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(54) **Title**: CARD CONNECTOR

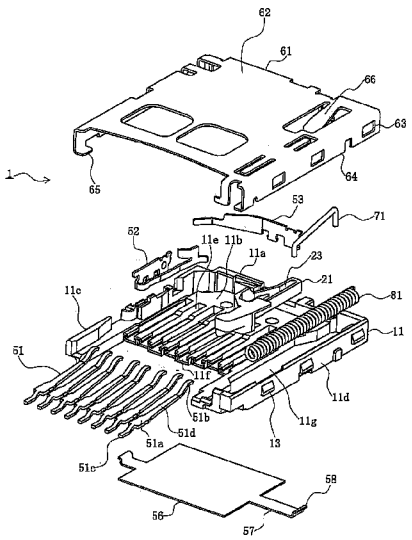

FIG. 1

(57) **Abstract**: A card connector having a housing and connection terminals is disclosed. A card, provided with terminal members, is accommodated in the housing. Connection terminals attached to the housing are capable of coming into contact with the terminal members of the card. Each connection terminal is provided with a proximal end portion held in the housing, a flexible portion extending from the proximal end portion, and a distal end portion connected to an extreme end of the flexible portion. The flexible portion is shaped with a width large on a side of the proximal end portion and small on a side of the distal end portion. The housing has a ground plate arranged to correspond to at least an extent of the flexible portion.

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CARD CONNECTOR

REFERENCE TO RELATED APPLICATIONS

[0001] The Present Invention claims priority of prior Japanese Patent Application No. 2008-298957, entitled "Card Connector," and filed 25 November 2008, the contents of which is fully incorporated in its entirety herein.

BACKGROUND OF THE PRESENT INVENTION

[0002] The present invention relates generally to a card connector. Hitherto, an electronic device or apparatus such as a personal computer, a cellular phone, a PDA (Personal Digital Assistant), a digital camera, a video camera, a music player, a game machine, or a vehicle navigation device is provided with a card connector for using a variety of memory cards which includes a SIM (Subscriber Identity Module) card, a MMC (registered trademark: Multi-Media Card), a SD (registered trademark: Secure Digital) card, a mini SD (registered trademark) card, an xD-Picture card (registered trademark), a Memory Stick (registered trademark), a Memory Stick Duo (registered trademark), a Smart Media (registered trademark), a Trans-Flash memory card, a micro SD (registered trademark) card, and the like.

[0003] In recent years, with an increase in a storage capacity of the memory cards, it has been required to speed up the transmission rate of data between an electronic device or apparatus and a memory card. In this regard, a technique has been proposed in which a ground plate is arranged in a card connector in order to secure matching of the characteristic impedance in the card connector to thereby reduce crosstalk (reference should be made to, for example, Japanese Patent Application Laid-Open (Kokai) No. 5-189625).

[0004] Fig. 9 is a view of a card connector according to the prior art. Referring to Fig. 9, a housing of a card connector, generally designated by reference numeral 811 is formed of an insulating material and is attached to a front surface of a printed board 891. Moreover, a plurality of pin terminals fitted in the housing 811, designated by reference numeral 851, has lower ends thereof being inserted to be connected by soldering to through holes 893 formed in the printed board 891. Furthermore, a memory card designated by reference numeral 901 is inserted in a groove 812 of the housing 811. The memory card 901 is provided with a plurality of terminal-socket holes 951 in which distal ends of the pin terminals 851 corresponding to the

respective terminal-socket holes 951 are received, whereby the memory card 901 is electrically connected to the pin terminals 851.

[0005] A metallic ground plate designated by reference numeral 861 is attached to the housing 811 so as to cover soldered portions of the pin terminals 851 being exposed from the housing 811. Moreover, flange portions 862 of the ground plate 861 are fixedly secured by bolts 863 penetrating the housing 811 and the printed board 891. Furthermore, lower ends of the bolts 863 are electrically connected to a ground pattern 892 of the printed board 891.

[0006] Owing to such a configuration, the exposed portions of the pin terminals 851 are covered by the ground plate 861 connected to the ground pattern 892, it is possible to obtain matching of the characteristic impedance of the card connector.

[0007] However, as will be understood from the foregoing, since the conventional card connector has such a configuration that only the soldered portions which are formed of the exposed portions of the pin terminals 851 are covered by the ground plate 861, it is often difficult to have complete matching of the characteristic impedance. Memory cards that are recently in wide use are flat plate-like cards which are not provided with the terminal-socket holes 951, but are configured to have contact pads arranged on one surface of the card to be in parallel with one another. Moreover, the terminals of the card connector are cantilever-like members formed of an elongated plate, having proximal end portions thereof being fixedly secured to the housing and distal end portions thereof being pressed against the contact pads of the card by the restoring properties of the terminals. In such a case, since it is necessary to allow a dimensional tolerance of the card, there is necessity for the respective terminals to have an extended length between the proximal end portion and the distal end portion thereof to some extent. For this reason, unless the characteristic impedance in the range from the proximal end portions to the distal end portions of the terminals is well controlled, it is practically difficult to have appreciable amount of matching the characteristic impedance of the card connector.

SUMMARY OF THE PRESENT INVENTION

[0008] Therefore, it is an object of the present invention to obviate the above-described problems encountered by the conventional card connector and to provide a card connector having such a configuration that a flexible portion of each connection terminal is formed in a shape having a large width on a side of a proximal end portion thereof and a small width on a side of a distal end

portion thereof, and that a ground plate is arranged for the flexible portion so as to have an extent thereof corresponding to at least the flexible portion, and when a card comes into contact with the connection terminal, the flexible portion is deformed so that a gap between the distal end portion and the ground plate decreases, whereby it is possible not only to appropriately control the characteristic impedance in the range from the proximal end portion to the distal end portion of the connection terminals, but also to secure matching of the characteristic impedance in the whole signal transmission line. Accordingly, the card connector is able to prevent occurrence of crosstalk even when used for high-speed signal transmission and to enable production thereof so as to have a dimensionally reduced height at a low cost and in a simple structure.

[0009] Therefore, in accordance with the present invention, a card connector is provided which comprises: a housing in which a card provided with terminal members is accommodated; and connection terminals attached to the housing to be capable of coming into contact with the terminal members of the card, wherein: each of the connection terminals is provided with a proximal end portion held in the housing, a flexible portion extending from the proximal end portion, and a distal end portion connected to an extreme end of the flexible portion; the flexible portion is formed in a shape having a width large on a side of the proximal end portion and small on a side of the distal end portion; the housing is provided with a ground plate which is arranged to correspond to at least an extent in which the flexible portion lie; and when the card is accommodated in the housing so that the distal end portions of the connection terminals come into contact with the terminal members of the card, the respective flexible portions are deformed to be distant from the ground plate by a gap decreasing in response to approach to the extreme ends thereof.

[0010] In accordance with another embodiment of the present invention, the card connector has such a configuration that the gap defined between the flexible portions and the ground plate varies depending on a change in the width of respective one of the flexible portions, so that a characteristic impedance of a signal transmission line formed by the connection terminals functioning as a signal line and the ground plate functioning as a ground line becomes constant.

[0011] In accordance with a further embodiment of the present invention, the card connector has such a configuration that the connection terminals and the ground plate are arranged to form a microstrip line structure.

[0012] In accordance with a still further embodiment of the present invention, the card connector has such a configuration that a pair of neighboring connection terminals among the connection terminals and the ground plate are arranged to form a microstrip line structure capable of transmitting a differential signal.

[0013] In accordance with a still further embodiment of the present invention, the card connector has such a configuration that the housing has a bottom wall portion thereof having an upper surface side on which the connection terminals are arranged and a lower surface side on which the ground plate is arranged.

[0014] In accordance with a still further embodiment of the present invention, the card connector has such a configuration that the housing has a cover member attached to an upper side thereof, and that the connection terminals are arranged at positions in the vicinity of a top plate portion of the cover member, the top plate portion functioning as the ground plate.

