

[DESCRIPTION]

[Title of Invention] TEST SOCKET FOR IC PACKAGE AND METHOD OF PRODUCING THE SAME

[Technical field]

[0001] The present disclosure relates to a test socket for IC (Integrated Circuit) package and method of producing the same.

[Background Art]

[0002] There are situations where IC packages such as SOP (Small Outline Package) and QFP(Quad Flat Package) has, additionally to lead terminals, a heat-dissipating and/or grounding pad on a bottom side of the IC package. In some instances, when testing such IC packages, a contact pin is desired which would be brought into thermal or electrical contact with the bottom side (e.g. the pad) of the IC package (see patent literatures 1 and 2 for example).

[Citation List]

[Patent literature]

[0003]

[PTL 1] Japanese Patent Application Laid-open No. 2005-5130

[PTL 2] Japanese Patent Application Laid-open No. 2005-166270

[Summary]

[Technical Problem]

[0004] In a situation where signal contact pins to be in contact with the lead terminals are arranged in an outer peripheral portion of a socket main body, there would be a constraint how a contact pin, to be in contact with the bottom side of the IC package, is arranged in the socket main body. The contact pin may be vertically inserted and secured to the socket main body under such a constraint for a purpose of providing the contact pin in the socket main body which would be brought into contact with the bottom side of the IC package, However, if a load were applied to the contact pin in the same vertical direction, the contact pin may possibly be displaced easily and its attachment posture may be altered.

[0005] Furthermore, each time of testing of the IC packages, an upper contact portion of the contact pin may be brought into contact with the bottom side of the IC package and may bear downward load. Moreover, while the socket is mounted onto a mounting board, a lower contact portion of the contact pin may bear upward load from the mounting board. Still further, there is also a possibility of application of external force which causes displacement or change in posture of the contact pin during a process of manufacturing or transportation of the sockets. The displacement or change in posture of the contact pin in the socket main body may possibly affect the condition of electrical or thermal coupling with the IC package or the mounting board, which would be not desirable.

[0006] Under the above-described exemplary technical problem, the present inventors have newly discovered a technical problem to prevent the contact pin, which is to be in contact with a bottom side of the IC package, from being easily displaced relative to the socket main body as bearing upward or downward or up-and-down bidirectional load. It should be noted that the above-noted technical problem may be caused in any system where a contact pin of socket is in electrical or thermal contact with a mounting board via soldering, or a system where a contact pin of socket is in electrical or thermal contact with a mounting

board while bearing upward load from the mounting board, or any other systems. In the system where a contact pin of socket is in electrical or thermal contact with a mounting board while bearing upward load from the mounting board, the contact pin continuously bears the upward load from the mounting board and thus is particularly susceptible to the vertical load.

[Solution to Problem]

[0007] A test socket for IC package according to an aspect of the present disclosure includes: an insulating socket main body onto which an IC package is mounted; a group of first contact pins attached to an outer peripheral portion of the socket main body so as to be electrically contactable to terminals (e.g. lead terminals) of the IC package; and one or more second contact pins attached to the socket main body so as to be contactable to a heat-dissipating and/or grounding pad exposed in a bottom side of the IC package, and positioned inward of the socket main body than the first contact pins. The socket main body includes a space which allows a lateral movement of the second contact pin toward the outer peripheral portion of the socket main body, the lateral movement of the second contact pin in the space allowing the attachment of the second contact pin to the socket main body, and upward and downward displacement of the second contact pin being prevented by the socket main body.

[0008] In some embodiments, the first contact pins are signal contact pins, and the second contact pins are grounding or heat-dissipating contact pins. The first contact pin may be configured to pinch a lead terminal of the IC package.

[0009] In some embodiments, the space includes a retaining groove formed in the socket main body so as to retain the second contact pin. The space may further include an introduction hole in spatial communication with the retaining groove so as to facilitate introduction of the second contact pin into the retaining groove. The retaining groove may extend toward a corner of the socket main body from an inward position in the socket main body. When the socket main body is viewed from above, the retaining groove may be elongated between a corner (e.g. column portion) and a corner of the socket main body. In a case where the socket main body includes the introduction hole, the retaining groove may be elongated between a corner (e.g. column portion) of the socket main body and the introduction hole when the socket main body is viewed from above.

Shape and size of the introduction hole would be various. Third contact pin (e.g. heat-dissipating contact pin) may be arranged in the introduction hole which is provided for the same or different purpose as the second contact pin.

[0010] In some embodiments, a plurality of the retaining grooves are arranged so as to retain a plurality of the second contact pins respectively, and the introduction hole is commonly arranged for the plurality of the retaining grooves.

