CONTACT AND CONNECTOR

Field of the Invention

[0001] This invention relates to a contact and a connector which are miniaturized and reduced in size and also can exhibit a low electrical resistance even if the contact and the connector are miniaturized and reduced in size.

Background of the Invention

[0002] The Japanese Patent Publication No. 3072071 discloses a contact for a low-profile connector or a miniaturized connector. In the contact disclosed by Japanese Patent Publication No. 3072071, the contact which is formed by punching out from a metal sheet includes a contact part for contacting with an object to be connected, and a spring part of meandering-curved shape for biasing the contact part toward the object to be connected, wherein the spring part of flat shape which is punched out is folded at the imaginary line along the extensible direction of the spring part. According to the contact disclosed by the Japanese Patent Publication No. 3072071, with this configuration, since the spring part of flat shape which is punched out is folded at the imaginary line along the extensible direction of the spring part, the interior volume of the housing accommodating the contact can be reduced.

Summary of the Invention

[0003] According to the contact disclosed by the above Japanese Patent Publication No. 3072071, since the spring part of flat shape which is punched out is folded at the imaginary line along the extensible direction of the spring part, it is difficult for the connector including this contact to have a low profile. If the spring part is formed to be bent in low profile, due to the fact that the spring part of

meandering-curved shape must be shortened in such the case, thus a sufficient elastic force is difficult to be obtained. Further, the width of the spring part of meandering-curved shape should be thin in order to be elastically deformable at the spring part, the cross-sectional area of the conductor of this part comes to be small, and this results in increasing the electrical resistance of the conductor when electricity flows therethrough. In contrast, if the cross-sectional area of the spring part increases, the part of meandering-curved shape comes to be thick, this makes it difficult to obtain a sufficient elastic force and the stress is concentrated to the curved or crooked part; thus the part comes to be easily broken.

[0004] The purpose of this invention is to provide a contact and a connector which are miniaturized and reduced in size and also exhibit a low electrical resistance even if the contact and the connector are miniaturized and reduced in size.

[0005] In order to solve the above problem, a contact of the first aspect of the present invention is formed by folding a metal sheet which is punched out in a predetermined shape, and the contact includes: a body part which is elastically deformable in a longitudinal direction; a contact part formed on one side of the body part; and a connecting part formed on the other side of the body part; wherein the body part is formed in a meandering shape between the contact part and the connecting part and so that the body part includes at least one first elastic part located in one side with respect to a central imaginary line which runs through the center of the body part in the longitudinal direction, at least one second elastic part located in the other side with respect to the central imaginary line, and a plurality of joining parts running across the central imaginary line and joining the first elastic part with the second elastic part, and the joining part is formed with a plurality of bend parts and is configured so that the wide planer surface of the

joining part is perpendicular to the central imaginary line and the edges of the joining part are curved.

[0006] A contact of second aspect of the present invention features that, in the contact of first aspect, the joining part is formed as a plurality of bend parts which constitute the meandering shape.

[0007] A contact of third aspect of the present invention features that, in the contact of first or second aspect, the joining part is formed as two bend parts which are folded in opposite directions each other.

[0008] A contact of fourth aspect of the present invention features that, in the contact of any first to third aspect, the first elastic part has a first folded part in which the sheet body is folded so that the wide spread plane thereof protrudes perpendicular to the longitudinal direction of the body part, the second elastic part has a second folded part in which the sheet body is folded so that the wide spread plane thereof protrudes toward the opposite direction to the first folded part, and one of the each thin side edges of the first folded part and the second folded part are directed to the central imaginary line.

[0009] A contact of fifth aspect of the present invention features that, in the contact of fourth aspect, the first elastic part has a pair of first arm portions extending from both sides of the first folded part, the second elastic part has a pair of second arm portions extending from both sides of the second folded part, The first arm portion located in the contact part side and the second arm portion located in the connecting member side are connected by the joining part, and the second arm portion located in the contact part side and the first arm portion

located in the connecting member side are connected by the joining part, respectively.

[0010] A contact of sixth aspect of the present invention features that the contact formed by folding a metal sheet which is punched out in a predetermined shape, the contact comprising: a body part which is elastically deformable in a longitudinal direction; a contact part formed on one side of the body part; and a connecting part formed on the other side of the body part; wherein the body part is formed from a sheet body which has: at least one first linear section to form a first elastic part located in one side of a central imaginary line which runs through the center of the body part in the longitudinal direction; at least one second linear section to form a second elastic part located in the other side of the central imaginary line; and a curved section being formed with a plurality of bend parts and crossing the central imaginary line to join the first linear section with the second linear section, and the body part is formed so as to fold the sheet body so that the central part of the first linear section is folded into a convex shape while the central part of the second linear section is folded into a concave shape.