[0015] In accordance with the present invention, the card connector has a configuration such that a flexible portion of each of the connection terminals is formed in a shape having a width large on the side of the proximal end portion thereof and small on the side of the distal end portion thereof, and that a ground plate arranged to have an extent thereof capable of corresponding to at least that of the flexible portion, and when a card comes into contact with the connection terminals, the flexible portions are deformed, respectively, in a manner such that a gap defined between the respective one of the connection terminals and the ground plate decreases in response to approach to the extreme end thereof. Owing to the described configuration, it is possible to appropriately control the characteristic impedance in the range from the proximal end portion to the distal end portion of the connection terminals. Moreover, it is possible to secure matching of the characteristic impedance in the overall signal transmission line. Accordingly, it is possible to provide a card connector which is capable of preventing occurrence of crosstalk even when used for high-speed signal transmission and can be produced with a dimensionally reduced height at a low cost and in a simple structure.

[0016] Therefore, in accordance with the present invention, a card connector is provided which comprises: a housing in which a card provided with terminal members is accommodated; and connection terminals attached to the housing to be capable of coming into contact with the terminal members of the card, wherein each of the connection terminals is provided with a proximal end portion held in the housing, a flexible portion extending from the proximal end

portion, and a distal end portion connected to an extreme end of the flexible portion; the flexible portion is formed in a shape having a large width on a side of the proximal end portion and a small width on a side of the extreme end portion; the housing is provided with a ground plate which is arranged to oppose the connection terminals, and the ground plate is provided with a coupling adjustment portion configured to adjustably regulate coupling with at least the flexible portion.

[0017] In accordance with another embodiment of the present invention, the card connector has such a configuration that the coupling adjustment portion is configured by an opening portion defined in the ground plate.

[0018] In accordance with a further embodiment of the present invention, the card connector has such a configuration that the opening portion is a slit-shaped opening formed in a shape analogous to the flexible portion of the connection terminal.

[0019] In accordance with a still further embodiment of the present invention, the card connector has such a configuration that the opening portion is arranged for being positioned immediately beneath the flexible portion.

[0020] In accordance with a still further embodiment of the present invention, the card connector has such a configuration that the opening portion is arranged to be positioned immediately beneath each intermediate portion located between the flexible portions of respective neighboring two of the connection terminals.

[0021] In accordance with another embodiment of the present invention, the card connector has such a configuration that the coupling adjustment portion comprises a projection member attached to the ground plate.

[0022] In accordance with a further embodiment of the present invention, the card connector has such a configuration that the housing has a covering member mounted on an upper side thereof, the connection terminals being arranged at positions in the vicinity of the top plate portion of the covering member, and the top plate portion functioning as the ground plate.

[0023] In accordance with the present invention, the card connector has such a configuration that the flexible portion of each of the connection terminals is formed in a shape having a large width on the side of the proximal end portion thereof and a small width on the side of the distal end portion thereof, and that a ground plate is arranged which is provided with a coupling adjustment portion capable of adjustably regulating coupling with the flexible portion. Owing to such a

configuration, it is possible to appropriately control the characteristic impedance in the range from the proximal end portion to the distal end portion of the terminals. Moreover, it is possible to secure matching of the characteristic impedance in the whole signal transmission line. Accordingly, it is possible to provide a card connector which is capable of preventing generation of crosstalk even when used for high-speed signal transmission and can be produced with a dimensionally reduced height at a low cost and in a simple structure.

BRIEF DESCRIPTION OF THE FIGURES

[0024] The organization and manner of the structure and operation of the Present Invention, together with further objects and advantages thereof, may best be understood by reference to the following Detailed Description, taken in connection with the accompanying Figures, wherein like reference numerals identify like elements, and in which:

[0025] Fig. 1 is an exploded perspective view of a card connector according to an embodiment of the present invention;

[0026] Fig. 2 is a bottom plan view of the card connector according to the embodiment of the present invention;

[0027] Fig. 3 is a top plan view of a housing of the card connector according to the embodiment of the present invention;

[0028] Fig. 4 is a top plan view of connection terminals of the card connector according to the embodiment of the present invention;

[0029] Fig. 5 is a perspective view of the card connector according to the embodiment of the present invention, illustrating a state where a card is inserted in the card connector;

[0030] Fig. 6 is a cross-sectional view of the card connector according to the embodiment of the present invention, illustrating the state where the card is inserted in the card connector, taken along the arrows A-A in Fig. 5;

[0031] Fig. 7 is a first view for illustrating a microstrip line structure in the card connector according to the embodiment of the present invention;

[0032] Fig. 8 is a second view for illustrating a microstrip line structure in the card connector according to the embodiment of the present invention; and

[0033] Fig. 9 is a schematic and exploded view of a card connector according to the prior art.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0034] While the Present Invention may be susceptible to embodiment in different forms, there is shown in the Figures, and will be described herein in detail, specific embodiments, with the understanding that the disclosure is to be considered an exemplification of the principles of the Present Invention, and is not intended to limit the Present Invention to that as illustrated.

[0035] In the embodiments illustrated in the Figures, representations of directions such as up, down, left, right, front, rear and the like, used for explaining the structure and movement of the various elements of the Present Invention, are not absolute, but relative. These representations are appropriate when the elements are in the position shown in the Figures. If the description of the position of the elements changes, however, it is assumed that these representations are to be changed accordingly. Description of preferred embodiments of the present invention will be provided below in detail with reference to the accompanying drawings.

[0036] Fig. 1 is an exploded perspective view of a card connector according to an embodiment of the present invention; Fig. 2 is a bottom plan view of the card connector according to the embodiment of the present invention; Fig. 3 is a top plan view of a housing of the card connector according to the embodiment of the present invention; and Fig. 4 is a top plan view of connection terminals of the card connector according to the embodiment of the present invention.

[0037] In the drawing figures, a card connector according to the present embodiment of the present invention, generally designated by reference numeral 1, is attached to a non-illustrated electronic device or apparatus. A later-described card 101 is inserted into the interior of the card connector 1, and the card 101 is mounted on the electronic device or apparatus via the card connector 1. Examples of the electronic device or apparatus include a personal computer, a cellular phone, a PDA, a digital camera, a video camera, a music player, a game machine, a car navigation device, and the like; however, the type of devices and apparatuses is not intended to be particularly limited.

[0038] Further, the card 101 is an IC card such as a SIM card, an MMC (registered trademark), an SD (registered trademark) card, a mini SD (registered trademark) card, an xD Picture card (registered trademark), a Memory Stick (registered trademark), a Memory Stick Duo (registered trademark), a Smart Media (registered trademark), a T-Flash (Trans-Flash) memory card, or a micro SD (registered trademark) card. Although the type of cards is not particularly limited, in

the present embodiment, the card 101 will be described as being a micro SD (registered trademark) card.

[0039] In addition, in the present embodiment, representations of directions such as up, down, left, right, front, rear, and the like, used for explaining the structure and movement of each part of the card connector 1, and the like, are not absolute, but relative. These representations are appropriate when each part of the card connector 1, and the like, is in the position shown in the drawing figures. If the position of the card connector 1, and the like, changes, however, it is assumed that these representations are to be changed according to a change in the position of the card connector, and the like.

[0040] Here, the card connector 1 is provided with a housing 11 that is integrally formed of an insulating material such as synthetic resin and a shell 61 as a covering member that is integrally formed by applying processing, e.g., punching and bending, to a plate member formed of a conductive material such as metal so as to be attached to the upper side of the housing 11. The shell 61 is configured to cover the housing 11 and at least a portion of an upper portion of the card 101 that is accommodated in the housing 11. Moreover, the card connector 1 has a generally flat rectangular parallelepiped shape and is attached to the electronic device or apparatus so that the card 101 is inserted from the front (the left lower side in Fig. 1) of the card connector 1.

