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(54) SOCKET FOR DIGITAL CAMERA MODULE

SOCKEL FÜR EIN DIGITALES KAMERAMODUL

SUPPORT POUR MODULE D'APPAREIL PHOTO NUMERIQUE

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(56) References cited:
EP-A- 1 387 607
EP-A- 1 471 731
EP-A- 1 511 298
US-A1- 2004 023 528
US-A1- 2005 153 600

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Description

Background Of The Invention

[0001] The present invention relates generally to a small size sockets that are used to house digital camera modules.

[0002] Conventionally, sockets (see, for example, Japanese Design Registration No. 1179175) have been used for mounting camera modules, each of which is composed of an optical element such as lens, and an image pickup device such as a CCD (Charge Coupled Device) or CMOS (Complementary Metal Oxide Semiconductor) image sensor, on substrates of small-sized electronic devices such as cellular phones and PDAs (Personal Digital Assistants), as is disclosed in Japanese Design Registration No. 1179175)

[0003] FIG. 24 is an exploded perspective view of the conventional socket. In FIG. 24, reference numeral 301 denotes a cover; reference numeral 311 denotes a housing body; reference numeral 312 denotes a shell; reference numeral 313 denotes a terminal; reference numeral 314 denotes a printed circuit board; and reference numeral 320 denotes a camera module. In this case, the housing body 311, which is made of resin and has a plurality of the terminals 313, is mounted on the printed circuit board 314, which serves as a substrate; and the camera module 320 is fitted into the housing body 311. Covering the side walls of the housing body 311, the shell 312, made of metal, serves as a shield against electromagnetic waves. After the camera module 320 is mounted in the housing body 311, the cover 301, made of metal, is attached, from above, to the housing body 311.

[0004] Since the conventional socket requires the cover 301 in order to prevent detachment of the camera module 320, the conventional socket involves a problem of an increased number of components. Accordingly, the number of steps for mounting the camera module 320 on the printed circuit board 314 increases, resulting in an increase in mounting cost. Also, since the housing body 311 has four side walls made of resin, the thickness of the side walls causes an increase in the outside dimensions of the housing body 311, resulting in an increase in occupation area on the printed circuit board 314. In small-sized electronic devices, the area of the printed circuit board 314 is limited, so that an increased occupation area raises a serious problem. Furthermore, since the shell 312, which covers the side walls, is formed by assembling a plurality of metal plate members, the assembly work unavoidably involves occurrence of dimensional errors, resulting in impaired dimensional accuracy.

[0005] A socket comprising a side wall member, terminals, a terminal support member and accommodating a camera module is known from US 2004 0023528.

Summary Of The Invention

[0006] It is a general object of the present invention to solve the above-mentioned problems in the conventional socket and to provide a socket which features a small number of components, small outside dimensions, small occupation area on a substrate, and high dimensional accuracy and allows a module to be readily and accurately mounted therein with low cost, by means of imparting thereto the form of a closed-bottomed container having an open end; i.e., attaching a shell to a bottom plate portion made of resin, the shell being made of a single metal plate member and assuming the form of a side wall which extends upright and encircles the perimeter of the bottom plate portion.

[0007] To achieve the above object, the present invention provides a socket for accommodating a camera module according to claim 1. The socket comprises a bottom member formed of a dielectric material and facing the bottom surface of the module; terminals attached to the bottom member; and a side wall member formed of a single metal plate, attached to the bottom member, and encircling the side wall surfaces of the module. The socket is adapted to elastically hold the module.

[0008] Preferably, the side wall member includes an inwardly projecting elastic engagement piece, and the elastic engagement piece engages with an engagement recess formed on the side wall surface of the module to thereby lock the module. The elastic engagement piece is an elongated member which has an end integrally connected to the side wall member, and portions of the side wall member located on opposite sides of the end of the elongated member collectively function as a torsion spring. The side wall member includes an inwardly projecting elastic contact piece, and the elastic contact piece comes into contact with a metal coating formed on the side wall surface of the module to thereby shield the module.

[0009] Preferably, the terminal includes an elastic arm piece which projects above the bottom member and comes into contact with a wiring trace on the bottom surface of the module. Preferably, the side wall member includes an insertion projection provided on an end, toward the bottom member, of the side wall member; the bottom member includes a side wall support portion which is formed in such a manner as to correspond to the insertion projection and projects above the upper surface of the bottom member, and an insertion through-hole which is formed in the bottom member at a position corresponding to the insertion projection; and the insertion projection is inserted into the insertion through-hole, and the outer surface of the side wall member abuts the inner surface of the side wall support portion.

[0010] The side wall member preferably includes a joint portion at which opposite end portions of the metal plate are crimp-joined. The side wall member further includes an engagement slot which is formed therein and into which a projection of the module is inserted, and a bridge portion which projects from an end, opposite the bottom member, of the side wall member and extends along an end portion of the engagement slot between

portions of the side wall member located on opposite sides of the engagement slot.

[0011] The socket according to the present invention assumes the form of a closed-bottomed container having an open end in which a shell is attached to a bottom plate portion made of resin, the shell being made of a single metal plate member and assuming the form of a side wall which extends upright and encircles the perimeter of the bottom plate portion. Accordingly, the socket features a small number of components, small outside dimensions, small occupation area on a substrate, and high dimensional accuracy and allows a module to be readily and accurately mounted therein with low cost.

[0012] These and other objects, features and advantages of the present invention will be clearly understood through a consideration of the following detailed description.

Brief Description Of The Drawings

[0013] The invention, together with its objects and the advantage thereof, may be best understood by reference to the following description taken in conjunction with the accompanying drawings, in which like reference numerals identify like elements in the figures and in which:

FIG. 1 is an exploded perspective view of a socket according to an embodiment of the present invention;
FIG. 2 is a front view of the socket of the embodiment;
FIG. 3 is a side view of the socket of the embodiment;
FIG. 4 is a plan view of the socket of the embodiment;
FIG. 5 is a sectional view of the socket of the embodiment taken along line A-A of FIG. 3;
FIG. 6 is a sectional view of the socket of the embodiment taken along line B-B of FIG. 2;
FIG. 7 is a sectional view of the socket of the embodiment taken along line C-C of FIG. 2;
FIG. 8 is a perspective view of a shell in the embodiment;
FIG. 9 is a partially enlarged view of the shell in the embodiment, showing a portion represented by F in FIG. 8;
FIG. 10 is a partially enlarged view of the shell in the embodiment, showing a portion represented by G in FIG. 8;
FIG. 11 is a partially enlarged view of the shell in the embodiment, showing a portion represented by H in FIG. 6;
FIG. 12 is a partially enlarged view of the shell in the embodiment, showing a portion represented by 1 in FIG. 5;
FIG. 13 is a front view of the shell in the embodiment;
FIG. 14 is a left-hand side view of the shell in the embodiment;
FIG. 15 is a right-hand side view of the shell in the embodiment;
FIG. 16 is a plan view of the shell in the embodiment;
FIG. 17 is a first enlarged view of a lock spring piece in the embodiment, showing a portion represented by **J** in FIG. 13;
FIG. 18 is a second enlarged view of the lock spring piece in the embodiment, showing the portion represented by **J** in FIG. 13;
FIG. 19 is an enlarged view of a grounding spring piece in the embodiment, showing a portion represented by **K** in FIG. 15;
FIG. 20 is a first sectional view of the socket of the embodiment taken along line **D-D** of FIG. 2;
FIG. 21 is a second sectional view of the socket of the embodiment taken along line **E-E** of FIG. 2;
FIG. 22 is a first sectional view of the socket of the embodiment, showing a condition after a module is mounted in the socket;
FIG. 23 is a second sectional view of the socket of the embodiment, showing a condition after the module is mounted in the socket; and,
FIG. 24 is an exploded perspective view of a conventional socket.

Detailed Description Of The Preferred Embodiments

[0014] FIG. 1 illustrates a socket 10 constructed in accordance with the principles of the present invention. The socket 10 is used to electrically connect a camera module 53 to a substrate 51. The camera module 53 uses an optical element such as lens, and an image pickup device such as a CCD or CMOS image sensor. However, the module 53 may be of any kind. The module 53 may be a sensor module that includes an infrared sensor or a fingerprint read sensor, or an acoustic module such as a microphone. The socket 10 is used to mount the module 53 on a small-sized electronic device such as a cellular phone or PDA. However, the socket 10 may be used to mount the module 53 on a device of any kind; for example, on a household electric device such as a TV, washing machine, or refrigerator, a security monitor, or an automobile. The socket 10 is mounted on a substrate such as a printed circuit board. However, the socket 10 may be mounted on a substrate of any kind.

[0015] As shown in FIG. 1, the socket 10 receives the module 53 and includes a housing member 11, which serves as a bottom member; terminals 21, which are attached to the housing member 11; and a shell 31, which is attached to the housing member 11 and serves as a side wall member. The socket 10 assumes the form of a closed-bottomed container having an open end. The shell 31 encircles at least a portion of a side wall surface 55 of the module 53. In other words, the shell 31 does not necessarily encircle the entire range extending from the lower end to the upper end of the side wall surface 55 of the module 53, but may encircle a portion of the range. Notably, in the present embodiment, the closed-bottomed container is substantially of a rectangular parallelepiped. That is, the shell 31 assumes a rectangular tubular shape such that one end of the rectangular tube

is closed with the housing member 11, whereas the other end of the rectangular tube is open.

[0016] The housing member 11 is a unitary plate-like member formed of dielectric material such as synthetic resin and does not have a side wall. A pair of shell support portions 12, which serve as side wall support portions, are integrally formed at longitudinally opposite ends of the housing member 11. The paired shell support portions 12 assume the form of a substantially rectangular plate and project above the upper surface of the housing member 11. A groove-like clearance 12a is formed between the main body of the housing member 11 and each of the paired shell support portions 12 so as to receive a portion of the lower end of the shell 31. As shown in FIG. 7, a slot-like insertion through-hole 12b is formed in the housing member 11 at a position corresponding to a central portion of each clearance 12a so as to receive a corresponding insertion projection 32 of the shell 31.

[0017] End projection pieces 13 and intermediate projection pieces 14 are formed at laterally opposite ends of the housing member 11 in such a manner as to project laterally outward. In the present embodiment, two of the intermediate projection pieces 14 are provided at each of the laterally opposite ends of the housing member 11. However, the number of the intermediate projection pieces 14 may be selected as appropriate. Side surfaces 13a of the end projection pieces 13 are flush with the corresponding longitudinally opposite end surfaces of the main body of the housing member 11. The side surfaces 13a desirably abut the inner surface of a lower end portion of the shell 31, but this is not mandatory. End surfaces 13b of the end projection pieces 13 and end surfaces 14a of the intermediate projection pieces 14 extend in the direction orthogonal to the side surfaces 13a and abut the inner surface of a lower end portion of the shell 31.

