[DESCRIPTION]

[Title of Invention]

CONTACT PIN AND SOCKET FOR INSPECTION

[Technical Field]

[0001]

The present invention relates to a contact pin and a socket for inspection.

[Background Art]

[0002]

Peripheral type IC packages such as a Quad Flat Package (QFP) or a Quad Flat Non-leaded package (QFN) have grounding pads called Exposed Pad (E-Pad) provided at the center on the back surface. Contact pins may be electrically contacted to such E-Pads for grounding and/or thermally contacted to the E-Pads for heat dissipation.

[0003]

Since only a limited space is available for mounting such a contact pin, probe type contact pins (for example, Patent Literature 1) have been conventionally employed.

[Citation List]

[Patent Literature]

[0004]

[PTL 1]

Japanese Patent Application Laid-Open No. 2021-42974

[Summary of Invention]

[Technical Problem]

[0005]

However, since a probe type contact pin is formed of three or more components including a plunger, a barrel, and a coil spring, for example, and employs an internal contact

system (a system in which the outer circumferential face of the plunger and the inner circumferential face of the barrel are contacted to each other), improvement on contact reliability is required.

[0006]

Accordingly, the present invention intends to provide a contact pin and a socket for inspection that can improve the contact reliability to an IC package.

[Solution to Problem]

[0007]

To achieve the above object, the contact pin and the socket for inspection of the present invention employ the following solutions.

That is, a contact pin according to the first aspect of the present invention includes a plurality of electrically conductive contacts, each of the contacts extending from a base end to a tip and having an elastic deformation part formed between the base end and the tip, and the elastic deformation part being elastically expandable and compressible in an extending direction, and the plurality of contacts are laterally stacked adjacent to each other and are movable independently of each other.

[0008]

According to the contact pin of the present aspect, since the plurality of contacts are laterally stacked adjacent to each other and are movable independently of each other, the contact pin can be in contact with the IC package at multiple contact points when a single contact is viewed as a single contact point. Further, the plurality of contacts can compensate distortion or variation in the extending direction (in the level). This can improve the contact reliability of the contact pin to the IC package.

Further, when each component is molded by press machining from a plate material, structural simplification, a cost reduction, a shorter delivery time, or the like can be realized.

[0009]

Further, the contact pin according to the second aspect of the present invention has: a compression interlock mechanism configured to, when one of the contacts is compressed by a predetermined amount, interlock the compressed contact and another contact adjacent to the compressed contact in a compression direction; and an expansion interlock mechanism configured to interlock one of the contacts and another contact adjacent to the one of the contacts in an expansion direction, in the contact pin according to the first aspect.

[0010]

According to the contact pin of the present aspect, since the contact has the compression interlock mechanism that, when one of the contacts is compressed by the predetermined amount, interlocks the compressed contact and the contact adjacent thereto in the compression direction, the elastic force thereof and the elastic force of the adjacent contact work on the compressed contact, and the contact pressure of the contact against the IC package can be increased.

Further, since the contact has the expansion interlock mechanism that interlocks a contact and another contact adjacent thereto in the expansion direction, even when the adjacent contact is stuck for some reason, the stuck can be eliminated by the expanded contact.

As described above, the use of the compression interlock mechanism and the expansion interlock mechanism can improve the contact reliability of the contact pin to the IC package.

[0011]

Further, in the contact pin according to the third aspect of the present invention, a contact of the plurality of contacts which has the base end at a higher height position in the extending direction and a contact of the plurality of contacts which has the base end at a

lower height position in the extending direction are alternatingly aligned and laterally stacked, in the contact pin according to the second aspect.

[0012]

According to the contact pin of the present aspect, since the contact having the base end at the higher height position in the extending direction and the contact having the base end at the lower height position in the extending direction are alternatingly aligned and laterally stacked, the elastic force of the shorter contact can be caused to work on the taller contact.

[0013]

Further, the contact pin according to the fourth aspect of the present invention has at least one casing that bundles the plurality of laterally stacked contacts, in the contact pin according to any one of the first aspect to the third aspect.

[0014]

According to the contact pin of the present aspect, since the casing that bundles the plurality of laterally stacked contacts is provided, the handleability of the laterally stacked contacts can be improved.

Further, the use of the casing as the function of a guide in expansion and compression of the contacts can improve the straightness of the contacts.

[0015]

Further, in the contact pin according to the fifth aspect of the present invention, the casing has a stopper configured to restrict an amount of compression of the contact, in the contact pin according to the fourth aspect.

[0016]

According to the contact pin of the present aspect, since the casing has the stopper configured to restrict the amount of compression of the contact, it is possible to prevent the

contact from being excessively compressed and damaged.

[0017]

Further, in the contact pin according to the sixth aspect of the present invention, the casing has a notch notched so as to expose a lower end of the elastic deformation part, in the contact pin according to the fourth aspect or the fifth aspect.

[0018]

According to the contact pin of the present aspect, since the casing has the notch notched so as to expose the lower end of the elastic deformation part, even when solder wicking or flux wicking occurs, the melted solder or flux flows so as to avoid the lower end of the elastic deformation part. Accordingly, the lower end of the elastic deformation part is not stuck by solder or flux, and desired elasticity can be exerted.

[0019]

Further, in the contact pin according to the seventh aspect of the present invention, the casing has a region having a lower wettability than other portions formed in a part of a portion located below the elastic deformation part of the contacts, in the contact pin according to the fourth aspect or the fifth aspect.

[0020]

According to the contact pin of the present aspect, since the casing has the region having a lower wettability than other portions formed in a part of a portion located below the elastic deformation part of the contacts, even when solder wicking or flux wicking occurs, the melted solder or flux is retained in the lower wettability region, and the elastic deformation part of the contact is not stuck by the solder or flux. Thus, desired elasticity can be exerted.

[0021]

Further, in the contact pin according to the eighth aspect of the present invention, the contact has a region having a lower wettability than other portions formed in a portion below

the elastic deformation part, in the contact pin according to any one of the first aspect to the seventh aspect.

[0022]

According to the contact pin of the present aspect, since the contact has the region having a lower wettability than other portions formed in a portion below the elastic deformation part, even when solder wicking or flux wicking occurs, the melted solder or flux is retained in the lower wettability region, and the elastic deformation part is not stuck by the solder or flux. Thus, desired elasticity can be exerted.

[0023]

Further, in the contact pin according to the ninth aspect of the present invention, each of the contacts has a protrusion protruding toward an adjacent contact of the contacts and configured to be contacted to the adjacent contact, in the contact pin according to any one of the first aspect to the eighth aspect.

[0024]

According to the contact pin of the present aspect, since each of the contacts has the protrusion protruding toward an adjacent contact of the contacts and configured to be contacted to the adjacent contact, a clearance can be provided between the contacts by the protrusion.

[0025]

Further, in the contact pin according to the tenth aspect of the present invention, the casing has a first plate-like part and a second plate-like part that face each other and between which the bundled contacts are arranged, the first plate-like part has a protrusion protruding toward the second plate-like part side, and the second plate-like part has a protrusion protruding toward the first plate-like part side, in the contact pin according to any one of the fourth aspect to the seventh aspect.

[0026]

According to the contact pin of the present aspect, since the first plate-like part has a protrusion protruding toward the second plate-like part side, and the second plate-like part has a protrusion protruding toward the first plate-like part side, a clearance can be provided between the casing and the contact by the protrusions.

[0027]

Further, the contact pin according to the eleventh aspect of the present invention has two casings, and in a state where both the casings overlap with each other, the first plate-like part of one of the casings faces the second plate-like part side of the other of the casings, and the second plate-like part of each of the casings faces the laterally stacked contacts, in the contact pin according to the tenth aspect.

[0028]

According to the contact pin of the present aspect, since two casings are provided and, in a state where both the casings overlap with each other, the first plate-like part of one of the casings faces the second plate-like part side of the other of the casings and the second plate-like part of each of the casings faces the laterally stacked contacts, a clearance can be provided between the casing and the contact or between the casings by the protrusions.

[0029]

Further, a socket for inspection according to the twelfth aspect of the present invention includes: contact pins according to any one of the first aspect to the eleventh aspect; and a housing configured to accommodate the contact pins.

[0030]

Further, in the socket for inspection according to the thirteenth aspect of the present invention, the housing has an upper housing and a lower housing that define a space in which the elastic deformation parts of the contact pins are accommodated, and the contact pins are

configured such that the elastic deformation parts are compressed by the upper housing and the lower housing, in the socket for inspection according to the twelfth aspect.

[Advantageous Effects of Invention]

[0031]

According to the present invention, the contact reliability to an IC package can be improved.

[Brief Description of Drawings]

[0032]

[Fig. 1]

Fig. 1 is a perspective view of a socket for inspection.

[Fig. 2]

Fig. 2 is a plan view of the socket for inspection.

[Fig. 3]

Fig. 3 is a longitudinal sectional view taken along the cut line III-III illustrated in Fig. 2.

[Fig. 4]

Fig. 4 is a longitudinal sectional view of the socket for inspection in a state where a movable housing has been pushed in.

[Fig. 5]

Fig. 5 is a longitudinal sectional view of the socket for inspection in a state where an IC package has been placed on a stage and the movable housing has been moved back to the original position.

[Fig. 6]

Fig. 6 is a perspective view in a state where electrical contacts and thermal contacts are laterally stacked.

[Fig. 7]

Fig. 7 is a perspective view of the contact pin.

[Fig. 8]

Fig. 8 is a perspective view of the electrical contact.

[Fig. 9]

Fig. 9 is a perspective view of the thermal contact.

[Fig. 10]

Fig. 10 is a perspective view of a state where electrical contacts and thermal contacts are aligned (state before laterally stacked).

[Fig. 11]

Fig. 11 is a top-right perspective view of a base end portion of the laterally stacked electrical contacts and thermal contacts.

[Fig. 12]

Fig. 12 is a top-left perspective view of the base end portion of the laterally stacked electrical contacts and thermal contacts.

[Fig. 13]

Fig. 13 is a front view of the base end portion of the laterally stacked electrical contacts and thermal contacts (before the electrical contact is pushed down).

[Fig. 14]

Fig. 14 is a front view of the base end portion of the laterally stacked electrical contacts and thermal contacts (after the electrical contact has been pushed down).

[Fig. 15]

Fig. 15 is a perspective view of the front side of a casing.

[Fig. 16]

Fig. 16 is a perspective view of the back side of the casing.

[Fig. 17]

Fig. 17 is a side view of the casing.

[Fig. 18]

Fig. 18 is a perspective view of a state where the laterally stacked electrical contacts and thermal contacts and the casing are aligned.