[0011] In some embodiments, the space includes a retaining groove formed in the socket main body so as to retain the second contact pin, the socket main body has a pair of wall surfaces opposed to define the retaining groove, and a plurality of coupling portions coupled to at least one of the pair of wall surfaces, and the plurality of coupling portions is arranged so as to define an insertion path into which an insertion portion of the second contact pin is inserted.

[0012] In some embodiments, the plurality of coupling portions are arranged alternately on the both upper and lower sides of the insertion path along the length direction of the insertion path.

[0013] In some embodiments, the plurality of coupling portions are arranged

such that the insertion portion of the second contact pin is pressed into the insertion path and/or the second contact pin is configured such that the insertion portion of the second contact pin is pressed into the insertion path.

[0014] In some embodiments, plural second contact pins are separately arranged in the socket main body, and the introduction hole is commonly arranged for plural retaining grooves which are configured to retain the plural second contact pins respectively.

[0015] In some embodiments, the second contact pin has an upper contact portion contactable to the heat-dissipating and/or grounding pad, a lower contact portion contactable to a mounting board on which the socket is mounted, and a middle portion interposed between the upper contact portion and the lower contact portion, the upper contact portion displaceable downward elastically in response to a load applied from above, the lower contact portion displaceable upward elastically in response to a load applied from below, and wherein the insertion portion of the second contact pin extends in a lateral direction from the middle portion.

[0016] In some embodiments, the socket main body and the second contact pin includes a complementary retaining structure so as to prevent falling of the second contact pin off from the socket main body.

[0017] In some embodiments, the second contact pin has an upper contact portion contactable to the heat-dissipating and/or grounding pad, and a lower contact portion contactable to a mounting board on which the socket is mounted, the upper contact portion displaceable downward elastically in response to a load applied from above, and the lower contact portion displaceable upward elastically in response to a load applied from below.

[0018] In some embodiments, the test socket further includes a cover arranged to be movable in an up-down direction relative to the socket main body to switch a state of the first contact pins; and a float member arranged to be movable in the up-down direction relative to the socket main body in synchronization with the up-down motion of the cover so as to switch a state of the second contact pin.

[0019] A method of producing a test socket for IC package according to another aspect of the present disclosure includes: attaching a group of first contact pins to an outer peripheral portion of an insulating socket main body; and attaching one or more second contact pins to the socket main body at inward position in the socket main body than the first contact pins, the second contact pin being moved laterally toward the outer peripheral portion of the socket main body in a space formed in the socket main body so that the second contact pin is attached to the socket main body by which upward and downward displacement of the second contact pin prevented.

[Advantageous Effects of Invention]

[0020] According to an aspect of the present disclosure, it may be suppressed that a contact pin, which is to be in contact with a bottom side of the IC package, is easily displaced relative to a socket main body as bearing upward or downward or up-and-down bidirectional load, thereby enhancing reliability in electrical or thermal connection with IC package.

[Brief Description of Drawings]

[0021]

[Fig. 1] Fig. 1 is a schematic perspective view of a test socket for IC package

according to an aspect of the present disclosure.

[Fig. 2] Fig. 2 is a schematic exploded perspective view of the test socket according to an aspect of the present disclosure. Note that signal contact pins are not attached to a socket main body.

[Fig. 3] Fig. 3 is a schematic top view of the test socket according to an aspect of the present disclosure.

[Fig. 4] Fig. 4 is a schematic cross-sectional view taken along an alternate long and short dash line A-A in Fig. 3, the socket being in a first state.

[Fig. 5] Fig. 5 is a schematic cross-sectional view taken along an alternate long and short dash line A-A in Fig. 3, the socket being in a second state.

[Fig. 6] Fig. 6 is a schematic cross-sectional view taken along an alternate long and short dash line B-B in Fig. 3, the socket being in the first state.

[Fig. 7] Fig. 7 is a schematic cross-sectional view taken along an alternate long and short dash line B-B in Fig. 3, the socket being in the second state.

[Fig. 8] Fig. 8 is a schematic diagram of process in which an IC package is mounted onto the socket main body while the socket is in the second state.

[Fig. 9] Fig. 9 is a schematic diagram illustrating that the socket is shifted from the second state to the first state, and a lead terminal of the IC package is pinched by a signal contact pin.

[Fig. 10] Fig. 10 is a schematic diagram illustrating that the ground contact pin is in a situation not in contact with the IC package (not illustrated) while the socket is in the second state.

[Fig. 11] Fig. 11 is a schematic diagram illustrating that the socket is shifted from the second state to the first state, and the ground contact pin is in a situation contactable with a bottom side of the IC package (not illustrated).

[Fig. 12] Fig. 12 is a schematic diagram illustrating that the ground contact pin is in a situation in contact with a bottom side of the IC package.

[Fig. 13] Fig. 13 is a schematic diagram illustrating that the ground contact pin is moved laterally and attached to the socket main body.

