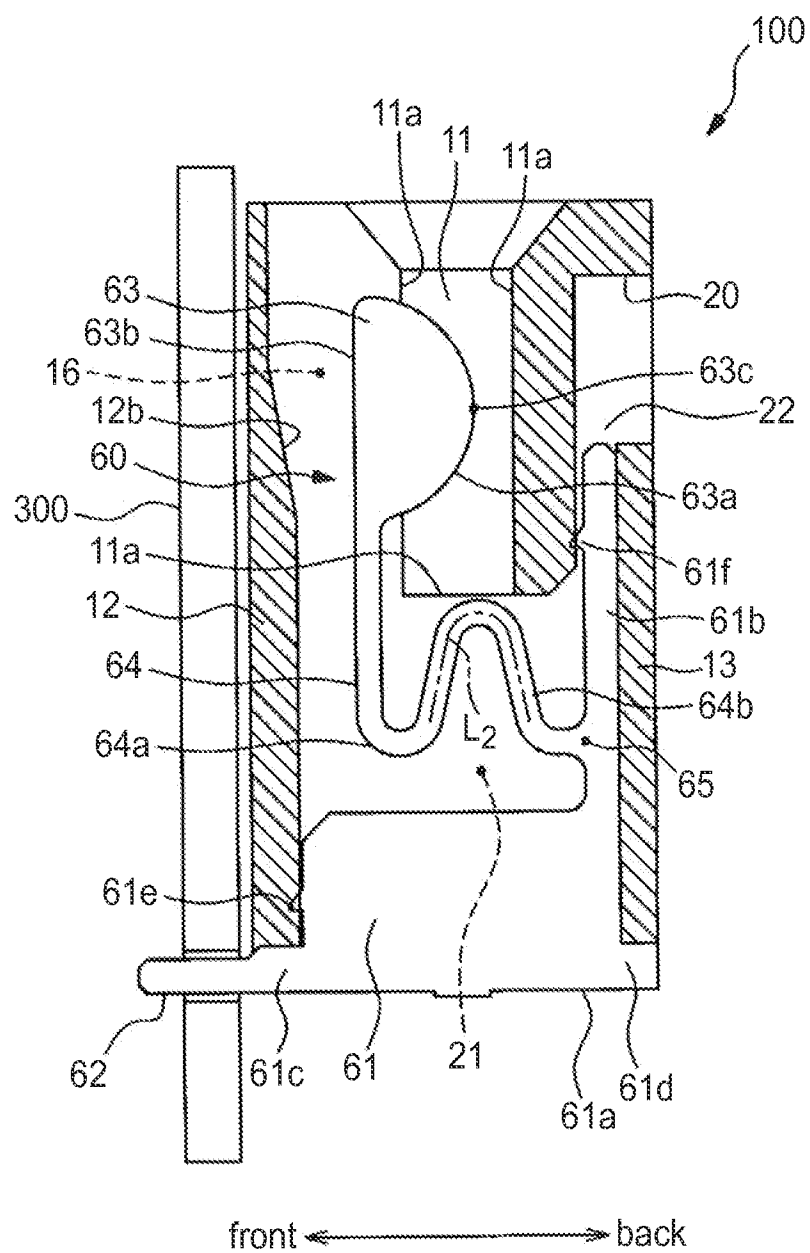