[0018] Seven laterally extending terminal reception grooves 15 are formed at predetermined pitches at each of the lateral ends of the housing member 11. The individual terminals 21 are fitted into the corresponding terminal reception grooves 15. The pitch and number of the terminal reception grooves 15 may be selected as appropriate. Not all of the terminal reception grooves 15 are necessarily occupied by one of the terminals 21. Some terminal reception grooves 15 may be unoccupied by the terminals 21, in accordance with the arrangement of pads exposed on the bottom surface of the module 53. As shown in FIG. 7, a deep portion of each of the terminal reception grooves 15 is formed into an accommodation recess 15a, which extends toward the longitudinal axis of the housing member 11 and accommodates the main body of the terminal 21. Entrance portions of the terminal reception grooves 15 are indented toward the longitudinal axis of the housing member 11 with respect to the end surfaces 13b of the end projection pieces 13 and the end surfaces 14a of the intermediate projection pieces 14. As shown in FIG. 4, a space for allowing movement of connection arm portions 23, which serve as elastic arm pieces, of the terminals 21 is provided between the inner surface of the shell 31 and the entrance portions of the terminal reception grooves 15.

[0019] The terminals 21 are formed as blanks from a metal sheet which are bent into shape. The main body of each terminal 21 has a configuration resembling the letter U and includes a lower base portion 21a and an upper base portion 21 b. The lower base portion 21a and the upper base portion 21b are integral with each other via a curved portion. The curved portion is elastically deformed, thereby effecting a spring function. The lower base portion 21a is wider than the upper base portion 21 b. The lower base portion 21a has projections formed on its corresponding opposite side surfaces. The projections bite into the corresponding side walls of the accommodation recess 15a of the housing member 11. A tail portion 22 extends from the distal end of the lower base portion 21a. The connection arm portion 23 extends from the distal end of the upper base portion 21b and functions as a contact piece, which is electrically connected to a pad exposed on the bottom surface of the module 53. The connection arm portion 23 is integral with the upper base portion 21b via a bend portion while extending obliquely upward. A contact portion 23a is formed in the vicinity of the upper end, which is a free end, of the contact arm portion 23. The contact portion 23a protrudes and abuts the surface of a pad exposed on the bottom surface of the module 53.

[0020] FIG. 7 illustrates the terminal 21 fitted into the terminal reception groove 15 of the housing member 11, and the lower base portion 21a fixedly held from opposite sides by the opposite side walls of the accommodation recess 15a. The projections of the lower base portion 21 a bite into the side walls of the accommodation recess 15a so that the lower base portion 21 a is reliably fixed. As shown in FIG. 6, the lower surface of the tail portion 22 projects downward slightly below the lower surface of the housing member 11, whereas the connection arm portion 23 projects upward greatly above the upper surface of the housing member 11. The tail portion 22 is connected to a wiring trace formed on the surface of the substrate 51 (which will be described later) by, for example, soldering.

[0021] The shell 31 is shown as formed from a single metal plate member, and the shell 31 is generally rectangular, being formed as follows: the metal plate member is bent at a right angle at four bend portions 35a, and its opposite ends are joined together in abutment. In other words, the shell 31 assumes a shape formed as follows: four rectangular planes are connected in a mutually orthogonal condition. The lower end of the shell 31 is connected to the perimeter of the housing member 11, and the shell 31 functions as a side wall of the socket 10. In other words, the four planes of the shell 31 serve as side walls that encircle the housing member 11 on all sides. In the example shown in FIG. 4, the shell 31 has a rectangular cross-sectional shape in which one pair of opposed sides are longer than the other pair of opposed sides. However, the cross-sectional shape may be

square. In this case, as shown in FIG. 3, a joint portion 37 is formed by joining the opposite ends of the metal plate member and located at a central portion of one side wall of the rectangular tubular member. A convex portion 37a is formed at one end of the metal plate member, whereas a concave portion corresponding to the convex portion 37a is formed at the other end of the metal plate member. The convex portion 37a and the concave portion are engaged together and then crimped so as to be mutually tightened, thereby strengthening the joint between the opposite ends at the joint portion 37. In the present embodiment, the opposite ends are joined together by crimping. However, the opposite ends may be joined together by means of, for example, soldering, welding, or bonding.

[0022] A plurality of projections are formed at the lower end of the shell 31 in a downward projecting condition. The projections include the insertion projections 32, wide projections 33, and narrow projections 34. In this case, the insertion projections 32 and the wide projections 33 are formed at opposed portions of the lower end corresponding to a pair of short sides of the shell 31, whereas the narrow projections 34 are formed at opposed portions of the lower end corresponding to a pair of long sides of the shell 31. The insertion projections 32 are formed at central portions of the lower end of short sides of the shell 31. The wide projections 33 are formed on opposite sides of the insertion projection 32. The joint portion 37 is located at the center of one of the two insertion projections 32. Six of the narrow projections 34 are formed at predetermined pitches at each of the portions of the lower end.

[0023] As shown in FIGS. 2, 3, 5, and 6, when the lower end of the shell 31 is connected to the perimeter of the housing member 11, the lower end surfaces of the insertion projections 32, wide projections 33, and narrow projections 34 project downward slightly below the lower surface of the housing member 11 as in the case of the lower surfaces of the tail portions 22. This allows the insertion projections 32, the wide projections 33, and the narrow projections 34 to be soldered to corresponding pads formed on the surface of the substrate 51. At least some of the pads are connected to relevant ground traces on the substrate 51. Accordingly, the shell 31 is grounded and thus can function as an electromagnetic shield.

[0024] All of the pads to which the narrow projections 34 are connected are connected to relevant ground traces on the substrate 51. Desirably, as shown in FIG. 7, the narrow projections 34 are located in the vicinity of the tips of the tail portions 22 of the terminals 21 and arranged, in plane, in such a manner as to serve as apexes of isosceles triangles, which the narrow projections 34 and the tips of the tail portions 22 form. In other words, desirably, on the cross-sectional view taken along line **C-C** of FIG. 2, the narrow projections 34 are located in the vicinity of the tips of the tail portions 22 of the terminals 21 and arranged in such a manner that the same distance is established between each of the narrow projections 34 and the tips of two tail portions 22 that, together with the narrow projection 34, form what is shown as an isosceles triangle.

[0025] As shown in FIGS. 5 to 7, in a state in which the lower end of the shell 31 is connected to the perimeter of the housing member 11, the insertion projections 32 are inserted into the corresponding insertion through-holes 12b. In this case, the inner surfaces of the wide projections 33 desirably abut the side surfaces 13a of the end projection pieces 13, but this is not mandatory. The end surfaces 13b of the end projection pieces 13 and the end surfaces 14a of the intermediate projection pieces 14 desirably abut the inner surfaces of lower end portions of the shell 31 corresponding to the short sides of the shell 31, but this is not mandatory. Furthermore, the outer surfaces of the insertion projections 32 abut the inner surfaces of the opposed shell support portions 12, and portions of the lower end of the shell 31 in the vicinity of the insertion projections 32 are fitted into the groove-like clearances 12a. Accordingly, the shell 31 and the housing member 11 are reliably connected, and the shell 31 is reliably held by the housing member 11. Thus, the socket shape is maintained firmly and consistently.

[0026] Desirably, the main body of the shell 31 includes a thick-walled portion 31 a and a thin-walled portion 31b. In this case, in view of strength of the shell 31, the thin-walled portion 31b desirably ranges over a predetermined distance from the upper end of the shell 31. Reference numeral 31 c denotes a boundary line between the thick-walled portion 31 a and the thin-walled portion 31b. An upper end portion of the shell 31 is bent at a bend portion 36a, thereby forming an inclined portion 36 that is inclined outward. The inclined portion 36 is included in the thin-walled portion 31b. The inclined portion 36 is belled out upward, thereby facilitating insertion of the module 53 into the shell 31 from above. In the thin-walled portion 31b, cut portions 35 are formed at positions corresponding to the bend portions 35a. Accordingly, the thin-walled portion 3 1 b is divided into four independent sections corresponding to four planes of the shell 31.

[0027] As shown in FIGS. 1 and 6, a vertically extending long engagement slot 47 is formed in a plane of the shell 31 that has the insertion projection 32 and does not have the joint portion 37. In order to indicate the orientation of the module 53; i.e., the polarity of the module 53, a polarity key is formed in an outwardly projecting condition on one side wall of the module 53. In mounting of the module 53, the module 53 is inserted into the shell 31 from above in such a manner that the polarity key is fitted into the engagement slot 47. In this manner, the module 53 is mounted in the socket 10 with predetermined orientation, and predetermined pads exposed on the bottom surface of the module 53 are connected to the connection arm portions 23 of the corresponding terminals 21.

[0028] A bridge portion 48 is formed integrally with the inclined portion 36 in such a manner as to project upward from the upper end of the inclined portion 36 and to extend

along the upper end of the engagement slot 47. The bridge portion 48 integrally connects portions of the inclined portion 36 located on opposite sides of the engagement slot 47, thereby enhancing the strength of a plane of the shell 31 in which the engagement slot 47 is formed, and preventing deformation of the plane. As shown in FIGS. 1 and 2, the bridge portion 48 is bent further from the inclined portion 36 to become substantially horizontal. Accordingly, as shown in FIGS. 1 and 4, an upper end portion of the engagement slot 47 opens upward, so that, in mounting of the module 53, the polarity key of the module 53 can be readily inserted from above into the engagement slot 47.

[0029] Two of first grounding spring pieces 41, which serve as elastic contact pieces, are formed on each of two planes of the shell 31 on which the insertion projection 32 is formed. The first grounding spring pieces 41 come into contact with a metal coating formed on the side wall surface 55 of the module 53 mounted in the socket 10 to thereby be electrically connected to the metal coating. The metal coating of the module 53 functions as an electromagnetic shield. Through contact with the first grounding spring pieces 41, the metal coating of the module 53 is electrically connected to a ground trace on the substrate 51 via the shell 31. The number and position of the first grounding spring pieces 41 can be selected as appropriate. Since the first grounding spring pieces 41 are formed by partially cutting the shell 31 by means of, for example, blanking, openings 42 are formed around the corresponding first grounding spring pieces 41.

[0030] Two of the second grounding spring pieces 43, which serve as elastic contact pieces, are formed on each of two planes of the shell 31 on which the insertion projection 32 is not formed. The second grounding spring pieces 43 come into contact with the metal coating formed on the side wall surface 55 of the module 53 mounted in the socket 10 to thereby be electrically connected to the metal coating. The second grounding spring pieces 43 are formed and function similarly to the first grounding spring pieces 41. The number and position of the second grounding spring pieces 43 can be selected as appropriate. In the present embodiment, the second grounding spring pieces 43 are formed adjacent to each other. As a result, an opening 44 is solely formed around two of the second grounding spring pieces 43.