[Fig. 14] Fig. 14 is a schematic diagram illustrating a variation where a plug is used to prevent the ground contact pin from being displaced or falling.

[Fig. 15] Fig. 15 is a schematic diagram illustrating a variation where the socket main body and the ground contact pin has a complementary retaining mechanism.

[Description of Embodiments]

[0022] Hereinafter, various embodiments and features will be described with reference to drawings. A skilled person would be able to combine respective embodiments and/or respective features without requiring excess description, and would appreciate synergistic effects of such combinations. Overlapping description among the embodiments are basically omitted. Referenced drawings aim mainly for describing inventions and are simplified for the sake of convenience of illustration. The respective features should be appreciated as universal features not only effective to a socket and a method of producing the same presently disclosed but also effective to other various sockets and methods of producing the same not disclosed in the present specification.

[0023] Fig. 1 is a schematic perspective view of test socket 91 (hereinafter simply referred to as socket 91) for IC package. Fig. 2 is a schematic exploded perspective view of the socket 91. Fig. 3 is a schematic top view of the socket 91. Note that signal contact pins 20 are not attached to a socket main body 10. Fig. 4 is a schematic cross-sectional view taken along an alternate long and short

dash line A-A in Fig. 3, the socket being in a first state. Fig. 5 is a schematic cross-sectional view taken along an alternate long and short dash line A-A in Fig. 3, the socket being in a second state.

[0024] As depicted in Fig. 1, the socket 91 is an open-top-type socket and is mounted onto a mounting board 92 referred to as a test board. The socket 91 may be secured to the mounting board 92 in various manners and, may be firmly secured thereto with screw(s). The IC package received in the socket 91 would be in electrical and thermal contact with the mounting board 92 via the socket 91. Needless to say, it is possible to employ other types of sockets than the open-top-type.

[0025] Typically, the IC packages are ones such as SOP (Small Outline Package) or QFP (Quad Flat Package). One or more IC chips may be mounted onto a lead frame and resin-molded so that the IC package is produced. Multiple lead terminals (e.g. gull-wing type lead terminals) extend out from the resin-molded portion of the IC package. A heat-dissipating and/or grounding pad (exposed metal region) is formed and exposed in a bottom side of the IC package. In other words, insulating material of the IC package may be partially removed or may be not formed so as to expose the pad. This allows the heat generated in the semiconductor chip inside the IC package to dissipate via the pad and/or a ground potential of the semiconductor chip inside the IC package to be set from the outside of the IC package. In QFPs, the lead terminals are arranged at a constant pitch at a higher density along four sides of the rectangular resin-molded portion thereof.

[0026] As depicted in Figs. 1 and 2, the socket 91 has an insulating socket main body 10 onto which the IC package is placed; signal contact pins 20 (first contact pins) attached and secured to an outer peripheral portion of the socket main body 10 so as to be in electrical contact with the lead terminals of the IC package; and ground contact pins 40 (second contact pins) attached and secured to the socket main body 10 so as to be in contact with a bottom side of the IC package at an inward position in the socket main body 10 than the signal contact pin 20. Furthermore, the socket 91 has a heat-dissipating contact pin 30 (third contact pin) arranged in the socket main body 10 so as to be in contact with a bottom side of the IC package at an inward position in the socket main body 10 than the signal contact pin 20; a cover 50 arranged to be movable in an up-down direction relative to the socket main body 10 to switch a state of the signal contact pin 20; and a float member 60 arranged to be movable in the up-down direction relative to the socket main body 10 in synchronization with the up-down motion of the cover 50 so as to switch a state of the heat-dissipating contact pin 30 and the ground contact pin 40.

[0027] The socket main body 10 is a stationary insulator secured onto the mounting board 92 and is configured from an assembly of a base member 10A and a bottom cover 10B not necessarily limited to this though. The base member 10A has an outer peripheral portion 6 to which the signal contact pins 20 are attached and secured, and an inner portion 7 in which the heat-dissipating contact pin 30 and the ground contact pins 40 are arranged. The inner portion 7 is offset downward from an upper surface of the outer peripheral portion 6 so as to form an accommodation space for the IC package. The bottom cover 10B is attached and secured to the inner portion 7 of the base member 10A so as to interpose the float member 60 and, as a result of this the inner portion 7

and the float member 60 are covered by bottom cover 10B from above.

[0028] The outer peripheral portion 6 of the base member 10A includes columns 11 at its corners. The column 11 has a space to receive a cylindrical portion 63 of the float member 60 described below, and an inner wall surface of the column 11 is provided with a notch that is elongated in the up-down direction to allow the float member 60 to move in the up-down direction. Retaining-groove arranged section 12 is interposed between the adjacent columns 11. Each retaining-groove arranged section 12 includes multiple retaining grooves to and by which the signal contact pins 20 are inserted and retained. Each retaining groove is interposed between adjacent separation walls, and ensuring insulation between the signal contact pins 20 retained by the adjacent retaining grooves.

