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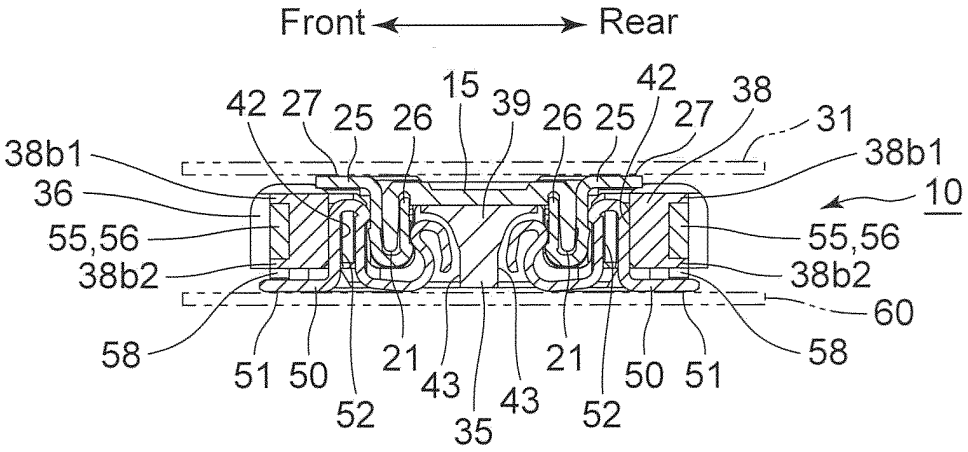
(54) **CONNECTOR**

(57) Provided is a connector effectively capable of reducing the possibility of short-circuiting and electrical discharge between a conductive member and circuit boards or contacts when a first connector and a second connector are connected even when the entire connector is low in profile.

A solution is provided in which the conductive member 55 is positioned between the first circuit board and the second circuit board when the first contacts 50 and the second contacts 25 are mounted to the circuit pattern of the first circuit board 60 and the circuit pattern of the second circuit board 31, respectively, and the outer peripheral wall 38 of the first insulator 36 includes the conductive-member shield portions 38a1 and 38a2, positioned between the conductive member and the first circuit board together with the tail portions 51 of the first contacts, and/or between the second circuit board and the conductive member.

Fig. 7



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Description

TECHNICAL FIELD

[0001] The present invention relates to a connector which allows circuit boards to be mutually connected and to which countermeasures against noise have been taken.

BACKGROUND ART

[0002] Electronic apparatuses and electrical apparatuses, such as desktop PCs (personal computers), laptop computers and tablet computers, generally contain a circuit board on which electronic components are mounted and another circuit board on which other electronic components are mounted.

[0003] A connector disclosed in Patent Literature 1 is a connector for use in connecting such two circuit boards to each other and includes a receptacle connector mounted on a circuit board (first circuit board / rigid board) and a plug connector mounted on another circuit board (second circuit board / rigid board).

[0004] The receptacle connector is provided with a receptacle insulator and a plurality of receptacle contacts. The receptacle insulator is provided with an annular outer peripheral wall and a fitting recess which is formed inside the outer peripheral wall. The plurality of receptacle contacts are made to be supported by the receptacle insulator while being arranged in the lengthwise direction of the receptacle connector. Each receptacle contact is provided with a tail portion, which is mounted onto a circuit pattern formed on the mounting surface of the first circuit board and a contact portion which is positioned in the fitting recess of the receptacle insulator.

[0005] On the other hand, the plug connector is provided with a plug insulator and a plurality of plug contacts. The plug insulator is provided with an annular pro jecting fitting portion which can be fitted into the aforementioned fitting recess. Each plug contact is provided with a tail portion which is mounted to a circuit pattern on the mounting surface of the second circuit board and a contact portion which is integral with the projecting fitting portion of the plug insulator.

[0006] Fitting (connecting) the projecting fitting portion of the plug connector into (to) the fitting recess of the receptacle connector causes the contact portion of each plug contact to come into contact with the contact portion of an associated receptacle contact and causes the first circuit board and the second circuit board to become parallel to each other. In addition, the electronic components mounted on the first circuit board and the electronic components mounted on the second circuit board are mutually electrically connected.

[0007] In recent electronic apparatuses and electrical apparatuses, an increase in information volume and higher communication speeds have progressed considerably, so that taking countermeasures against noise in the apparatuses has become a key issue. Accordingly, there has been a strong desire to improve the resistance to noise with respect to the connector and to suppress noise about the periphery of the connector.