[0031] Two of lock spring pieces 45, which serve as elastic contact pieces, are formed on each of two planes of the shell 31 on which the insertion projection 32 is not formed. The lock spring pieces 45 are engaged with corresponding engagement recesses 57 (which will be described later) formed on the side wall surface 55 of the module 53 mounted in the socket 10 to thereby lock the module 53. As in the case of the first grounding spring pieces 41 and the second grounding spring pieces 43, since the lock spring pieces 45 are formed by partially cutting the shell 31 by means of, for example, blanking, openings 46 are formed around the corresponding lock spring pieces 45. In the case where the metal coating of the module 53 is also formed on the surfaces of the engagement recesses 57, the lock spring pieces 45 also function as grounding spring pieces like the first and second grounding spring pieces 41 and 43.

[0032] Next, the configuration of the shell 31 will be described in detail with reference to FIGS. 8 to 16.

[0033] FIG. 8 is a perspective view of the shell 31 as viewed from above along an opposite direction of FIG. 1. An upper end portion of the engagement slot 47 and the shape of the bridge portion 48 are apparently seen in FIG. 8. The following conditions are apparently seen in FIGS. 9, 12, 13, and 16: the bridge portion 48 is bent further from the inclined portion 36 to become substantially horizontal; and an upper end portion of the engagement slot 47 opens upward. The shape of the joint portion 37 and convex portion 37a is apparently seen in FIG. 8. The following condition is apparently seen in FIGS. 10 and 15: the joint portion 37 extends vertically between the upper end of the inclined portion 36 and the lower end of the insertion projection 32.

[0034] The first grounding spring pieces 41, the second grounding spring pieces 43, and the lock spring pieces 45 project inward from the inner surface of the side wall of the shell 31. As shown in FIGS. 13 to 15, the first grounding spring pieces 41, the second grounding spring pieces 43, and the lock spring pieces 45 assume the form of such an elongated narrow, rectangular member which has an upper end integrally connected to the thin-walled portion 31b of the shell 31, extends obliquely downward, and is free at its lower end. As shown in FIGS. 11 and 12, lower end portions of the first grounding spring pieces 41, second grounding spring pieces 43, and lock spring pieces 45 are curved outward such that curved portions project most inward. Accordingly, in the course of mounting of the module 53, the curved portions of the first grounding spring pieces 41, second grounding spring pieces 43, and lock spring pieces 45 abut the side wall surface 55 of the module 53, so that the side wall surface 55 of the module 53 can smoothly move while being in contact with the curved portions.

[0035] As shown in FIG. 11, a lower end portion of each of the lock spring pieces 45 is greatly curved to become substantially horizontal, and the angle of bend at the curved portion is acute. Accordingly, the curved portion of the lock spring piece 45 fits the engagement recess 57 formed on the side wall surface 55 of the module 53, so that the curved portion is securely engaged with the engagement recess 57 and is, once engaged, hardly disengaged. As shown in FIGS. 11, 12, and 16, the curved portions of the lock spring pieces 45 project inward more than the curved portions of the first grounding spring pieces 41 and second grounding spring pieces 43. This is because the curved portions of the first grounding spring pieces 41 and second grounding spring pieces 43 come into contact with the side wall surface 55 of the module 53 mounted in the socket 10, whereas the curved portions of the lock spring pieces 45 are engaged with the corresponding engagement recesses 57 formed on

the side wall surface 55 of the module 53.

[0036] Next, the spring function of the first grounding spring pieces 41, second grounding spring pieces 43, and lock spring pieces 45 will be described with reference to FIGS. 17 to 19. In the course of mounting of the module 53, the curved portion, which is a free end portion, of each of the lock spring pieces 45 is pressed outward by the side wall surface 55 of the module 53 to a position in the vicinity of the inner wall surface of the shell 31. Subsequently, upon completion of the mounting of the module 53, the curved portion of the lock spring piece 45 must enter the engagement recess 57 of the module 53. Accordingly, the curved portion must move over a long range and must be subjected, over the entire range of movement, to such a force as to press the curved portion toward the side wall surface 55 or engagement recess 57 of the module 53. In other words, the lock spring piece 45 must function as a spring over the entire range of movement of the curved portion.

[0037] In order to meet the above requirement, the lock spring pieces 45 and the openings 46 assume the shapes and dimensions shown in FIG. 17. Each of the openings 46 includes a laterally extending wide portion 46a located in a region of the thin-walled portion 31 b of the shell 31 from which the lock spring piece 45 projects. In FIG. 17, **L1** denotes the distance from the free end of the lock spring piece 45 to a boundary portion between the lock spring piece 45 and the thin-walled portion 31b; i.e., the length of the lock spring piece 45; **L2** denotes the distance from the upper end of the wide portion 46a to the upper end of the inclined portion 36; **W1** denotes the width of the lock spring piece 45; and **W2** denotes the distance between the opposite ends of the wide portion 46a.

[0038] **L1** is desirably set long in order that the lock spring piece 45 functions as a spring; in other words, in order to achieve the following condition: while the range of movement of the curved portion of the lock spring piece 45 is secured, the lock spring piece 45 is subjected to such a force as to press the curved portion toward the side wall surface 55 or engagement recess 57 of the module 53 without involvement of permanent deformation of the lock spring piece 45. However, because of restrictions on, for example, the vertical dimension of the shell 36 and the position of the engagement recess 57 of the module 53, it is difficult for **L1** to be sufficiently long. Thus, in the present embodiment, **W2** is rendered great to the greatest possible extent, and **L2** is rendered small to the greatest possible extent. By this procedure, in FIG. 18, a hatched area 45a assumes a long, narrow, rectangular shape and functions as a torsion spring. That is, the area 45a undergoes elastic, torsional deformation. Particularly, in the present embodiment, since the area 45a is located at the thin-walled portion 31b, even when force that is applied from the lock spring piece 45 to the area 45a is weak, the area 45a undergoes torsional deformation; i.e., functions as a torsion spring. Accordingly, the lock spring piece 45 functions as a spring; in other words, while the range of movement of the curved portion of the lock spring piece 45 is secured, the lock spring piece 45 is subjected to such a force as to press the curved portion toward the side wall surface 55 or engagement recess 57 of the module 53 without involvement of permanent deformation of the lock spring piece 45. The dimensions **L2, W1,** and **W2** can be set arbitrarily in such a manner that the area 45a functions as a torsion spring.

[0039] Meanwhile, in the course of mounting of the module 53, a long range of movement is not required for the curved portions, which are free end portions, of the first grounding spring pieces 41 and second grounding spring pieces 43. Accordingly, as compared with the lock spring pieces 45, the range of movement can be shorter for the curved portions of the first grounding spring pieces 41 and second grounding spring pieces 43 in association with function as springs of the first and second grounding spring pieces 41 and 43, so that an area that functions as a torsion spring is not required. Thus, as shown in FIG. 19, a region of the thin-walled portion 31b of the shell 31 from which each of the first grounding spring pieces 41 projects is relatively distant from the upper end of the inclined portion 36. In the case of the lock spring pieces 45, the wide portions 46a are provided at the respective openings 46. Similarly, in the case of the first grounding spring pieces 41, wide portions 42a can also be provided at the respective openings 42. The same also applies to the second grounding spring pieces 43.

[0040] As shown in FIGS. 20 and 21, the socket 10 is mounted beforehand on the substrate 51. The substrate 51 has wiring traces. The wiring traces are exposed on the surface of the substrate 51 at least in a region where the socket 10 is mounted, thereby forming connection portions such as lands and pads. The terminals 21 of the socket 10 can be connected to the connection portions by means of, for example, soldering. Specifically, the lower surfaces of the tail portions 22 of the terminals 21 are connected to the corresponding connection portions by means of, for example, soldering. The substrate 51 also has grounding traces. The grounding traces are exposed on the surface of the substrate 51 at least in a region where the socket 10 is mounted, thereby forming connection portions such as lands and pads. The insertion projections 32, the wide projections 33, and the narrow projections 34 of the socket 10 can be connected to the connection portions by means of, for example, soldering. Specifically, the lower end surfaces of the insertion projections 32, wide projections 33, and narrow projections 34 are connected to the connection portions by means of, for example, soldering.

[0041] In a state before the module 53 is mounted, the free ends of the connection arm portions 23 of the terminals 21 project greatly upward above the upper surface of the housing member 11. The curved portions of the first grounding spring pieces 41, second grounding spring pieces 43, and lock spring pieces 45 project greatly inward from the inner wall surface of the shell 31. When t1 represents the thickness of the thick-walled portion 31a

of the shell 31, and t2 represents the thickness of the thin-walled portion 31 b, **t1** and **t2** exhibit the relationship **"t1> t2."**

[0042] Then, the module 53 is inserted from above into the shell 31 to thereby be mounted in the socket 10 as shown in FIGS. 22 and 23. The module 53 has a top surface 54, the side wall surface 55, and a bottom surface 56. A metal coating is formed on the top surface 54 and side wall surface 55 by, for example, plating. Predetermined pads are exposed on the bottom surface 56 and connected to the connection arm portions 23 of the corresponding terminals 21. Since the inclined portion 36 is formed at the upper end of the shell 31 in such a manner as to be belled out upward, the module 53 can be readily inserted into the shell 31 from above. A polarizing key (not shown) is formed in an outwardly projecting condition on one plane of the side wall surface 55 of the module 53. In mounting of the module 53, the module 53 is inserted into the shell 31 from above in such a manner that the polarizing key is fitted into the engagement slot 47 of the shell 31. Since an upper end portion of the engagement slot 47 opens upward, the polarity key of the module 53 can be readily inserted from above into the engagement slot 47. Accordingly, the module 53 is mounted in the socket 10 with predetermined orientation, and predetermined pads exposed on the bottom surface 56 of the module 53 are connected to the connection arm portions 23 of the corresponding terminals 21.

[0043] In the course of insertion of the module 53 into the shell 31, the side wall surface 55 of the module 53 moves while being in contact with the curved portions of the first grounding spring pieces 41, second grounding spring pieces 43, and lock spring pieces 45. In this case, the curved portions are pressed outward by the side wall surface 55 of the module 53 and approach the inner wall surface of the shell 31. When the condition of FIGS. 22 and 23 is established as a result of completion of mounting of the module 53, the curved portions, which are free ends, of the lock spring pieces 45 enter the corresponding engagement recesses 57 of the module 53 and engage with the engagement recesses 57. The curved portions of the first and second grounding spring pieces 41 and 43 remain being pressed by the side wall surface 55 of the module 53. In this case, the spring function of the first and second grounding spring pieces 41 and 43 maintains the electrical connection between the curved portions and the metal coating formed on the side wall surface 55.