[Fig. 19]

Fig. 19 is a side view of the contact pin.

[Fig. 20]

Fig. 20 is a front view of the contact pin.

[Fig. 21]

Fig. 21 is a front view of the electrical contact.

[Fig. 22]

Fig. 22 is a front view of the casing.

[Fig. 23]

Fig. 23 is a back view of the casing.

[Fig. 24]

Fig. 24 is a front view for comparison between base end portions of the electrical contact, a shorter thermal contact, and a taller thermal contact.

[Fig. 25]

Fig. 25 is a table illustrating an example of combinations of the contacts.

[Fig. 26]

Fig. 26 is a top-right perspective view of base end portions of laterally stacked electrical contacts.

[Fig. 27]

Fig. 27 is a top-right perspective view of base end portions of laterally stacked

electrical contacts and taller thermal contacts.

[Fig. 28]

Fig. 28 is a top-right perspective view of base end portions of laterally stacked shorter thermal contacts and taller thermal contacts.

[Fig. 29]

Fig. 29 is a perspective view of a casing according to a modified example.

[Fig. 30]

Fig. 30 is a perspective view of the contact pin.

[Fig. 31]

Fig. 31 is a perspective view of the casing according to the modified example.

[Fig. 32]

Fig. 32 is a perspective view of the contact pin.

[Description of Embodiments]

[0033]

A contact pin and a socket for inspection according to one embodiment of the present invention will be described below with reference to the drawings.

[0034]

[Configuration of socket for inspection]

A socket for inspection 10 is a device for electrically connecting an IC package 20 and a printed wiring board (inspection board) to each other.

The IC package 20 is of the peripheral type such as a QFP or a QFN, for example.

[0035]

As illustrated in Fig. 1 to Fig. 5, the socket for inspection 10 as an example has a lower housing 11, an upper housing 12, a stage 13, a movable housing 14, and a contact pin 100.

[0036]

The lower housing 11 is a component placed on an inspection board (not illustrated) and serves as a base of the socket for inspection 10.

[0037]

As illustrated in Fig. 1 and Fig. 3 to Fig. 5, a lower recess 11a and a lower through hole 11b are formed inside the lower housing 11.

The lower recess 11a is a portion in which a part of the contact pin 100 is accommodated and is a hollow having an opening facing the upper housing 12.

The lower through hole 11b is a through hole extending downward from the bottom of the lower recess 11a and reaching the outside of the lower housing 11.

[0038]

The upper housing 12 is a component installed from above the lower housing 11. The upper housing 12 is configured to be able to vertically move closer to or away from the lower housing 11. Note that the upper housing 12 is pushed upward by a pushing member (not illustrated), thus is most distant from the lower housing 11 when no load is applied (see Fig. 3 and Fig. 5), and comes closer to the lower housing 11 by being pushed downward (see Fig. 4).

[0039]

An upper recess 12a and an upper through hole 12b are formed inside the upper housing 12.

The upper recess 12a is a portion in which the contact pin 100 described later is accommodated and is a hollow having an opening facing the lower housing 11.

The upper through hole 12b is a through hole extending upward from the top surface of the upper recess 12a and reaching the outside of the upper housing 12.

[0040]

The stage 13 is a component on which the IC package 20 is placed, and the stage 13 is installed above the upper housing 12.

The stage 13 is fixed to the lower housing 11.

[0041]

The movable housing 14 is a component installed above the stage 13. The movable housing 14 is configured to be able to vertically move closer to or away from the lower housing 11. Note that the movable housing 14 is pushed upward by a pushing member (not illustrated), thus is most distant from the lower housing 11 when no load is applied (see Fig. 3 and Fig. 5), and comes closer to the lower housing 11 by being pushed downward (see Fig. 4).

[0042]

As illustrated in Fig. 1 to Fig. 5, a package accommodating part 14a is formed in the movable housing 14.

The package accommodating part 14a is an opening that enables access to the stage 13 from above.

[0043]

As illustrated in Fig. 5, the contact pin 100 is a component that is thermally and/or electrically contacted to a pad (E-Pad) provided at the center on the back surface of the IC package 20.

As illustrated in Fig. 3, the contact pin 100 is provided to the socket for inspection 10 in a state where the middle portion of the contact pin 100 is accommodated and held in an accommodating space 15 defined by the lower recess 11a and the upper recess 12a and the tip portion of the contact pin 100 protrudes out of the lower through hole 11b and in a state where the base end portion of the contact pin 100 protrudes out of the upper through hole 12b.

The detailed configuration of the contact pin 100 will be described later.

[0044]

As illustrated in Fig. 1 to Fig. 5, a number of peripheral contact pins 16 held by the lower housing 11 are arranged around the stage 13.

The tips (upper ends) of the peripheral contact pins 16 are configured such that, when the movable housing 14 is pushed into the lower housing 11 side, the tips are moved outward away from the circumferential edge of the stage 13 and accommodated in the circumferential wall of the lower housing 11 (see Fig. 4). Further, the tips of the peripheral contact pins 16 are configured such that, when the movable housing 14 is moved back to the original position, the tips come close to the circumferential edge of the stage 13 and protrude from the circumferential wall of the lower housing 11 (see Fig. 3 and Fig. 5).

[0045]

Before the IC package 20 is placed on the socket for inspection 10, first, the movable housing 14 is pushed into the lower housing 11 side to separate the tip of each peripheral contact pin 16 from the circumferential edge of the stage 13, as illustrated in Fig. 4. Accordingly, a width through which the IC package 20 can be accepted is ensured above the stage 13.

[0046]

Further, when the movable housing 14 is pushed into, the upper housing 12 is also pushed into the lower housing 11 side. In response, the accommodating space 15 in which the middle portion of the contact pin 100 is accommodated are vertically reduced in volume.

At this time, the contact pin 100 (in detail, elastic deformation parts 112, 122 described later) is compressed in accordance with the reduction of the accommodating space 15.

[0047]

Next, as illustrated in Fig. 5, after the IC package 20 is placed on the stage 13, the movable housing 14 is moved back to the original position.

At this time, since the tip of each peripheral contact pins 16 is also moved back to the original position, the tip of each peripheral contact pin 16 is contacted to a lead wire extending from the circumferential edge of the IC package 20. Further, at the same time, the IC package 20 is pushed against the stage 13.

[0048]

Further, when the movable housing 14 has moved back to the original position, the upper housing 12 has also moved back to the original position. In response, the accommodating space 15 in which the middle portion of the contact pin 100 is accommodated expands vertically (back to the original state).

Since the IC package 20 is installed on the stage 13, however, the contact pin 100 (in detail, elastic deformation parts 112, 122 described later) maintains the state compressed by the IC package 20.

[0049]

Note that the contact pin 100 is obviously also applicable to other forms of sockets for inspection than the socket for inspection 10 described above.

Herein, other forms of sockets for inspection are, for example, sockets for inspection having a form in which the probe type contact pin as a peripheral contact pin is located below the IC package 20 and, when the IC package 20 is pushed from above by a latch or a pusher, the contact pin 100 and the peripheral contact pin come into contact with terminals or lead wires of the IC package 20.

[0050]

[Details of contact pin]

As illustrated in Fig. 6, the contact pin 100 has electrical contacts (contacts) 110 and

thermal contacts (contacts) 120, for example, which are alternatingly, laterally stacked to form the contact pin 100.

Further, as illustrated in Fig. 7, the contact pin 100 may have a casing 140 that bundles the electrical contacts 110 and the thermal contacts 120.

Note that the terms of “electrical” and “thermal” are used for convenience in order to distinguish the types of contacts from each other and are not intended to limit the use thereof.

[0051]

< Electrical contact >

As illustrated in Fig. 8, each electrical contact 110 is a thin plate-like component extending in a predetermined direction (the vertical direction in Fig. 8).

The electrical contact 110 mainly has a function of conducting electricity in the contact pin 100 (electrical contacting).

The electrical contact 110 has electrical conductivity and is formed such that Ni plating as an undercoat is applied to a substrate of a Cu based material (for example, beryllium copper), and plating whose main component is an Au based material is applied to the surface of the Ni layer. Note that these materials are mere examples.

[0052]

The electrical contact 110 has a base end side plate-like part 111 located on the upper end side, an elastic deformation part 112 located at the middle, and a tip side plate-like part 113 located on the lower end side.

[0053]

The base end side plate-like part 111 is a portion that is contacted to the IC package 20.

A rectangular wider part 111a is formed in the lower part of the base end side plate-like part 111, and the external shape thereof is substantially an inverse-T shape.

[0054]

An upper claw 111b, an upper notch 111c, a lower claw 111d, a lower notch 111e, and contact protruding parts 111f are formed in the portion of the base end side plate-like part 111 above the wider part 111a.

[0055]

The upper claw 111b is a portion having a shape such that a part of a first side face of the base end side plate-like part 111 is bent in a direction orthogonal to the extending direction of the electrical contact 110. In the case of Fig. 8, a part of the right face of the base end side plate-like part 111 is bent to the front, and thereby the upper claw 111b is formed.

[0056]

The upper notch 111c is a portion having a shape such that a second side face of the base end side plate-like part 111 is partially notched. In the case of Fig. 8, the left face of the base end side plate-like part 111 is partially notched, and thereby the upper notch 111c is formed.

The upper notch 111c is formed at substantially the same height position as that of the upper claw 111b.

[0057]

The lower claw 111d is a portion having a shape such that a part of the second side face of the base end side plate-like part 111 is bent to a direction orthogonal to the extending direction of the electrical contact 110 and a direction opposite to the upper claw 111b. In the case of Fig. 8, a part of the left face of the base end side plate-like part 111 is bent to the backside, and thereby the lower claw 111d is formed.

The lower claw 111d is formed below the upper notch 111c.

[0058]

The lower notch 111e is a portion having a shape such that the first side face of the base end side plate-like part 111 is partially notched. In the case of Fig. 8, the right face of the base end side plate-like part 111 is partially notched, and thereby the lower notch 111e is formed.

The lower notch 111e is formed at substantially the same height position as that of the lower claw 111d.

[0059]

The contact protruding parts 111f are portions protruding in the extending direction of the electrical contact 110 from the top face of the base end side plate-like part 111. In Fig. 8, substantially triangular two contact protruding parts 111f are formed on the top face of the base end side plate-like part 111.

The contact protruding parts 111f have a function of physically contacting the IC package 20 in the electrical contact 110.

