

TITLE OF INVENTION: SOCKET**TECHNICAL FIELD**

[0001] The present invention relates to a socket, in particular to a socket for inspection of IC chip.

BACKGROUND ART

[0002] A socket for inspection of IC chip is demanded to be downsized, in addition to electric connection secured between the IC chip and the socket. For example, Patent Literature 1 discloses an IC socket provided with a support member configured to locate a pivoting shaft of a pressure pad at a proximal position when the pressure pad is located at a pressing position and to locate the pivoting shaft of the pressure pad at a distal position when the pressure pad is located at a release position.

[0003] Also, there are technical problems of lateral deviation of the IC chip and potential damage to the IC chip (e.g. scratches on the surface of the IC chip) due to physical contact between the IC chip and the socket when the IC chip is being pressed down. For example, Patent Literature 2 discloses an IC test handler including a clamp device that may suppress an amount of lateral deviation of an IC during an IC clamping process and prevent a terminal contact failures from occurring even for the ICs with rear-surface terminals arranged at a narrower terminal pitch. An IC pressing portion always moves to draw an arc-like trajectory with a same posture owing to a parallel link mechanism, and thus an oblique downward force would not be imparted to the IC at the time of contact with the IC, therefore an amount of lateral deviation of the IC being suppressed.

[0004] Patent Literature 3 discloses a socket that protects a top surface of a semiconductor device from contact scratches using a latch plate. The distal end of a latch member is prevented from coming into direct contact with a BGA by the latch plate and the BGA is pushed down in the vertical direction.

PATENT LITERATURES

[0005] PTL1: Japanese patent application Laid-open No. 2004-325393

PTL 2: Japanese patent application Laid-open No. 2004-184173

PTL 3: Japanese patent application Laid-open No. 2009-140629

TECHNICAL PROBLEM

[0006] There is a technical problem of suppressing or avoiding a damage of an IC chip due to a contact with a pressing member while promoting downsizing of a socket for a purpose of high-density mounting of the sockets on a substrate.

SOLUTION TO SOLVE THE PROBLEM

[0007] A socket according to an aspect of the present disclosure may include:

a base that includes a mounting section on which an IC chip is mounted, the base supporting a plurality of contact members which are electrically connectable to the IC chip;

an operational member that is vertically movable relative to the base and is shaped to allow introduction of the IC chip onto the mounting section;

a pivoting member that pivots relative to the base in accordance with a vertical movement of the operational member; and

a pressing member that moves, in accordance with pivoting of the pivoting member, between a contact position and a retracted position with keeping its posture constant, the pressing member at the contact position being in contact with a top surface of the IC chip mounted on the mounting section, and the retracted position being remote from the contact position in a socket outward direction obliquely and upwardly.

[0008] In some embodiments, the pressing member at the retracted position is located above the pivoting member.

[0009] In some embodiments, the pressing member at the retracted position in its entirety is placed inside of a contour of the socket.

[0010] In some embodiments, the constant posture is a substantially horizontal posture.

[0011] In some embodiments, the pressing member includes a heat dissipation member made of metal, the heat dissipation member having a bottom surface that is in contact with the top surface of the IC chip when the pressing member is located at the contact position. The heat dissipation member may be mounted on the pressing member so as to be elastically movable in a vertical direction.

[0012] In some embodiments, the pressing member includes a contactable member capable of coming into contact with the top surface of the IC chip, the contactable member being elastically displaceable in a vertical direction.

[0013] In some embodiments, it further includes: at least one upper link that couples an upper end of the pressing member to the operational member; and at least one lower link that couples a lower end of the pressing member to the operational member and is provided in parallel to the upper link, wherein a parallel link is configured by the pressing member, the operational member, the upper link, and the lower link. The lower link may include a joint with the pivoting member at a position between a joint between the lower link and the pressing member and a joint between the lower link and the operational member. The pivoting member may include a lower end rotatably supported by the base, an upper end rotatably coupled to the lower link, and a protruding portion protruding in the socket outward direction between the lower end and the upper end. A top dead center may be established based on an interference between the pressing member and the upper link. A bottom dead center of the pressing member may be established based on an interference between the lower link and the base.

[0014] In some embodiments, the pressing member is urged toward a guide included in the base by an elastic member at a free end of the pivoting member, and a posture of the pressing member is kept constant based on contact between the pressing member and the guide.

[0015] In some embodiments, the pressing member is swingably attached to a free end of the pivoting member and includes a guide protrusion that is engaged with a guide groove formed at the base, and the guide groove is formed in an arc shape for the constant posture of the pressing member. A bottom dead center of the pressing member may be established based on an interference between the pressing member and the base.

[0016] A method of electrically connecting an IC chip to a socket according to an aspect of the present disclosure may include:

a first step including lowering an operational member of the socket, which is vertically movable relative to a base of the socket, against an upwardly urging force caused by an elastic member, wherein a pivoting member pivots in a socket outward direction as the operational member descends, and the pressing member moves, in accordance with pivoting of the pivoting member, from a lower position toward an upper position obliquely and upwardly remote from the lower position with keeping its posture constant; and

a second step of mounting, after the first step, an IC chip onto a mounting section of the base via an opening formed in the operational member.

[0017] A socket according to another aspect of the present disclosure may include:

a base that includes a mounting section on which an IC chip is mounted, the base supporting a plurality of contact members which are electrically connectable to the IC chip;

an operational member that is vertically movable relative to the base and is shaped to allow introduction of the IC chip onto the mounting section; and

first and second pressing members, each of which moving, in accordance with a vertical movement of the operational member, between a first position and a second position with keeping its posture constant, the second position being obliquely and upwardly remote from the first position in a socket outward direction, said each pressing member at the first position being in contact with a top surface of the IC chip mounted on the mounting section, wherein

each of the first and second pressing members includes a heat dissipation member in which heat dissipation fins are arranged at a predetermined interval, and

when the first and second pressing members are located at the first position, the heat dissipation fins of the first pressing member and the heat dissipation fins of the second pressing member are alternately arranged when viewed from a side of the socket.