[0044] In a state in which the module 53 is mounted, the terminals 21 are pressed from above by the bottom surface 56 of the module 53 and thus elastically deformed as shown in FIGS. 22 and 23. Accordingly, the spring function of the terminals 21 maintains the electrical connection between the contact portions 23a of the connection arm portions 23 and the corresponding pads exposed on the bottom surface 56 of the module 53. Furthermore, although the module 53 is subjected to pushing-up force induced by the spring function of the terminals 21, the upward movement of the module 53 is prevented, since the curved portions of the lock spring pieces 45 are engaged with the corresponding engagement recesses 57. Accordingly, the module 53 is elastically held in the vertical direction between the terminals 21 and the lock spring pieces 45. Therefore, the module 53 is free from play in the vertical direction.

[0045] Furthermore, the spring function of the lock spring pieces 45 elastically holds the module 53 from opposite sides, and the spring function of the first and second grounding spring pieces 41 and 43 elastically holds the modules 53 from four directions. Therefore, the module 53 is free from play in the horizontal direction.

[0046] As described above, in the present embodiment, the socket 10 includes the housing member 11 made of a dielectric material and not having a side wall, and the shell 31 formed of a single metal plate, attached to the housing member 11, and encircling at least a portion of the side wall surface 55 of the module 53, and elastically holds the module 53 accommodated therein.

[0047] Since a cover for preventing detachment of the module 53 is not required, the number of components can be reduced, and the number of steps for mounting the module 53 can be reduced, so that mounting cost can be reduced. A side wall made of a dielectric material is not employed, and the shell 31 formed of a metal plate encircles the module 53. Thus, the outside dimensions of the socket 10 can be reduced, and the occupation area on the substrate 51 can be reduced. Furthermore, since the shell 31 is formed of a single metal plate, not a plurality of members, an impairment in dimensional accuracy of the shell 31 can be prevented which could otherwise result from unavoidable dimensional errors associated with assembly of the members.

Claims

1. A socket (10) for accommodating a camera module (53), comprising:

   a terminal support member (11) formed of a dielectric material and facing a bottom surface of the camera module when it is inserted into the socket; a plurality of conductive terminals (21) supported by the terminal support member;
   a side wall member (31) formed of a single metal plate, and attached to said terminal support member, and the side wall member forming a continuous structure that encloses side wall surfaces of said camera module; and,
   a plurality of spring arms (41, 43, 45) formed in said side wall member and extending interior of said socket for elastically holding said camera module in place.

2. The camera module socket of claim 1, wherein each spring arm (41, 43, 45) includes an elongated arm having an end integrally connected to said side wall

member.

3. The camera module socket of claim 2, wherein each spring arm (41, 43, 45) is vertically oriented and is connected to said side wall member at an top end thereof.

4. The camera module socket of claim 1, wherein each of said terminals includes a base portion (21a, 21b) and a contact portion (23a) bent upon the base portion, the contact portion extending upwardly with the interior of said socket at an angle, said terminal base portions being held within respective slots (15) of said terminal support member, said terminal contact portions extending upwardly through the terminal support member slots.

5. The camera module socket of claim 1, wherein said side wall member includes a thick walled portion (31a) and a thin walled portion (31b).

6. The camera module socket of claim 1, wherein said side wall member includes a vertical polarizing slot (47) for orienting said camera module socket for insertion into said socket.

7. The camera module socket of claim 6, wherein said side wall member includes a bridge portion (48) that bridges the vertical slot but does not interfere with insertion of said camera module into said socket.

8. The camera module socket of claim 1, wherein said spring arms include grounding spring arms (41, 43) and locking spring arms (45).

9. The camera module socket of claim 8, wherein the grounding spring arms (41, 43) are shorter in length than the locking spring arms (45).

10. The camera module socket of claim 8, wherein said grounding spring arms (41, 43) are arranged in pairs in said side wall member.

Patentansprüche

1. Sockel (10) zur Aufnahme eines Kameramoduls (53), umfassend:

ein Anschlussträgerbauteil (11), gebildet aus einem dielektrischen Material und gerichtet auf eine Unterseite des Kameramoduls, wenn dieses in den Sockel eingesetzt ist;
eine Vielzahl von leitenden Anschlüssen (21), getragen von dem Anschlussträgerbauteil;
ein Seitenwandteil (31), gebildet aus einer einzelnen Metallplatte und angebracht an das Anschlussträgerbauteil, wobei das Seitenwandbauteil eine kontinuierliche Struktur bildet, die die Seitenwandflächen des Kameramoduls einschließt; und
eine Vielzahl von Federarmen (41, 43, 45), gebildet in dem Seitenwandbauteil und sich in den Sockel erstreckend, um das Kameramodul elastisch an Ort und Stelle zu halten.

2. Kameramodulsockel nach Anspruch 1, wobei jeder Federarm (41, 43, 45) einen verlängerten Arm aufweist, der integral bzw. einstückig mit dem Seitenwandbauteil verbunden ist.

3. Kameramodulsockel nach Anspruch 2, wobei jeder Federarm (41, 43, 45) senkrecht ausgerichtet ist, und mit dem Seitenwandbauteil an einem oberen Ende hiervon verbunden ist.

4. Kameramodulsockel nach Anspruch 1, wobei jeder der Anschlüsse einen Basisabschnitt (21a, 21b) umfasst, und einen Kontaktabschnitt (23a), gebogen am Basisabschnitt, wobei der Kontaktabschnitt sich im Inneren des Sockels in einem Winkel nach oben erstreckt, wobei die Anschlussbasisabschnitte in entsprechenden Schlitzen (15) des Anschlussträgerbauteils gehalten werden, wobei die Anschlusskontaktabschnitte sich nach oben durch die Anschlussträgerbauteilschlitze erstrecken.

5. Kameramodulsockel nach Anspruch 1, wobei das Seitenwandbauteil einen Abschnitt mit dicker Wandung (31a) und einen Abschnitt mit dünner Wandung (31 b) aufweist.

6. Kameramodulsockel nach Anspruch 1, wobei das Seitenwandbauteil einen vertikal polarisierenden Schlitz (47) zur Ausrichtung des Kameramodulsokkels zum Einsetzen in den Sockel aufweist.

7. Kameramodulsockel nach Anspruch 6, wobei das Seitenwandbauteil einen Brückenabschnitt (48) umfasst, der die vertikalen Schlitze überbrückt, aber nicht beim Einsetzen des Kameramoduls in den Sokkel stört.

8. Kameramodulsockel nach Anspruch 1, wobei die Federarme Erdungsfederarme (41, 43) und Arretierungsfederarme (45) umfassen.

9. Kameramodulsockel nach Anspruch 8, wobei die Erdungsfederarme (41, 43) eine kürzere Länge aufweisen als die Arretierungsfederarme (45).

10. Kameramodulsockel nach Anspruch 8, wobei die Erdungsfederarme (41, 43) paarweise in dem Seitenwandbauteil angeordnet sind.

Revendications

1. Support (10) pour loger un module d'appareil photo (53), comprenant :

   un élément de support de bornes (11) formé d'un matériau diélectrique et faisant face à une surface inférieure du module d'appareil photo lorsqu'il est inséré dans le support ;
   une pluralité de bornes conductrices (21) supportées par l'élément de support de bornes ;
   un élément de paroi latérale (31) formé d'une seule plaque métallique et fixé audit élément de support de bornes, et l'élément de paroi latérale formant une structure continue qui enclôt les surfaces de paroi latérale dudit module d'appareil photo ; et,
   une pluralité de bras à ressort (41, 43, 45) formée dans ledit élément de paroi latérale et s'étendant à l'intérieur dudit support pour maintenir élastiquement en place ledit module d'appareil photo.

2. Support de module d'appareil photo selon la revendication 1, dans lequel chaque bras à ressort (41, 43, 45) comprend un bras allongé ayant une extrémité solidairement reliée audit élément de paroi latérale.

3. Support de module d'appareil photo selon la revendication 2, dans lequel chaque bras à ressort (41, 43, 45) est verticalement orienté et est relié audit élément de paroi latérale au niveau d'une extrémité supérieure de celui-ci.

4. Support de module d'appareil photo selon la revendication 1, dans lequel chacune desdites bornes comprend une partie de base (21a, 21 b) et une partie de contact (23a) repliée sur la partie de base, la partie de contact s'étendant vers le haut par rapport à l'intérieur dudit support et à un certain angle, lesdites parties de base des bornes étant maintenues dans des fentes respectives (15) dudit élément de support de bornes, lesdites parties de contact des bornes s'étendant vers le haut à travers les fentes de l'élément de support de bornes.

5. Support de module d'appareil photo selon la revendication 1, dans lequel ledit élément de paroi latérale comprend une partie à paroi épaisse (31a) et une partie à paroi mince (31b).

6. Support de module d'appareil photo selon la revendication 1, dans lequel ledit élément de paroi latérale comprend une fente de polarisation verticale (47) pour orienter ledit support de module d'appareil photo pour son insertion dans ledit support.