Although the shape of the contact protruding part 111f or the number of contact protruding parts 111f is not limited to that in the form of Fig. 8, it is preferable to form the contact protruding parts 111f so as to have a small contact area with the IC package 20 in terms of increasing the contact pressure and ensuring the contact reliability.

[0060]

Protrusions 111g and protrusions 111h are formed arranged in a staggered manner on the surface of the base end side plate-like part 111.

Each of the protrusions 111g is a portion protruding in the plate thickness direction from the surface of the base end side plate-like part 111. The protruding amount of the protrusion 111g is smaller than the plate thickness of the electrical contact 110. The protrusion 111g is a part that is contacted to the surface of the base end side plate-like part 121 of the adjacent thermal contact 120.

Each of the protrusions 111h is a portion protruding in the plate thickness direction and the direction opposite to the protrusions 111g from the surface of the base end side plate-like part 111. The protruding amount of the protrusion 111h is substantially the same as that of the protrusion 111g. The protrusion 111h is a part that is contacted to the surface of the base end side plate-like part 121 of the adjacent thermal contact 120. Note that the thermal contact 120 to which the protrusions 111h is contacted is different from the thermal contact 120 to which the protrusions 111g is contacted.

In the case of Fig. 8, although the protrusions 111g protrude on the front side and the protrusions 111h protrude on the backside, these protrusion directions are mere examples.

[0061]

The elastic deformation part 112 is an elastically expandable or compressible portion. In the case of Fig. 8, the elastic deformation part 112 is a bellows-like plate spring having an upper end 112a connected to the bottom face of the wider part 111a of the base end side plate-like part 111 and a lower end 112b connected to the tip side plate-like part 113 (in detail, the top face of the wider part 113a of the tip side plate-like part 113).

Note that the shape of the elastic deformation part 112 is not limited to a bellows-like plate spring.

[0062]

The tip side plate-like part 113 is a portion that is contacted to an inspection board.

A rectangular wider part 113a is formed in the upper part of the tip side plate-like part 113, and the external shape thereof is substantially a T shape.

[0063]

An upper claw 113b, an upper notch 113c, a lower claw 113d, a lower notch 113e, and a press-fit claw 113h are formed in a portion of the tip side plate-like part 113 below the wider part 113a.

[0064]

The upper claw 113b is a portion having a shape such that a part of a first side face of the tip side plate-like part 113 is bent in a direction orthogonal to the extending direction of the electrical contact 110. In the case of Fig. 8, a part of the right face of the tip side plate-like part 113 is bent to the front, and thereby the upper claw 113b is formed.

[0065]

The upper notch 113c is a portion having a shape such that a second side face of the tip side plate-like part 113 is partially notched. In the case of Fig. 8, the left face of the tip side plate-like part 113 is partially notched, and thereby the upper notch 113c is formed.

The upper notch 113c is formed at substantially the same height position as that of the upper claw 113b.

[0066]

The lower claw 113d is a portion having a shape such that a part of the second side face of the tip side plate-like part 113 is bent to a direction orthogonal to the extending direction of the electrical contact 110 and a direction opposite to the upper claw 113b. In the case of Fig. 8, a part of the left face of the tip side plate-like part 113 is bent to the backside, and thereby the lower claw 113d is formed.

The lower claw 113d is formed below the upper notch 113c.

[0067]

The lower notch 113e is a portion having a shape such that the first side face of the tip side plate-like part 113 is partially notched. In the case of Fig. 8, the right face of the tip side plate-like part 113 is partially notched, and thereby the lower notch 113e is formed.

The lower notch 113e is formed at substantially the same height position as that of the lower claw 113d.

[0068]

The press-fit claw 113h is a protrusion formed in at least one of the first side face and the second side face of the tip side plate-like part 113 below the wider part 113a and above the upper notch 113c. Note that the press-fit claw 113h may be formed below the upper notch 113c in accordance with the space.

The press-fit claw 113h has a function of locking the electrical contact 110 to the lower housing 11. Note that, when it is not required to lock the electrical contact 110 to the lower housing 11, the press-fit claw 113h may be omitted.

[0069]

Protrusions 113i and protrusions 113j are formed arranged in a staggered manner on the surface of the tip side plate-like part 113.

Each of the protrusions 113i is a portion protruding in the plate thickness direction from the surface of the tip side plate-like part 113. The protruding amount of the protrusion 113i is smaller than the plate thickness of the electrical contact 110 and substantially the same as that of the protrusion 111g of the base end side plate-like part 111. The protrusion 113i is a part that is contacted to the surface of the tip side plate-like part 123 of the adjacent thermal contact 120.

Each of the protrusions 113j is a portion protruding in the plate thickness direction and the direction opposite to the protrusions 113i from the surface of the tip side plate-like part 113. The protruding amount of the protrusion 113j is substantially the same as that of the protrusion 113i. The protrusion 113j is a part that is contacted to the surface of the tip side plate-like part 123 of the adjacent thermal contact 120. Note that the thermal contact 120 to which the protrusions 113j is contacted is different from the thermal contact 120 to which the protrusions 113i is contacted.

In the case of Fig. 8, although the protrusions 113i protrude on the front side and the protrusions 113j protrude on the backside, these protrusion directions are mere examples.

[0070]

The electrical contact 110 is molded by, for example, press machining from a plate material that becomes the substrate.

Accordingly, a large number of electrical contacts 110 can be produced with high accuracy and with suppressed variation among products.

[0071]

< Thermal contact >

As illustrated in Fig. 9, each thermal contact 120 is a thin plate-like component extending in a predetermined direction (the vertical direction in Fig. 9). The external shape of the thermal contact 120 substantially matches the external shape of the turned-over electrical contact 110 except for the upper part of the base end side plate-like part 121.

The thermal contact 120 mainly has a function of transferring heat in the contact pin 100 (thermal contacting).

The thermal contact 120 has electrical conductivity and is formed such that Ni plating as an undercoat is applied to a substrate of a Cu based material (for example, beryllium copper), and plating whose main component is an Au based material is applied to the surface of the Ni layer. Note that these materials are mere examples.

[0072]

The thermal contact 120 has the base end side plate-like part 121 located on the upper end side, an elastic deformation part 122 located at the middle, and a tip side plate-like part 123 located on the lower end side.

[0073]

The base end side plate-like part 121 is a portion that is contacted to the IC package 20.

A rectangular wider part 121a is formed in the lower part of the base end side plate-

like part 121, and the external shape thereof is substantially an inverse-T shape.

[0074]

An upper claw 121b, an upper notch 121c, a lower claw 121d, and a lower notch 121e are formed in the portion of the base end side plate-like part 121 above the wider part 121a.

[0075]

The upper claw 121b is a portion having a shape such that a part of a first side face of the base end side plate-like part 121 is bent in a direction orthogonal to the extending direction of the thermal contact 120. In the case of Fig. 9, a part of the left face of the base end side plate-like part 121 is bent to the backside, and thereby the upper claw 121b is formed.

[0076]

The upper notch 121c is a portion having a shape such that a second side face of the base end side plate-like part 121 is partially notched. In the case of Fig. 9, the right face of the base end side plate-like part 121 is partially notched, and thereby the upper notch 121c is formed.

The upper notch 121c is formed at substantially the same height position as that of the upper claw 121b.

[0077]

The lower claw 121d is a portion having a shape such that a part of the second side face of the base end side plate-like part 121 is bent to a direction orthogonal to the extending direction of the thermal contact 120 and a direction opposite to the upper claw 121b. In the case of Fig. 9, a part of the right face of the base end side plate-like part 121 is bent to the front, and thereby the lower claw 121d is formed.

The lower claw 121d is formed below the upper notch 121c.

[0078]

The lower notch 121e is a portion having a shape such that the first side face of the base end side plate-like part 121 is partially notched. In the case of Fig. 9, the left face of the base end side plate-like part 121 is partially notched, and thereby the lower notch 121e is formed.

The lower notch 121e is formed at substantially the same height position as that of the lower claw 121d.

[0079]

Note that no portion corresponding to the contact protruding part 111f is formed on the top face of the base end side plate-like part 121. That is, the top face of the base end side plate-like part 121 is formed planar.

[0080]

A plurality of protrusions 121g and a plurality of protrusions 121h are formed arranged in a staggered manner on the surface of the base end side plate-like part 121.

Each of the protrusions 121g is a portion protruding in the plate thickness direction from the surface of the base end side plate-like part 121. The protruding amount of the protrusion 121g is smaller than the plate thickness of the thermal contact 120. The protrusion 121g is a part that is contacted to the surface of the base end side plate-like part 111 of the adjacent electrical contact 110.

Each of the protrusions 121h is a portion protruding in the plate thickness direction and the direction opposite to the protrusions 121g from the surface of the base end side plate-like part 121. The protruding amount of the protrusion 121h is substantially the same as that of the protrusion 121g. The protrusion 121h is a part that is contacted to the surface of the base end side plate-like part 111 of the adjacent electrical contact 110. Note that the electrical contact 110 to which the protrusions 121h is contacted is different from the electrical contact 110 to which the protrusions 121g is contacted.

In the case of Fig. 9, although the protrusions 121g protrude on the front side and the protrusions 121h protrude on the backside, these protrusion directions are mere examples.

Note that the shape of each protrusion, the number of protrusions, and the arrangement of the protrusions are not limited to the depicted form.

[0081]

The elastic deformation part 122 is an elastically expandable or compressible portion. In the case of Fig. 9, the elastic deformation part 122 is a bellows-like plate spring having an upper end 122a connected to the bottom face of the wider part 121a of the base end side plate-like part 121 and a lower end 122b connected to the tip side plate-like part 123 (in detail, the top face of the wider part 123a of the tip side plate-like part 123).

Note that the shape of the elastic deformation part 122 is not limited to a bellows-shaped plate spring.

[0082]

The tip side plate-like part 123 is a portion that is contacted to an inspection board.

A rectangular wider part 123a is formed in the upper part of the tip side plate-like part 123, and the external shape thereof is substantially a T shape.

[0083]

An upper claw 123b, an upper notch 123c, a lower claw 123d, a lower notch 123e, and a press-fit claw 123h are formed in a portion of the tip side plate-like part 123 below the wider part 123a.

[0084]

The upper claw 123b is a portion having a shape such that a part of a first side face of the tip side plate-like part 123 is bent in a direction orthogonal to the extending direction of the thermal contact 120. In the case of Fig. 9, a part of the left face of the tip side plate-like part 123 is bent to the backside, and thereby the upper claw 123b is formed.

[0085]

The upper notch 123c is a portion having a shape such that a second side face of the tip side plate-like part 123 is partially notched. In the case of Fig. 9, the right face of the tip side plate-like part 123 is partially notched, and thereby the upper notch 123c is formed.