TECHNICAL EFFECT

[0018] According to an aspect of the present disclosure, it may be facilitated that a damage of an IC chip due to a contact with a pressing member is suppressed or avoided while promoting downsizing of a socket for a purpose of high-density mounting of the sockets on a substrate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] Fig. 1 is a schematic top view of a substrate for IC chip inspection in which a large number of sockets according to an aspect of the disclosure are mounted on the substrate at high density;

Fig. 2 is a schematic perspective view of the socket in a closed state;

Fig. 3 is a schematic perspective view of the socket in an open state;

Fig. 4 is a schematic side view of the socket in the closed state;

Fig. 5 is a schematic side view of the socket in the open state;

Fig. 6 is a schematic top view of the socket in the closed state;

Fig. 7 is a schematic top view of the socket in the open state;

Fig. 8 is a schematic cross-sectional diagram of the socket in the closed state taken along alternate long and two short dashes CX1 in Fig. 6;

Fig. 9 is a schematic cross-sectional diagram of the socket in the open state taken along the alternate long and two short dashes CX1 in Fig. 7;

Fig. 10 is a schematic diagram illustrating a pressing member moving obliquely upward in a socket outward direction from a contact position to a retracted position in a constant posture in the socket;

Fig. 11 is a schematic cross-sectional diagram of the socket in the open state taken along alternate long and two short dashes CX2 in Fig. 7;

Fig. 12 is a top schematic diagram illustrating a state in which contact surfaces of the pressing members are superimposed on predetermined regions of an IC chip;

Fig. 13 is a top schematic diagram illustrating a state in which the contact surfaces of the pressing member and the predetermined regions of the IC chip are superimposed in a manner different from a manner illustrated in Fig. 12;

Fig. 14 is a schematic diagram illustrating that a stop position of the pressing member can be set based on a collision between the pressing member and a base;

Fig. 15 is a schematic cross-sectional diagram of another socket in the closed state;

Fig. 16 is a schematic cross-sectional diagram of the other socket in the open state;

Fig. 17 is a schematic cross-sectional diagram of yet another socket in the closed state;

Fig. 18 is a schematic cross-sectional diagram of the yet other socket in the open state;

Fig. 19 is a schematic diagram illustrating that an interference is caused between the pressing member and a first link so as to set a top dead center of the pressing member;

Fig. 20 is a schematic top view of a socket according to a modified example; and

Fig. 21 is a schematic cross-sectional diagram of the socket taken along alternate long and short dashes in Fig. 20.

DETAILED DESCRIPTION OF THE INVENTION

[0020] Hereinafter, various embodiments and features according to the present disclosure would be discussed with reference to drawings. A skilled person would be able to combine respective embodiments and/or respective features without requiring excess descriptions, and would appreciate synergistic effects of such combinations. Overlapping descriptions among the embodiments would be basically omitted. Referenced drawings aim mainly for describing inventions and are simplified for the sake of convenience of preparation of drawings. The respective features should be appreciated as universal features not only effective to a presently illustrated socket and a method of connecting it with an IC chip but also effective to other various sockets and methods of connecting it with an IC chip not illustrated in the present specification.

[0021] As illustrated in Fig. 1, sockets 1 are two-dimensionally mounted at high density on a top surface of an inspection substrate 8. IC chips are mounted on the sockets 1 and are connected to an inspection device via wirings of the inspection substrate 8. Input signals such as a clock signal and a test signal are fed to the IC chip (via the inspection substrate 8 and the socket 1) so that output signals are obtained from the IC chips (via the socket 1 and the inspection substrate 8), and thus allowing an inspection of the IC chip to be carried out (e.g. determination be made whether an output signal pattern coincides with a correct signal pattern). It is a prerequisite for a correct verification on operation of the IC chips that electric connection are well established between the sockets 1 and the IC chips mounted on the sockets 1. Note that the inspection substrate 8 includes a top surface that is parallel to a plane defined by X-Y axes and with which a Z axis perpendicularly intersects, and includes wirings (surface wirings and/or internal wirings) for electric connection between the sockets 1 and the external inspection device.

[0022] In Fig. 1, the sockets 1 are arranged at a predetermined pitch P1 in the X-axis direction and arranged at a predetermined pitch P2 in the Y-axis direction. The predetermined pitch P1 and the predetermined pitch P2 are equal. Note that the sockets 1 have a first lateral width parallel to the X axis and a second lateral width parallel to the Y axis. The first lateral width and the second lateral width are equal. When the first lateral width and the second lateral width of the sockets 1 are different, the predetermined pitch P1 and the predetermined pitch P2 may also be differentiated. As it is seen from explanation below, the sockets 1 are adapted to high-density arrangement on the inspection substrate 8. To put it briefly, a pressing member explained below does not protrude from the contour of the socket 1 in a top view of the socket 1. Note that, the contour of the sockets 1 may be defined by a contour

of an operational member explained below in the top view of the socket 1, but should not be limited to this.

[0023] In the present specification, a "socket outward direction" indicates a direction from an internal position of the socket 1 to an external position of the socket 1 in the top view of the socket 1 as indicated by an arrow D1 illustrated in Fig. 1 and is typically orthogonal to one side of an (e.g. rectangular) contour of the socket 1. A socket inward direction indicates a direction from the external position of the socket 1 to the internal position of the socket 1 in the top view of the socket 1 as indicated by an arrow D2 illustrated in Fig. 1 and is typically orthogonal to one side of an (e.g. rectangular) contour of the socket 1.