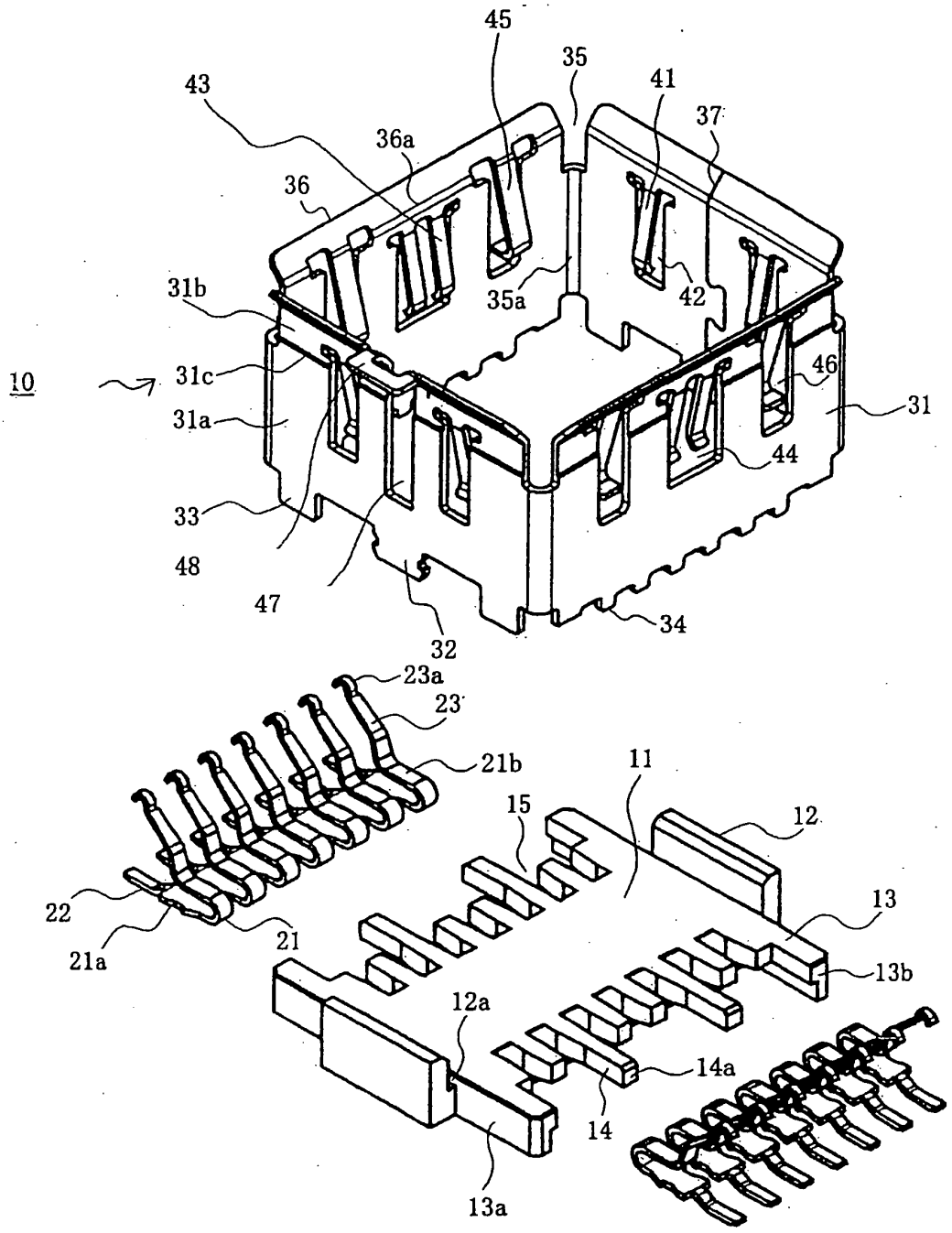
7. Support de module d'appareil photo selon la revendication 6, dans lequel ledit élément de paroi latérale comprend une partie de pont (48) qui ponte la fente verticale mais n'interfère pas avec l'insertion dudit module d'appareil photo dans ledit support.

8. Support de module d'appareil photo selon la revendication 1, dans lequel lesdits bras à ressort comprennent des bras à ressort de mise à la masse (41, 43) et des bras à ressort de blocage (45).

9. Support de module d'appareil photo selon la revendication 8, dans lequel les bras à ressort de mise à la masse (41, 43) sont plus courts en longueur que les bras à ressort de blocage (45).

10. Support de module d'appareil photo selon la revendication 8, dans lequel lesdits bras à ressort de mise à la masse (41, 43) sont agencés en paires dans ledit élément de paroi latérale.

FIG. 1


45
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41
43
37
36a
36
35a
42
31b
46
10
31c
31
31a
44
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48
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34
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23a
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21b
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21a
13b
12a
14a
14
13a

FIG. 2

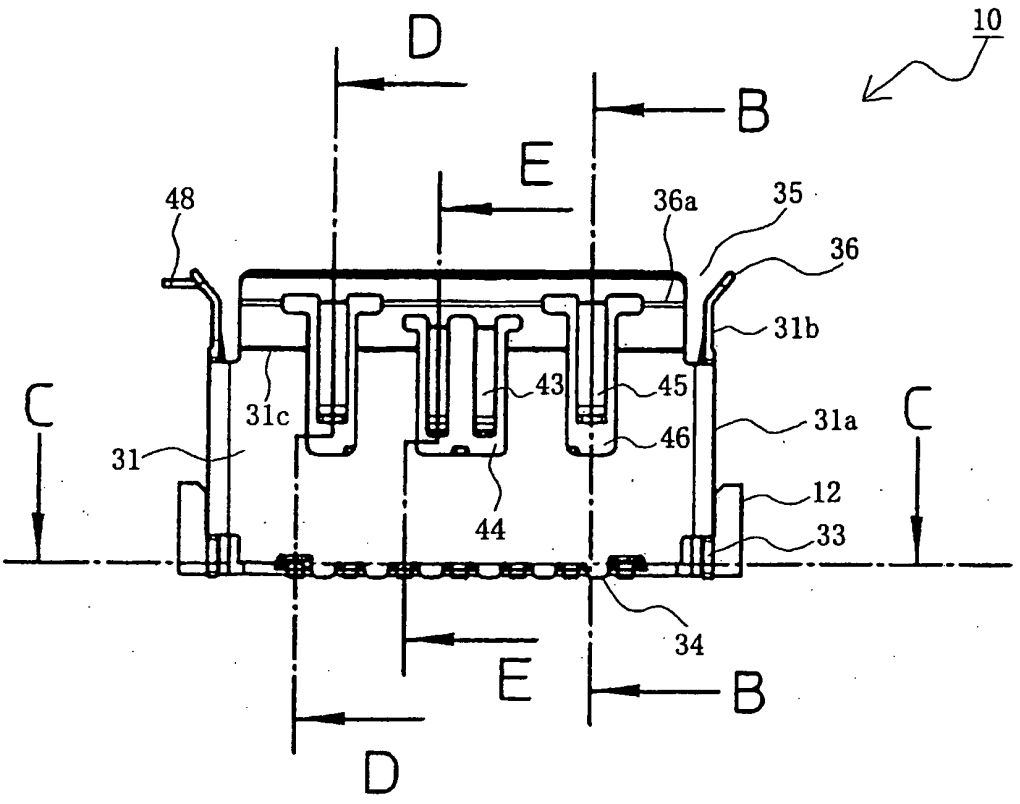


FIG. 8

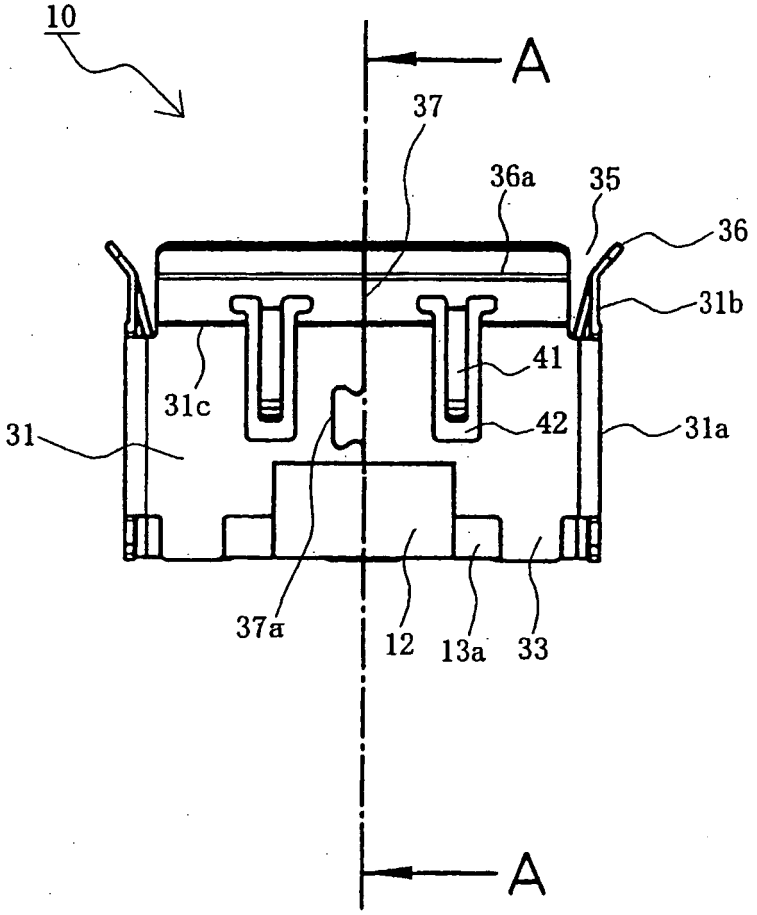
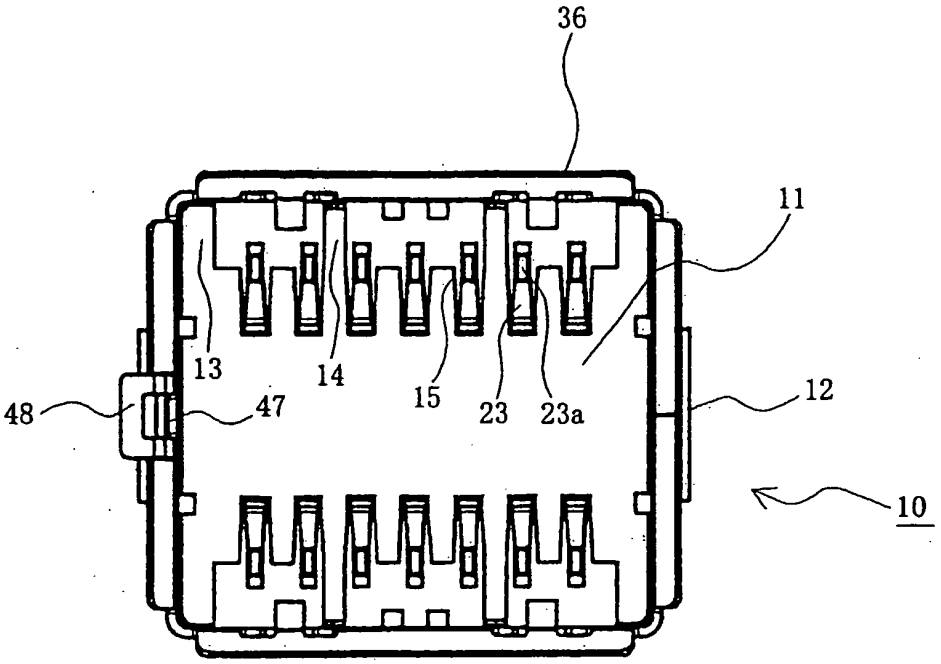