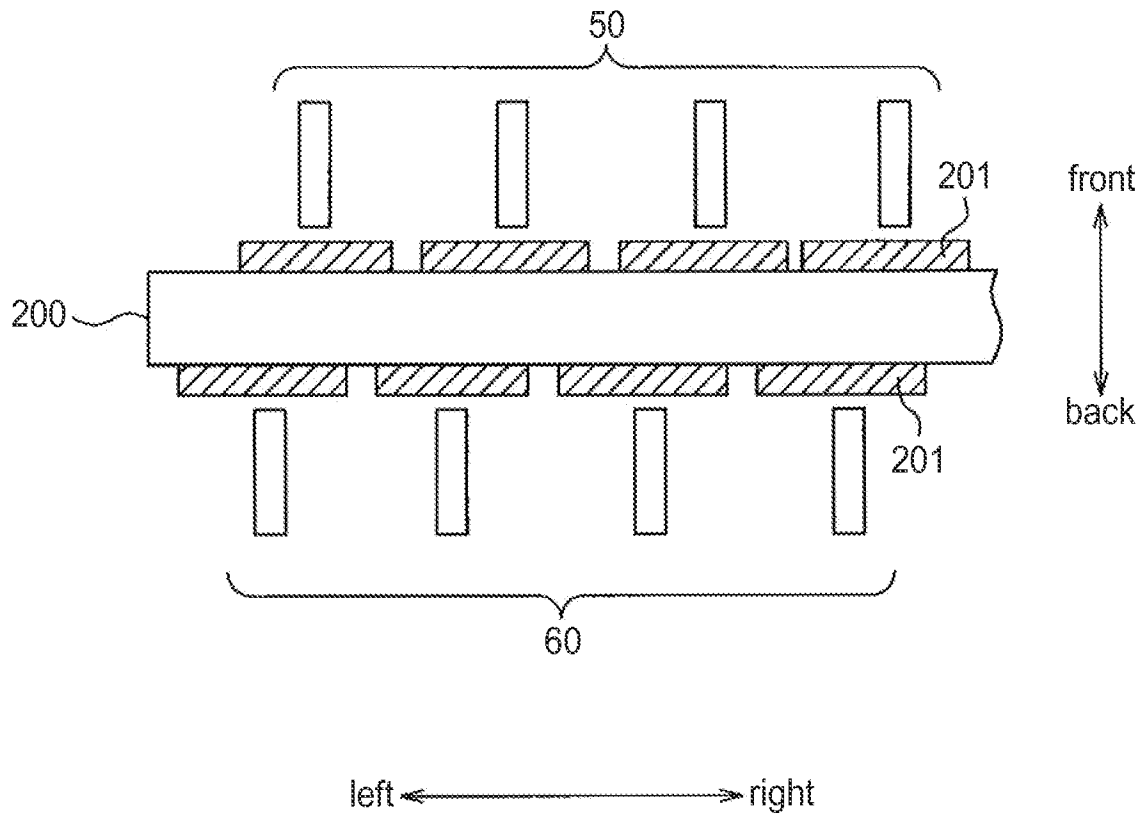