The upper notch 123c is formed at substantially the same height position as that of the upper claw 123b.

[0086]

The lower claw 123d is a portion having a shape such that a part of the second side face of the tip side plate-like part 123 is bent to a direction orthogonal to the extending direction of the thermal contact 120 and a direction opposite to the upper claw 123b. In the case of Fig. 9, a part of the right face of the tip side plate-like part 123 is bent to the front, and thereby the lower claw 123d is formed.

The lower claw 123d is formed below the upper notch 123c.

[0087]

The lower notch 123e is a portion having a shape such that the first side face of the tip side plate-like part 123 is partially notched. In the case of Fig. 9, the left face of the tip side plate-like part 123 is partially notched, and thereby the lower notch 123e is formed.

The lower notch 123e is formed at substantially the same height position as that of the lower claw 123d.

[0088]

The press-fit claw 123h is a protrusion formed in at least one of the first side face and the second side face of the tip side plate-like part 123 below the wider part 123a and above the upper notch 123c. Note that the press-fit claw 123h may be formed below the upper notch 123c in accordance with the space.

The press-fit claw 123h has a function of locking the thermal contact 120 to the lower

housing 11. Note that, when it is not required to lock the thermal contact 120 to the lower housing 11, the press-fit claw 123h may be omitted.

[0089]

A plurality of protrusions 123i and a plurality of protrusions 123j are formed arranged in a staggered manner on the surface of the tip side plate-like part 123.

Each of the protrusions 123i is a portion protruding in the plate thickness direction from the surface of the tip side plate-like part 123. The protruding amount of the protrusion 123i is smaller than the plate thickness of the thermal contact 120 and substantially the same as that of the protrusion 121g of the base end side plate-like part 121. The protrusion 123i is a part that is contacted to the surface of the tip side plate-like part 113 of the adjacent electrical contact 110.

Each of the protrusions 123j is a portion protruding in the plate thickness direction and the direction opposite to the protrusions 123i from the surface of the tip side plate-like part 123. The protruding amount of the protrusion 123j is substantially the same as that of the protrusion 123i. The protrusion 123j is a part that is contacted to the surface of the tip side plate-like part 113 of the adjacent electrical contact 110. Note that the electrical contact 110 to which the protrusions 123j is contacted is different from the electrical contact 110 to which the protrusions 123i is contacted.

In the case of Fig. 9, although the protrusions 123i protrude on the front side and the protrusions 123j protrude on the backside, these protrusion directions are mere examples.

Note that the shape of each protrusion, the number of protrusions, and the arrangement of the protrusions are not limited to the depicted form.

[0090]

The thermal contact 120 is molded by, for example, press machining from a plate material that becomes the substrate.

Accordingly, a large number of thermal contacts 120 can be produced with high accuracy and with suppressed variation among products.

[0091]

The thermal contact 130 described later also has the same configuration as the thermal contact 120 except for the dimension (the height position of the upper end) of the base end side plate-like part 131.

[0092]

< Interlocking mechanism >

The electrical contacts 110 and the thermal contacts 120 configured as described above are aligned alternatingly in the plate thickness direction as illustrated in Fig. 10 and laterally stacked as illustrated in Fig. 6.

[0093]

In this state, as illustrated in Fig. 11 to Fig. 13, the contact pin 100 has the following structural features in a state where the electrical contacts 110 and the thermal contacts 120 are alternatingly, laterally stacked.

[0094]

That is, the upper claw 111b engages in the upper notch 121c adjacent thereto in front, the upper claw 121b engages in the upper notch 111c adjacent thereto on backside, the lower claw 111d engages in the lower notch 121e adjacent thereto on backside, and the lower claw 121d engages in the lower notch 111e adjacent thereto in front.

[0095]

In this state, as illustrated in Fig. 13, the lower claw 121d and the lower notch 111e are designed in the dimensions so that the lower end of the lower claw 121d is contacted to the lower end of the lower notch 111e adjacent in front in a state where the positions of the top face of the wider part 111a and the top face of the wider part 121a are matched. In Fig.

13, a contact part between a notch and a claw is indicated by a circle of a two-dot chain line.

Further, the upper claw 111b and the upper notch 121c are designed in the dimensions so as not to be contacted to each other in a state where the positions of the top face of the wider part 111a and the top face of the wider part 121a are matched.

Further, the upper claw 121b and the upper notch 111c are designed in the dimensions so as not to be contacted to each other in a state where the positions of the top face of the wider part 111a and the top face of the wider part 121a are matched.

Further, the lower claw 111d and the lower notch 121e are designed in the dimensions so as not to be contacted to each other in a state where the positions of the top face of the wider part 111a and the top face of the wider part 121a are matched.

[0096]

As illustrated in Fig. 11 to Fig. 13, in a state where the positions of the top face of the wider part 111a and the top face of the wider part 121a are matched, the upper end (the apexes of the contact protruding parts 111f) of the base end side plate-like part 111 is located above the upper end (the top face) of the base end side plate-like part 121. That is, the electrical contact 110 is designed to be taller than the thermal contact 120.

[0097]

Note that, in Fig. 13, the cross-hatched region (component) represents the thermal contact 120. Further, the white region (component) displayed in a part of the cross-hatched region represents a part of the electrical contact 110 in front of and adjacent to the cross-hatched thermal contact 120. That is, Fig. 13 displays three components, namely, an electrical contact 110, a thermal contact 120, and another electrical contact 110 from back to front. The same applies to Fig. 14.

[0098]

As illustrated in Fig. 3, in the contact pin 100 configured as described above, a

portion from the wider part 111a to the wider part 113a of the electrical contact 110 and a portion from the wider part 121a to the wider part 123a of the thermal contact 120 (collectively, referred to as “middle portion of the contact pin 100”) are accommodated in the accommodating space 15 defined by the lower recess 11a and the upper recess 12a.

[0099]

In this state, the top face of each wider part 111a and the top face of each wider part 121a are in contact with the top surface of the upper recess 12a, and the positions thereof are matched. Further, the bottom face of each wider part 113a and the bottom face of each wider part 123a are in contact with the bottom surface of the lower recess 11a, and the positions thereof are matched.

Further, in this state, the elastic deformation part 112 of the electrical contact 110 and the elastic deformation part 122 of the thermal contact 120 are compressed, and the electrical contact 110 and the thermal contact 120 are shorter than the natural lengths thereof. That is, this is a state where a preload is applied to the electrical contact 110 and the thermal contact 120.

Note that application of a preload is not essential. In such a case, each length of the elastic deformation part 112 of the electrical contact 110 and the elastic deformation part 122 of the thermal contact 120 is substantially the same as the natural length thereof when accommodated in the accommodating space 15.

[0100]

Further, when the middle portion of the contact pin 100 is accommodated in the accommodating space 15, a portion of the base end side plate-like part 111 above the wider part 111a and a portion of the base end side plate-like part 121 above the wider part 121a (collectively, referred to as “base end portion of the contact pin 100”) are inserted in the upper through hole 12b of the upper housing 12, and the ends thereof protrude out of the

upper housing 12.

[0101]

Further, when the middle portion of the contact pin 100 is accommodated in the accommodating space 15, a portion of the tip side plate-like part 113 below the wider part 113a and a portion of the tip side plate-like part 123 below the wider part 123a (collectively, referred to as “tip portion of the contact pin 100”) are inserted in the lower through hole 11b of the lower housing 11, and the ends thereof protrude out of the lower housing 11.

Further, when the press-fit claw 113h and the press-fit claw 123h have been formed, the press-fit claw 113h and the press-fit claw 123h engage into the circumferential wall of the lower through hole 11b, and thereby the contact pin 100 is locked to the lower housing 11.

[0102]

Next, the motion of the contact pin 100 will be described.

As illustrated in Fig. 13, in a state where the position of the top face of the wider part 111a and the top face of the wider part 121a are matched, since the upper end of the base end side plate-like part 111 is located above the upper end of the base end side plate-like part 121, the electrical contact 110 first comes into contact with the IC package 20 in the case where the IC package 20 is mounted in the socket for inspection 10 (see Fig. 5).

[0103]

In the process after the electrical contact 110 has come into contact with the IC package 20, the electrical contact 110 and the thermal contact 120 move as follows.

[0104]

[When electrical contacts are pushed down (contact pins are compressed)]

As illustrated in Fig. 13 and Fig. 14, first, only the electrical contact 110 is pushed down by the IC package 20, and the elastic deformation part 112 is compressed.

At this time, the electrical contact 110 is movable independently of the thermal

contact 120. That is, during the process in which only the electrical contact 110 is being pushed down by the IC package 20, the electrical contact 110 slides against the thermal contact 120.

[0105]

Afterwards, when the electrical contact 110 has been pushed down by a predetermined amount, the lower end of the upper claw 111b comes into contact with the lower end of the upper notch 121c adjacent thereto in front, and the upper end of the upper claw 121b comes into contact with the upper end of the upper notch 111c adjacent thereto on backside. Further, in response to the electrical contact 110 being lowered, the lower end of the lower notch 111e is spaced away from the lower end of the lower claw 121d adjacent thereto on backside.

In Fig. 14, a contact part between a notch and a claw is indicated by a circle of a two-dot chain line.

[0106]

Note that the “predetermined amount” is determined by the distance between the lower end of the upper claw 111b and the lower end of the adjacent upper notch 121c (the distance between the lower end of the upper claw 121b and the lower end of the adjacent upper notch 111c) in a state where the positions of the top face of the wider part 111a and the top face of the wider part 121a are matched.

Further, the “predetermined amount” is smaller than the final displacement by which the electrical contact 110 is pushed down by the IC package 20.

[0107]

Next, when the electrical contact 110 has been further pushed down (that is, the electrical contact 110 has been pushed down beyond the predetermined amount), since the lower end of the upper claw 111b is in contact with the lower end of the upper notch 121c

and the upper end of the upper notch 111c is in contact with the upper end of the upper claw 121b, the electrical contact 110 will be further pushed down while interlocked with the thermal contact 120.

That is, when the electrical contact 110 has been pushed down beyond the predetermined amount, the electrical contact 110 and the thermal contact 120 are interlocked in the direction in which the electrical contact 110 is pushed down.

[0108]

When the electrical contact 110 and the thermal contact 120 are interlocked, the electrical contact 110 is subjected not only to restoring force of the elastic deformation part 112 of its own but also to restoring force of the elastic deformation part 122 of the thermal contact 120 via the contact part. That is, the contact pressure of the electrical contact 110 against the IC package 20 increases, and this improves the electrical contact property.