FIG. 4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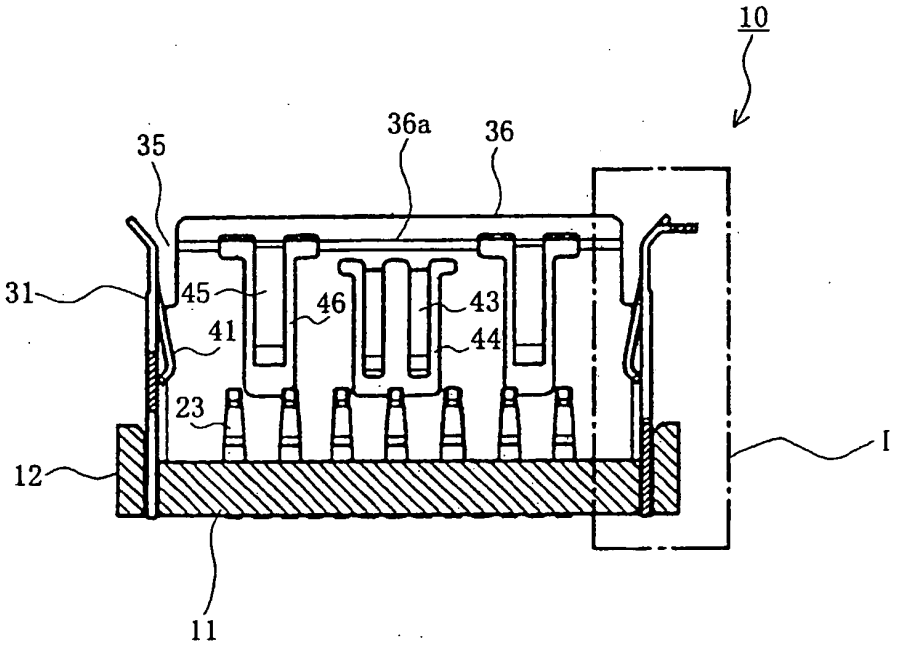
11
13
14
15
23
23a
12
48
47
10

FIG. 5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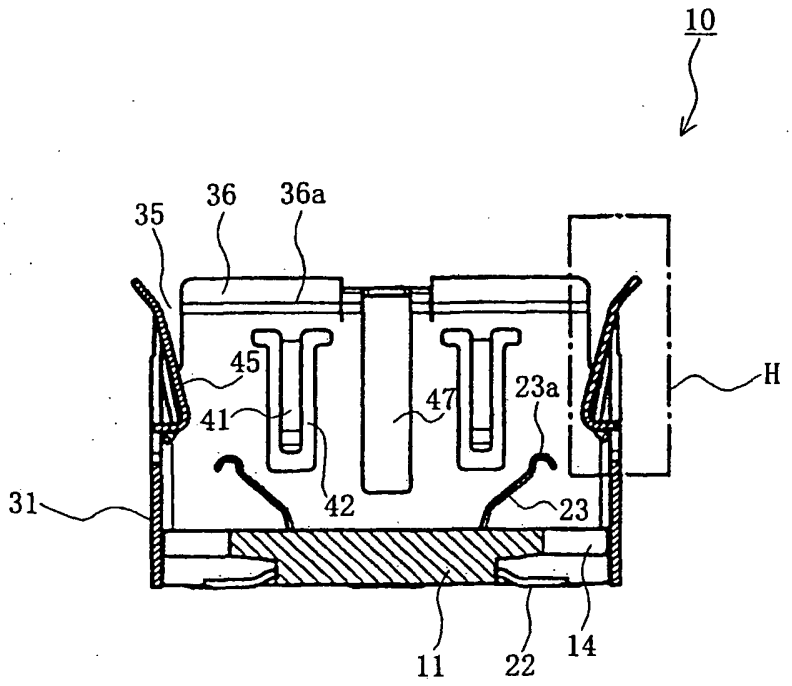
36a
36
35
31
45
46
43
41
44
23
12
I
11

FIG. 6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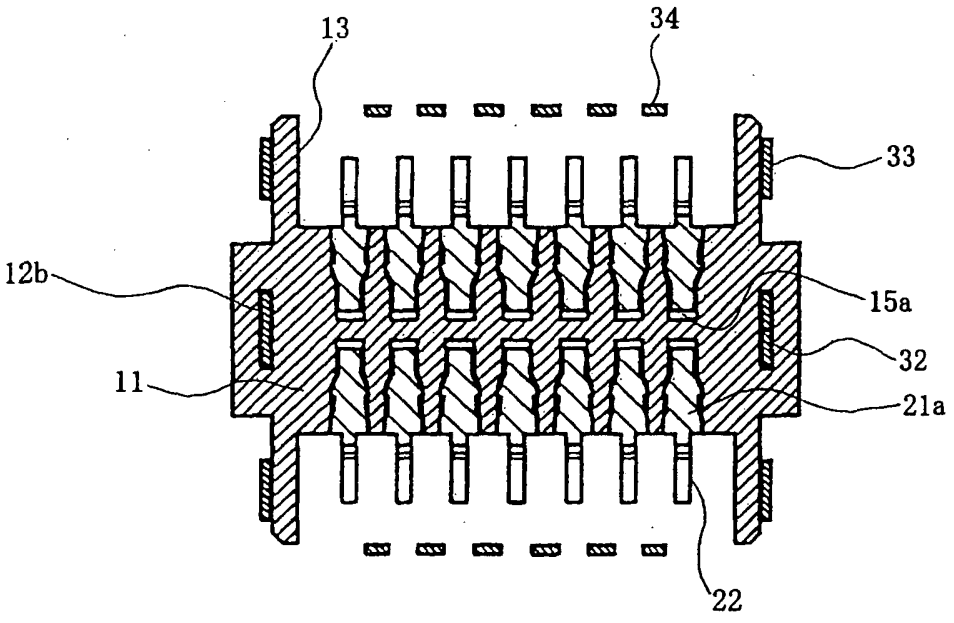
36
36a
45
41
47
23a
H
31
42
23
11
22
14

FIG. 7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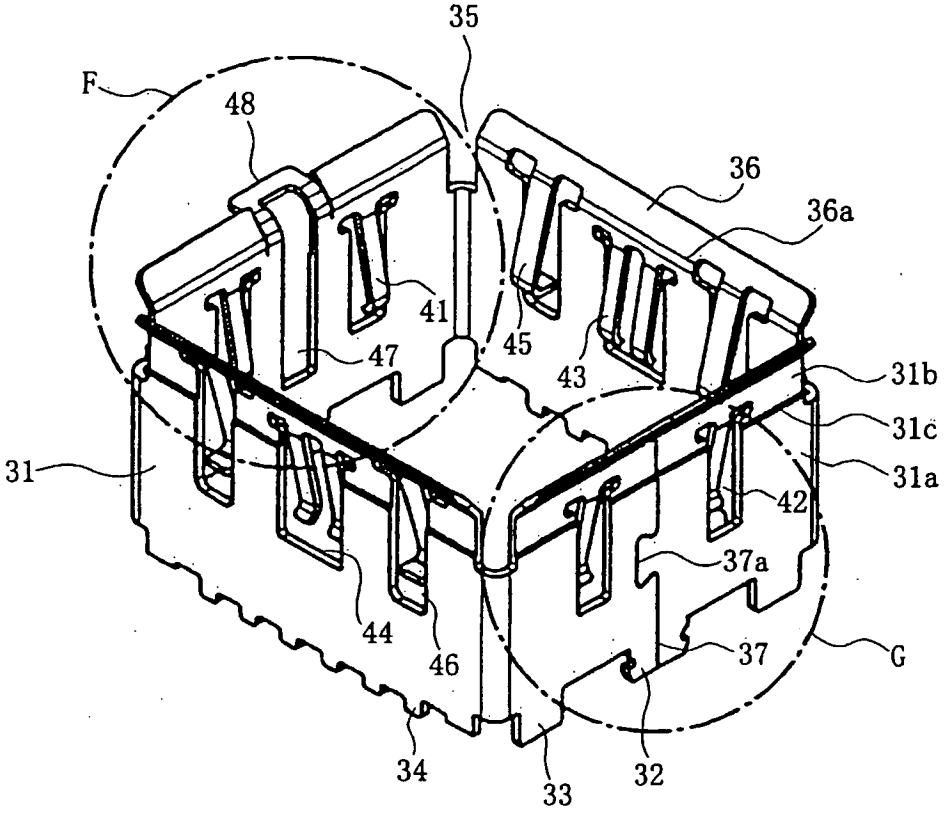
34
33
12b
15a
32
11
21a
22

FIG. 8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F
48
36
36a
41
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47
43
31b
31c
31
31a
42
37a
44
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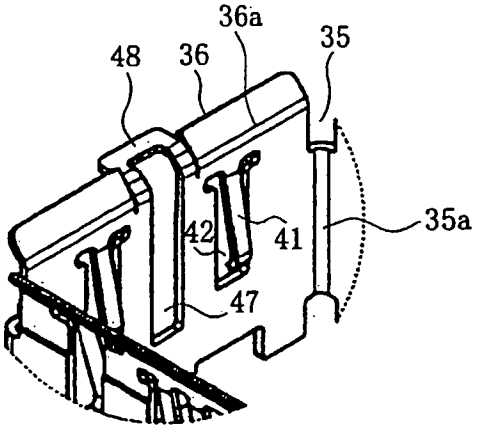
37
G
34
33
32