[0024] Fig. 2 is a schematic perspective view of the socket 1 in a closed state. Fig. 3 is a schematic perspective view of the socket 1 in an open state. Fig. 4 is a schematic side view of the socket 1 in the closed state. Fig. 5 is a schematic side view of the socket 1 in the open state. Fig. 6 is a schematic top view of the socket 1 in the closed state. Fig. 7 is a schematic top view of the socket 1 in the open state. Fig. 8 is a schematic cross-sectional diagram of the socket 1 in the closed state taken along alternate long and two short dashes CX1 in Fig. 6. Fig. 9 is a schematic cross-sectional diagram of the socket 1 in the open state taken along the alternate long and two short dashes CX1 in Fig. 7.

[0025] The socket 1 includes a base 2, an operational member 3, a pivoting member 4, and a pressing member 5. The base 2 is assembled from one or a plurality of resin parts, and is typically an assembly of a plurality of resin parts. Similarly, the operational member 3 is assembled from one or a plurality of resin parts, and is provided to be capable of vertically moving relative to the base 2. When the operational member 3 is pushed down, the socket 1 takes the open state illustrated in Fig. 3 as a deformed state. In the

open state, an IC chip 9 may be mounted on the socket 1 and the IC chip 9 may be taken out from the socket 1. Note that conveyance of the IC chip 9 may be carried out using a suction tool or the like. The IC chip 9 is mounted on the socket 1 when the socket 1 is in the open state, and the socket 1 is subsequently shifted to the closed state so that the socket 1 and the IC chip 9 are electrically connected.

[0026] The base 2 includes a mounting section 21, on which the IC chip 9 is mounted, and a base wall 22 provided around the mounting section 21, and supports a plurality of contact members 99 (see Fig. 10 as well in addition to Fig. 8 and Fig. 9) electrically connectable to the IC chip 9 (e.g. lead terminals of the IC chip 9 and/or bumps formed on the bottom surface of the IC chip 9). The mounting section 21 includes a mounting surface 21a on which the IC chip 9 is mounted. The mounting surface 21a is typically a flat surface orthogonal to the Z axis. However, unevenness may be formed at the mounting surface 21a such as through-holes or slits for the contact members 99 or recesses corresponding to the bumps on the bottom surface of the IC chip 9.

[0027] The base wall 22 of the base 2 extends upward from the mounting surface 21a (or a plane including the mounting surface 21a) of the mounting section 21, thus defining (at least partially) an arrangement space for the IC chip 9 over the mounting surface 21a. The inner wall surface of the base wall 22 may function as a guide surface for guiding the movement of the IC chip 9 conveyed onto the mounting surface 21a by a conveyance device such as a suction chuck. Note that the base wall 22 may be partially or locally provided around the entire periphery of the mounting surface 21a, and thus interference with the pivoting member 4 discussed below is avoided. In an illustrated example, the base wall 22 includes four wall portions corresponding to four sides that define the rectangular contour of the mounting surface 21a. A

cutout or an opening 23 is formed in each of wall portions opposed in the Y-axis direction. The cutout or the opening 23 has a meaning that is same as a space where the base wall 22 is not formed. The pivoting member 4 is allowed to pivot at a large pivotal angle by the cutout or the opening 23.

[0028] Each contact member 99 may be an assembly of a pair of pin members. Suitably, an interval between the paired pin members (in particular, between the top tips of the paired pin members) changes in accordance with a vertical movement of the operational member 3, thereby allowing the pin members to hold the bump of the IC chip 9 therebetween. When the operational member 3 is located at an initial position (a top dead center), an interval between the top tip of one pin member and the top tip of the other pin member is minimized. The interval between the top tips of the pin members increases as the operational member 3 descends. The interval between the top tips of the pin members is maximized when the operational member 3 is located at the lowest position (a bottom dead center). Collision between the contact members 99 and the bumps on the bottom surface of the IC chip 9 at the time of mounting of the IC chip 9 is avoided by such switching of the contact members 99 between open and closed states. Note that a member that moves in the horizontal direction in accordance with the vertical movement of the operational member 3 may be used to effect the switching of open and closed states of the pin members in accordance with the vertical movement of the operational member 3. Contact members having other configurations may also be adoptable. For example, a contact member configured for contact not with the bump of the IC chip 9 but with a lead terminal provided in the outer periphery of the IC chip 9 may also be adopted.

[0029] The number and the arrangement of the contact members 99 supported by the base 2 may be variously changed according to the number

and the positions of bumps of the IC chip 9 (or according to the number and the positions of lead terminals). Typically, the contact members 99 are (e.g. linearly) arranged along a side defining the outer periphery of the mounting section 21 (or a side of the IC chip 9 mounted on the mounting section 21) in the top view. Array of other contact members may also be adoptable.

[0030] The operational member 3 is provided to be vertically moveable relative to the base 2 and suitably engages with the base 2 so as to be slideable (capable of linearly moving) in the vertical direction. For example, a protruded guide extending in the vertical direction is provided in one of the base 2 and the operational member 3, and a groove in which the protruded guide fits is formed in the other one. The operational member 3 may stably move vertically relative to the base 2 based on the engagement between the protruded guide and the groove. The operational member 3 is shaped to allow introduction of the IC chip 9 onto the mounting section 21. Typically, the operational member 3 is a frame-like or tubular member including an opening 35 through which the IC chip 9 is allowed to be introduced. The operational member 3 includes a hollow tube 33 surrounding the base 2 in a plane orthogonal to the vertical direction and an opening 35 at least partially defined by the hollow tube 33.

[0031] In the illustrated example, the hollow tube 33 includes four wall portions provided on the outer periphery of the four wall portions of the base wall 22 of the base 2 noted above. Likewise the base wall 22 of the base 2, the hollow tube 33 includes a cutout 34 in each of the wall portions opposed in the Y-axis direction. The cutout 34 may be formed to allow pivoting of a lower link 62 discussed below. The cutout or the opening 23 of the base 2 and the cutout 34 of the hollow tube 33 are positioned adjacently in the socket inward and outward directions so as to be in spatial communication. The IC chip 9 in

the socket 1 or a heat dissipation member 52 discussed below may be cooled (heat-dissipated) by air blowing. Note that the hollow tube 33 includes a protruding portion 36 extending upward and projecting into the cutout 34. Lower links 62 explained below are provided on both sides of the protruding portion 36.