[0011] A connector of the present invention features that the connector is provided with the contact according to any one of first through sixth aspect.

[0012] According to the contact of the first aspect of the present invention, the contact is formed so that the first elastic part and the second elastic part which can be elastically deformable are protruded in the vertical direction and that the first elastic part and the second elastic part are joined by the joining part having the bend part. Thus, the body part of the contact can obtain a sufficient elasticity and also miniaturization and saving the space can be achieved. Further, since the

joining part has the bend parts, therefore, even if the contact is miniaturized, the joining part which joins the first elastic part with the second elastic part can be formed in a long length and the contact which body part has a sufficient elasticity can be obtained.

[0013] According to the contact of the second aspect of the present invention, the joining part is formed in a meandering shape, thus the joining part can be lengthened and miniaturization and saving space can be obtained.

[0014] According to the contact of the third aspect of the present invention, the joining part can be easily formed.

[0015] According to the contact of the fourth aspect of the present invention, the first folded part of the first elastic part of the body part and the second folded part of the second elastic part of the body part are formed by bending the wide spread plane of the sheet body, thus the body part can be elastically deformed without reducing the cross sectional area of the sheet body constituting the body part, thus the electric resistance of the contact can be reduced.

[0016] According to the contact of the fifth aspect of the present invention, since the joining part which joins the first elastic part with the second elastic part can be easily formed, the contact can be easily manufactured.

[0017] According to the contact of the sixth aspect of the present invention, the contact is formed so that the first elastic part and the second elastic part in which the elastic, and deformable first and second linear sections are formed so as to protrude by bending are joined by the joining part having the bent part, thus the

joining part which joins the first elastic part with the second elastic part can be formed in a long length and the contact which body part has a sufficient elasticity can be obtained. Further, the first elastic part of the body part and the second elastic part of the body part are formed by bending the wide spread plane of the sheet body, thus the body part can be elastically deformed without reducing the cross sectional area of the sheet body constituting the body part, thus the electric resistance of the contact can be reduced.

[0018] According to the connector of the present invention, the connector being provided with the contact which exhibits the effects of the contact of the above first through sixth aspects can be obtained.

Brief Description of the Drawings

[0019] FIG. 1A shows a perspective view of the connector according to one embodiment. FIG. 1B shows a perspective view of the same connector of FIG. 1A viewing from another direction.

[0020] FIG. 2 shows an exploded perspective view of the connector according to the embodiment.

[0021] FIG. 3 shows a perspective view of the contact according to the embodiment.

[0022] FIG. 4 shows a perspective view of the same contact of FIG. 3 viewing from another direction.

[0023] FIG. 5A shows a plan view of the contact according to the embodiment. FIG. 5B shows a side view of the contact viewing from one side. FIG. 5C shows a bottom view of the contact.

[0024] FIG. 6A shows a plane view of the contact in the state that the contact is not folded up. FIG. 6B shows a plan view of the contact in the state that the contact is folded up. FIG. 6C shows a side view of the connector of FIG. 6B viewing from one direction.

Description of the Preferred Embodiment

[0025] An embodiment of the present invention will be described hereinafter with referring to the drawings. The following embodiment is to exemplify a contact and a connector for embodying the technical concept of the present invention, and is not intended to limit the present invention into the above but can also be equally applicable to other embodiments within the scope of the claims.

[0026] Now, a connector 10 according to the embodiment will be explained with reference to FIGS. 1 to 5. The connector 10 according to the embodiment of the present invention, as shown in FIGS. 1 and 2, including a housing 40, a plurality of contacts 11 attached to the housing, and one couple of mounting members 52 for mounting the housing 40 onto a member to be mounted such as a substrate. When the connector 10 touches with a complementary member to be contacted such as a secondary battery, the contacts 11 attached to the housing 40 are elastically deformed. In this embodiment, three contacts 11 are provided in the connector 10.

[0027] Referring now to FIGS. 3 to 5, the contact 11 will be explained. In this

embodiment, although the contact located in the center position between the other two connectors is slightly small in shape, however, the basic configuration of each contact is almost the same, therefore, one contact 11 will be explained as an example. As shown in FIG. 3 and 4, the lateral direction of the contact is referred to as "X direction", the vertical direction of the contact is referred to as "Y direction", and the longitudinal direction of the contact is referred to as "Z direction".