[0041] As illustrated in the drawing figures, the housing 11 is provided with a bottom wall portion 11b having such a shape that a front end portion thereof (the left lower side in Fig. 3) serving as a front side in relation to an insertion direction of the card 101 is formed in an approximately U or inverted C shape by cutting and an innermost wall portion 11a that is erected from the bottom wall portion 11b so as to extend along an edge at the innermost side (the right upper side in Fig. 3) of an innermost portion of the bottom wall portion 11b. Here, the bottom wall portion 11b is provided with a plurality of terminal-accommodation grooves 11e which is formed in an upper surface thereof so as to extend in the front-rear direction (the up-down direction in Fig. 3), and in which terminals 51 functioning as connection terminals are received and accommodated therein. Moreover, in portions on a front end side of the respective terminal-accommodation grooves 11e, terminal holding portions 11f configured to be capable of holding the connection terminals 51 are formed.

[0042] Moreover, each of the connection terminals 51 is provided with a proximal end portion 51a that is integrally formed of a plate member formed of a conductive and elastic material such as metal and is held in the terminal holding portion 11f, an arm portion 51d as a flexible portion that extends from the proximal end portion 51a toward the innermost wall portion 11a, i.e., toward the rear side (the right upper side in Fig. 1), a contact portion 51b as a distal end portion that is connected to a distal end of the arm portion 51d, and a solder tail portion 51c that extends from the proximal end portion 51a toward the front side.

[0043] As illustrated in Fig. 4, the arm portion 51d has a tapered shape in top plan view having a width thereof gradually narrowing toward the distal end, in which a portion thereof close to the proximal end portion 51a is a large-width portion 51e having the largest width and a portion thereof close to the contact portion 51b is a small-width portion 51f having the smallest width. In other words, the arm portion 51d is tapered in top plan view. In the example illustrated in Fig. 4, although both lateral edges of the arm portion 51d are formed in a straight-line shape, they may be formed in a curved shape. That is, the arm portion 51d may have any shape in top plan view as long as a width thereof monotonically decreases from the large-width portion 51e to the small-width portion 51f. Moreover, a thickness dimension, namely, a plate thickness, of the arm portion 51d is constant between the large-width portion 51e and the small-width portion 51f.

[0044] Moreover, since the arm portion 51d is obliquely connected to the proximal end portion 51a, in a state where the connection terminals 51 are fitted in the housing 11, the proximal end portion 51a held in the terminal holding portion 11f is substantially parallel with the lower surface of the bottom wall portion 11b, while the arm portion 51d is inclined with respect to the lower surface of the bottom wall portion 11b so as to rise as it goes toward an extreme end thereof.

[0045] The contact portion 51b has a curved lateral shape so as to protrude upwardly from the distal end of the arm portion 51d. Therefore, in a state where the connection terminals 51 are fitted in the housing 11 and the card 101 is not yet inserted thereto, the proximal end portion 51a is positioned to be lower than the upper surface of the bottom wall portion 11b, while at least a portion of the contact portion 51b protrudes out from the upper surface of the bottom wall portion 11b. Moreover, in a state where the connection terminals 51 are fitted in the housing 11, the proximal end portion 51a, the arm portion 51d, and the contact portion 51b are all received in the terminal-accommodation groove 11e, as viewed from the above. Furthermore, as illustrated

in Fig. 4, the contact portion 51b except a distal end thereof has the same width as the small-width portion 51f and has a substantially uniform shape in top plan view.

[0046] The solder tail portion 51c extends frontward from an edge at the front side of the bottom wall portion 11b and toward the lower surface of the bottom wall portion 11b and is electrically connected to signal lines, contact pads, terminals, and the like, formed in a later-described wiring board 91 of the electronic device or apparatus, that is, counterpart terminal members, by means of soldering or the like.

[0047] Further, the housing 11 includes a first side wall portion 11c as a side wall having an L-shape in cross-section view and extending in the front-rear direction along one lateral edge of the bottom wall portion 11b and a second side wall portion 11d as a side wall extending in the front-rear direction along the other lateral edge of the bottom wall portion 11b. A card guide mechanism accommodation portion 11g is formed at an inner side of the second side wall portion 11d, and a slide member 21 of a card guide mechanism for guiding the card 101 inserted into the card connector 1 is attached to the interior of the card guide mechanism accommodation portion 11g so as to be freely slidable in the front-rear direction.

[0048] Here, the slide member 21 is provided with a card holding portion for holding the card 101 and a slide cam portion as a movable cam member. When the card holding portion is engaged with the lateral surfaces of the card 101, the slide member 21 holds the card 101 and moves in the front-rear direction together with the card 101. Moreover, the slide member 21 is urged in a direction opposite to the insertion direction of the card 101, that is, in an ejection direction of the card 101, upon receipt of an urging force of an urging member 81 formed of a coil spring.

[0049] The card connector 1 is a so-called push-in/push-out type connector, or commonly known as, a push-push type connector that requires an operation of pushing the card 101 when the card 101 is inserted into the card connector 1 or even when the card 101 is ejected out of the card connector 1. Such an operation is the same as an alternate action (in case of a position retention type switch or a push-on/push-off type switch) in the field of a push button switch. The slide cam portion of the slide member 21 functions as a slide cam in a cam mechanism of a heart-shaped cam for realizing the push-push type action.

[0050] For this reason, a cam groove 23 is formed in an upper surface of the slide cam portion, and a free end of an elongated pin member 71 as a fixed cam member is engaged with the cam

groove 23. Further, the other end of the pin member 71 as a fixed end is latched to the housing 11 so as to be pivotably coupled thereto. Moreover, the pin member 71 and the cam groove 23 cooperate with each other to enable the slide member 21 that moves together with the card 101 to perform the push-push type action. With this arrangement, when the card 101 is moved in the insertion direction to reach a termination point by a push operation of pushing the card 101 in the insertion direction, the card guide mechanism moves the card 101 in a direction opposite to the insertion direction from the termination point by an urging force of the urging member 81 so that the card 101 is ejected.

[0051] The pin member 71 is held by being urged downward from above by a plate spring 66 of the shell 61. The plate spring 66 is formed by applying bending processing to a portion of the shell 61 so as to be pressed toward the bottom wall portion 11b of the housing 11. The pin member 71 is disposed between the plate spring 66 and the slide member 21 or the housing 11 so as to be held in a state where it is not separated apart from the slide member 21 or the housing 11.

[0052] Moreover, a card detection switch configured to be capable of detecting that the contact pads as the terminal members of the card 101 are in contact with the connection terminals 51 and thus detecting that the card 101 is fitted in the card connector 1 has a first contact member 52 thereof being attached to the first side wall portion 11c and a second contact member 53 thereof being attached to the innermost wall portion 11a. Furthermore, in a state where the card 101 is not yet inserted, the first contact member 52 and the second contact member 53 are not in contact with each other, and thus, the card detection switch is in a non-conduction state, that is, in an OFF state. Furthermore, when the card 101 is inserted, the first contact member 52 and the second contact member 53 are brought into contact with each other, and thus, the card detection switch enters into a conduction state, that is, in an ON state.

[0053] Further, the shell 61 has a generally rectangular top plate portion 62 and a plurality of lateral plate portions 64 that is erected from a plurality of locations of lateral edges of the top plate portion 62. A plurality of latching openings 63 is formed in the lateral plate portions 64, so that when the shell 61 is attached to an upper side of the housing 11, the latching openings 63 are latched to latching projections 13 that are formed on outer surfaces of the innermost wall portion 11a, the first side wall portion 11c, and the second side wall portion 11d of the housing 11, and thus, the shell 61 is fixed to the housing 11. Moreover, latching projection pieces 65 are formed

in a lower end of some of the lateral plate portions 64, so that when the shell 61 is attached to the upper side of the housing 11, the latching projection pieces 65 are latched to the lower surface of the bottom wall portion 11b, and thus, the shell 61 is firmly fixed to the housing 11.