[0032] In the present embodiment, the socket 1 further includes the pivoting member 4 and the pressing member 5. The pivoting member 4 pivots relative to the base 2 in accordance with the vertical movement of the operational member 3. In accordance with the pivoting of the pivoting member 4, the pressing member 5 moves between a contact position (see Fig. 8), where the pressing member 5 is in contact with the top surface of the IC chip 9 mounted on the mounting section 21, and a retracted position (see Fig. 9), which is remote from the contact position in the socket outward direction obliquely and upwardly, with keeping its posture constant. With such configuration, it is facilitated that a damage of the IC chip 9 due to a contact with the pressing member 5 is suppressed or avoided while promoting downsizing of the socket 1. Note that the oblique and upward movement of the pressing member 5 away from the contact position toward the retracted position may be understood by assuming a base level being set at the pressing member 5 located at the contact position, but it may also be understood based on comparison with the mounting surface 21a of the socket 1 or the IC chip 9 being mounted on the mounting surface 21a.

[0033] The pivoting member 4 is pivotably supported by the base 2, and pivots in accordance with the vertical movement of the operational member 3. The pivoting member 4 pivots in order to generate a force in the horizontal direction (orthogonal to the vertical direction) based on the vertical movement of the operational member 3 (in other words, it pivots in order to cause a

displacement of a part (e.g. an upper end 4b) of the pivoting member 4 along the horizontal direction). Specifically, the pivoting member 4 pivots in the socket outward direction as the operational member 3 descends, and pivots in the socket inward direction as the operational member 3 ascends. For this purpose, the pivoting member 4 may be urged to pivot in the socket outward direction by a none-illustrated spring. Note that a pivoting shaft of the pivoting member 4 is located at a predetermined position of the base 2 (does not move in the vertical direction unlike embodiments illustrated in Fig. 15 to Fig. 18 discussed below).

[0034] The pivoting member 4 may be variously shaped and may suitably be shaped to bend at least in one location. In an illustrated example (see Fig. 9), the pivoting member 4 includes: a lower end 4a that is rotatably supported by the base 2; an upper end 4b that is rotatably coupled to the lower link 62 explained below and is arranged so as to receive a force from the spring for the operational member at the closed state; and a protruding portion 4c that protrudes in the socket outward direction between the lower end 4a and the upper end 4b so as to receive a force from the operational member 3. The pivoting member 4 is bent at one location between the lower end 4a and the upper end 4b. The protruding portion 4c is formed on the external angle side of the bent part. The protruding portion 4c is formed as a protuberance having a pair of moderately inclined surfaces. The upper end 4b is capable of moving between a socket outward position (see Fig. 9) and a socket inward position (see Fig. 8) relative to a pivoting axis of the lower end 4a. The protruding portion 4c is provided in order to prevent, based on an interference between the protruding portion 4c and the operational member 3 (the inner wall surface thereof), the pivoting member 4 from pivotally moving when the pressing member 5 is located at the contact position. This is because there is a possibility that the pivoting member 4 may unintentionally pivot according to a

balance of forces applied to the operational member 3 and the pressing member 5.

[0035] The pressing member 5 itself may be utilized as a link component (one link of four links) of a parallel link in order to cause the pressing member 5 to shift between the contact position and the retracted position while keeping the constant posture, it should not necessarily be limited to this though. In this case, the socket 1 may further include at least one upper link 61 (suitably, a pair of upper links 61) that couples the upper end 4b of the pressing member 5 to the operational member 3 and at least one lower link 62 (suitably a pair of lower links 62) that couples the lower end 4a of the pressing member 5 to the operational member 3 and is arranged in parallel to the upper link 61. The parallel link is configured by the pressing member 5, the operational member 3, the upper link 61, and the lower link 62. By configuring the parallel link to be supported by the pivoting member 4, the pressing member 5 may be moved between the contact position and the retracted position in accordance with the vertical movement of the operational member 3. Note that the lower link 62 may include a joint with the pivoting member 4 at a position between a joint between the lower link 62 and the pressing member 5 and a joint between the lower link 62 and the operational member 3.

[0036] The pressing member 5 extends in the vertical direction in parallel to a wall portion of the hollow tube 33 of the operational member 3. A joint (a second joint J2) of the pressing member 5 and the upper link 61 is located above a joint (a first joint J1) of the pressing member 5 and the lower link 62 and these joints are disposed on the same perpendicular line (see Fig. 8). A joint (a fourth joint J4) of the upper link 61 and the operational member 3 is located above a joint (a third joint J3) of the lower link 62 and the operational member 3 and these joints are disposed on the same perpendicular line. The

vertical distance between the first and second joints is equal to the vertical distance between the third and fourth joints. The distance between the first and third joints is equal to the distance between the second and fourth joints. Typically, the distance between the first and third joints is greater than the vertical distance between the first and second joints. Note that a shaft is provided at the third joint J3 so as to extend along the X axis and to penetrate through the protruding portion 36 of the above-noted operational member 3.

[0037] As the operational member 3 starts descending against an urging force of the spring for the operational member 3, the lower link 62 starts pivoting in the socket outward direction relative to the pivoting axis thereof in the operational member 3 (note that it could also be said that the lower link 62 pivots in the socket outward direction around a pivoting axis (a coupling shaft S3) of the upper end 4b of the pivoting member 4). Simultaneously with the initiation of the pivoting of the lower link 62, the upper link 61 starts pivoting in the socket outward direction relative to the pivoting axis thereof. Similarly, the pressing member 5 starts moving from the contact position toward the retracted position. As the operational member 3 descends to a position (in the vicinity of the protruding portion 4c or below the protruding portion 4c) where the operational member 3 allows the pivoting member 4 to pivot in the socket outward direction, the pivoting member 4 starts pivoting in the socket outward direction.