FIG. 5

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*FIG. 6*

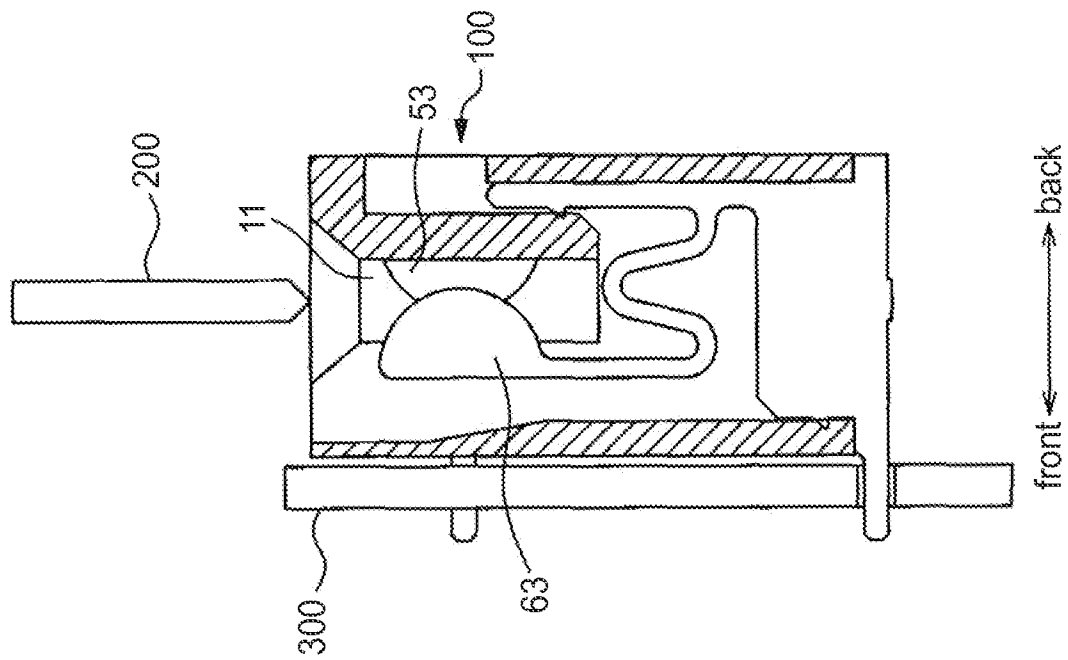


FIG. 7a

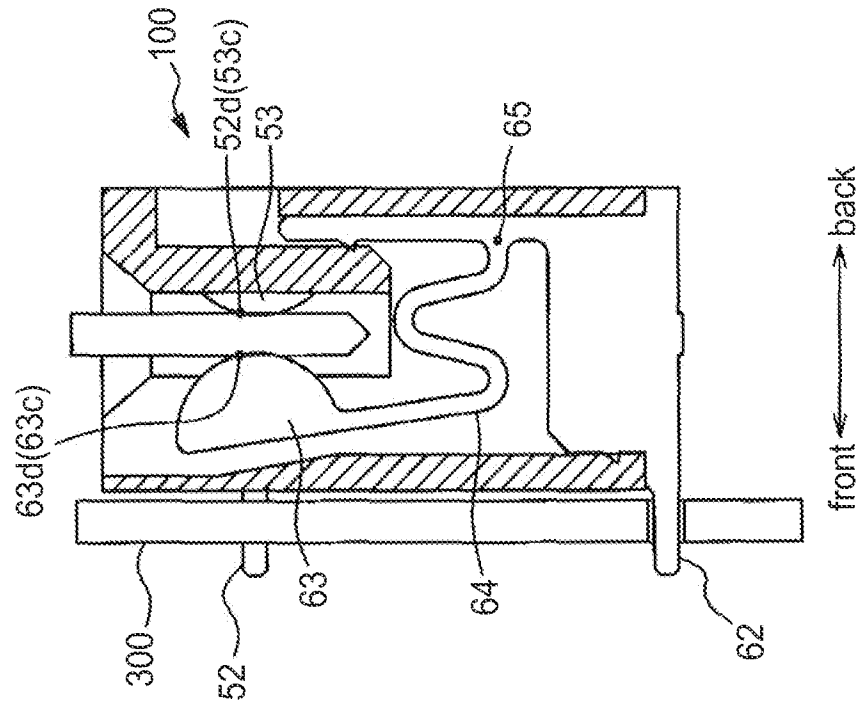


FIG. 7b

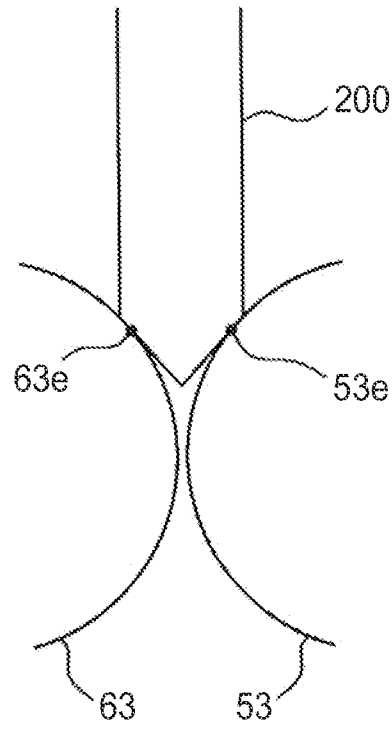


FIG. 8a

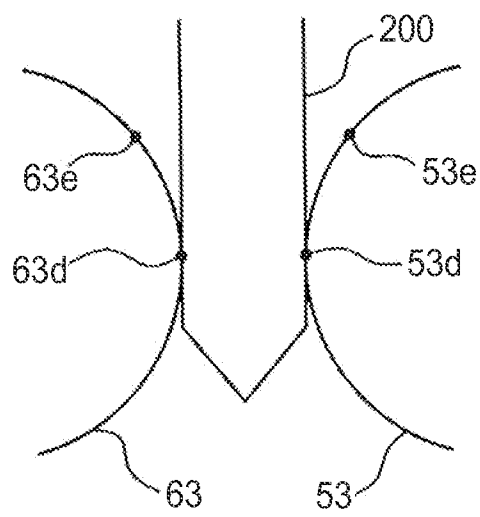


FIG. 8b

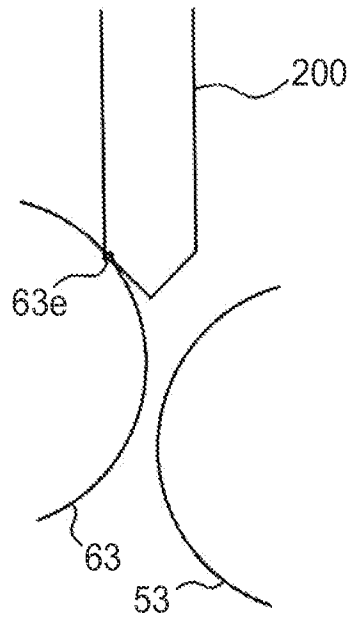


FIG. 9a

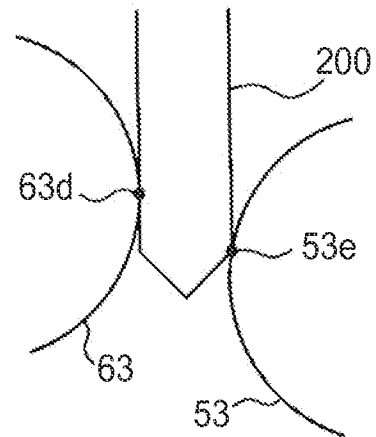


FIG. 9b

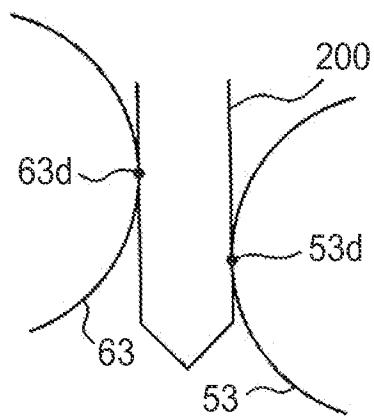


FIG. 9c

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2011/024834

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01R12/73 H01R12/58
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06K H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 385 314 A1 (AMP INC [US] WHITAKER CORP [US]) 5 September 1990 (1990-09-05)	1,2,4,5
Y	column 3, line 37 - line 48; figures 3-4	3,6
Y	----- US 6 464 521 B1 (KURATORI FUMIO [JP] ET AL) 15 October 2002 (2002-10-15) paragraph [0037]; figures 5,12 paragraph [0043]	3,6
A	----- DE 37 44 541 A1 (LOTTER KARL [DE]) 13 July 1989 (1989-07-13) * abstract; figure 1	1
A	----- US 5 254 017 A (TONDREAU ROBERT J [US] ET AL) 19 October 1993 (1993-10-19) figure 5	1
	----- -/-	



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

16 March 2011

Date of mailing of the international search report

24/03/2011

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Authorized officer

Jiménez, Jesús

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2011/024834

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

International application No

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