[0029] The bottom cover 10B has an upper surface 14 on which the IC package is placed, and is attached and secured onto the inner portion 7 of the base member 10A. In particular, an upwardly protruding rib 15 is formed at a rim of the upper surface 14 of the bottom cover 10B, and thus positioning of the IC package (particularly its resin-molded portion) on the upper surface 14 is facilitated. The bottom cover 10B has a X-shaped guide hole G1 by which the float member 60 is guided for its upward and downward displacement, and an aperture is formed in the upper surface 14 of the bottom cover 10B. The guide hole G1 receives a part of the float member 60 (e.g. an entirety of center portion 61 and a part of extending portion 62) described below. The bottom cover 10B is provided with four legs 96, and each leg 96 is inserted into a retaining groove in the inner portion 7 of the base member 10A. In a process of insertion of the leg 96 into the retaining groove, a protrusion at the lower end of the leg 96 rides over a protrusion formed on a wall surface of the retaining groove, thereby the bottom cover 10B is locked by the base member 10A.

[0030] The heat-dissipating contact pin 30 is a rod-like metal-made member with a spring capability which allows expansion and contraction in the up-down direction. For example, the heat-dissipating contact pin 30 is an assembly of plural parts and, as depicted in Fig. 2, has upper and lower parts 31 and 32 which are movable relative to each other, and a spring 35 that is held between flanges 33 and 34 of the upper and lower parts 31 and 32 and urges the upper and lower parts 31 and 32 to the opposite sides along the up-down direction. The upper part 31 would be in contact with, at its upper surface, the heat-dissipating and/or grounding pad in the bottom side of the IC package. The lower part 32 would be in contact with, at its lower surface, a heat-dissipating wiring on the mounting board 92. The upper part 31 and the lower part 32 are mechanically assembled in an expandable and contractible manner and so as not to be separated one another.

[0031] The ground contact pin 40 is a pin-type metal-made member with a spring capability which allows expansion and contraction in the up-down direction and for example, is made of copper or copper alloy with a plating layer formed on the surface thereof. As depicted in Fig. 2, the ground contact pin 40 has a middle portion 41; a lower contact portion 42 coupled to the middle portion 41 via a spring portion 43 so as to be in elastic contact with a wiring pad of the mounting board 92; an upper contact portion 44 coupled to the middle portion 41 via a spring portion 45 so as to be in elastic contact with the bottom side of the IC package; and a pressed portion 46 coupled to the middle portion 41 via the upper contact portion 44 and the spring portion 45 so as to be downwardly

pressed by a pressing portion 66 of the float member 60. The middle portion 41 of the ground contact pin 40 includes an insertion portion 49 which is inserted into and retained by an insertion path 81 in the retaining groove 17 of the base member 10A as described below.

[0032] The number of the heat-dissipating contact pin 30 and the number of the ground contact pin 40 may be modified as desired. For instance, increased number of the heat-dissipating contact pins 30 allows increased heat-dissipating capability of the socket 91. Increased number of the ground contact pins 40 allows reduced resistance to ground potential.

[0033] The signal contact pin 20 is a pin-type metal-made member having a spring capability which allows expansion and contraction in the up-down direction and for example, is made of copper or copper alloy with a plating layer formed on the surface thereof. As depicted in Figs. 4 and 5, the signal contact pin 20 has a middle portion 21; a lower contact portion 22 coupled to the middle portion 21 via a spring portion 23 so as to be in elastic contact with a wiring pad of the mounting board 92; and a pinching portion 24 configured to pinch an end of a lead terminal of the IC package.

[0034] The pinching portion 24 has a contact portion 25 on and with which an end of lead terminal of the IC package is placed and is in contact; a pressing portion 26 coupled to the middle portion 21 via the spring portion 27 so as to be urged toward the contact portion 25; and a lever 28 operated by the cover 50 so as to move the pressing portion 26 away from the contact portion 25.

[0035] The middle portion 21 includes an insertion portion 29, which is pressed into a slot 13 in the retaining groove arranged section 12 of the outer peripheral portion 6 of the base member 10A. As the insertion portion 29 is pressed into the slot 13, the signal contact pin 20 is attached and secured to the retaining groove arranged section 12 of the base member 10A. Note that the signal contact pins 20 are a transmission path used for various purposes such as data transmission, control signal transmission, test signal transmission, and clock signal transmission.

[0036] The cover 50 includes a resin-made rectangular frame 51 with a window through which the IC package may pass. The inner surface of the rectangular frame 51 includes a sloped guide surface by which the width of the window is narrowed downward, thus facilitating smoother movement of the IC package toward the socket main body 10. Four corners of the rectangular frame 51 are provided with 4 hollow cylindrical portions 52 which extend downward. The hole of the cylindrical portion 52 reaches to the upper surface of the rectangular frame 51 and is open at the upper surface of the rectangular frame 51.