[0038] The above-noted pivoting of the upper link 61, the lower link 62, and the pivoting member 4 continue, followed by the pressing member 5 reaching the retracted position remote from the IC chip 9 obliquely and upwardly, thus making it possible to introduce the IC chip 9 into the socket 1 and detach the IC chip 9 from the socket 1 without being obstructed by the pressing member 5. The pressing member 5, located at the retracted position,

may be located above the pivoting member 4 and/or may be positioned offset in the socket outward direction away from the pivoting axis of the pivoting member 4 (see the amount of offset indicated by an arrow D3 in Fig. 9). Accordingly, it is possible to ensure a sufficient aperture width for mounting or detaching the IC chip 9 into and from the socket 1 in the open state.

[0039] The pressing member 5 in its entirety, located at the retracted position, may be placed inside of the contour of the socket 1. Accordingly, the socket 1 in the open state may be kept in the smaller size. The contour of the socket 1 may be defined by the contour of the operational member 3 when the socket 1 is viewed from above. If the pressing member 5 moves in the socket outward direction too much, the size of the socket 1 in the open state would increase and it would be harder to mount the sockets 1 at higher density on the inspection substrate 8 (that is, it would be required to dispose the sockets 1 at a larger pitch).

[0040] Likewise the pressing member 5, the upper link 61 and the lower link 62 may also be located directly above the operational member 3 (e.g. the wall portion of the hollow tube 33) and/or may be placed inside of the contour of the socket 1 (when viewed from above) when the pressing member 5 is located at the retracted position. Similarly, when the pressing member 5 is located at the retracted position, a part (e.g. the upper end 4b and the protruding portion 4c) of the pivoting member 4 may also be located directly above the operational member 3 (e.g. the wall portion of the hollow tube 33) and/or may be placed inside of the contour of the socket 1 (when viewed from above).

[0041] When the pressing member 5 is located at the retracted position, the upper and lower links 61 and 62 are preferably inclined slightly in the socket inward direction with respect to the vertical direction for a purpose of stable operation of the parallel link. For this object, a protrusion that limits an angle

of the upper link 61 or lower link 62 (with respect to the vertical direction) may be provided (e.g. in the base 2).

[0042] As an option, the pressing member 5 may be utilized for heat dissipation of the IC chip 9. In some cases, the pressing member 5 includes a main body 51 and a heat dissipation member 52 which is made of metal. When the pressing member 5 is located at the contact position, the heat dissipation member 52 is in direct contact with the IC chip 9, and thus promoting the heat dissipation. Additionally, the socket 1 (to put it briefly, the base 2 and the operational member 3) may be shaped such that the heat dissipation member 52 may be visible from a side when the pressing member 5 is located at the contact position (e.g. the cutout or the opening 23 and the cutout 34 may be formed as illustrated in Fig. 4). Accordingly, the heat dissipation member 52 may be effectively cooled by air blowing.

[0043] The heat dissipation member 52 may be variously shaped. Preferably, the heat dissipation member 52 includes a plurality of heat dissipation fins 53 each extending in the vertical direction and an interconnection plate 54 to which the heat dissipation fins 53 are connected (suitably, at lower ends of the heat dissipation fins 53). The heat dissipation fins 53 may be arranged at a predetermined interval in parallel to one another. A ventilation path is defined between the heat dissipation fins 53 adjacent to each other in the arrangement direction of the heat dissipation fins 53. At least when the pressing member 5 is located at the contact position, the interconnection plate 54 may be provided to face the mounting surface 21a of the mounting section 21 of the base 2 in parallel. When the pressing member 5 is located at the contact position, the pressing member 5 comes into contact with the top surface of the IC chip 9 at the bottom surface of the heat dissipation member 52 (e.g. the bottom surface of the interconnection plate 54).

Accordingly, it may be possible to more efficiently disperse heat generated by the IC chip 9 at the time of an inspection of the IC chip 9.

[0044] In some cases, when each of the two pressing members 5 disposed to face each other as a pair in the socket is located at the contact position (a first position), the heat dissipation fins 53 of one pressing member 5 and the heat dissipation fins 53 of the other pressing member 5 may be alternately arranged when viewed from a side of the socket. In other words, an array of the heat dissipation fins 53 of one pressing member 5 is positioned offset in the lateral direction relative to an array of the heat dissipation fins 53 of the other pressing member 5. Accordingly, the cooling of the heat dissipation fins 53 by the air blowing may be promoted. Note that the offset of the array of the heat dissipation fins 53 may be visible via a ventilation port (e.g. the above-noted cutout 34) of the operational member 3.

[0045] The heat dissipation member 52 is more often harder than the main body 51 because of a difference of material between metal and resin. For this reason, the top surface of the IC chip 9 may be easily scratched. The heat dissipation member 52 may be mounted on the pressing member 5 so as to be elastically displaceable in the vertical direction, thus allowing that the damage to the IC chip 9 at the time of contact is more securely or sufficiently avoided. For example, the pressing member 5 may further include a spring (not illustrated) that urges the heat dissipation member 52 downward relative to the main body 51. When the pressing member 5 descends and the heat dissipation member 52 comes into contact with the IC chip 9, the heat dissipation member 52 may be displaced upward against the urging of the spring, thus reducing a force applied to the IC chip 9. Note that a member arranged so as to be elastically displaceable in the vertical direction should not be limited to the heat dissipation member 52, and it would also be possible to

replace it with other members (for convenience, referred to as a contactable member) as long as the member would come into contact with the top surface of the IC chip 9.