[0008] Hence, the receptacle connector disclosed in Patent Literature 1 is equipped with a conductive member (shieldmember) made of metal which is provided on the outer peripheral surface of the receptacle insulator to cover this outer peripheral surface.

[0009] This conductive member is electrically continuous with a ground pattern formed on the first circuit board. Therefore, external noise entering the receptacle contacts of the receptacle connector (and the plug contacts) and the leakage of noise from the receptacle contacts (and the plug contacts) to the outside can be reduced.

CITATION LIST

PATENT LITERATURE

[0010] Patent Literature 1: Japanese Unexamined Patent Publication No. 2013-140755

SUMMARY OF THE INVENTION

TECHNICAL PROBLEM

[0011] In recent years, the distance between mutually facing surfaces of a first circuit board and a second circuit board has been reduced due to the slimming of the connector has progressed due to the slimming of electronic apparatuses and electrical apparatuses. Therefore, the distances from the conductive member to the first circuit board and the second circuit board, and the distance from the conductive member to the tail portions of the receptacle contacts, have reduced.

[0012] Accordingly, in the case where the tail portions of the receptacle contacts are soldered onto the mounting surface of the first circuit board or minute foreign particles such as dust or the like are adhered to the same mounting surface or tail portions, there is a possibility of (electrical) short-circuiting occurring between the conductive member and each of the first and second circuit boards (the circuit patterns thereof) and between the conductive member and the tail portions of the receptacle contacts via solder or foreign particles.

[0013] Furthermore, before the receptacle connector and the plug connector are mutually connected, sometimes static electricity which has flowed to the plug connector from hands of a worker, etc., is intentionally discharged to the first circuit board (to the ground pattern thereof) from the conductive member by bringing a metal member (e.g., a metal fitting for fixing the plug insulator to the second circuit board), on the plug connector side, into contact with the conductive member. This causes the static electricity to flow into the receptacle contacts and the circuit pattern of the first circuit board, thus making it possible to prevent the electronic components, etc.,

which are connected to the first circuit board (and the second circuit board), from being electrostatically damaged by static electricity.

[0014] However, when the distance from the conductive member to the tail portions of the receptacle contacts is small, there is a possibility of electrical discharge occurring between the conductive member and the tail portions of the receptacle contacts, and accordingly, there is a possibility of the aforementioned static electricity flowing into the receptacle contacts and the circuit pattern of the first circuit board.

[0015] In recent years, the distance between the first circuit board and the second circuit board (the height of the connector in an engaged state) has been reduced to 1 mm or less (the distance between the conductive member and the tail portions has also been extremely reduced) when the receptacle connector and the plug connector are mutually connected, and accordingly, the possibility of the above described problems ("short-circuiting" and "electrostatic discharge damage") occurring have increased.

[0016] The present invention provides a connector that is effectively capable of reducing the possibility of short-circuiting and electric discharge occurring between the conducted member and the circuit boards or the contacts when the first connector and the second connector are mutually connected, even in the case where the entire connector is configured to have a low profile.

SOLUTION TO PROBLEM

[0017] The connector according to the present invention is characterized by a connector including a first connector including a first insulator which has an annular outer peripheral wall and a fitting recess formed inside the outer peripheral wall, a plurality of first contacts which are supported by the first insulator and each have a first contact portion that is positioned in the fitting recess and a tail portion that is mountable to a circuit pattern of the first circuit board, and a conductive member supported by the first insulator; and a second connector including a second insulator which has an annular projecting fitting portion capable of being fitted into the fitting recess, and a plurality of second contacts which are supported by the second insulator, are mountable to a circuit pattern of the second circuit board and each have a second contact portion which comes in contact with the first contact portion when the projecting fitting portion is fitted into the fitting recess. The conductive member is positioned between the first circuit board and the second circuit board when the first contacts and the second contacts are mounted to the circuit pattern of the first circuit board and the circuit pattern of the second circuit board, respectively. The outer peripheral wall includes a conductive-member shield portion which is positioned between the conductive member and the first circuit board together with the tail portion and/or between the second circuit board and the conductive member.

[0018] The conductive-member shield portion can include a first shield portion positioned between the conductive member and the first circuit board together with the tail portion; and a second shield portion positioned between the second circuit board and the conductive member.