[0037] The rectangular frame 51 has a groove 53 into which the lever 28 of the signal contact pin 20 is inserted from below. When the cover 50 descends, the lever 28 moves into the groove 53 further and is brought into contact with a bottom surface 53B of the groove 53. As the cover 50 descends further, the lever 28 is pushed outward by the bottom surface 53B, and the pressing portion 26 is pulled upward away from the contact portion 25.

[0038] The float member 60 is a X-shaped member with a center portion 61 and four extending portions 62 which radially extend from the center portion 61. The center portion 61 has an engagement hole 64 into and with which an upper portion of the heat-dissipating contact pin 30 is placed and engaged. The engagement hole 64 of the float member 60 is sectioned into an upper hole 64A

and a lower hole 64B, and a pressed surface is formed between them which crosses or is orthogonal to the central axis CL. The heat-dissipating contact pin 30 (e.g. the flange 33) touches this pressed surface, and the float member 60 is urged upwardly. Note that the upper hole 64A is reduced in diameter than the lower hole 64B. Note that, when the float member 60 descends, the heat-dissipating contact pin 30 is compressed as bearing downward load from the float member 60. Once this downward load to the cover 50 is removed, the heat-dissipating contact pin 30 stretches longer and pushes the float member 60 upward.

[0039] The extending portion 62 has an insertion groove 65 into which an upper portion of the ground contact pin 40 is inserted (in particular, the upper contact portion 44, the spring portion 45, the pressed portion 46). The insertion groove 65 is provided with a pressing portion 66 that presses the pressed portion 46 of the ground contact pin 40 downward as the float member 60 descends. The pressed portion 46 is positioned directly beneath the pressing portion 66, and the pressed portion 46 is pressed downward by the pressing portion 66 as the float member 60 descends. An insertion space for the upper contact portion 44 is arranged to the side of the central axis CL of the socket 91 adjacently relative to the pressing portion 66, an insertion space for the spring portion 45 is formed at the opposite side. As the pressing portion 66 presses the pressed portion 46 downward, the upper contact portion 44 of the ground contact pin 40 displaces closer to the central axis CL of the socket 91 and/or downward. Once the downward load to the cover 50 is removed, the float member 60 ascends and the ground contact pin 40 recovers to the initial posture.

[0040] The outer end of each extending portion 62 is provided with a hollow cylindrical portion 63 to be disposed co-axially with the cylindrical portion 52 of the cover 50. The cylindrical portion 52 of the cover 50 is inserted into a through-hole of the cylindrical portion 63 of the float member 60. The float member 60 and the cover 50 are mechanically coupled by pins 72 with each spring 71 interposed between the cylindrical portion 63 of the float member 60 and the cylindrical portion 52 of the cover 50. The spring 71 is a compression coil spring, and the cover 50 and the float member 60 are urged by the spring 71 away from one another in the up-down direction. Each spring 71' is interposed between the base member 10A and the cover 50 which are urged by the spring 71' in a direction away from one another.

[0041] The cover 50 and the float member 60 may be assembled as follows. Firstly, the cylindrical portion 52 is inserted through the spring 71 and then through the cylindrical portion 63 of the float member 60. This results in a condition where the spring 71 is interposed between the cylindrical portion 52 and the cylindrical portion 63. The pin 72 is inserted into the inside of the cylindrical portion 52 and an inserted end of the pin 72 is swaged. As such, the cover 50 and the float member 60 are assembled.

[0042] When the bottom cover 10B is attached to the base member 10A, the float member 60 is interposed between the base member 10A and the bottom cover 10B. Therefore, the assembly of the float member 60 and the cover 50 is prevented from dropping off the socket main body 10. Of course, the assembly of the float member 60 and the cover 50 is arranged to be movable in the up-down direction relative to the socket main body 10.

[0043] Fig. 6 is a schematic cross-sectional view taken along an alternate long

and short dash line B-B in Fig. 3, the socket being in a first state. Fig. 7 is a schematic cross-sectional view taken along an alternate long and short dash line B-B in Fig. 3, the socket being in the second state. As appreciated from Figs. 6 and 7, the socket main body 10 includes a retaining groove 17 that retains the ground contact pin 40, and an introduction hole 16 that is spatially coupled to the retaining groove 17 so as to facilitate introduction of the ground contact pin 40 into the retaining groove 17. The introduction hole 16 is formed on the central axis CL of the socket 91 and penetrates the inner portion (e.g., the inner portion 7) of the socket main body 10. The retaining groove 17 includes a partial space extending from an inner position in the socket main body 10 toward the outer peripheral portion 6. In detail, the respective wall surfaces 18 defining the retaining groove 17 extend from a wall surface defining the introduction hole 16 toward the outer peripheral portion 6 (e.g. its corner (e.g., the column 11)).