FIG. 9


36a
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48
36
35a
42
41
47

FIG. 10

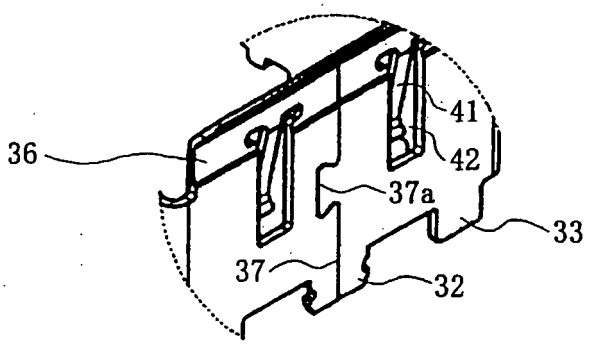


FIG. 11

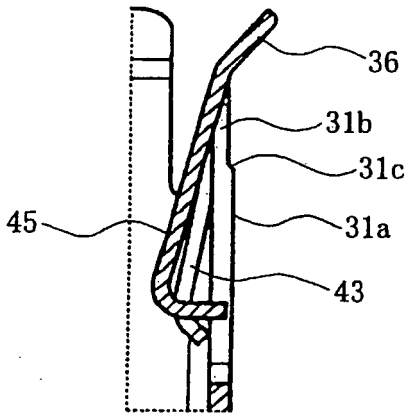


FIG. 12

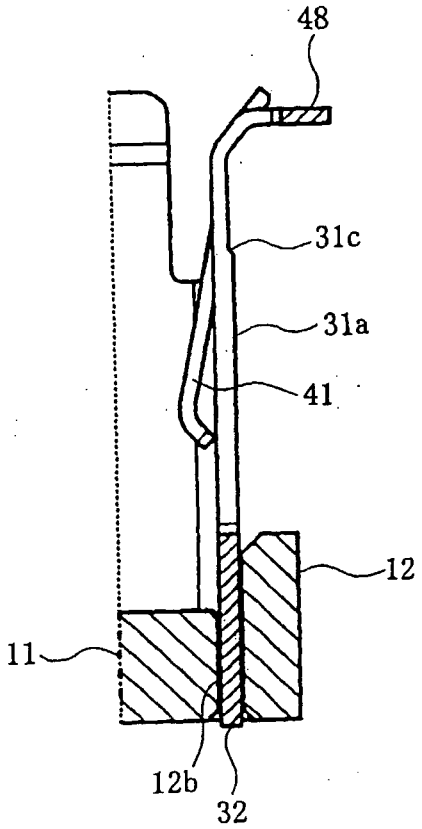


FIG. 13

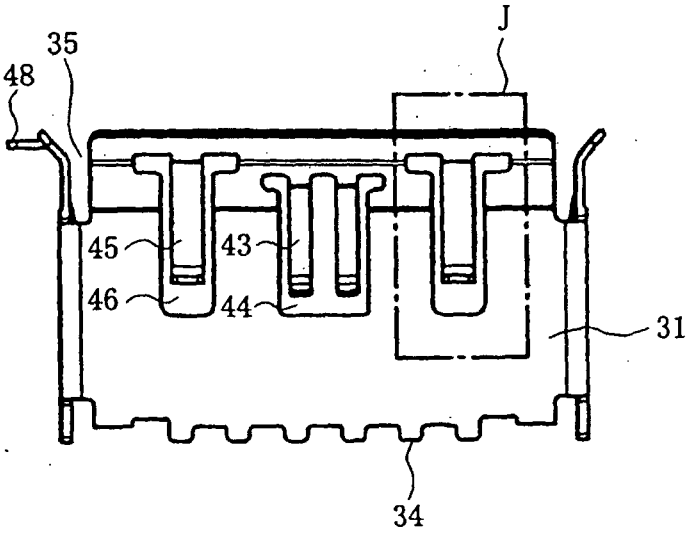


FIG. 14

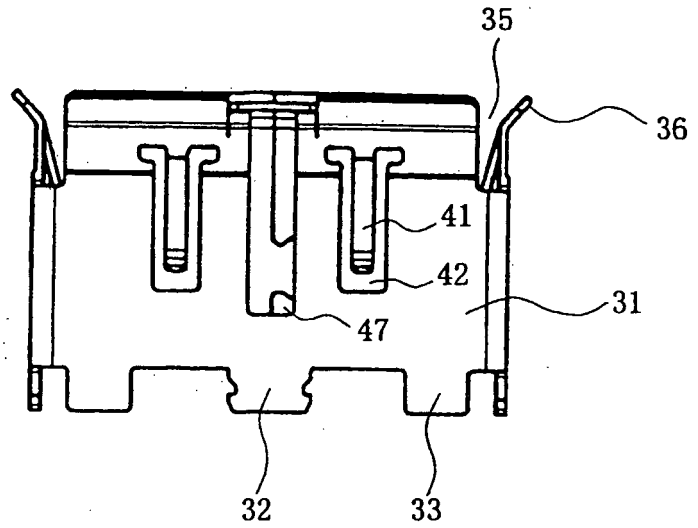


FIG. 15

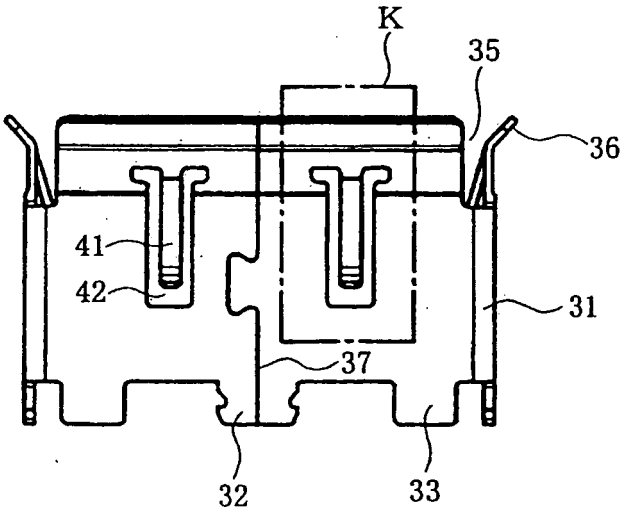


FIG. 16

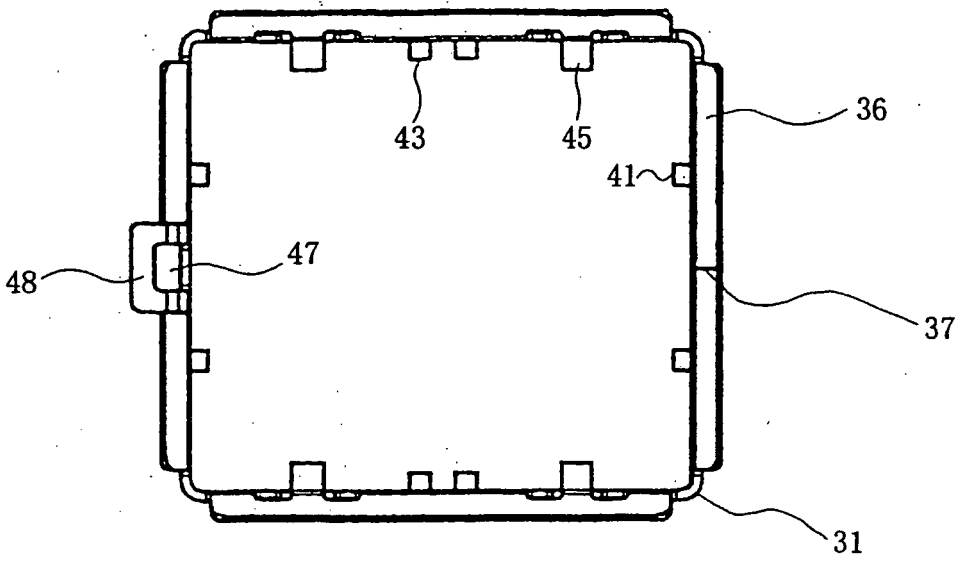


FIG. 17

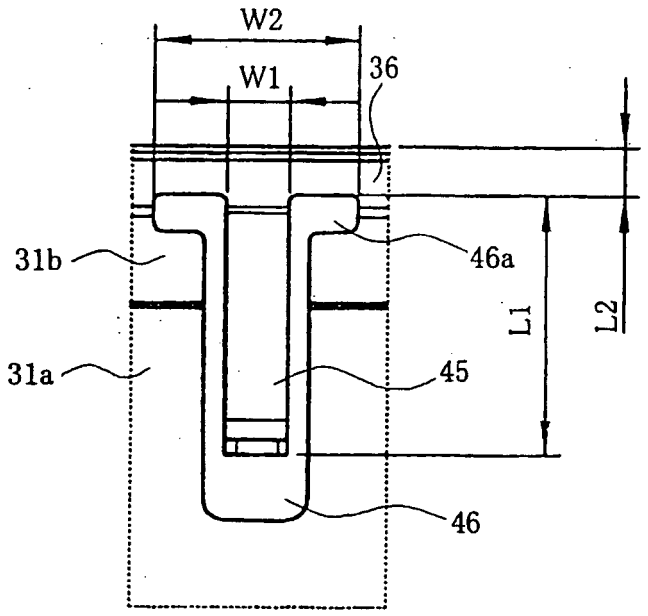


FIG. 18.

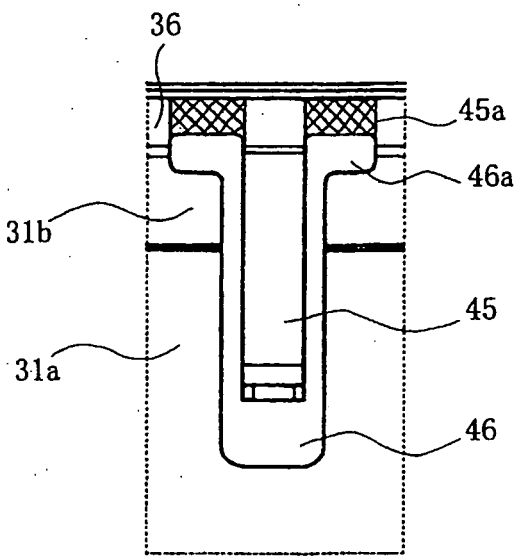


FIG. 19

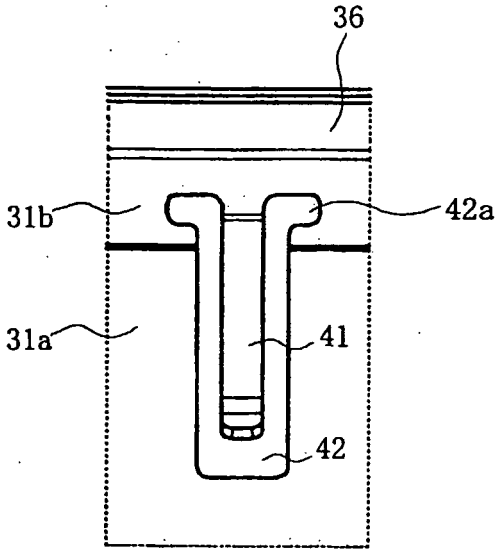
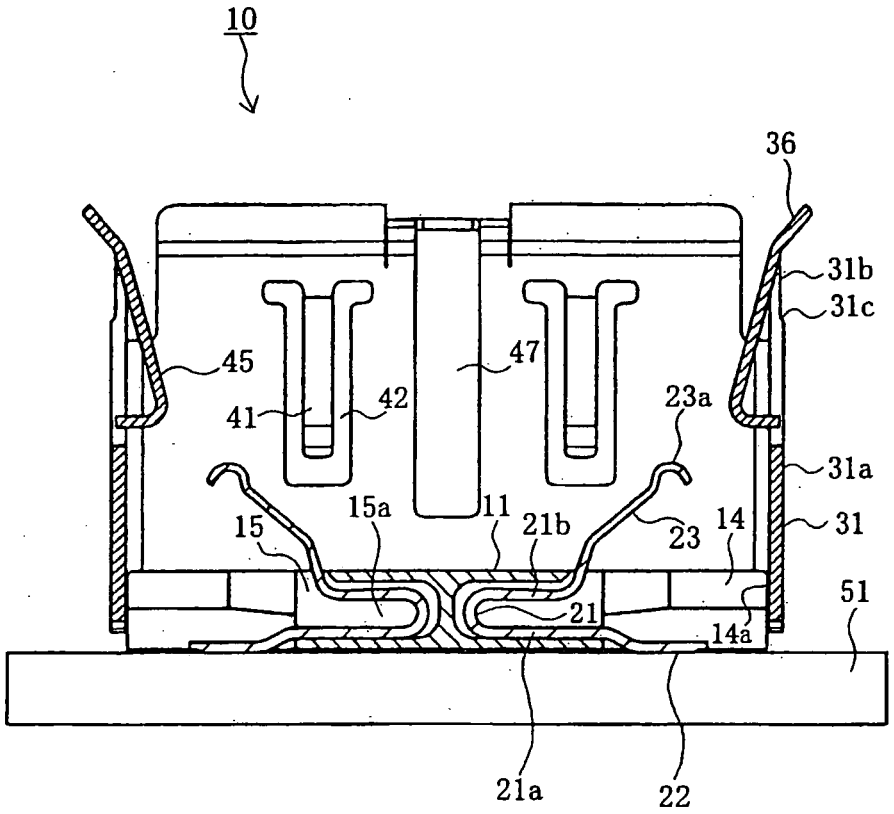