[0109]

[When electrical contacts are moved back to the original position (contact pins are expanded)]

When the electrical contact 110 is moved back to the original position from being pushed down beyond the predetermined amount, the electrical contact 110 and the thermal contact 120 are usually expanded at the same time and moved back to the original position.

[0110]

However, when the thermal contact 120 is stuck (which is a phenomenon of being caught) for some reason, only the electrical contact 110 continues to move back to the original position. Thus, in the process in which the electrical contact 110 is being expanded, the lower end of the lower notch 111e comes into contact with the lower end of the lower claw 121d adjacent thereto on backside.

In response, the stuck thermal contact 120 is subjected to the restoring force of the

elastic deformation part 112 of the electrical contact 110 via the contact part.

Thus, the thermal contact 120 is moved back to the original position while being interlocked with the electrical contact 110. That is, the stuck state of the thermal contact 120 is eliminated.

[0111]

Further, even when the electrical contact 110 is stuck for some reason, the lower end of the upper notch 121c is in contact with the lower end of the upper claw 111b adjacent thereto on backside, and the upper end of the upper claw 121b is in contact with the upper end of the upper notch 111c adjacent on backside. Thus, the stuck electrical contact 110 is subjected to the restoring force of the elastic deformation part 122 of the thermal contact 120 via the contact part.

Thus, the electrical contact 110 is moved back to the original position while being interlocked with the thermal contact 120. That is, the stuck state of the electrical contact 110 is eliminated.

[0112]

To summarize the above, with the upper claw 111b engaged in the upper notch 121c, the upper claw 121b engaged into the upper notch 111c, the lower claw 111d engaged into the lower notch 121e, and the lower claw 121d engaged into the lower notch 111e, the followings are configured:

(1) a mechanism (compression interlock mechanism) that interlocks the electrical contact 110 and the thermal contact 120 adjacent thereto in the compression direction when the electrical contact 110 is pushed down (compressed) by a predetermined amount, and

(2) a mechanism (expansion interlock mechanism) that interlocks the electrical contact 110 and the thermal contact 120 adjacent thereto in the expansion direction when the electrical contact 110 is moved back to the original position from being pushed down beyond

the predetermined amount.

[0113]

Note that a similar interlock mechanism can be employed also for the tip side plate-like part 113 of the electrical contact 110 and the tip side plate-like part 123 of the thermal contact 120.

[0114]

In the process of the contact pin 100 being compressed or expanded, the laterally stacked electrical contacts 110 and thermal contacts 120 may slide against each other.

At this time, as illustrated in Fig. 8 and Fig. 9, the protrusions 111g and the protrusions 111h provided to the base end side plate-like part 111, the protrusions 121g and the protrusions 121h provided to the base end side plate-like part 121, the protrusions 113i and the protrusions 113j provided to the tip side plate-like part 113, and the protrusions 123i and the protrusions 123j provided to the tip side plate-like part 123 function as follows.

[0115]

As illustrated in Fig. 10, the base end side plate-like part 111 is in contact with the base end side plate-like part 121 adjacent on backside via the protrusions 111h. Further, the base end side plate-like part 111 is in contact with the base end side plate-like part 121 adjacent in front via the protrusions 111g. Further, the base end side plate-like part 121 is in contact with the base end side plate-like part 111 adjacent on backside via the protrusions 121h. Further, the base end side plate-like part 121 is in contact with the base end side plate-like part 111 adjacent in front via the protrusions 121g.

In the same manner to the above, the tip side plate-like part 113 is in contact with the tip side plate-like part 123 adjacent on backside via the protrusions 113j. Further, the tip side plate-like part 113 is in contact with the tip side plate-like part 123 adjacent in front via the protrusions 113i. Further, the tip side plate-like part 123 is in contact with the tip side

plate-like part 113 adjacent on backside via the protrusions 123j. Further, the tip side plate-like part 123 is in contact with the tip side plate-like part 113 adjacent in front via the protrusions 123i.

Further, the protruding amounts of respective protrusions are substantially the same.

[0116]

Note that, in Fig. 10, the protrusion 111h and the protrusion 113j indicated by two-dot chain lines represent a view of the protrusion 111h and the protrusion 113j of the adjacent electrical contact 110 in contact. Further, the protrusion 121h and the protrusion 123j indicated by two-dot chain lines represent a view of the protrusion 121h and the protrusion 123j of the adjacent thermal contact 120 in contact.

[0117]

The protrusions 111h, the protrusions 113j, the protrusions 121h, and the protrusions 123j are arranged so as not to interfere with each other when the electrical contacts 110 and the thermal contacts 120 are laterally stacked. Similarly, although not illustrated, the protrusions 111g, the protrusions 113i, the protrusions 121g, and the protrusions 123i are arranged so as not to interfere with each other when the electrical contacts 110 and the thermal contacts 120 are laterally stacked.

[0118]

As described above, because such protrusions are provided, sliding parts are limited to these protrusions on the base end side plate-like part 111 and the base end side plate-like part 121. Thus, sliding with a large face can be avoided, and the sliding area can be reduced.

Herein, in terms of reducing the sliding area, it is preferable that respective protrusions (in particular, the protrusion 111g, the protrusion 111h, the protrusion 121g, and the protrusion 121h) have a shape such that the contact part is close to a point as much as

possible, such as being tapered in the protruding direction, being hemispherical, or the like.

[0119]

Furthermore, because such protrusions are provided, a clearance is ensured between the electrical contact 110 and the thermal contact 120. Further, the distance (the dimension of the clearance) between the electrical contact 110 and the thermal contact 120 can be determined by the protruding amount of these protrusions.

By suitably setting this clearance, that is, by suitably setting the protruding amount of each protrusion, it is possible to prevent melted solder or flux from rising in the clearance due to a capillary phenomenon when the socket for inspection 10 is mounted on the printed wiring board.

[0120]

Further, because such a clearance is provided, the electrical contact 110 and the thermal contact 120 are spaced away from each other in the plate thickness direction, and therefore, a larger bending amount can be ensured for each claw (the upper claw 111b, the lower claw 111d, the upper claw 113b, the lower claw 113d, the upper claw 121b, the lower claw 121d, the upper claw 123b, and the lower claw 123d). A smaller bending amount may make it difficult to bend each claw in press machining and result in a poor machining property. Accordingly, the bending amount is ensured as large as possible, and thereby the machining property in press machining is improved.

[0121]

Further, because such a clearance is provided, interference with a punching burr occurring on the thermal contact 120 or the electrical contact 110 facing the electrical contact 110 or the thermal contact 120 can be avoided.

[0122]

Further, because such a clearance is provided, vibration (motion in the plate thickness

direction) of the elastic deformation part 112 of the electrical contact 110 or the elastic deformation part 122 of the thermal contact 120 can be absorbed by the clearance.

[0123]

Note that, when the protruding amounts are made equal for all the protrusions, the electrical contact 110 and the thermal contact 120 are made parallel. In detail, the base end side plate-like part 111 and the base end side plate-like part 121 are made parallel, and the tip side plate-like part 113 and the tip side plate-like part 123 are made parallel.

[0124]

< Casing >

The electrical contact 110 and the thermal contact 120 configured as set forth are bundled and held by the casing 140, as illustrated in Fig. 7.

The casing 140 is formed such that Ni plating as an undercoat is applied to a substrate of a Cu based material (for example, beryllium copper), and plating whose main component is an Au based material is applied to the surface of the Ni layer. Note that, while these materials are mere examples, the casing 140 has substantially the same electrical conductivity as or preferably higher electrical conductivity than the electrical contact 110 and the thermal contact 120.

[0125]

As illustrated in Fig. 15 to Fig. 17, the casing 140 has a first plate-like part 141, a second plate-like part (stationary piece) 142 facing the first plate-like part 141, and a connecting plate-like part 143 connecting these plate-like parts to each other.

[0126]

The first plate-like part 141 is a plate-like portion extending in the same direction as the electrical contact 110 and the thermal contact 120.

In the first plate-like part 141, a movable piece 141d is formed in the upper part, a

wider part 141b and a press-fit claw 141h are formed in the middle, and a protrusion 141a is formed below the movable piece 141d.

[0127]

As illustrated in Fig. 17, the movable piece 141d has a bent part located above the upper end of the second plate-like part 142 and being convex on the second plate-like part 142 side, and this bent part is elastically contacted to the base end side plate-like part 111 of the electrical contact 110 located at the outermost face or the base end side plate-like part 121 of the thermal contact 120 located at the outermost face.

[0128]

As illustrated in Fig. 15 or Fig. 16, the wider part 141b is a portion where both side faces of the first plate-like part 141 are partially widened in the width direction.

[0129]

As illustrated in Fig. 15, the press-fit claw 141h is a protrusion formed on both side faces of the first plate-like part 141 below the wider part 141b.

The press-fit claw 141h has a function of locking the casing 140 to the lower housing 11. Note that, when it is not required to lock the casing 140 to the lower housing 11, the press-fit claw 141h may be omitted.

[0130]

The protrusion 141a has a vertically long shape formed from an area near the base end of the movable piece 141d to the lower part of the first plate-like part 141 and protrudes toward the second plate-like part 142 side (backside of Fig. 15).

The protrusion 141a is a portion that, when the casing 140 is overlapped with another casing 140, is contacted to the second plate-like part 142 of another casing 140.

[0131]

The second plate-like part 142 is a plate-like portion extending in the same direction

as the electrical contact 110 and the thermal contact 120.

The second plate-like part 142 is arranged facing the first plate-like part 141.

In the second plate-like part 142, a base end holding part 142d is formed in the upper part, a wider part 142b and a press-fit claw 142h are formed in the middle, and a tip holding part 142e is formed in the lower part.

[0132]

As illustrated in Fig. 15 to Fig. 17, the base end holding part 142d is a claw-like portion protruding from both side faces of the second plate-like part 142 toward the first plate-like part 141.

[0133]

As illustrated in Fig. 15 or Fig. 16, the wider part 142b is a portion where both side faces of the second plate-like part 142 are partially widened in the width direction.

[0134]

As illustrated in Fig. 15 to Fig. 17, the tip holding part 142e is a portion protruding from the first side face of the second plate-like part 142 to the first plate-like part 141 side (front side in Fig. 15) and bent such that a part of the end face thereof is made parallel to the second plate-like part 142.

[0135]

As illustrated in Fig. 16, the press-fit claw 142h is a protrusion formed on both side faces of the second plate-like part 142 below the wider part 142b.