[0028] The contact 11 is formed by punching out one sheet metal and folding up as one piece. The contact 11 includes a body part 12, a contact part 25 located one side of the body part 12 in the longitudinal direction, and a connecting part 30 located at the opposite side of the body part 12. The contact 11 can be extensible and elastically deformable in the longitudinal direction.

[0029] The body part 12 is formed in a meandering shape between the contact part 25 and the connecting part 30 and so that, in the case that the center line throughout the center of the contact in the longitudinal direction is referred to as "central imaginary line a", the area of one side with respect to the central imaginary line a is referred to as "first imaginary area b", and the area of the other side with respect to the central imaginary line a is referred to as "second imaginary area c", the body part 12 includes a plurality of first elastic parts 13 located in the first imaginary area b, a plurality of second elastic parts 18 located in the second imaginary area c, and joining parts 23 which cross the central imaginary line a and join the first elastic parts 13 with the second elastic parts 18 (refer to FIG. 5A and 5C).

[0030] The first elastic parts 13 are one of portions to be elastically deformed when the contact 11 contacts with a terminal of a complementary connector and

are located at a plurality of locations such as, in this embodiment, three locations. The each first elastic parts 13 is formed with first folded parts 14 in which the sheet metal constituting the body part 12 is folded in the wide spread plane thereof along the lateral direction so as to convex upward in the vertical direction. Thus, the first folded part 14 is formed in an inverted-U shape.

[0031] The first folded part 14 has a first flat portion 16a which is partially formed in a flat shape at the uppermost portion 16 of the convex and a pair of first arm portions 17a, 17b which extend downward from the first flat portion 16a in the vertical direction at the side toward the contact part 25 and the side toward the connecting part 30. The one of thin side edges 15 of the sheet body forming the first folded part 14 is directed to the central imaginary line a.

[0032] The second elastic parts 18 are, as the same with the first elastic parts 13, one of portions to be elastically deformed when the contact 11 contacts with the terminal of the complementary connector and are located at a plurality of locations such as, in this embodiment, three locations. The each second elastic parts 18 is formed with second folded parts 19 in which the sheet metal constituting the body part 12 is folded in the wide spread plane thereof along the lateral direction so as to concave downward in the vertical direction opposite to the convexed direction of the first folded part 14. Thus, the second folded part 19 is formed in a U shape.

[0033] The second folded part 19 has a second flat portion 21a which is partially formed in a flat shape at the lowermost portion 21 of the concave and a pair of second arm portions 22a, 22b which extend upward from the second flat portion 21a in the vertical direction at the side toward the contact part 25 and the side toward the connecting part 30. The one of thin side edges of the second folded

part is directed to the central imaginary line a.

[0034] The joining parts 23 are arranged at a plurality of locations in the body part 12 of meandering shape so as to cross the central imaginary line a which extends longitudinally, and so that the wide spread plane of the body part 12 is oriented perpendicular to the central imaginary line a. The each joining parts 23 is also formed in a meandering shape with two bend parts 24 curving back toward the opposite direction. In this embodiment, the joining part 23 has approximately an S shape. In this embodiment, the contact 11 includes seven joining parts 23; among which joining parts 23, five joining parts 23 join the first elastic parts 13 with the second elastic parts 18 while the two joining parts located both ends join the body part 12 with the contact part 25 or the connecting part 30.

[0035] More precisely, some joining parts 23 join the first arm portions 17a located on the contact part 25 side of the first folded parts 14 constituting the first elastic parts 13 with the second arm portions 22b located on the connecting part 30 side of the second folded parts 19 constituting the second elastic parts 18 while the other joining parts 23 join the first arm portions 17b located on the connecting part 30 side of the first folded parts 14 constituting the first elastic parts 13 with the second arm portions 22a located on the contact part 25 side of the second folded parts 19.

[0036] The contact part 25 is provided on one end of the body part 12 and constitutes a portion to be contacted with the terminal of the element to be connected. The contact part 25 is formed by folding one end 26 of the joining part 23 located on the contact part 25 side of the body part 12. The contact part 25 includes an extending part 27 which extends into the lateral direction so as to

cross the central imaginary line a and a contact segment 28 which extends from the approximately central portion of the extending part 27 toward the direction opposite to the body part 12 and is folded upward and back toward the body part 12. The folded portion of the contact segment 28 is to contact with the terminal of the element to be connected.