[0019] The conductive member can include an outer peripheral-side shield member which covers an outer peripheral surface of the outer peripheral wall.

ADVANTAGEOUS EFFECTS OF THE INVENTION

[0020] After the tail portions of the first contacts of the first connector are mounted to the first circuit board (to the circuit pattern thereof) and second contacts of the second connector are mounted to the second circuit board (to the circuit pattern thereof), fitting the projecting fitting portion of the second insulator into the fitting recess of the first insulator causes the first contacts and the second contacts to be electrically continuous with each other.

[0021] In the case where the connector is configured to have a low-profile structure, the distance from the conductive member to the first circuit board and the tail portions and the distance from the conductive member to the second circuit board (at least one of the former distance and the latter distance) become small.

[0022] However, since the outer peripheral wall of the first insulator is equipped with the conduct ive-member shield portion that is positioned between the conductive member and each of the first circuit board and the tail portions, and (or) between the second circuit board and the conductive member, the possibility of short-circuit and electric discharge occurring between the connective member and the first circuit board, the second circuit board and/or the tail portions can be effectively reduced when the first connector and the second connector are mutually connected.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

FIG. 1 is a perspective view of a receptacle connector and a plug connector of an embodiment according to the present invention in a separated state, viewed from above.

FIG. 2 is a perspective view of the receptacle connector and the plug connector in a separated state, viewed from below.

FIG. 3 is a perspective view of the receptacle connector and the plug connector in a connected state, viewed from above.

FIG. 4 is an exploded perspective view of the receptacle connector, viewed from above.

FIG. 5 is an exploded perspective view of the receptacle connector, viewed from below.

FIG. 6 is a plan view of the connector.

FIG. 7 is a cross sectional view taken along the line VII-VII shown in FIG. 6, viewed in the direction of the appended arrows.

FIG. 8 is a cross sectional view taken along the line VIII-VIII shown in FIG. 6, viewed in the direction of the appended arrows.

FIG. 9 is a cross sectional view taken along the line IX-IX shown in FIG. 6, viewed in the direction of the appended arrows.

FIG. 10A is a cross sectional view of a side portion of a first modified embodiment, taken at the same position as the cross section shown in FIG. 7 and FIG. 10B is a cross sectional view of a side portion of a second modified embodiment, taken at the same position as the cross section shown in FIG. 7.

FIG. 11 is a perspective view of a shell of a third modified embodiment.

DESCRIPTION OF EMBODIMENTS

[0024] An embodiment according to the present invention will be hereinafter discussed with reference to the attached drawings. In the following descriptions, forward and rearward directions, leftward and rightward directions, and upward and downward directions are determined with reference to the directions of the arrows shown in the drawings.

[0025] The present embodiment of the connector 10 is provided with a plug connector 15 and a receptacle connector 35.

[0026] First the detailed structure of the plug connector 15 (second connector) will be hereinafter discussed with reference mainly to FIGS. 1 and 2.

[0027] The plug connector 15 is provided with a plug insulator 16, a plurality of plug contacts 25 (second contacts) and two metal fittings 28, which constitute major elements of the plug connector 15.

[0028] The plug insulator 16 is formed from electrically-insulative andheat-resistant synthetic resin and is shaped into a tabular member extending in the leftward and rightward directions. The plug insulator 16 is provided with a top plate portion 17 which constitutes the top of the plug insulator 16 and a projecting fitting portion 18, having the shape of an annular wall, which projects downward from the entire outer edge of the lower surface of the top plate portion 17. The space formed between the top plate portion 17 and the projecting fitting portion 18 forms an engaging recess 19. A plurality of contact fixing grooves 21 are formed in each of the front and rear walls of the projecting fitting portion 18. The contact fixing grooves 21 are arranged in the leftward and rightward directions and each of which is formed into a substantially U-shaped in cross section, extending from one side (front/rear side) to the other side (rear/front side) of the wall (the front/rear wall of the projecting fitting portion 18) across the lower end of the wall (see FIG. 7). In addition, left and right metal fitting member fixing recesses 22 are formed on the upper surfaces of the left and right ends of the projecting fitting portion 18 to be recessed downward, respectively (see FIG. 9).