[0044] In the present embodiment, the socket main body 10 includes a space 8 which allows a lateral movement of the ground contact pin 40 toward the outer peripheral portion 6 of the socket main body 10, and the ground contact pin 40 is attached to the socket main body 10 by the lateral movement (or via the lateral movement) of the ground contact pin 40 in the space 8, thus upward and downward displacement of the ground contact pin 40 is prevented by the socket main body 10. For example, a lower portion of the ground contact pin 40 is introduced from above into and received in the introduction hole 16. Next, lower portion of the ground contact pin 40 is moved from the introduction hole 16 to the retaining groove 17, and inserted into and retained by the retaining groove 17. As such, the ground contact pin 40 is attached to the socket main body 10 via the lateral movement of the ground contact pin 40, and the upward and downward displacement of the ground contact pin 40 is prevented by the socket main body 10. Displacement or posture change of the ground contact pin 40 in the socket main body 10 would be impeded, and the reliability of electrical or thermal connection with the IC package or the mounting board would be enhanced.

[0045] Note that, the space 8 described above includes a retaining space of the retaining groove 17. In cases where the introduction hole 16 is formed in the socket main body 10, the space 8 described above includes an internal space of the introduction hole 16. In the fully assembled socket 91, the heat-dissipating contact pin 30 may be arranged in the introduction hole 16, and the ground contact pin 40 may be arranged in the retaining groove 17, not necessarily limited to this though. Thus, it should be noted that, in the present specification, the space does not indicate a state where no object is placed therein.

[0046] The lateral movement direction of the ground contact pin 40 typically matches a direction orthogonal to the central axis CL of the socket 91 but not necessarily limited to this, and it may be slanted by a given angle (e.g. equal to or less than 35°) to the direction orthogonal to the central axis CL of the socket 91. The introduction hole 16 is formed to allow the ground contact pin 40 to be inserted into the retaining groove 17. It is not necessarily a requisite to arrange the heat-dissipating contact pin 30 in the introduction hole 16.

[0047] In some cases, plural retaining grooves 17 are formed (e.g. radially) to retain the plural ground contact pins 40 respectively. The introduction hole 16 is commonly arranged for the plural retaining grooves 17, facilitating the

downsizing of the socket main body 10.

[0048] In some cases, the socket main body 10 has a pair of wall surfaces 18 opposed to define the retaining groove 17 and a plurality of coupling portions 19 coupled to at least one of the pair of wall surfaces 18 (both in the illustrated example), and the plurality of coupling portions 19 are arranged to define an insertion path 81 to which the insertion portion 49 of the ground contact pin 40 is inserted. The insertion portion 49 of the ground contact pin 40 is inserted into (e.g. pressed into) and retained in the insertion path 81.

[0049] Two or more (preferably three or more) coupling portions 19 may be arranged alternately on the both upper and lower sides of the insertion path 81 along the length of the insertion path 81. In this case, the coupling portions 19 may be molded by a common injection-molding technique. The length direction of the insertion path 81 is typically a direction orthogonal to the central axis CL of the socket 91, but may be slanted by a given angle. The insertion portion 49 of the ground contact pin 40 may be appropriately shaped to be pressed into the insertion path 81. Protrusion or recess may be provided on the wall surface 18 for a purpose of retaining the ground contact pin 40 or for other purposes.

[0050] Hereinafter, Figs. 8-12 would be referred to describe a process in which the IC package 200 is mounted onto the socket main body 10. Fig. 8 is a schematic diagram of process in which the IC package 200 is mounted onto the socket main body 10 while the socket 91 is in the second state. Fig. 9 is a schematic diagram illustrating that the socket 91 is shifted from the second state to the first state, and a lead terminal 202 of the IC package 200 is pinched by a signal contact pin. Fig. 10 is a schematic diagram illustrating that the second contact pin is in a situation not in contact with the IC package (not illustrated) while the socket 91 is in the second state. Fig. 11 is a schematic diagram illustrating that the socket 91 is shifted from the second state to the first state, and the second contact pin is in a situation contactable with a bottom side of the IC package (not illustrated). Fig. 12 is a schematic diagram illustrating that the second contact pin is in a situation in contact with a bottom side of the IC package 200.