The press-fit claw 142h has a function of locking the casing 140 to the lower housing 11. Note that, when it is not required to lock the casing 140 to the lower housing 11, the press-fit claw 142h may be omitted.

[0136]

The connecting plate-like part 143 is a plate-like portion connecting the first side face

of the first plate-like part 141 and the first side face of the second plate-like part 142 to each other above the wider part 141b and the wider part 142b.

[0137]

As illustrated in Fig. 17, a plurality of circular protrusions 142a protruding toward the first plate-like part 141 side (backside in Fig. 17) are formed on a portion inside the second plate-like part 142 corresponding to the position of the tip side plate-like part 113 of the electrical contact 110 or the tip side plate-like part 123 of the thermal contact 120. The protruding amounts of respective protrusions 142a are substantially the same.

The protrusions 142a are portions that are contacted to the tip side plate-like part 113 of the electrical contact 110 located at the outermost face or the tip side plate-like part 123 of the thermal contact 120 located at the outermost face.

Note that the shape of the protrusion 142a, the number of protrusions 142a, and the arrangement of the protrusions 142a are not limited to the depicted form.

[0138]

It is preferable to prepare two casings 140 each configured as described above, as illustrated in Fig. 18.

Each casing 140 is fitted from the side of the electrical contact 110 and the thermal contact 120 so that the laterally stacked electrical contacts 110 and thermal contacts 120 are inserted between the first plate-like part 141 and the second plate-like part 142. In this state, the second plate-like part 142 of the other casing 140 is overlapped with the inside of the first plate-like part 141 of one casing 140, and the second plate-like part 142 of the one casing 140 is overlapped with the inside of the first plate-like part 141 of the other casing 140.

[0139]

Accordingly, each casing 140 holds the laterally stacked electrical contacts 110 and thermal contacts 120 so that the laterally stacked electrical contacts 110 and thermal contacts

120 are slidable against each other by each movable piece 141d. Further, each casing 140 guides the laterally stacked electrical contacts 110 and thermal contacts 120 by the connecting plate-like part 143, the base end holding part 142d, and the tip holding part 142e so that the laterally stacked electrical contacts 110 and thermal contacts 120 do not fluctuate.

Thus, as illustrated in Fig. 7, Fig. 19, and Fig. 20, the laterally stacked electrical contacts 110 and thermal contacts 120 are bundled by the two casings 140 in a state where a moderate contact pressure is maintained in the lateral stacking direction. Further, since the casings 140 function as a guide for the laterally stacked electrical contacts 110 and thermal contacts 120, the straightness in expansion and compression of the electrical contact 110 and the thermal contact 120 is improved.

[0140]

In this state, the casing 140 is in contact with the electrical contact 110 and the thermal contact 120 so as to bypass the elastic deformation part 112 of the electrical contact 110 and the elastic deformation part 122 of the thermal contact 120 by the bent part of the movable piece 141d and the protrusion 142a of the second plate-like part 142.

Accordingly, a path bypassing the elastic deformation part 112 and the elastic deformation part 122 having long paths and thus having high electrical resistance or thermal resistance can be formed by using the casing 140, as indicated by the arrow illustrated in Fig. 17.

[0141]

Further, as illustrated in Fig. 18 and Fig. 19, in a state where two casings 140 are overlapped with each other, the protrusion 141a formed on the first plate-like part 141 of one casing 140 comes into contact with the second plate-like part 142 of the other casing 140, and thereby a clearance is ensured between the first plate-like part 141 (the portion except for the protrusion 141a) of the one casing 140 and the second plate-like part 142 of the other casing

140. Further, the distance between the first plate-like part 141 of one casing 140 and the second plate-like part 142 of the other casing 140 can be determined by the protruding amount of the protrusion 141a.

By suitably setting this clearance, that is, by suitably setting the protruding amount of the protrusion 141a, it is possible to prevent melted solder or flux from rising in the clearance due to a capillary phenomenon.

[0142]

Further, because such a clearance is provided, interference with a punching burr occurring on the second plate-like part 142 of another casing 140 facing the first plate-like part 141 can be avoided.

[0143]

Further, when the protrusion 141a is formed from a position closer to the movable piece 141d as much as possible, the protrusion 141a can be contacted to the upper part (that is, a position close to the IC package 20) of the second plate-like part 142 of another casing 140 that is the contact target. Further, with the protrusion 141a having a vertically long shape, the contact area with the second plate-like part 142 can be increased. This can improve heat dissipation performance via the casing 140.

[0144]

Herein, in Fig. 18, the protrusion 141a indicated by a two-dot chain line in the second plate-like part 142 of the left casing 140 represents a contact part with the protrusion 141a formed on the first plate-like part 141 of the right casing 140.

[0145]

Further, in a state where the casing 140 holds the laterally stacked electrical contacts 110 and thermal contacts 120, when the protrusion 142a formed on the second plate-like part 142 of the casing 140 comes into contact with the electrical contact 110 or the thermal

contact 120, a clearance is ensured between the second plate-like part 142 (the portion except for the protrusion 142a) of the casing 140 and the electrical contact 110 or the thermal contact 120. Further, the distance between the second plate-like part 142 and the electrical contact 110 or the thermal contact 120 can be determined by the protruding amount of the protrusion 142a.

[0146]

By suitably setting this clearance, that is, by suitably setting the protruding amount of the protrusion 142a, it is possible to prevent melted solder or flux from rising in the clearance due to a capillary phenomenon.

[0147]

Further, because such a clearance is provided, the second plate-like part 142 and the electrical contact 110 or the thermal contact 120 are spaced away from each other in the plate thickness direction, and therefore, a larger bending amount can be ensured for the tip holding part 142e that holds the electrical contact 110 or the thermal contact 120. A smaller bending amount may make it difficult to bend the tip holding part 142e in press machining and result in a poor machining property. Accordingly, the bending amount is ensured as large as possible, and thereby the machining property in press machining is improved.

[0148]

Further, because such a clearance is provided, interference with a punching burr occurring on the electrical contact 110 or the thermal contact 120 facing the second plate-like part 142 can be avoided.

[0149]

Further, because such a clearance is provided, vibration (motion in the plate thickness direction) of the elastic deformation part 112 of the electrical contact 110 or the elastic deformation part 122 of the thermal contact 120 facing the second plate-like part 142 can be

absorbed by the clearance.

[0150]

Herein, the protrusion 142a indicated by a two-dot chain line in the front thermal contact 120 represents a contact part with the protrusion 142a formed on the second plate-like part 142 of the left casing 140.

[0151]

Note that, although one casing 140 may be enough, it is preferable to provide two casings 140 in terms of stability of holding or the function as a guide.

Further, also in terms of ensuring a large sectional area of the bypass path, it is preferable to use two casings 140.

[0152]

The casing 140 is molded by, for example, press machining from a plate material that becomes the substrate.

Accordingly, a large number of casings 140 can be produced with high accuracy and with suppressed variation among products.

[0153]

The contact pin 100 formed as described above may have at least any one of the following mechanisms.

[0154]

< Mechanism for preventing excessive compression >

As illustrated in Fig. 7, the contact pin 100 may be configured such that, when the electrical contact 110 and the thermal contact 120 are pushed down, the bottom face of the wider part 111a of the electrical contact 110 and the bottom face of the wider part 121a of the thermal contact 120 come into contact with the top face of the connecting plate-like part 143 of the casing 140. That is, the top face of the connecting plate-like part 143 may be used as

a stopper against the bottom face of the wider part 111a and the bottom face of the wider part 121a.

This makes it possible to restrict the amount of compression of the electrical contact 110 and the thermal contact 120 and therefore prevent the electrical contact 110 and the thermal contact 120 from being excessively compressed and damaged.

[0155]

< Mechanism (notch) for preventing solder wicking / flux wicking >

As illustrated in Fig. 15, Fig. 16, and Fig. 20, in the assembled contact pin 100, the notch 141c and the notch 142c that expose the lower end 112b of the elastic deformation part 112 and the lower end 122b of the elastic deformation part 122 may be provided in the first plate-like part 141 and the second plate-like part 142 of the casing 140.

In the case of Fig. 20, the notch 141c is formed in the first plate-like part 141 right above the wider part 141b, and the notch 142c is formed in the second plate-like part 142 right above the wider part 142b.

[0156]

Even when solder wicking or flux wicking occurs when the contact pin 100 is soldered, the notch 141c and the notch 142c allow the melted solder or flux to flow so as to avoid the lower end 112b of the elastic deformation part 112 and the lower end 122b of the elastic deformation part 122.

Accordingly, the elastic deformation part 112 and the elastic deformation part 122 are not stuck by solder or flux, and desired elasticity can be exerted.

[0157]

< Mechanism (region R) for preventing solder wicking / flux wicking >

As illustrated in Fig. 21, a region R having a lower wettability than other regions may be provided on the surface of the tip side plate-like part 113 of the electrical contact 110. In

the case of Fig. 21, the region R is provided in a portion of the tip side plate-like part 113 below the wider part 113a.

Accordingly, even when solder wicking or flux wicking occurs when the contact pin 100 is soldered, the melted solder or flux will be retained in the region R, and the elastic deformation part 112 are not stuck by the solder or flux. Thus, desired elasticity can be exerted.

Note that the region R may also be provided in the thermal contact 120.

[0158]

An example method of reducing wettability may be a method of applying masking to a portion corresponding to the region R in advance before applying plating of an Au based material to the electrical contact 110 and then exposing the Ni layer that is the undercoat in the region R.

[0159]

Further, as illustrated in Fig. 22 and Fig. 23, the region R having a lower wettability than other regions may be provided on the surface of the first plate-like part 141 and the second plate-like part 142 in the casing 140 in the same manner as with the electrical contact 110.

It is preferable to provide the region R in a portion located below the elastic deformation part 112 and the elastic deformation part 122, for example, a portion below the wider part 141b of the first plate-like part 141 and a portion below the wider part 142b of the second plate-like part 142 when the casing 140 bundles the electrical contacts 110 and the thermal contacts 120.

[0160]

[Combination of Contact Pins]

The example of two types of contacts, namely, the electrical contact 110 and the

thermal contact 120 shorter than the electrical contact 110 has been described so far.

However, the contact pin 100 may be configured in accordance with the use by preparing a thermal contact 130 having the same vertical height as the electrical contact 110, as illustrated in Fig. 24, and then selecting and combining some of the listed contacts, as illustrated in the table of Fig. 25.

[0161]

Note that “height (shorter/taller)” means the distance from the top face of the wider part 111a, 121a, 131a to the upper end of the base end side plate-like part 111, 121, 131, as illustrated in Fig. 24.