[0037] The extending part 27 joined with the body part 12 and the distal end of the contact segment 28 are formed with engaging parts 29 protruding from the central imaginary line a toward the lateral direction. These engaging parts 29 are to position the contact 11 not to move in the housing 40 when the contact 11 is disposed in the housing 40.

[0038] The connecting part 30 is provided on the other end of the body part 12 and is to be connected with an element to be connected such as a substrate mounted in the electronic apparatus by soldering. The connecting part 30 is formed by folding one end 31 of the joining part 23 located on the connecting part 30 side of the body part 12, and is formed with a contact segment 32 of flat plate shape at the distal end side thereof.

[0039] The contact 11 is formed with a housing fixing part 33 located between the joining part 23 and the connecting section 32 of the body part 12 for fixing the contact 11 inside the housing 40 when the contact 11 is accommodated in the housing 40. The housing fixing part 33, in the portion between the joining portion 23 and the contact segment 32, extends from the central imaginary line a toward the both lateral directions, and is formed with L-shaped fixing segments 34 which are folded in right angle at the lateral ends of the above extending portion and extended toward the contact part 25.

[0040] Referring now to FIG. 6, the manufacturing process of the contact 11 will be explained. FIG. 6A shows a contact 11' of an extended state in which the metal sheet is punched out into a predetermined shape during the manufacturing of the contact 11. The contact 11' is formed with an elongated curved section 12' constituting the body part 12, plate like portion 25' constituting the contact part 25 which is joined with the one end of the curved section 12', and an approximately cross shape section 30' constituting the connecting part 30 which is joined with the other end of the curved section 12'.

[0041] The curved section 12' constituting the body part 12, in the case that the center line throughout the center of the contact in the longitudinal direction is referred to as "central imaginary line a", the area of one side with respect to the central imaginary line a is referred to as "first imaginary area b", and the area of the other side with respect to the central imaginary line a is referred to as "second imaginary area c", is formed, in parallel to the central imaginary line a, with a plurality of, in the embodiment—three, first linear sections 35 constituting the first elastic parts 13 in the first imaginary area b, and a plurality of, in the embodiment—three, second linear sections 37 constituting the second elastic parts 18 in the second imaginary area c. The curved section 12' is further formed with curved sections 39 constituting the joining parts 23 joining the first linear sections 35 with the second linear sections 37 so as to cross the central imaginary line a. The curved sections 39 includes substantially S-shape parts and substantially inverted S-shape parts which are alternatively disposed and each of which has two bend parts 24 curving in opposite direction with respect to each other.

[0042] The body part 12 is formed so that the first linear sections 35 in the first imaginary area b are folded so as to convex upward at the each center part 36 thereof to form the first elastic parts 13 while the second linear sections 37 in the second imaginary area c are folded so as to concave downward at the each center part 38 thereof to form the second elastic parts 18. By forming the first elastic parts 13 and the second elastic parts 18 in this way, the curved sections 39 which cross the central imaginary line a are vertically turned with the state in that the curved sections 39 are joined with the first elastic parts 13 and with the second elastic parts 18.

[0043] The contact part 25 is formed by folding the plate like portion 25' at approximately the central portion in the longitudinal direction. At this moment, the contact part 25 is folded so that the position of the engaging part 29 formed at the proximal end of the contact part 25 joined to the joining part 23 corresponds to the position of the engaging part 29 formed at the distal end of the contact part 25 in the vertical direction.

[0044] The connecting part 30 is formed so that the approximately cross shape section 30' is folded vertically upward at a portion joining to the curved section 39 such that the planer surface of the portion to which the housing fixing part 33 is formed is oriented perpendicular to the longitudinal direction, and further that the contact segments 32 is folded at the joining portion joined with the housing fixing part 33 such that the contact segments 32 is directed toward the longitudinal direction. Each fixing segments 34 of the housing fixing part 33 is folded at right angle. The contact is thus formed as described above.

[0045] The contact 11 is thus formed so that the first folded parts 14 of the first

elastic parts 13 and the second folded parts 19 of the second elastic parts 18 both of which are elastically deformable are protruded upward or downward in the vertical direction and the first elastic parts 13 and the second elastic parts 18 are joined together by the joining parts 23 having a plurality of bend parts 24. Thus, the body part 12 can be formed in an elongated shape and can obtain a sufficient elasticity, and also miniaturization and saving space can be achieved. The first folded part 14 of the first elastic parts 13 of the body part 12 and the second folded part 19 of the second elastic parts 18 of the body part 12 are formed by bending the wide spread plane of the sheet body, thus the body part can be elastically deformed without reducing the cross-sectional area of the sheet body constituting the body part 12, thus the electric resistance of the contact 11 can be reduced.