[0051] In an instance depicted in Figs. 8 and 10, the socket 91 is in the second state, and the IC package 200 can be set onto the socket 91. As the cover 50 is pushed downward, the socket 91 is shifted from the first state to the second state. In detail, the float member 60 descends as the cover 50 descends. While the cover 50 and the float member 60 descend, the cover 50 operates the signal contact pin 20 into a condition capable of receiving the lead terminal 202 of the IC package 200. For example, the cover 50 pushes down the lever 28 outward, and the pressing portion 26 is pulled upward away from the contact portion 25. Also, the float member 60 pushes the heat-dissipating contact pin 30 downward, and then pushes the pressed portion 46 of the ground contact pin 40 downward, resulting in a lowered position of the upper contact portion 44. Accordingly, it is avoided that the heat-dissipating contact pin 30 and the ground contact pin 40 are brought into contact with the bottom side of the IC package 200.

[0052] In an instance depicted in Figs. 9 and 11, the socket 91 returns to the first state, and the IC package 200 is reliably set onto the socket 91. As the downward pressing of the cover 50 is released, the socket 91 automatically returns from the second state to the first state. In detail, the float member 60 ascends as the cover 50 ascends. While the cover 50 and the float member 60

ascend, the signal contact pin 20 returns to its initial posture, the lever 28 moves inward, the pressing portion 26 moves closer to the contact portion 25, and a terminal end of the lead terminal 202 of the IC package 200 is interposed between them. The heat-dissipating contact pin 30 stretches longer upward to push the float member 60 upward, and the upper contact portion 44 of the ground contact pin 40 moves to its initial height. Accordingly, it is ensured that the heat-dissipating contact pin 30 and the ground contact pin 40 are brought into contact with the bottom side of the main body 201 of the IC package 200 (See Fig. 12).

[0053] A process to remove the IC package off from the socket 91 would be understandable from the foregoing descriptions and thus omitted.

[0054] Next, an overview on a method of producing the socket 91 would be discussed. The present production method includes attaching a group of signal contact pins 20 to the outer peripheral portion 6 of the insulating socket main body 10; and attaching one or more ground contact pins 40 to the socket main body 10 at an inward position of the socket main body 10 than the signal contact pins 20. Here, the ground contact pin 40 is moved laterally in the space 8 of the socket main body 10 toward the outer peripheral portion 6 of the socket main body 10, and the ground contact pin 40 is attached to the socket main body 10 which impedes the displacement of the ground contact pin 40 in the up-down direction. After the ground contact pin 40 is set, the heat-dissipating contact pin 30 is placed in the introduction hole 16. The ground contact pin 40 may be moved by human or robot. As the contact pin is a metal part susceptible to deformation, it is recommendable to carefully handle it such as using a tweezer or the like. As already discussed, discussion on coupling of the base member 10A and the bottom cover 10B and attaching of an assembly of the float member 60 and the cover 50 would be not repeated here.

[0055] As depicted in Fig. 13, the ground contact pin 40 is moved downward and placed in the introduction hole 16. Next, the ground contact pin 40 is moved laterally toward the outer peripheral portion 6 of the socket main body 10. This allows the insertion portion 49 of the ground contact pin 40 to be inserted to and retained by the retaining groove 17. In particular, the insertion portion 49 of the ground contact pin 40 is inserted to and retained by the insertion path 81 formed by the plurality of coupling portions 19.

[0056] In cases where the heat-dissipating contact pin 30 is also arranged in the socket main body 10 additionally to the ground contact pins 40, the accommodation space (in particular, the introduction hole 16) for the heat-dissipating contact pin 30 in the socket main body 10 would be understood as being utilized for the lateral movement of the ground contact pin 40 into the retaining groove 17 either.

[0057] Note that the heat-dissipating contact pin 30 is placed in the introduction hole 16 so that the ground contact pin 40 may be prevented from slipping off from the retaining groove 17. As an alternative to the heat-dissipating contact pin 30, a plug member 250 may be used for preventing the ground contact pin 40 from slipping off from the retaining groove 17 (See Fig. 14).

[0058] In order to prevent the ground contact pin 40 from slipping off from the socket main body 10, the socket main body 10 and the ground contact pin 40 may include a complementary retaining structure (See Fig. 15). A locking portion

181 is formed on the wall surface 18 of the retaining groove 17 of the socket main body 10, and the ground contact pin 40 has a locked portion 47. As the ground contact pin 40 is inserted into the retaining groove 17, the locked portion 47 is locked by the locking portion 181. Snap feeling would be sensed which indicates the end of insertion of the ground contact pin 40, suppressing insufficient insertion of the ground contact pin 40. The locked portion 47 is a recess and the locking portion 181 is a lance that may enter into the recess (slanted metal portion). It would be possible to invert the locking portion 181 and the locked portion 47 in terms of the relationship of protrusion and recess. [0059] Based on the above teachings and disclosures, a skilled person in the art would be able to add various modifications to the respective embodiments and the respective features. It is optional to operate the heat-dissipating contact pin 30 and the ground contact pin 40 not to be in contact with the bottom side of the IC package being mounted onto the socket main body 10, and this may be omitted in some embodiments. The introduction hole should not be limited to a cylindrical space but may be formed to be a narrow slit elongated in a given direction like the retaining groove. Position and number of the introduction hole would be adjustable.