[0046] As already illustrated in the drawings referred to in the above description, the socket 1 may have an increased lateral width in one direction (e.g. the X-axis direction) with respect to the two directions of X- and Y-axes of the socket 1 at the time of the top view of the socket 1. This may result in increased contact area of the pressing member 5 (e.g. the heat dissipation member 52) and the IC chip 9. It may be promoted that the IC chip 9 is pressed by more equal force and/or is heat-dissipated more uniformly.

[0047] An additional parallel link to the above-noted parallel link may be employed in order to stably support the laterally-elongated pressing member 5. To put it briefly, the socket 1 may include a pair of upper links 61 and 63 arranged to sandwich the pressing member 5 or a part of the pressing member 5 in the width direction of the socket 1 (e.g. the X-axis direction) and a pair of lower links 62 and 64 arranged to sandwich the pressing member 5 or a part of the pressing member 5 in the width direction of the socket 1 (e.g. the X-axis direction). That is, at one end of the pressing member 5 in the X-axis direction, the upper end of the pressing member 5 is (rotatably) axially coupled to the upper link 61 and the lower end of the pressing member 5 is (rotatably) axially coupled to the lower link 62. At the other end of the pressing member 5 in the X-axis direction, the upper end of the pressing member 5 is (rotatably) axially coupled to the upper link 63 and the lower end of the pressing member 5 is (rotatably) axially coupled to the lower link 64. As shown in the drawings, it is desirable to position the lower link 62 closer to the center of the socket 1 in the width direction than the upper link 61, and to position the lower link 64

closer to the center of the socket 1 in the width direction than the upper link 63. Accordingly, the cutout 34 may be formed larger at the operational member 3.

[0048] The socket 1 may include a pair of the pivoting members 41 and 42 in order to individually support the above-noted pair of parallel links. A coupling shaft S3 may be commonly used for a joint between the pivoting member 41 and the lower link 62 and a joint between the pivoting member 42 and the lower link 64, but should not be limited to this. The pivoting member 41 may be positioned closer to the center of the socket 1 in the width direction than the lower link 62 for a purpose of downsizing of the socket 1. Similarly, the pivoting member 42 may be positioned closer to the center of the socket 1 in the width direction than the lower link 64.

[0049] An upper shaft S1 penetrating through the pressing member 5 or a part of the pressing member 5 may be laid over between the upper link 61 and the upper link 63. The upper shaft S1 is capable of rotating relative to the pressing member 5 (e.g. to the main body 51 of the pressing member 5). Similarly, a lower shaft S2 penetrating through the pressing member 5 or a part of the pressing member 5 may be laid over between the lower link 62 and the lower link 64. The lower shaft S2 is capable of rotating relative to the pressing member 5 (e.g. to the main body 51 of the pressing member 5). In this way, the pressing member 5 is capable of moving in a stabler posture. Note that the upper shaft S1 and the lower shaft S2 extend along the X axis likewise the coupling shaft S3.

[0050] An upper slot 56 extending in the vertical direction, into which the upper shaft S1 is inserted, and a lower slot 57 extending in the vertical direction, into which the lower shaft S2 is inserted, may be formed in the heat dissipation member 52 (e.g. the respective heat dissipation fins 53 extending in the vertical direction), allowing the heat dissipation member 52 to be elastically

displaced in the vertical direction at the pressing member 5 as described above and thus promoting that an appropriately adjusted pressing-down force is applied from the pressing member 5 to the IC chip 9. Typically, the upper and lower slots 56 and 57 are opened in an elliptical shape elongated in the vertical direction, but other opening shapes may also be adopted.

[0051] Shafts (see dotted lines in Fig. 2) may be used for the joints of the operational member 3 with the link 61 to 64, but other means may also be adopted. A shaft (see a shaft S9 in Fig. 8) may be used for the joint between the base 2 and the pivoting member 4, but other means may also be adopted. As the other means, a projection-recess-based rotatable fitting, bearings and the like may be envisaged.

[0052] The socket 1 may be configured to be in mirror symmetry with respect to a center plane PL (see Fig. 2) of the socket 1. Accordingly, one socket 1 may include two pressing members 5 corresponding to opposed two sides of the rectangular contour of the socket 1. The pressing members 5 may move between the contact position and the retracted position in accordance with the vertical movement of the operational member 3 as described above (see Fig. 10). When the pressing members 5 include heat dissipation members 52, the heat dissipation of the IC chip 9 is further promoted. Note that an embodiment in which one pressing member 5 is only provided to correspond to one side of the rectangular contour of the socket 1 is also assumed. Similarly, an embodiment in which four pressing members 5 are provided to correspond to four sides of the rectangular contour of the socket 1 is also assumed. Five or six pressing members 5 may also be provided in the same manner as described above if the contour of the socket 1 is a pentagon or a hexagon.

[0053] As discussed in the foregoing, the pressing member 5 may be moved with the constant posture in the socket outward direction obliquely and upwardly from the contact position to the retracted position based on the vertical movement of the operational member 3 (see Fig. 10). As a result, the socket 1 shifts from the closed state to the open state. As illustrated in Fig. 10 and Fig. 11, a latch 7 may be deployed in addition to the pressing member 5 so as to press down the IC chip 9. The latch 7 is pivotably supported by the base 2 as illustrated in Fig. 11, and is located between the pivoting members 41 and 42 in the illustrated example. Note that the latch 7 is narrower in the X-axis direction than the pressing member 5. The latch 7 is always urged by a spring and pivots in the socket inward direction (around a pivoting shaft of the latch 7 in the base 2). The latch 7 includes a pressing portion 71 for pressing the IC chip 9 and an urged portion 72 urged upward by the spring which are on both sides of the pivoting axis of the latch 7. At the time of descending of the operational member 3, the urged portion 72 of the latch 7 is pushed down by the operational member 3, and the latch 7 pivots in the socket outward direction against the urging force of the spring. In this way, likewise the release of the pressing action by the pressing member 5, the pressing-down action by the latch 7 against the IC chip 9 may be released based on the descending of the operational member 3.