[0054] The housing 11 is further provided with a metallic bottom plate 56 functioning as a ground plate. The metallic bottom plate 56 is attached to the lower surface of the bottom wall portion 11b and has a rectangular shape as illustrated in Fig. 2. A dimension in the front-rear direction (the up-down direction in Fig. 2) of the metallic bottom plate 56 is equal to or larger than the entire length of the arm portion 51d of each connection terminal 51, and in the example illustrated in the drawing figures, the dimension is equal to or larger than a dimension measured from the middle of the proximal end portion 51a to a distal end of the contact portion 51b. Moreover, in the example illustrated in the drawing figures, a dimension in the width direction (the left-right direction in Fig. 2) of the metallic bottom plate 56 is substantially identical with a dimension measured from the left edge of the leftmost connection terminal 51 in an array of connection terminals 51 arranged in the width direction and fitted in the housing 11 to the right edge of the rightmost connection terminal 51 in the array. In addition, attachment strip portions 57 are extended from both lateral ends in the width direction of the metallic bottom plate 56, and a protrusive latching portion 58 is formed in a distal end of each of the attachment strip portions 57. The protrusive latching portions 58 are latched to the latching openings 63 of the shell 61 together with the latching projections 13 of the housing 11, so that the metallic bottom plate 56 is not only fixedly secured to the housing 11 but also is electrically connected to the shell 61 to be held at the same potential level as the shell 61.

[0055] The metallic bottom plate 56 is arranged to be in tight contact with the lower surface of the bottom wall portion 11b, and that as viewed from the above or the below, it corresponds to an extent of area ranging from the middle of the proximal end portion 51a to an extreme end of the contact portion 51b and an extent of area ranging from the left edge of the leftmost connection terminal 51 in an array of the connection terminals 51 to the right edge of the rightmost connection terminal 51 in the array. In this way, the metallic bottom plate 56 is disposed at respective positions immediately beneath and in extremely close proximity to portions ranging from the middles of the proximal end portions 51a to the extreme ends of the contact portions 51b of all of the connection terminals 51 and therefore, a microstrip line structure is formed with respect to all of the connection terminals 51.

[0056] On the other hand, in a case where it is not necessary to form the microstrip line structure with respect to all of the connection terminals 51 but the microstrip line structure needs to be formed with respect to only several of the connection terminals 51, the dimension in the width direction of the metallic bottom plate 56 is set to be small, and the metallic bottom plate 56 is arranged such that as viewed from the above or the below, it can correspond to an extent of area ranging from the left edge of the leftmost connection terminal 51 to the right edge of the rightmost connection terminal 51 in the array of the several connection terminals 51.

[0057] Moreover, since the metallic bottom plate 56 only needs to correspond to at least the entire range of portion of the arm portion 51d with respect to the longitudinal direction of the connection terminal 51, the dimension in the front-rear direction of the metallic bottom plate 56 may be set to be small and the metallic bottom plate 56 may be arranged such that as viewed from the above or the below, it corresponds to an extent of area ranging from the large-width portion 51e of the arm portion 51d to the small-width portion 51f.

[0058] Furthermore, the metallic bottom plate 56 must not necessarily be a member that is formed to be separated from the housing 11 but may be a metallic sheet that is formed to be attached to the lower surface of the bottom wall portion 11b of the housing 11 by means of plating, deposition or coating.

[0059] Next, a description of the relationship between the connection terminals 51 and the metallic bottom plate 56 when the card 101 is inserted in the card connector 1 having the above-described structure will now be provided herein below.

[0060] Fig. 5 is a perspective view of the card connector according to the embodiment of the present invention, illustrating a state where a card is inserted in the card connector; and Fig. 6 is a cross-sectional view of the card connector according to the embodiment of the present invention, illustrating the state where the card is inserted into the card connector, taken along the arrows A-A in Fig. 5.

[0061] In this embodiment, as illustrated in Figs. 5 and 6, the card connector 1 is mounted on a front surface of the wiring board 91. In this case, the lower surfaces of the solder tail portions 51c of the connection terminals 51 are in abutting contact with the upper surfaces of the counterpart terminal members, such as signal lines, contact pads, or terminals, being exposed to the front surface of the wiring board 91 to be electrically connected to each other by means of soldering or the like. Moreover, the lower surfaces of the latching projection pieces 65 of the

shell 61 are in abutting contact with the upper surfaces of counterpart ground members 92, such as ground lines or ground pads, being exposed to the front surface of the wiring board 91 to be electrically connected to each other by means of soldering or the like.

[0062] First, a user inserts the card 101 from the front side (the left lower side in Fig. 5 and the left side in Fig. 6) of the card connector 1 by the user's fingers or the like. Moreover, the card 101 is inserted in a posture wherein a front end thereof 101a is directed toward the innermost wall portion 11a of the housing 11, a surface thereof having non-illustrated contact pads formed thereon opposes the bottom wall portion 11b, and a surface thereof without the contact pads formed thereon opposes the top plate portion 62 of the shell 61.

[0063] Subsequently, when the user pushes the card 101 to be inserted into the deeper side, the card 101 is engaged with the card holding portion of the slide member 21 to be moved toward the innermost wall portion 11a together with the slide member 21. At this time, the slide member 21 pressurizes the urging member 81 formed of the coil spring. Then, the slide member 21 and the card 101 are in a full-stroke state wherein they reach the termination point which is the deepest insertion position.

[0064] Subsequently, when the user stops the operation of pushing the card 101 to release the application of the pressing force to the card 101, the slide member 21 and the card 101 are moved in a direction where they are moved away from the innermost wall portion 11a by the repulsive force of the urging member 81. Then, the free end of the pin member 71 being engaged with the cam groove 23 of the slide member 21 is latched to a portion of the cam groove 23 to thereby stop the movement of the slide member 21, whereby the slide member 21 and the card 101 are stopped at the lock position, as illustrated in Figs. 5 and 6. In this way, the card 101 enters into a state of being certainly received in the housing 11.

[0065] In this manner, in response to the card 101 being held at the lock position, the card 101 enters into a state where it is able to transmit/receive data to/from a calculation unit or the like of the electronic device or apparatus provided with a board having the card connector 1 mounted thereon. Moreover, when the card 101 is held at the lock position, the first contact member 52 of the card detection switch is displaced by being pushed by the card 101 to make contact with the second contact member 53, so that the card detection switch is turned on. Furthermore, the respective contact pads of the card 101 are brought into contact with the corresponding contact portions 51b of the connection terminals 51 to be electrically connected with each other.

[0066] In such a case, as illustrated in Fig. 6, the contact portions 51b of the connection terminals 51 are pressed from above by the contact pads of the card 101, so that the connection terminals 51 are elastically deformed, whereby a spring force is exerted so that the contact portions 51b are pressed against the contact pads. Accordingly, secure contact between the contact pads and the connection terminals 51 can be maintained.

[0067] Here, when the deformation state of the connection terminal 51 as illustrated in Fig. 6 is observed in detail, it can be known that the proximal end portion 51a, the contact portion 51b, and the solder tail portion 51c are not substantially deformed and that only the cantilever-like arm portion 51d having a flat-plate shape is deformed mainly. In addition, it can be known that the arm portion 51d is deformed not only in a portion thereof but the whole body thereof ranging from the large-width portion 51e to the small-width portion 51f is substantially uniformly deformed. This is because as described above, although the arm portion 51d has a uniform plate thickness, it has a tapered planar shape having a width thereof gradually narrowing toward the distal end thereof, that is, a shape having a width monotonically decreasing from the large-width portion 51e to the small-width portion 51f.

[0068] If the arm portion 51d has a uniform width over the entire length thereof, a bending moment generated in response to pressing of the contact pads of the card 101 becomes the maximum at a portion thereof close to the proximal end portion 51a, so that there is a possibility that the portion close to the proximal end portion 51a is broken upon receipt of a large bending stress. Moreover, in order to avoid the breakage, it is necessary to increase the overall plate thickness of the arm portion 51d or the connection terminal 51, which may not only increase the cost but also increase the overall height of the card connector 1, and hence, it is difficult to miniaturize the card connector 1.