[0029] Each plug contact 25 is made of sheet copper alloy (for example, phosphor bronze, beryllium copper, titanium copper or Corson copper) having spring elasticity, and is formed into the shape as shown in the drawings by stamp forming. The surface of each plug contact 25 is coated with plating such as tin-plating or gold-plating. Each plug contact 25 is provided with a contact portion 26 (second contact portion) and a tail portion 27. The contact portion 26 constitutes the inner part of the substantially U-cross-sectional shaped body of the plug contact 25 and extends in the upward and downward directions, and the tail portion 27 extends substantially horizontally from the upper end of the outer part of the body of the plug contact 25.

[0030] The plug contacts 25 are fixed to the plug insulator 16 by being fitted (press-fitted) into the contact fixing grooves 21 from below, respectively (see FIGS. 1, 2, 7, etc.).

[0031] Each plug-side metal fitting 28 is formed into the shape shown in the drawings by stamping a metal plate, and a pair of tail portions 29 which are positioned substantially horizontally are formed on the upper end of each plug-side metal fitting 28.

[0032] Each plug-side metal fitting 28, in a fixed state, has been press-fitted into the associated metal fitting member fixing recess 22 from above, and each tail portion 29 projects upward from the upper surface of the plug insulator 16.

[0033] The plug connector 15 that has the above described configuration is mounted to a mounting surface formed on one side of a circuit board 31 (rigid board/second circuit board; see FIGS. 1 and 7 through 9). Specifically, the tail portion 27 of each plug contact 25 is soldered to a circuit pattern (not shown) formed on the mounting surface (lower surface) of the circuit board 31, and the pair of tail portions 29 of each plug-side metal fitting 28 are soldered to a ground pattern (not shown) formed on the same mounting surface of the circuit board 31 (i.e., are connected using a so-called straight (ST) connection). In addition to the plug connector 15, electronic components (e.g., a module for high-performance, a semi-conductor, a large-capacity memory, etc.) are mounted onto the mounting surface of the circuit board 31.

[0034] The detailed structure of the receptacle connector 35 (first connector) will be hereinafter discussed with reference to FIGS. 1 through 6.

[0035] The receptacle connector 35 is provided with a receptacle insulator 36 (first insulator), a plurality of receptacle contacts 50 (first contacts) and two shells 55 (conductive members), which constitute major elements of the receptacle connector 35.

[0036] The receptacle insulator 36 is formed from electrically-insulative and heat-resistant synthetic resin by injection molding (specifically by insert molding as will be discussed later) and is shaped into a member extending

in the leftward and rightward directions. The receptacle insulator 36 is provided with a bottom plate portion 37 which constitutes the bottom part of the receptacle insulator 36, an outer peripheral wall 38 which is formed as an annular wall protrudes upward from the entire peripheral edge of the upper surface of the bottomplate portion 37, and a projecting engaging portion 39 which projects upward from the upper surface of the bottom plate portion 37. The projecting engaging portion 39 that is spaced circumferentially inwards from the outer peripheral wall 38 extends linearly in the leftward and rightward directions. The space formed between the outer peripheral wall 38 and the projecting engaging portion 39 constitutes an annular fitting recess 40.

[0037] The outer peripheral wall 38, except for the front, the rear and both the left and right ends thereof, includes a front wall 38a and a rear wall 38b. As shown in the drawings, the front surface of the front wall 38a is positioned one step behind the portions of the outer peripheral wall 38 that are positioned on both the left and right sides of the front wall 38a, and the rear surface of the rear wall 38b is positioned one step in front of the portions of the outer peripheral wall 38 that are positioned on both the left and right sides of the rear wall 38b. A plurality of contact fixing grooves 42 (the number of which is identical to that of the plug contacts 25) are formed in each of the rear surface of the front wall 38a and the front surface of the rear wall 38b; the plurality of contact fixing grooves 42 are arranged in the leftward and rightward directions and are each formed extending in the upward and downward directions. In addition, deformation allowing grooves 43 which are continuous with the contact fixing grooves 42 of the front wall 38a are formed on the portions of the receptacle insulator 36 which extend over the following two surfaces: the bottom surface of the bottom plate portion 37 that is positioned immediately in front of the projecting engaging portion 39, and the front surface of the projecting engaging portion 39. Likewise, deformation allowing grooves 43 which are continuous with the contact fixing grooves 42 of the rear wall 38b are formed on the portions of the receptacle insulator 36 which extend over the following two surfaces: the bottom surface of the bottomplate portion 37 that is positioned immediately behind the projecting engaging portion 39, and the rear surface of the projecting engaging portion 39 (see FIGS. 5 and 7).