[0046] The configuration of the housing 40 will be explained hereinafter. The housing 40 is, as shown in FIGS. 1 and 2, a low profile, rectangular parallelepiped shape including a front face 42 formed at one side with openings 43 through which the contact parts 25 of the contacts 11 are projected, a rear face 44 formed at the other side with insertion ports 45 to which the contacts 11 are inserted, a bottom face 48 for mounting on the member to be mounted, a top face 47 opposing to the bottom face 48, and a side face 49 and the other side face 50; inside of which housing 40 a contact housing part 41 accommodating a plurality of contacts 11 is formed.

[0047] The front face 42 of the housing 40 is formed with the plurality of openings 43 in the rectangular planer face thereof. These openings 43 are communicated with the contact housing part 41 formed inside the housing 40. The size of these openings 43 are set to a size through which openings 43 the contact part 25 of the contact 11 can be inserted but the engaging parts 29 formed on the contact part

25 cannot be inserted.

[0048] The rear face 44 of the housing 40 is formed with the plurality of insertion ports 45 in the rectangular planer face thereof. Each of the insertion ports 45 is the portion through which the contact 11 is inserted and is communicated with the contact housing part 41 formed inside the housing 40.

[0049] The bottom face 48 of the housing 40 is formed as a rectangular planer plane having a large area and is to mount onto the member to be mounted such as the substrate. The top face 47 of the housing 40 is formed as a rectangular planar plane having a large area. The bottom face 48 of the housing 40 is formed so as to be relatively smaller than the top face 47 of the housing 40.

[0050] The side faces 49 and 50 are rectangular planes and formed with steps extending in the longitudinal direction. These steps are boundaries between the top face 47 side and the bottom face 48 side by which step the square areas of the top face 47 and the bottom face 48 are different. The side faces 49 and 50 are formed with mounting member attached parts 51 for attaching the mounting members 52 extending downward from the top face 47.

[0051] The contact housing part 41 inside the housing 40 is formed in a size that can mainly accommodate the body parts 12 of the contacts 11 and so that the contacts 11 can freely expand by the body parts 12 being elastically deform inside the contact housing part 41. The rear face 44 of the contact housing part 41 is formed with insertion sections 46 into which the housing fixing parts 33 formed on the contacts 11 at the connecting parts 30 side are inserted.

[0052] The mounting member 52 is, as shown in FIG. 2, formed by punching out a metal sheet and bending the punched sheet. The mounting member 52 includes an attachment part 53 to be attached to the mounting member attached parts 51 of the housing 40 and a mounting part 54 to be mounted onto the substrate.

[0053] Further, referring now to FIGS. 1 and 2, an assembling process of the connector 10 according to the embodiment will be described. The assembling process of the connector 10 is implemented by inserting the contact part 25 side of the contacts 11 into the insertion ports 45 formed in the rear face 44 of the housing 40, thus the contacts 11 are disposed in the contact housing part 41 inside housing 40. Then, the contact parts 25 of the inserted contacts 11 project from the openings 43 formed in the front face 42 of the housing 40, and the housing fixing parts 33 of the contacts 11 formed at the connecting part 30 side are positioned and fixed to the insertion sections 46 formed on the rear face 44 of the contact housing part 41. In this state, the engaging parts 29 of the contact 11 formed at the contact part 25 side abut against the inner face around the opening 43 of the front face 42 of the housing 40, thus the contacts 11 are held in the place.

[0054] Afterward, mounting members 52 are attached to the housing 40 by inserting the mounting members 52 from the top face 47 side of the housing 40 into the mounting member attached parts 51 formed on the side faces 49, 50 of the housing. The connector 10 is thus assembled.

[0055] In the connector 10 of the embodiment, the case in which the three contacts are employed is explained. However, this invention is not limited to this case but also can be applied to the case in which four or more contacts are

employed.

[0056] Further, in the contact 11 of the embodiment, the case in which the bend parts constituting the joining parts are formed from the sheet body into the curved shape is explained. However, this invention is not limited to the above case but also can be applied to the case in which the joining parts are formed into a linearly bent shape.