Further, the thermal contact 130 may be denoted as “taller thermal contact 130” for convenience.

[0162]

< Only electrical contact >

As illustrated in Fig. 26, the contact pin 100 may be formed of only the electrical contacts 110 for all the contacts.

This contact pin 100 is used when the primary purpose is to have electrical contact with the IC package 20.

[0163]

In such a configuration, all the electrical contacts 110 will be in contact with the IC package 20.

[0164]

In this state, since the electrical contacts 110 are movable independent of each other, even when the E-Pad of the IC package 20 has distortion or the heights of these electrical contacts 110 have slight variation, the levels can be compensated to absorb the distortion or the slight variation. As used herein, “slight variation” refers to variation within a smaller

range than the distance between the lower end of the upper claw 111b and the lower end of the adjacent upper notch 111c.

[0165]

Note that, since all the electrical contacts 110 have the same height, the compression interlock mechanism does not function.

[0166]

< Electrical contact + thermal contact (short) >

As already described, as illustrated in Fig. 11, the contact pin 100 may be formed of the electrical contacts 110 and the shorter thermal contacts 120 in combination.

This contact pin 100 is used when the purpose is to have electrical contact and thermal contact with the IC package 20.

[0167]

In such a configuration, the electrical contacts 110 will be in contact with the IC package 20.

[0168]

In this state, since the electrical contacts 110 are movable independent of each other in a predetermined range of the pushed-down amount, even when the E-Pad of the IC package 20 has distortion or the heights of these electrical contacts 110 have slight variation, the levels can be compensated to absorb the distortion or the slight variation. As used herein, “slight variation” refers to variation within a smaller range than the distance between the lower end of the upper claw 111b and the lower end of the adjacent upper notch 121c (the distance between the lower end of the upper claw 121b and the lower end of the adjacent upper notch 111c).

Further, the contact pressure at the electrical contact 110 against the IC package 20 is increased by the compression interlock mechanism, and the electrical contact property is thus

improved. Further, stuck prevention is realized by the expansion interlock mechanism.

[0169]

Note that, although the thermal contact 120 is not contacted to the IC package 20, heat of the IC package 20 is transferred to the thermal contact 120 via the electrical contact 110. Thus, the thermal contact 120 has a function of increasing the sectional area of the heat transfer path, and as a result, the thermal performance is improved.

[0170]

< Electrical contact + thermal contact (tall) >

As illustrated in Fig. 27, the contact pin 100 may be formed of the electrical contacts 110 and the taller thermal contacts 130 in combination.

This contact pin 100 is used when the purpose is to have electrical contact and thermal contact with the IC package 20.

[0171]

In such a configuration, all the electrical contacts 110 and all the thermal contacts 130 will be in contact with the IC package 20.

[0172]

In this state, since the electrical contacts 110 and the thermal contacts 130 are movable independent of each other, even when the E-Pad of the IC package 20 has distortion or the heights of these electrical contacts 110 have slight variation, the levels can be compensated to absorb the distortion or the slight variation. As used herein, “slight variation” refers to variation within a smaller range than the distance between the lower end of the upper claw 111b and the lower end of the adjacent upper notch 131c.

Further, since the thermal contact 130 is directly contacted to the IC package 20, the thermal performance is improved. Furthermore, the thermal contact 130 and the IC package 20 are contacted to each other at the surfaces thereof, which is advantageous in efficiency of

heat transfer.

[0173]

Note that, since all the electrical contacts 110 and the thermal contacts 130 have the same height, the compression interlock mechanism does not function.

[0174]

< Thermal contact (short) + thermal contact (tall) >

As illustrated in Fig. 28, the contact pin 100 may be formed of the shorter thermal contacts 120 and the taller thermal contacts 130 in combination.

This contact pin 100 is used when the purpose is to have electrical contact and thermal contact with the IC package 20.

[0175]

In such a configuration, all the taller thermal contacts 130 will be in contact with the IC package 20.

[0176]

In this state, since the thermal contacts 130 are movable independent of each other in a predetermined range of the pushed-down amount, even when the E-Pad of the IC package 20 has distortion or the heights of these thermal contacts 130 have slight variation, the levels can be compensated to absorb the distortion or the slight variation. As used herein, “slight variation” refers to variation within a smaller range than the distance between the lower end of the upper claw 131b and the lower end of the adjacent upper notch 121c.

Further, the contact pressure at the thermal contact 130 against the IC package 20 is increased by the compression interlock mechanism, and the electrical contact property is thus improved. Further, stuck prevention is realized by the expansion interlock mechanism.

[0177]

Note that, although the thermal contact 120 is not contacted to the IC package 20,

heat of the IC package 20 is transferred to the thermal contact 120 via the thermal contact 130. Thus, the thermal contact 120 has a function of increasing the sectional area of the heat transfer path, and as a result, the thermal performance is improved.

[0178]

< Only thermal contact >

For example, the contact pin 100 may be formed of only the shorter thermal contacts 120 for all the contacts.

This contact pin 100 is used when the primary purpose is to have thermal contact with the IC package 20.

[0179]

In such a configuration, all the thermal contacts 120 will be in contact with the IC package 20.

[0180]

In this state, since the thermal contacts 120 are movable independent of each other, even when the E-Pad of the IC package 20 has distortion or the heights of these thermal contacts 120 have slight variation, the levels can be compensated to absorb the distortion or the slight variation. As used herein, “slight variation” refers to variation within a smaller range than the distance between the lower end of the upper claw 121b and the lower end of the adjacent upper notch 121c.

[0181]

Note that, since all the thermal contacts 120 have the same height, the compression interlock mechanism does not function.

[0182]

The same applies to a case where the contact pin 100 is formed of only the taller thermal contacts 130 for all the contacts.

[0183]

[Modified example of casing]

Other than the casing 140 illustrated in Fig. 18, for example, a casing 240 illustrated in Fig. 29 or a casing 340 illustrated in Fig. 31 may be used to bundle the electrical contacts 110 and/or the thermal contacts 120.

[0184]

< Casing 240 >

As illustrated in Fig. 29, the casing 240 has a first plate-like part 241, a second plate-like part 242 facing the first plate-like part 241, and a connecting plate-like part 243 connecting these plate-like parts to each other.

[0185]

The first plate-like part 241 is a plate-like portion extending in the same direction as the thermal contact 120.

In the first plate-like part 241, a movable piece 241a is formed in the upper part, and a wider part 241b is formed in the middle.

[0186]

The movable piece 241a has a tip part inclined to the second plate-like part 242 side, and this tip part is elastically contacted to the base end side plate-like part 121 of the thermal contact 120 located at the outermost face.

[0187]

The wider part 241b is a portion where both side faces of the first plate-like part 241 are partially widened in the width direction and is contacted to the wider part 123a of the thermal contact 120 located at the outermost face.

[0188]

The second plate-like part 242 is a plate-like portion extending in the same direction

as the thermal contact 120.

In the second plate-like part 242, a movable piece 242a is formed in the upper part, and a wider part 242b is formed in the middle.

[0189]

The movable piece 242a has a tip part inclined to the first plate-like part 241 side, and this tip part is elastically contacted to the base end side plate-like part 121 of the thermal contact 120 located at the outermost face.

[0190]

The wider part 242b is a portion where both side faces of the second plate-like part 242 are partially widened in the width direction and is contacted to the wider part 123a of the outermost thermal contact 120.

[0191]

The connecting plate-like part 243 is a plate-like portion connecting the first side face of the first plate-like part 241 and the first side face of the second plate-like part 242 to each other below the wider part 241b and the wider part 242b.

[0192]

The casing 240 configured as set forth is fitted from the side of the thermal contact 120 so that the laterally stacked thermal contacts 120 are inserted between the first plate-like part 241 and the second plate-like part 242, as illustrated in Fig. 30.

[0193]

In this state, the first plate-like part 241 is in contact with the thermal contact 120 so as to bypass the elastic deformation part 122 by the tip part of the movable piece 241a and the wider part 241b.

Further, the second plate-like part 242 is in contact with the thermal contact 120 so as to bypass the elastic deformation part 122 by the tip part of the movable piece 242a and the

wider part 242b.

Accordingly, a path bypassing the elastic deformation part 112 and the elastic deformation part 122 having long paths and thus having high electrical resistance or thermal resistance can be formed by using the casing 240. Further, variation in the thicknesses of the laterally stacked thermal contacts 120 can be efficiently absorbed.

[0194]

Note that, in the contact pin 100 illustrated in Fig. 30, the casing 240 bundles only the thermal contacts 120 but may bundle the electrical contacts 110 or the thermal contacts 130 or a combination thereof in the same manner as the casing 140.

[0195]

< Casing 340 >

As illustrated in Fig. 31, the casing 340 has a first plate-like part 341, a second plate-like part 342 facing the first plate-like part 341, and a connecting plate-like part 343 connecting these plate-like parts to each other.

[0196]

The first plate-like part 341 is a plate-like portion extending in the same direction as the thermal contact 120.

[0197]

The first plate-like part 341 has a bent part convex to the second plate-like part 342 side at the tip, and this bent part is contacted to the tip side plate-like part 123 of the outermost thermal contact 120.

[0198]

The second plate-like part 342 is a plate-like portion extending in the same direction as the thermal contact 120.

[0199]

The second plate-like part 342 has a bent part convex to the first plate-like part 341 side at the tip, and this bent part is contacted to the tip side plate-like part 123 of the outermost thermal contact 120.

[0200]

The connecting plate-like part 343 is a plate-like portion connecting the top face of the first plate-like part 341 and the top face of the second plate-like part 342 to each other.

In this state, the first plate-like part 341 and the second plate-like part 342 are elastically connected to the connecting plate-like part 343.

[0201]

The casing 340 configured as set forth is fitted from above of the thermal contact 120 so that the laterally stacked thermal contacts 120 are inserted between the first plate-like part 341 and the second plate-like part 342, as illustrated in Fig. 32.

In this state, the connecting plate-like part 343 is in contact with the upper faces of all the thermal contacts 120.

[0202]

Note that, in the contact pin 100 illustrated in Fig. 32, the casing 340 bundles only the thermal contacts 120 but may bundle the thermal contacts 130 or a combination thereof.

[0203]

According to the present embodiment, the following effects and advantages are achieved.

That is, since the plurality of contacts (for example, the electrical contacts 110 and the thermal contacts 120) are laterally stacked adjacent to each other and are movable independently of each other, the contact pin 100 can be contacted to the IC package 20 at multiple contact points when a single contact is viewed as a single contact point. Further, the plurality of contacts can compensate distortion or variation in the level. This can

improve the contact reliability of the contact pin 100 to the IC package 20.