[0038] Each receptacle contact 50 is made of the same material as each plug contact 25 and is formed in a similar manner to each plug contact 25. Each receptacle contact 50 is provided with a substantially horizontal tail portion 51, a fixed portion 52 which extends upward from the inner end of the tail portion 51 and a resilient contact portion 53 (first contact portion), which is substantially S-shaped and is continuous with the upper end of the fixed portion 52.

[0039] Each receptacle contact 50 is inserted into one contact fixing groove 42 and the associated deformation allowing groove 43 from below the receptacle insulator 36, and the fixed portion 52 is press-fitted into (fixed to) the contact fixing groove 42. Fixing the receptacle contacts 50 (the fixed portions 52) to the receptacle insulator 36 (the contact fixing grooves 42) causes the resilient contact portions 53 to be spaced from the inner surfaces of the deformation allowing grooves 43, thus allowing the resilient contact portions 53 to be resiliently deformed inside the deformation allowing grooves 43 (see FIG. 7). In addition, the tail portion 51 of each receptacle contact 50 is positioned below the lower surface of the bottom plate portion 37 (see FIGS. 1 through 3, etc.).

[0040] The shapes of the front and rear pair of shells 55 are in forward-and-rearward symmetry to each other. Each shell 55 is formed of a metal plate (conductive material) by press-forming and is provided with an outer circumferential-side shield portion 56 which extends in the leftward and rightward directions and has the same leftward/rightward length as the front wall 38a and the rear wall 38b. The outer circumferential-side shield portion 56 is provided at each of the left and right ends thereof with a fixed portion 57 which has a substantially L-shape in a plan view and is greater in width in the upward and downward directions than the outer circumferential-side shield portion 56. At the lower end of each fixed portion 57 is formed a tail portion 58 which is provided at a position lower than the position of the lower surface of the outer circumferential-side shield portion 56.

[0041] The front and rear shells 55, except the tail portions 58 of the fixed portions 57 and the outer peripheral surfaces of the outer circumferential-side shield portions 56, are embedded in the receptacle insulator 36. Specifically, the receptacle insulator 36 and each shell 55 are integrated by molding the receptacle insulator 36 with each shell 55 by insert molding. On the other hand, the outer circumferential-side shield portion 56 of the front shell 55 covers the front surface of the front wall 38a while the outer circumferential-side shield portion 56 of the rear shell 55 covers the rear surface of the rear wall 38b (the outer circumferential-side shield portions 56 of the front and rear shells 55 are in contact with the front and rear walls 38a and 38b, respectively).

[0042] An upper shield portion 38a1 (conductive-member shield portion) (second shield portion) and a lower shield portion 38a2 (conductive-member shieldportion) (first shieldportion) which project forward are formed at the upper edge and the lower edge of the front wall 38a across the length of the front wall 38a, respectively, when the receptacle insulator 36 is formed by insert molding (injection molding). Likewise, an upper shield portion 38b1 (conductive-member shield portion) (second shield portion) and a lower shield portion 38b2 (conductive-member shield portion)(first shield portion) which project rearward are formed at the upper edge and the lower edge of the rear wall 38b across the length of the rear wall 38b, respectively, when the receptacle insulator 36 is formed by insert molding (injection molding). In addition, as shown in FIGS. 3, 7 and 8, the upper shield portion 38a1 and the lower shield portion 38a2 are positioned

on (comes in contact with) the upper and lower surfaces of the outer circumferential-side shieldportion 56 of the front shell 55, respectively, and the upper shield portion 38b1 and the lower shield portion 38b2 are positioned on (comes in contact with) the upper and lower surfaces of the outer circumferential-side shield portion 56 of the rear shell 55, respectively. Additionally, the lower shield portion 38a2 is positioned immediately above the tail portions 51 of the front receptacle contacts 50 and the lower shield portion 38b2 is positioned immediately above the tail portions 51 of the rear receptacle contacts 50.

[0043] By soldering the tail portion 51 of each receptacle contact 50 to a circuit pattern (not shown) formed on the mounting surf ace of a circuit board 60 (rigid board/ first circuit board), having the shape of a plate parallel (or substantially parallel) to the circuit board 31, and by soldering the tail portions 58 to a ground pattern formed on the same mounting surface of the circuit board 60, the receptacle connector 35 that has the above described configuration is fixed (mounted) onto the circuit board 60 (see FIGS. 7 through 9) (what is called a straight (ST) connection). In addition to the receptacle connector 35, electronic components (e.g., a CPU, a controller, a memory, etc.) are mounted onto the mounting surface of the circuit board 60.