[0069] To the contrary, in the present embodiment, since the arm portion 51d has a shape having a width monotonically decreasing between the large-width portion 51e and the small-width portion 51f, a portion where the bending moment is large has a large width while a portion where the bending moment is small has a small width, so that the bending stress becomes uniform over the entire range of the arm portion 51d. Therefore, the arm portion 51d is deformed not only in a portion thereof but the whole body thereof ranging from the large-width portion 51e to the small-width portion 51f is substantially uniformly deformed. Owing to such a configuration, since the arm portion 51d is prevented from being broken upon receipt of a large bending stress in a

portion thereof, it is possible to decrease the overall plate thickness of the arm portion 51d or the connection terminal 51. As a result, it is possible not only to reduce the cost but also to realize a reduced height and miniaturization of the card connector 1.

[0070] In addition, when the deformation state of the connection terminal 51 as illustrated in Fig. 6 is observed in detail, it can be understood that the arm portion 51d is inclined to fall as it goes toward an extreme end thereof, and as a result, it approaches the metallic bottom plate 56 as it goes the extreme end. That is, the arm portion 51d is deformed such that a gap defined between the arm portion 51d per se and the metallic bottom plate 56 decreases depending on a reduction in a width thereof which monotonically decreases from the large-width portion 51e to the small-width portion 51f. Owing to such a configuration, it is possible to appropriately control the characteristic impedance of a signal transmission line in which the connection terminals 51 function as a signal line and the metallic bottom plate 56 functions as a ground line. In other words, the characteristic impedance of the microstrip line structure formed by the connection terminals 51 and the metallic bottom plate 56 can be controlled to be constant.

[0071] Next, a description of control of the characteristic impedance of a microstrip line structure will now be provided herein below.

[0072] Fig. 7 is a first view for explanatorily illustrating a microstrip line structure in the card connector according to the embodiment of the present invention; and Fig. 8 is a second view for explanatorily illustrating a microstrip line structure in the card connector according to the embodiment of the present invention.

[0073] Referring to Fig. 7, there is illustrated a schematic view of a single-mode microstrip line structure formed by any one of the connection terminals 51 and the metallic bottom plate 56 functioning as a ground plate. In Fig. 7, a dielectric body disposed between the connection terminal 51 and the metallic bottom plate 56, designated by reference numeral 30, is formed by the bottom wall portion 11b of the housing 11 and/or an air layer. Moreover, "W" is a width of the connection terminal 51, "t" is a thickness of the connection terminal 51, "h" is a thickness of the dielectric body 30, namely, a distance between the connection terminal 51 and the metallic bottom plate 56, and "εr" is a permittivity of the dielectric body 30.

[0074] The characteristic impedance Z0 of the single-mode microstrip line structure as illustrated in Fig. 7 is expressed by the following formula (1):

$$Z_0 = \frac{60}{\sqrt{0.475\,\varepsilon_r + 0.67}} \ln\left[\frac{4h}{0.67(0.8W + t)}\right]$$

[0075] From the formula (1), it can be understood that in order to make the characteristic impedance Z0 constant, the distance h between the connection terminal 51 and the metallic bottom plate 56 must be changed if the width W of the connection terminal 51 varies. For example, when it is assumed that the dielectric body 30 has a permittivity εr of 3.8 and the connection terminal 51 has a thickness t of 0.2, in order to make the characteristic impedance Z0 constant at 50 [Ω], the width W of the connection terminal 51 and the distance h between the connection terminal 51 and the metallic bottom plate 56 are necessary to be changed so as to satisfy any of the following formulas (1-1) to (1-3)

W=0.8:h=0.45 ---- Formula (1-1),
W=0.5:h=0.29 ---- Formula (1-2), and
W=0.3:h=0.19 ---- Formula (1-3)

[0076] Referring to Fig. 8, there is illustrated a schematic view of a microstrip line structure formed by the connection terminals 51 and the metallic bottom plate 56, in which a differential signal is transmitted using one of a pair of neighboring connection terminals 51 as a positive signal line and using the other one as a negative signal line. In Fig. 8, "S" is a width of a space between neighboring connection terminals 51, and "P" is a pitch of the connection terminals 51. That is, S=P-W.

[0077] The characteristic impedance Zdiff of the differential signal microstrip line structure as illustrated in Fig. 8 is expressed by the following formula (2).

$$Z_{diff} = 2Z_0\left(1 - 0.48e^{-0.96\frac{S}{h}}\right)$$

[0078] From the formula (2), it can be understood that in order to make the characteristic impedance Zdiff constant, since the width S of the space between the connection terminals 51 varies if the pitch P of the connection terminals 51 is set to have a fixed value and the width W

of the connection terminal 51 varies, the distance h between the connection terminals 51 and the metallic bottom plate 56 must be changed. For example, when it is assumed that the dielectric body 30 has a permittivity εr of 3.8 and the connection terminal 51 has a thickness t of 0.2, in order to make the characteristic impedance Zdiff constant at 50 [Ω], the width W of the connection terminal 51 and the distance h between the connection terminals 51 and the metallic bottom plate 56 are necessary to be changed so as to satisfy any of the following formulas (2-1) to (2-3).

W=0.8:h=1.05 ---- Formula (2-1),

W=0.5:h=0.34 ---- Formula (2-2), and

W=0.3:h=0.19 ---- Formula (2-3)

[0079] In the case of the differential signal microstrip line structure, when the pitch P of the connection terminals 51 is set to have a fixed value, since the coupling becomes strong if the width W of the connection terminal 51 is large, it is necessary to dispose the metallic bottom plate 56 to be located distant from the connection terminals 51.

[0080] Hereinabove, the present embodiment has been described for a case where the card connector 1 is configured such that the card 101 is inserted in a posture wherein a surface thereof having the contact pads arranged thereon opposes the bottom wall portion 11b and a surface thereof without the contact pads arranged thereon opposes the top plate portion 62 of the shell 61. However, the card connector 1 may be configured such that the card connector 101 is inserted in a posture wherein a surface thereof having the contact pads arranged thereon opposes the top plate portion 62 of the shell 61 and a surface thereof without the contact pads arranged thereon opposes the bottom wall portion 11b. In such a case, the connection terminals 51 are not attached to the upper surface of the bottom wall portion 11b, but are arranged to be in the vicinity of the top plate portion 62 of the shell 61, that is, to be located between the inserted card 101 and the top plate portion 62 of the shell 61, similar to the card connector disclosed in Japanese Patent Application Laid-Open (Kokai) No. 2006-313459. Therefore, when the top plate portion 62 of the shell 61 is formed so as to correspond to a range of areas from the middle of the proximal end portion 51a to an extreme end of the contact portion 51b, as viewed from the above or the below, the top plate portion 62 functions as the metallic bottom plate 56 which is

the ground plate, whereby the above-described microstrip line structure can be formed by the connection terminals 51 and the top plate portion 62.

[0081] As described above, the card connector 1 according to the present embodiment includes the housing 11 in which the card 101 provided with the contact pads is accommodated; the connection terminals 51 that are attached to the housing 11 and are capable of coming into contact with the contact pads of the card 101, wherein: each of the connection terminals 51 is provided with the proximal end portion 51a held in the housing 11, the arm portion 51d extending from the proximal end portion 51a, and the contact portion 51b connected to the distal end of the arm portion 51d; the arm portion 51d is formed to have a shape have a width large on the side of the proximal end portion 51a and small on the side of the contact portion 51b; the housing 11 is provided with the metallic bottom plate 56 arranged to correspond to at least an extent of portion of the arm portion 51d; and when the card 101 is accommodated in the housing 11 so that the contact portion 51b comes into contact with the contact pads of the card 101, the arm portion 51d is deformed so that a gap defined between the arm portion 51d per se and the metallic bottom plate 56 decreases depending on approach to the extreme portion thereof.

[0082] Owing to such a configuration, it is possible to appropriately control the characteristic impedance ranging from the proximal end portion 51a to the contact portion 51b of the connection terminals 51. Moreover, it is possible to secure matching of the characteristic impedance in the entire signal transmission line. Accordingly, even when the card connector 1 is used for high-speed signal transmission, it is possible to prevent occurrence of crosstalk. Moreover, the card connector 1 can be produced with a dimensionally reduced height and at a low cost.