[Reference codes]

[0060]

- 8 Space
- 10 Socket main body
- 16 Introduction hole
- 17 Retaining groove
- 20 Signal contact pin (first contact pin)
- 30 Heat-dissipating contact pin
- 40 Ground contact pin (second contact pin)
- 91 Socket

[Claims]

1. A test socket for IC package, the test socket comprising:
 - an insulating socket main body onto which an IC package is mounted;
 - a group of first contact pins attached to an outer peripheral portion of the socket main body so as to be electrically contactable to terminals of the IC package; and
 - one or more second contact pins attached to the socket main body so as to be contactable to a heat-dissipating and/or grounding pad exposed in a bottom side of the IC package, and positioned inward of the socket main body than the first contact pins, wherein
 - the socket main body includes a space which allows a lateral movement of the second contact pin toward the outer peripheral portion of the socket main body, the lateral movement of the second contact pin in the space allowing the attachment of the second contact pin to the socket main body, and upward and downward displacement of the second contact pin being prevented by the socket main body.
2. The socket of Claim 1, wherein the space includes a retaining groove formed in the socket main body so as to retain the second contact pin, the retaining groove extending toward a corner of the socket main body from an inward position in the socket main body.
3. The socket of Claim 2, wherein the space further includes an introduction hole in spatial communication with the retaining groove so as to facilitate introduction of the second contact pin into the retaining groove.
4. The socket of Claim 3, wherein a plurality of the retaining grooves are arranged so as to retain a plurality of the second contact pins respectively, and the introduction hole is commonly arranged for the plurality of the retaining grooves.
5. The socket of any one of Claims 1 to 4, wherein the space includes a retaining groove formed in the socket main body so as to retain the second contact pin,
 - the socket main body has a pair of wall surfaces opposed to define the retaining groove, and a plurality of coupling portions coupled to at least one of the pair of wall surfaces, and
 - the plurality of coupling portions is arranged so as to define an insertion path into which an insertion portion of the second contact pin is inserted.
6. The socket of Claim 5 wherein the plurality of coupling portions are arranged alternately on the both upper and lower sides of the insertion path along the length direction of the insertion path.
7. The socket of Claim 5 or 6 wherein the plurality of coupling portions are arranged such that the insertion portion of the second contact pin is pressed into the insertion path and/or the second contact pin is configured such that the insertion portion of the second contact pin is pressed into the insertion path.

8. The socket of any one of Claims 5 to 7, wherein the second contact pin has an upper contact portion contactable to the heat-dissipating and/or grounding pad, a lower contact portion contactable to a mounting board on which the socket is mounted, and a middle portion interposed between the upper contact portion and the lower contact portion, the upper contact portion displaceable downward elastically in response to a load applied from above, the lower contact portion displaceable upward elastically in response to a load applied from below, and wherein

the insertion portion of the second contact pin extends in a lateral direction from the middle portion.

9. The socket of any one of Claims 1 to 8, wherein the socket main body and the second contact pin includes a complementary retaining structure so as to prevent falling of the second contact pin off from the socket main body.

10. The socket of any one of Claims 1 to 9, wherein the second contact pin has an upper contact portion contactable to the heat-dissipating and/or grounding pad, and a lower contact portion contactable to a mounting board on which the socket is mounted, the upper contact portion displaceable downward elastically in response to a load applied from above, and the lower contact portion displaceable upward elastically in response to a load applied from below.

11. The socket of any one of Claims 1 to 10, further comprising:

a cover arranged to be movable in an up-down direction relative to the socket main body to switch a state of the first contact pins; and

a float member arranged to be movable in the up-down direction relative to the socket main body in synchronization with the up-down motion of the cover so as to switch a state of the second contact pin.

12. A method of producing a test socket for IC package, the method comprising: attaching a group of first contact pins to an outer peripheral portion of an insulating socket main body; and

attaching one or more second contact pins to the socket main body at inward position in the socket main body than the first contact pins, the second contact pin being moved laterally toward the outer peripheral portion of the socket main body in a space formed in the socket main body so that the second contact pin is attached to the socket main body by which upward and downward displacement of the second contact pin prevented.

13. The method of producing the socket of Claim 12, wherein the second contact pin has an upper contact portion contactable to the heat-dissipating and/or grounding pad exposed in a bottom side of the IC package, a lower contact portion contactable to a mounting board on which the socket is mounted, and a middle portion interposed between the upper contact portion and the lower contact portion, the upper contact portion displaceable downward elastically in response to a load applied from above, the lower contact portion displaceable upward elastically in response to a load applied from below, and wherein

the middle portion is provided with an insertion portion which is inserted

into a retaining groove formed in the socket main body as the space.