FIG. 20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36
31b
31c
45
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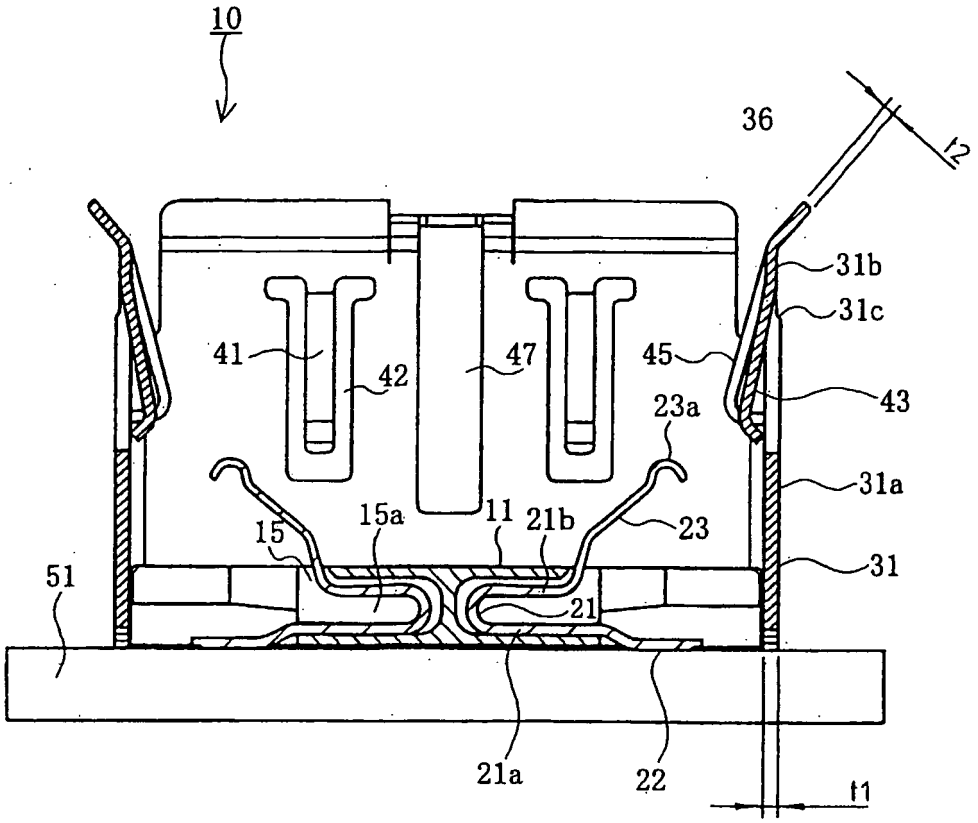
14a
21a
22

FIG. 21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31c
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21a
22
t1

FIG. 22

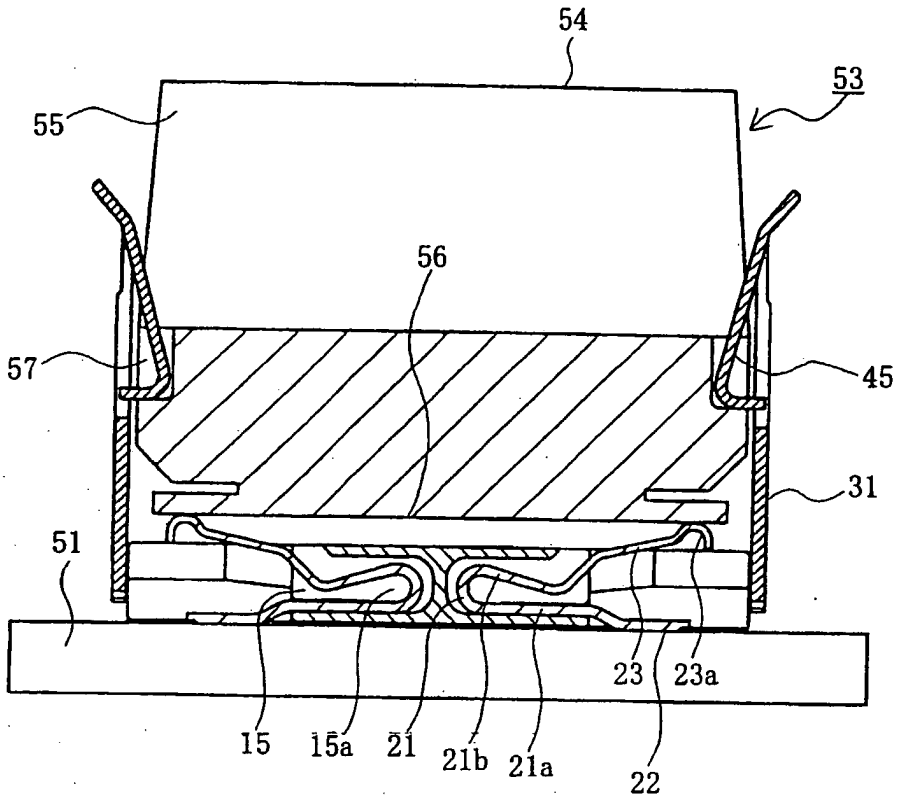


FIG. 2.3

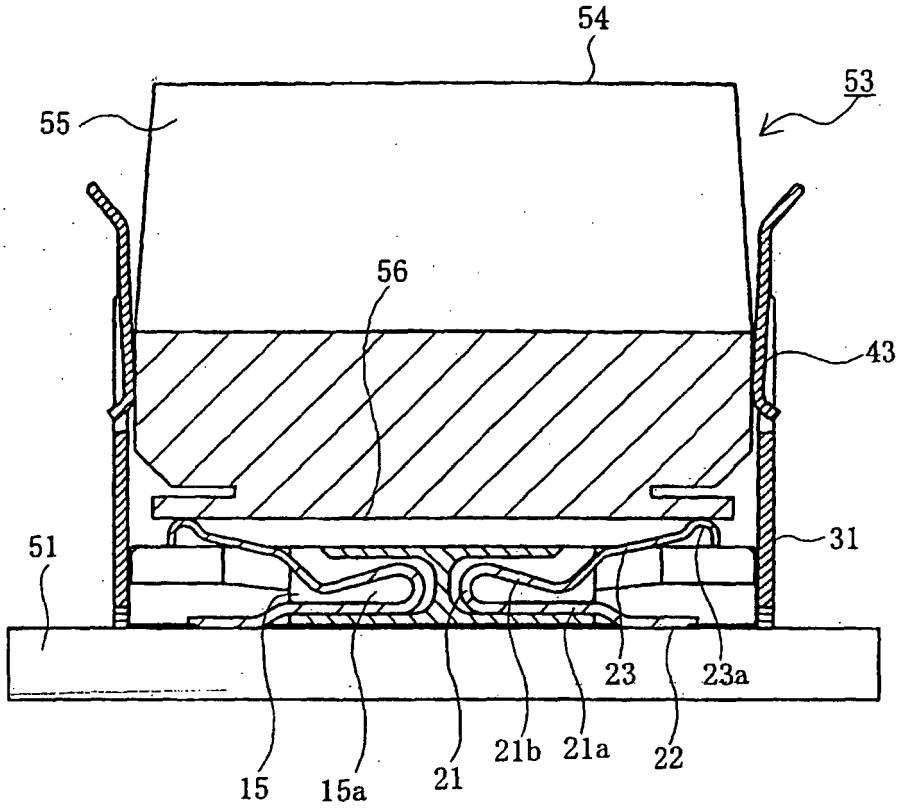
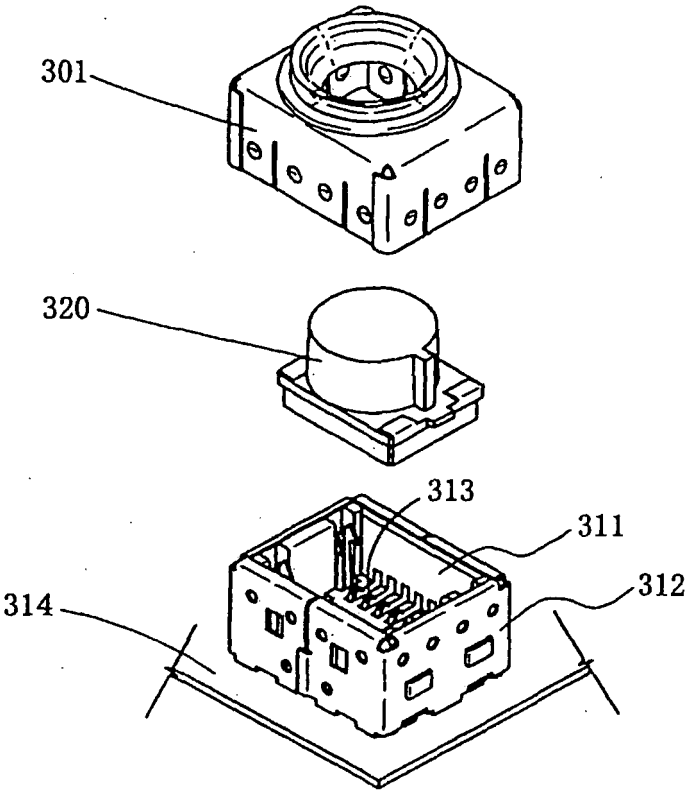


FIG. 24



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Patent documents cited in the description

- US 20040023528 A **[0005]**