[0083] Moreover, the gap between the arm portion 51d and the metallic bottom plate 56 varies with the change in the width of the arm portion 51d, so that the characteristic impedance of a signal transmission line in which the connection terminals 51 are used for forming a signal line and the metallic bottom plate 56 are used for forming a ground line becomes constant. Owing to such a configuration, it is possible to secure matching of the characteristic impedance to thereby reduce a signal loss such as reflection, attenuation, resonance or radiation in the signal transmission line.

[0084] Furthermore, the connection terminals 51 are arranged on the upper surface side of the bottom wall portion 11b of the housing 11 and the metallic bottom plate 56 is arranged on the

lower surface of the bottom wall portion 11b. Owing to such a configuration, it is possible to form a microstrip line structure so as to correspond to an arbitrary portion of an arbitrary one of the connection terminals 51 by varying the dimension and location of the metallic bottom plate 56.

[0085] Furthermore, the housing 11 may have the shell 61 attached to the upper side thereof, the connection terminals 51 may be arranged at positions in the vicinity of the top plate portion 62 of the shell 61, and the top plate portion 62 may function as the metallic bottom plate 56. In such a case, it is possible to obtain a card connector 1 in which the card 101 is inserted in a posture wherein a surface thereof having the contact pads arranged thereon opposes the top plate portion 62 of the shell 61 and a surface thereof without the contact pads arranged thereon opposes the bottom wall portion 11b.

[0086] While a preferred embodiment of the Present Invention is shown and described, it is envisioned that those skilled in the art may devise various modifications without departing from the spirit and scope of the foregoing Description and the appended Claims.

CLAIMS

What Is Claimed Is:

1. A card connector (1) comprising:

a housing (11) in which a card (101) provided with terminal members is accommodated; and

connection terminals (51) that are attached to the housing (11) to be capable of coming into contact with the terminal members of the card (101);

wherein:

each of the connection terminals (51) is provided with a proximal end portion (51a) held in the housing (11), a flexible portion (51d) extending from the proximal end portion (51a), and a distal end portion (51b) connected to an extreme end of the flexible portion (51d);

the flexible portion (51d) is formed in a shape having a width large on a side of the proximal end portion (51a) and small on a side of the distal end portion (51b);

the housing (11) is provided with a ground plate (56) which is arranged to correspond to at least an extent in which the flexible portion (51d) lie; and

when the card (101) is accommodated in the housing (11) so that the distal end portions (51b) of the connection terminals come into contact with the terminal members of the card (101), the respective flexible portions (51d) are deformed to be distant from the ground plate (56) by a gap decreasing in response to approach to the extreme ends thereof.

2. The card connector (1) according to Claim 1, wherein the gap defined between the flexible portions (51d) and the ground plate (56) varies depending on a change in the width of respective one of the flexible portions (51d), so that a characteristic impedance of a signal transmission line formed by the connection terminals (51) functioning as a signal line and the ground plate (56) functioning as a ground line becomes constant.

3. The card connector (1) according to Claim 2, wherein the connection terminals (51) and the ground plate (56) are arranged to form a microstrip line structure.

4. The card connector (1) according to Claim 3, wherein the housing (11) has a bottom wall portion (11b) thereof having an upper surface side on which the connection terminals (51) are arranged, and a lower surface side on which the ground plate (56) is arranged.

5. The card connector (1) according to Claim 4, wherein the housing (11) has a cover member (61) attached to an upper side thereof, and the connection terminals (51) are arranged at positions in the vicinity of a top plate portion (62) of the cover member (61), the top plate portion (62) functioning as the ground plate (56).

6. The card connector (1) according to Claim 1, wherein the connection terminals (51) and the ground plate (56) are arranged to form a microstrip line structure.

7. The card connector (1) according to Claim 6, wherein the housing (11) has a bottom wall portion (11b) thereof having an upper surface side on which the connection terminals (51) are arranged, and a lower surface side on which the ground plate (56) is arranged.

8. The card connector (1) according to Claim 7, wherein the housing (11) has a cover member (61) attached to an upper side thereof, and the connection terminals (51) are arranged at positions in the vicinity of a top plate portion (62) of the cover member (61), the top plate portion (62) functioning as the ground plate (56).

9. The card connector (1) according to Claim 1, wherein a pair of neighboring connection terminals (51) among the connection terminals (51) and the ground plate (56) are arranged to form a microstrip line structure capable of transmitting a differential signal.

10. The card connector (1) according to Claim 9, wherein the housing (11) has a bottom wall portion (11b) thereof having an upper surface side on which the connection terminals (51) are arranged, and a lower surface side on which the ground plate (56) is arranged.

11. The card connector (1) according to Claim 10, wherein the housing (11) has a cover member (61) attached to an upper side thereof, and the connection terminals (51) are arranged at positions in the vicinity of a top plate portion (62) of the cover member (61), the top plate portion (62) functioning as the ground plate (56).

12. The card connector (1) according to Claim 1, wherein the housing (11) has a bottom wall portion (11b) thereof having an upper surface side on which the connection terminals (51) are arranged, and a lower surface side on which the ground plate (56) is arranged.

13. The card connector (1) according to Claim 1, wherein the housing (11) has a cover member (61) attached to an upper side thereof, and the connection terminals (51) are arranged at positions in the vicinity of a top plate portion (62) of the cover member (61), the top plate portion (62) functioning as the ground plate (56).

14. The card connector (1) according to Claim 2, wherein a pair of neighboring connection terminals (51) among the connection terminals (51) and the ground plate (56) are arranged to form a microstrip line structure capable of transmitting a differential signal.

15. The card connector (1) according to Claim 14, wherein the housing (11) has a bottom wall portion (11b) thereof having an upper surface side on which the connection terminals (51) are arranged, and a lower surface side on which the ground plate (56) is arranged.

16. The card connector (1) according to Claim 15, wherein the housing (11) has a cover member (61) attached to an upper side thereof, and the connection terminals (51) are arranged at positions in the vicinity of a top plate portion (62) of the cover member (61), the top plate portion (62) functioning as the ground plate (56).

17. The card connector (1) according to Claim 2, wherein the housing (11) has a bottom wall portion (11b) thereof having an upper surface side on which the connection terminals (51) are arranged, and a lower surface side on which the ground plate (56) is arranged.

18. The card connector (1) according to Claim 17, wherein the housing (11) has a cover member (61) attached to an upper side thereof, and the connection terminals (51) are arranged at positions in the vicinity of a top plate portion (62) of the cover member (61), the top plate portion (62) functioning as the ground plate (56).

19. The card connector (1) according to Claim 2, wherein the housing (11) has a cover member (61) attached to an upper side thereof, and the connection terminals (51) are arranged at positions in the vicinity of a top plate portion (62) of the cover member (61), the top plate portion (62) functioning as the ground plate (56).

20. The card connector (1) according to Claims 3, wherein the housing (11) has a cover member (61) attached to an upper side thereof, and the connection terminals (51) are arranged at positions in the vicinity of a top plate portion (62) of the cover member (61), the top plate portion (62) functioning as the ground plate (56).