[0054] In a case where it is known that the IC chip 9 has heat generation regions 91 and 92 in advance as illustrated in Fig. 12, the heat dissipation members 52 of the pressing members 5 may be selectively brought into contact with the heat generation regions 91 and 92 which are targeted regions. Note that the heat generation regions 91 and 92 are regions that generate heat more greatly than other portions (e.g. a peripheral region) of the IC chip at the time of operation of the IC chip 9. Fig. 13 illustrates an example in which two heat dissipation members 52 are allocated to one heat generation region 93 in the

IC chip 9. In this way, the position, the size, and the shape of the pressing member 5 (or the heat dissipation member 52) in the socket 1 may be changed according to a position and a range of the heat generation region 93 in the IC chip 9.

[0055] The pressing member 5 descends and reaches the bottom dead center as the operational member 3 ascends. The bottom dead center of the pressing member 5 may be established based on an interference between the pressing member 5 and the base 2. For this purpose, a first stopped portion 58 may be provided in the pressing member 5 (e.g. the main body 51) as illustrated in Fig. 14. When the pressing member 5 is located at the contact position, the stopped portion 58 comes into contact with the base 2 (e.g. the top surface of the base wall 22), thus defining the stop position (the bottom dead center) of the pressing member 5 and optimizing a contact position of the pressing member 5 with the IC chip 9. For example, it may be avoided that the pressing member 5 excessively presses down the IC chip 9. The stopped portion 58 may be provided in the vicinity of the second joint J2 of the upper link 61 and the pressing member 5 (e.g. adjacent to the second joint J2 in the socket inward direction). The stopped portion 58 may also be provided in another component such as the heat dissipation member 52, the upper link 61, or the lower link 62. In some cases, the bottom dead center of the pressing member 5 is established based on an interference between the lower link 62 and the base 2. For a purpose of sufficient restraint of the stopped portion 58 by the base 2, the base 2 may be provided with a protrusion protruding in the socket inward direction in a degree such that attachment and detachment of the IC chip 9 is not impeded.

[0056] It is not a must to adopt the parallel link for a purpose of retaining the constant posture of the pressing member 5. This aspect would be briefly

discussed with reference to Fig. 15 to Fig. 18. In Fig. 15 and Fig. 16, the pressing member 5 is urged toward a guide plate 110 of the base 2 by a spring 120 at a free end of the pivoting member 4 and the posture of the pressing member 5 is kept constant based on contact between the pressing member 5 and the guide plate 110. The guide plate 110 is a part of the base 2 and is provided directly above the base wall 22 described above. Therefore, even if the guide plate 110 is provided, there is no problem in attachment and detachment of the IC chip 9 to and from the socket 1. More specifically, the guide plate 110 includes a guide surface 111 along which the pressing member 5 slides. The guide surface 111 includes a curved surface curved along a pivoting locus of the free end of the pivoting member 4. Naturally, guides other than the guide plate 110 may also be adopted.

[0057] In a case illustrated in Fig. 17 and Fig. 18, the pressing member 5 is swingably attached to the free end of the pivoting member 4, and includes guide protrusions 511 and 512 which are respectively engaged with guide grooves 211 and 212 formed at the base 2. The guide grooves 211 and 212 are formed in an arc shape for keeping the pressing member 5 at a constant posture. The guide grooves 211 and 212 are formed on the inner wall surface of the guide plate 110 included in the base 2. The guide grooves 211 and 212 may be formed to curve along the pivoting locus of the free end of the pivoting member 4. The guide protrusions 511 and 512 are protrusions protruding in the socket outward direction. Other configurations may also be adopted.

[0058] In the embodiment illustrated in Fig. 15 to Fig. 18, the pivoting axis of the pivoting member 4 moves vertically and down in accordance with the vertical movement of the operational member 3. The pivoting member 4 includes engaging protrusions that engage in the guide grooves 211 and 212

provided in the base 2, whereby a pivoting posture of the pivoting member 4 is stabilized. The pivoting member 4 may also be provided in other forms.

[0059] The pressing member 5 ascends and reaches the top dead center as the operational member 3 descends. A posture of the pressing member 5 at the top dead center may be established based on an interference between the pressing member 5 and the upper links 61 and 63. For example, the pressing member 5 (e.g. the main body 51) may be provided with a second stopped portion 59 as illustrated in Fig. 19. When the pressing member 5 is located at the retracted position (the top dead center), the stopped portion 59 comes into contact with the upper link 63, thus preventing the pressing member 5 from rotating while keeping the posture of the pressing member 5 constant. The pressing member 5 does not further move in the socket outward direction even with an external force applied, and thus preventing stack of the parallel link that may otherwise occur. Just to make sure, if the upper links 61 and 63 and the lower links 62 and 64 are disposed on the same perpendicular line, there is a possibility that the parallel link does not function correctly. As discussed above, when the pressing member 5 is located at the retracted position, the upper and lower links 61 and 62 are desirably slightly inclined in the socket inward direction with respect to the vertical direction.

[0060] Fig. 20 is a schematic top view of a socket according to a modified example. Fig. 21 is a schematic sectional diagram of the socket taken along alternate long and short dash lines in Fig. 20. As can be seen from Fig. 20 and Fig. 21, the protruding portion 4c has a length that is set such that the operational member 3 collides with the protruding portion 4c as the operational member 3 ascends. As the operational member 3 ascends, the operational member 3 collides with the protruding portion 4c of the pivoting member 4 and pushes the protruding portion 4c upward and accordingly, the pivoting member

4 pivots in the socket inward direction. As a result, it is ensured that the pressing member 5 descends and reaches the contact position.

[0061] Based on the teaching described above, those skilled in the art may add various changes to the embodiments and the characteristics. Those skilled in the art may understand a method of assembling the socket 1 by referring to the drawings of the application. Detailed explanation of the method is omitted.