[0204]

Further, when each component is molded by press machining from a plate material, structural simplification, a cost reduction, a shorter delivery time, or the like can be realized.

[0205]

Further, since the compression interlock mechanism is provided, the elastic force thereof and the elastic force of the adjacent thermal contact 120 work on the electrical contact 110, for example, and the contact pressure of the electrical contact 110 against the IC package 20 can be increased.

Further, since the expansion interlock mechanism is provided, even when the electrical contact 110 or the thermal contact 120, for example, is stuck for some reason, the stuck can be eliminated by the expanded electrical contact 110 or thermal contact 120.

As described above, the use of the compression interlock mechanism and the expansion interlock mechanism can improve the contact reliability of the contact pin 100 to the IC package 20.

[0206]

Further, since the electrical contact 110 having the higher height position and the thermal contact 120 having the lower height position are alternatingly aligned and laterally stacked, the elastic force of the shorter thermal contact 120 can be caused to work on the taller electrical contact 110.

[0207]

Further, since the casing 140 is provided, the handleability of the laterally stacked electrical contacts 110 and thermal contacts 120 can be improved.

[0208]

Further, the use of the casing 140 as the function of a guide in expansion and

compression of the electrical contact 110 and the thermal contact 120, the straightness of the electrical contact 110 and the thermal contact 120 can be improved.

[0209]

Further, since the casing 140 has the notch 141c and the notch 142c, even when solder wicking or flux wicking occurs, the melted solder or flux flows so as to avoid the lower end 112b of the elastic deformation part 112 and the lower end 122b of the elastic deformation part 122. Accordingly, the lower end 112b of the elastic deformation part 112 and the lower end 122b of the elastic deformation part 122 are not stuck by solder or flux, and desired elasticity can be exerted.

[0210]

Further, since the region R having a lower wettability is formed in the electrical contact 110 and the thermal contact 120, even when solder wicking or flux wicking occurs, the melted solder or flux is retained in the lower wettability region R, and the lower end 112b of the elastic deformation part 112 and the lower end 122b of the elastic deformation part 122 are not stuck by the solder or flux. Thus, desired elasticity can be exerted. The same applies to the casing 140.

[0211]

Further, since the protrusions 111g, 111h, 113i, 113j are formed on the electrical contact 110 and the protrusions 121g, 121h, 123i, 123j are formed on the thermal contact 120, a clearance can be provided between the electrical contact 110 and the thermal contact 120 by respective protrusions. Further, it is possible to determine the distance between the electrical contact 110 and the thermal contact 120 by the protruding amount of each protrusion.

By suitably setting this clearance, that is, by suitably setting the protruding amount of each protrusion, it is possible to prevent melted solder or flux from rising in the clearance due

to a capillary phenomenon.

Further, because such a clearance is provided, the electrical contact 110 and the thermal contact 120 are spaced away from each other in the plate thickness direction. Thus, a large bending amount of each claw can be ensured, and the machining property in press machining is improved.

Further, because such a clearance is provided, interference with a punching burr occurring on the thermal contact 120 or the electrical contact 110 facing the electrical contact 110 or the thermal contact 120 can be avoided.

Further, because such a clearance is provided, vibration (motion in the plate thickness direction) of the elastic deformation part 112 of the electrical contact 110 or the elastic deformation part 122 of the thermal contact 120 can be absorbed by the clearance.

[0212]

Further, since the protrusion 141a is formed on the first plate-like part 141, a clearance can be provided between the first plate-like part 141 and the second plate-like part 142 of the other casing 140 by the protrusion 141a. Further, it is possible to determine the distance between the first plate-like part 141 of one casing 140 and the second plate-like part 142 of the other casing 140 by the protruding amount of the protrusion 141a.

By suitably setting this clearance, that is, by suitably setting the protruding amount of the protrusion 141a, it is possible to prevent melted solder or flux from rising in the clearance due to a capillary phenomenon.

Further, because such a clearance is provided, interference with a punching burr occurring on the second plate-like part 142 of another casing 140 facing the first plate-like part 141 can be avoided.

Further, when the protrusion 141a is formed from a position closer to the movable piece 141d as much as possible, the protrusion 141a can be contacted to the upper part (that

is, a position close to the IC package 20) of the second plate-like part 142 of another casing 140 that is the contact target. Further, with the protrusion 141a having a vertically long shape, the contact area with the second plate-like part 142 can be increased. This can improve heat dissipation performance via the casing 140.

[0213]

Further, since the protrusion 142a is formed on the second plate-like part 142, a clearance can be provided between the second plate-like part 142 and the electrical contact 110 or the thermal contact 120. Further, it is possible to determine the distance between the second plate-like part 142 and the electrical contact 110 or the thermal contact 120 by the protruding amount of the protrusion 142a.

By suitably setting this clearance, that is, by suitably setting the protruding amount of the protrusion 142a, it is possible to prevent melted solder or flux from rising in the clearance due to a capillary phenomenon.

Further, because such a clearance is provided, the second plate-like part 142 and the electrical contact 110 or the thermal contact 120 are spaced away from each other in the plate thickness direction, and therefore, a larger bending amount can be ensured for the tip holding part 142e that holds the electrical contact 110 or the thermal contact 120. A smaller bending amount may make it difficult to bend the tip holding part 142e in press machining and result in a poor machining property. Accordingly, the bending amount is ensured as large as possible, and thereby the machining property in press machining is improved.

Further, because such a clearance is provided, interference with a punching burr occurring on the electrical contact 110 or the thermal contact 120 facing the second plate-like part 142 can be avoided.

Further, because such a clearance is provided, vibration (motion in the plate thickness direction) of the elastic deformation part 112 of the electrical contact 110 or the elastic

deformation part 122 of the thermal contact 120 facing the second plate-like part 142 can be absorbed by the clearance.

[0214]

Note that the contact target of the contact pin 100 is not limited as long as the contact pin 100 according to the present embodiment can be replaced with a conventional probe pin.

For example, the contact target of the contact pin 100 may be solder ball terminals when the IC package 20 is a Ball Grid Array (BGA) or land terminals when the IC package 20 is a Land Grid Array (LGA).

[Reference Signs List]

[0215]

10 socket for inspection

11 lower housing

11a lower recess

11b lower through hole

12 upper housing

12a upper recess

12b upper through hole

13 stage

14 movable housing

14a package accommodating part

15 accommodating space

16 peripheral contact pin

20 IC package

100 contact pin

110 electrical contact (contact)

111 base end side plate-like part

111a wider part

111b upper claw

111c upper notch

111d lower claw

111e lower notch

111f contact protruding part

111g protrusion (front side)

111h protrusion (backside)

112 elastic deformation part

112a upper end

112b lower end

113 tip side plate-like part

113a wider part

113b upper claw

113c upper notch

113d lower claw

113e lower notch

113h press-fit claw

113i protrusion (front side)

113j protrusion (backside)

120 thermal contact (contact)

121 base end side plate-like part

121a wider part

121b upper claw

121c upper notch

121d lower claw

121e lower notch

121g protrusion (front side)

121h protrusion (backside)

122 elastic deformation part

122a upper end

122b lower end

123 tip side plate-like part

123a wider part

123b upper claw

123c upper notch

123d lower claw

123e lower notch

123h press-fit claw

123i protrusion (front side)

123j protrusion (backside)

130 thermal contact (contact)

131 base end side plate-like part

131a wider part

131b upper claw

131c upper notch

131d lower claw

131e lower notch

140 casing

141 first plate-like part

141a protrusion

141b wider part

141c notch

141d movable piece

141h press-fit claw

142 second plate-like part (stationary piece)

142a protrusion

142b wider part

142c notch

142d base end holding part

142e tip holding part

142h press-fit claw

143 connecting plate-like part

240 casing

241 first plate-like part

241a movable piece

241b wider part

242 second plate-like part

242a movable piece

242b wider part

243 connecting plate-like part

340 casing

341 first plate-like part

342 second plate-like part

343 connecting plate-like part

[CLAIMS]

1. A contact pin comprising a plurality of electrically conductive contacts, each of the contacts extending from a base end to a tip and having an elastic deformation part formed between the base end and the tip, and the elastic deformation part being elastically expandable and compressible in an extending direction,

wherein the plurality of contacts are laterally stacked adjacent to each other and are movable independently of each other.

2. The contact pin according to claim 1 further comprising:

a compression interlock mechanism configured to, when one of the contacts is compressed by a predetermined amount, interlock the compressed contact and another contact adjacent to the compressed contact in a compression direction; and

an expansion interlock mechanism configured to interlock one of the contacts and another contact adjacent to the one of the contacts in an expansion direction.

3. The contact pin according to claim 2, wherein a contact of the plurality of contacts which has the base end at a higher height position in the extending direction and a contact of the plurality of contacts which has the base end at a lower height position in the extending direction are alternatingly aligned and laterally stacked.

4. The contact pin according to claim 1 or 2 further comprising at least one casing that bundles the plurality of laterally stacked contacts.

5. The contact pin according to claim 4, wherein the casing has a stopper configured to restrict an amount of compression of the contact.

6. The contact pin according to claim 4, wherein the casing has a notch notched so as to expose a lower end of the elastic deformation part.

7. The contact pin according to claim 4, wherein the casing has a region having a lower wettability than other portions formed in a part of a portion located below the elastic deformation part of the contacts.

8. The contact pin according to claim 1 or 2, wherein the contact has a region having a lower wettability than other portions formed in a portion below the elastic deformation part.

9. The contact pin according to claim 1, wherein each of the contacts has a protrusion protruding toward an adjacent contact and configured to be contacted to the adjacent contact.

10. The contact pin according to claim 4,

wherein the casing has a first plate-like part and a second plate-like part that face each other and between which the laterally stacked contacts are arranged,

wherein the first plate-like part has a protrusion protruding toward the second plate-like part side, and

wherein the second plate-like part has a protrusion protruding toward the first plate-like part side.

11. The contact pin according to claim 10 further comprising two casings,

wherein in a state where both the casings overlap with each other,

the first plate-like part of one of the casings faces the second plate-like part side of the

other of the casings, and

the second plate-like part of each of the casings faces the laterally stacked contacts.

12 A socket for inspection comprising:

a plurality of contact pins according to claim 1 or 2; and

a housing configured to accommodate the contact pins.

13. The socket for inspection according to claim 12,

wherein the housing has an upper housing and a lower housing that define a space in which the elastic deformation parts of the contact pins are accommodated, and

wherein the contact pins are configured such that the elastic deformation parts are compressed by the upper housing and the lower housing.