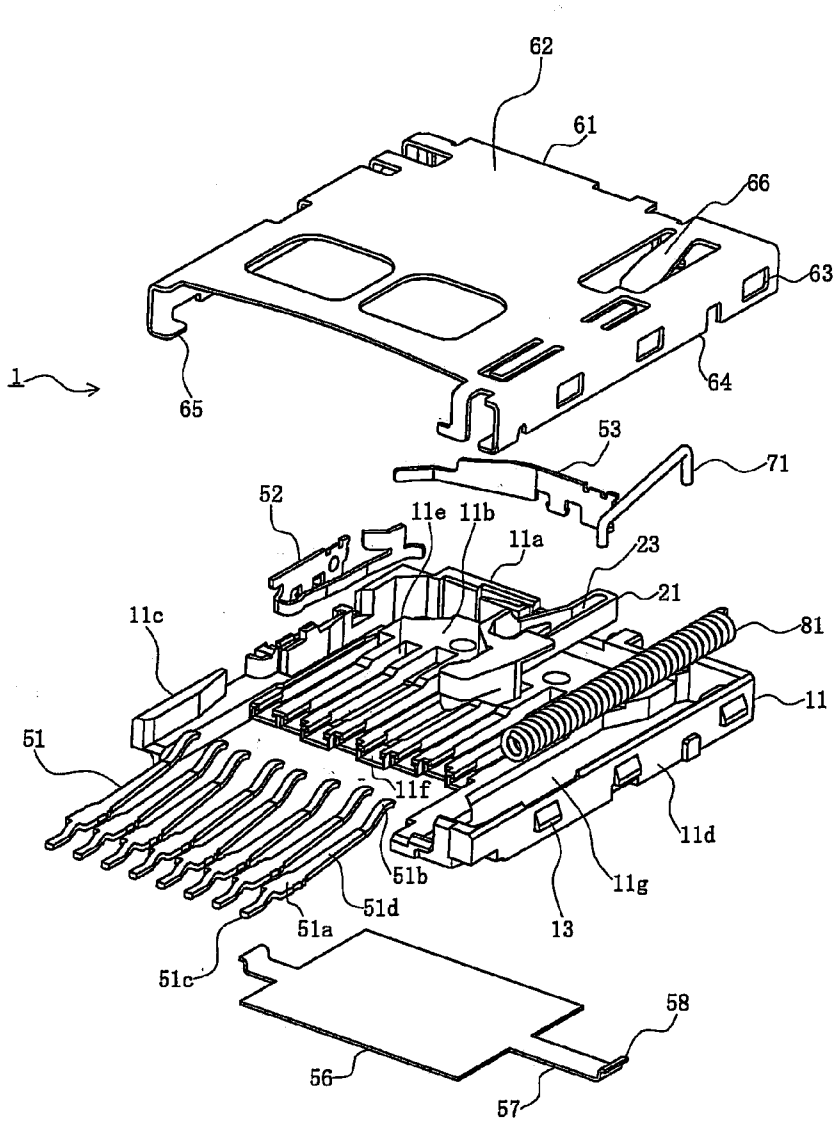
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FIG. 1