Description of Reference Numerals

1: Socket

2: Base

3: Operational member

4: Pivoting member

4a: Lower end

4b: Upper end

4c: Protruding portion

5: Pressing member

7: Latch

8: Inspection substrate

9: IC chip

21: Mounting section

21a: Mounting surface

22: Base wall

23: Opening

33: Hollow tube

34: Cutout

35: Opening

41: Pivoting member

42: Pivoting member

51: Main body

52: Heat dissipation member

53: Heat dissipation fin

54: Interconnection plate

56: Upper slot

57: Lower slot

61: Upper link

62: Lower link

63: Upper link

64: Lower link

71: Pressing portion

72: Urged portion

91: Heat generation region

92: Heat generation region

93: Heat generation region

99: Contact member

CLAIMS**1.** A socket comprising:

a base that includes a mounting section on which an IC chip is mounted, the base supporting a plurality of contact members which are electrically connectable to the IC chip;

an operational member that is vertically movable relative to the base and is shaped to allow introduction of the IC chip onto the mounting section;

a pivoting member that pivots relative to the base in accordance with a vertical movement of the operational member; and

a pressing member that moves, in accordance with pivoting of the pivoting member, between a contact position and a retracted position with keeping its posture constant, the pressing member at the contact position being in contact with a top surface of the IC chip mounted on the mounting section, and the retracted position being remote from the contact position in a socket outward direction obliquely and upwardly.

2. The socket according to claim 1, wherein the pressing member at the retracted position is located above the pivoting member.

3. The socket according to claim 1, wherein the pressing member at the retracted position in its entirety is placed inside of a contour of the socket.

4. The socket according to claim 1, wherein the constant posture is a substantially horizontal posture.

5. The socket according to claim 1, wherein the pressing member includes a heat dissipation member made of metal, the heat dissipation member having a bottom surface that is in contact with the top surface of the IC chip when the pressing member is located at the contact position.
6. The socket according to claim 1, wherein the pressing member includes a contactable member capable of coming into contact with the top surface of the IC chip, the contactable member being elastically displaceable in a vertical direction.
7. The socket according to any one of claims 1 to 6, further comprising: at least one upper link that couples an upper end of the pressing member to the operational member; and at least one lower link that couples a lower end of the pressing member to the operational member and is provided in parallel to the upper link, wherein a parallel link is configured by the pressing member, the operational member, the upper link, and the lower link.
8. The socket according to claim 7, wherein a bottom dead center of the pressing member is established based on an interference between the lower link and the base.
9. The socket according to claim 7, wherein the lower link includes a joint with the pivoting member at a position between a joint between the lower link and the pressing member and a joint between the lower link and the operational member.
10. The socket according to claim 7, wherein the pivoting member includes a lower end rotatably supported by the base, an upper end rotatably coupled to

the lower link, and a protruding portion protruding in the socket outward direction between the lower end and the upper end.

11. The socket according to claim 10, wherein the protruding portion has a length that is set such that the operational member collides with the protruding portion as the operational member ascends.

12. The socket according to claim 7, wherein a posture of the pressing member at a top dead center is maintained based on an interference between the upper link and the pressing member.

13. The socket according to claim 7, wherein the at least one upper link includes a pair of upper links arranged to sandwich the pressing member or a part of the pressing member in a width direction of the socket, and

the at least one lower link includes a pair of lower links arranged to sandwich the pressing member or a part of the pressing member in the width direction of the socket.

14. The socket according to claim 13, wherein an upper shaft is laid over between the pair of upper links, the upper shaft penetrating through the pressing member or a part of the pressing member; and

a lower shaft is laid over between the pair of lower links, the lower shaft penetrating through the pressing member or a part of the pressing member.

15. The socket according to claim 14, wherein a heat dissipation member is mounted on the pressing member so as to be elastically displaceable in a vertical direction, and

the heat dissipation member includes: an upper slot extending in the vertical direction into which the upper shaft is inserted, and a lower slot extending in the vertical direction into which the lower shaft is inserted.

16. The socket according to any one of claims 1 to 6, wherein the pressing member is urged toward a guide included in the base by an elastic member at a free end of the pivoting member, and a posture of the pressing member is kept constant based on contact between the pressing member and the guide.

17. The socket according to any one of claims 1 to 6, wherein the pressing member is swingably attached to a free end of the pivoting member and includes a guide protrusion that is engaged with a guide groove formed at the base, and the guide groove is formed in an arc shape for the constant posture of the pressing member.

18. The socket according to any one of claims 1 to 6, wherein a bottom dead center of the pressing member is established based on an interference between the pressing member and the base.

19. A socket comprising:

a base that includes a mounting section on which an IC chip is mounted, the base supporting a plurality of contact members which are electrically connectable to the IC chip;

an operational member that is vertically movable relative to the base and is shaped to allow introduction of the IC chip onto the mounting section; and

first and second pressing members, each of which moving, in accordance with a vertical movement of the operational member, between a

first position and a second position with keeping its posture constant, the second position being obliquely and upwardly remote from the first position in a socket outward direction, said each pressing member at the first position being in contact with a top surface of the IC chip mounted on the mounting section, wherein

each of the first and second pressing members includes a heat dissipation member in which heat dissipation fins are arranged at a predetermined interval, and

when the first and second pressing members are located at the first position, the heat dissipation fins of the first pressing member and the heat dissipation fins of the second pressing member are alternately arranged when viewed from a side of the socket.

20. A method of electrically connecting an IC chip to a socket, the method comprising:

a first step including lowering an operational member of the socket, which is vertically movable relative to a base of the socket, against an upwardly urging force caused by an elastic member, wherein a pivoting member pivots in a socket outward direction as the operational member descends, and the pressing member moves, in accordance with pivoting of the pivoting member, from a lower position toward an upper position obliquely and upwardly remote from the lower position with keeping its posture constant; and

a second step of mounting, after the first step, an IC chip onto a mounting section of the base via an opening formed in the operational member.