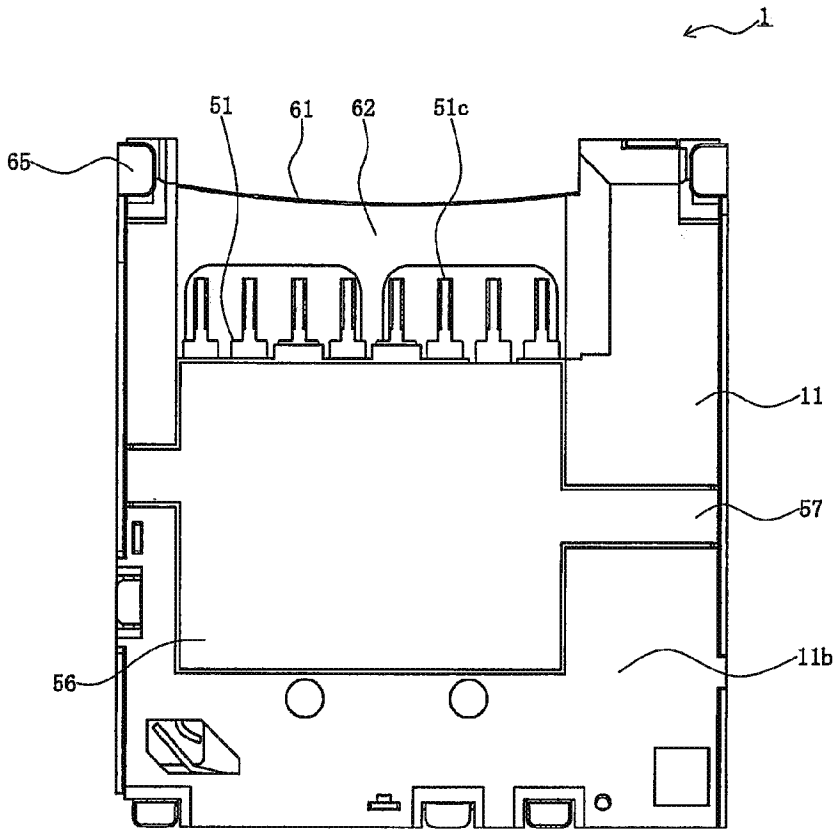


FIG. 2

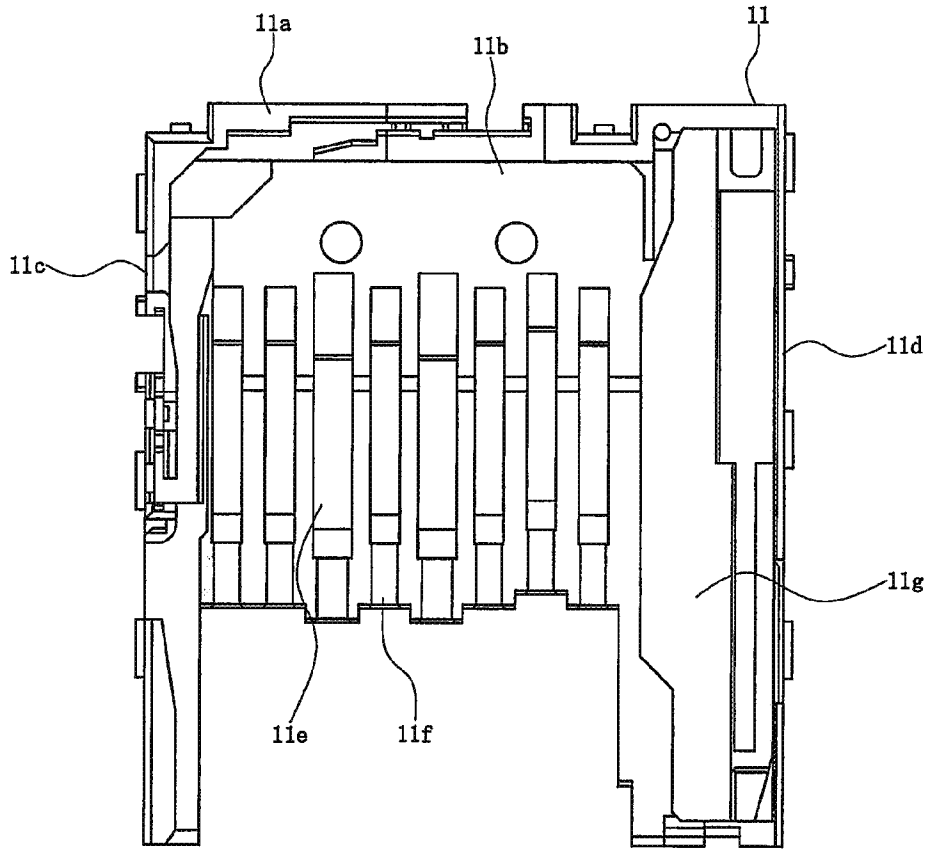


FIG. 3

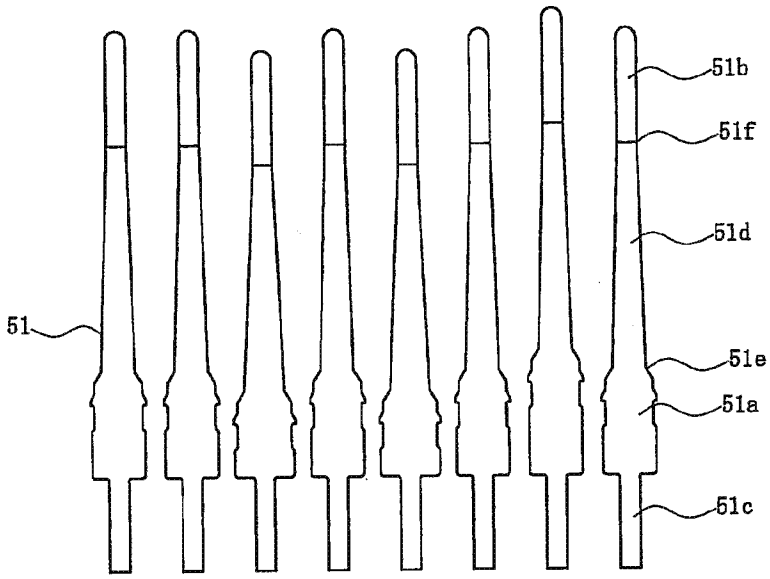


FIG. 4

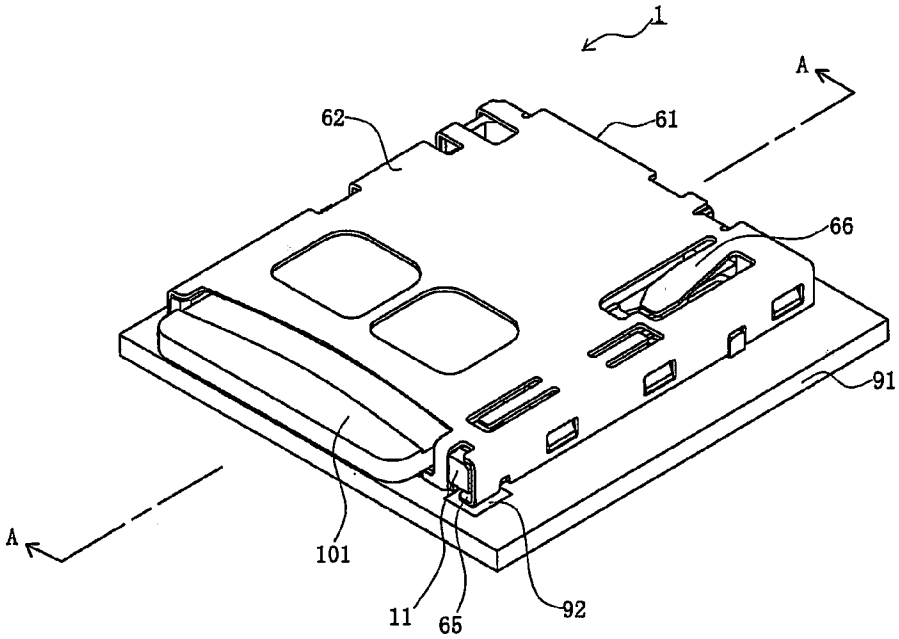
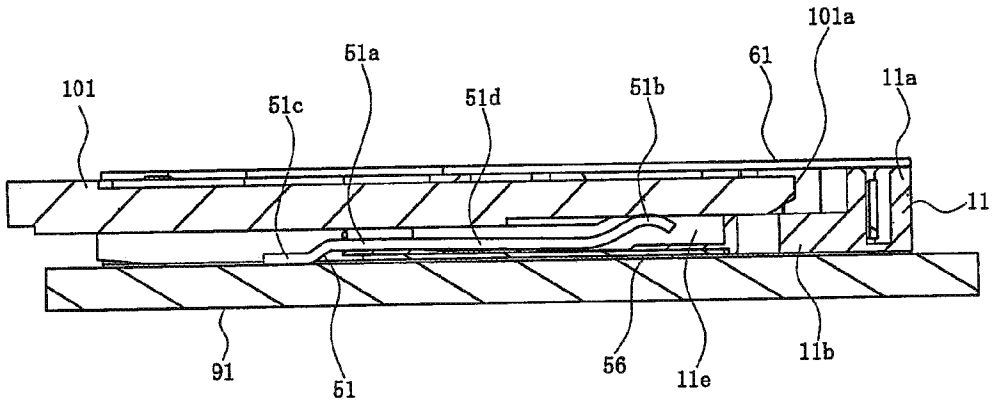


FIG. 5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101
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51c
51d
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11
91
51
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11e
11b

FIG. 6

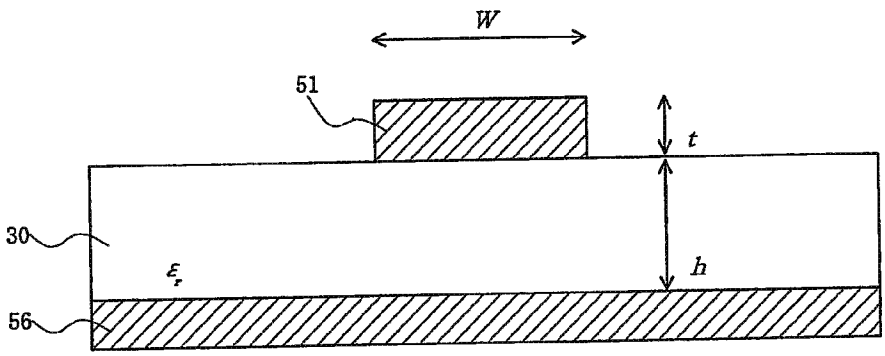
W
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FIG. 7

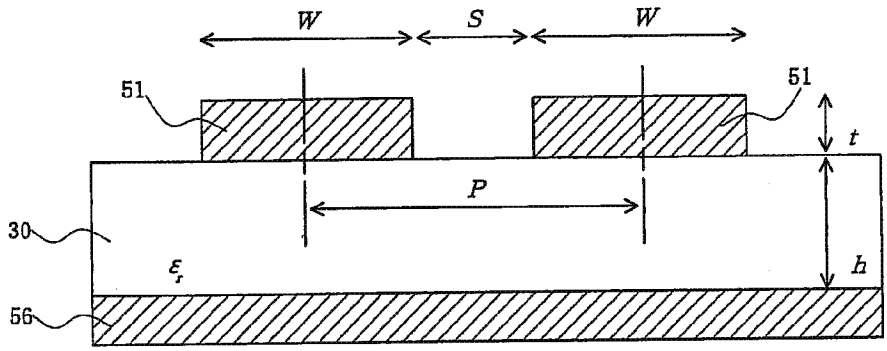

FIG. 8

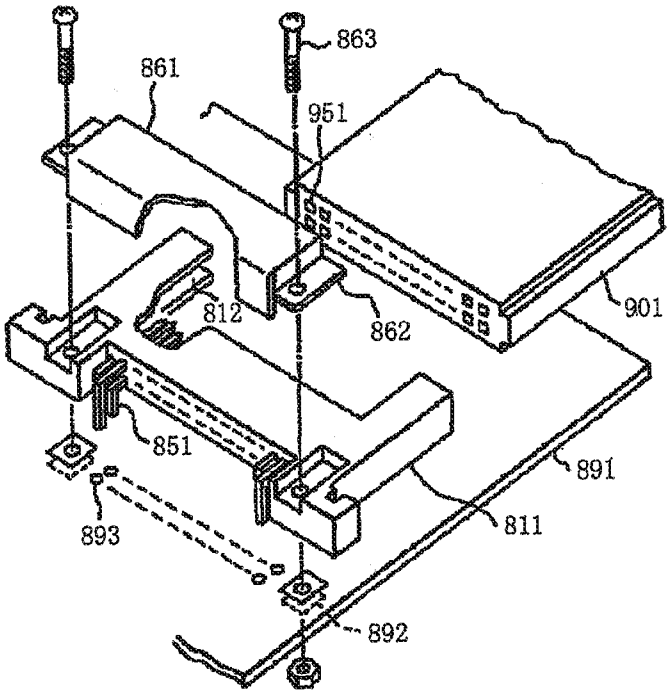

FIG. 9
PRIOR ART

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2009/065888

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06K7/00 H01R23/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06K H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 05 189625 A (FUJITSU LTD) 30 July 1993 (1993-07-30) cited in the application abstract	1
A	US 2002/102883 A1 (MITHUHASHI SEIICHIROU [JP] ET AL) 1 August 2002 (2002-08-01) paragraph [0043] - paragraph [0048]; figure 3	1

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 April 2010	03/05/2010

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	de Ronde, Jan

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2009/065888

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 5189625 A	30-07-1993	NONE	
US 2002102883 A1	01-08-2002	CN 1369935 A	18-09-2002
		JP 2002231343 A	16-08-2002