[0044] The plug connector 15 and the receptacle connector 35 that have the above described configurations are mutually connected in a manner which will be discussed hereinafter. First, as shown in FIGS. 1 and 2, the plug connector 15 and the receptacle connector 35 are made to face each other in the upward and downward directions with the positions of the plug connector 15 and the receptacle connector 35 aligned in the forward/rearward direction and the leftward and rightward directions. Subsequently, the plug connector 15 is brought down to fit the projecting fitting portion 18 into the fitting recess 40 and to fit the engaging recess 19 onto the engaging protrusion 39 (see FIGS. 7 through 9). Thereupon, the contact portion 26 of each plug contact 25 comes into contact with the resilient contact portion 53 of the associated receptacle contact 50 while resiliently deforming the resilient contact portion 53 of the associated receptacle contact 50; accordingly, electrical continuity is established between the circuit boards 31 and 60 via the plug contacts 25 and the receptacle contacts 50.

[0045] In addition, the outer circumferential-side shield portions 56 and the fixed portions 57 of the front and rear shells 55 are positioned on the outer circumferential side of each plug contact 25 and each receptacle contact 50. Accordingly, the front and rear shells 55 can prevent external noise from entering each plug contact 25 and each receptacle contact 50 and prevent noise from externally leaking from each plug contact 25 and each receptacle contact 50 (the shells 55 exhibit its shielding capability). Therefore, this makes it possible to conduct high-speed communications of (large volume of) information between the aforementioned electronic components (e.g., a module for high-performance, a semi-conductor, a large-capacity memory, etc.) which are mounted on the circuit board 31 and the aforementioned electronic components (e.g., a CPU, a controller, a memory, etc.) which are mounted on the circuit board 60.

[0046] In addition, the upper surface of the outer circumferential-side shield portion 56 is not exposed because the upper shield portions 38a1 and 38b1 are formed on the receptacle insulator 36. Accordingly, when the plug connector 15 is fitted into the receptacle connector 35, neither the plug contacts 25 nor the projecting fitting portion 18 comes into contact with the outer circumferential-side shield portion 56, so that there is no possibility of either the plug contacts 25 or the projecting fitting portion 18 being scratched or caught by the outer circumferential-side shield portion 56. Accordingly, the shells 55 exhibit its shielding capability within the connector 10, while the plug connector 15 and the receptacle connector 35 can be smoothly fitted to and engaged with each other.

[0047] Additionally, since the present embodiment of the connector 10 (the plug connector 15 and the receptacle connector 35) has a low-profile structure, upon the plug connector 15 and the receptacle connector 35 being mutually connected, the distance (distance in the upward and downward directions) between the mutually facing surfaces of the circuit boards 31 and 60 is small, the distance from the outer circumferential-side shield portion 56 of each shell 55 to the lower surface of the circuit board 31 is small, and also both the distance from the outer circumferential-side shield portion 56 of each shell 55 to the upper surface of the circuit board 60 and the distance from the outer circumferential-side shield portion 56 of each shell 55 to the tail portion 51 of each receptacle contact 50 are small. Specifically, when the distance between the mutually facing surfaces of the circuit boards 31 and 60 (the height of the connector 10 in an engaged state) is 0.6 mm and the thickness (upward and downward dimensions) of the outer circumferential-side shieldportions 56 is 0.28 mm, the distance from the outer circumferential-side shield portion 56 of each shell 55 to the lower surface of the circuit board 31 is set at 0.16 mm, the distance from the outer circumferential-side shield portion 56 of each shell 55 to the upper surface of the circuit board 60 is set at 0.16 mm, the distance between the outer circumferential-side shield portion 56 of each shell 55 and the tail portions 51 of the associated (front or rear) receptacle contacts 50 is set at 0.1 mm, and the thickness of the lower shield portion 38a2 and the thickness of the lower shield portion 38b2 is set at 0.05 mm.

[0048] Whereas, the receptacle insulator 36 is provided with the upper shield portion 38a1 and the upper shield portion 38b1, which are positioned between the circuit board 31 and the outer circumferential-side shield portions 56, and the lower shield portion 38a2 and the lower shield portion 38b2, which are positioned between the outer circumferential-side shield portions 56 and the circuit board 60 together with the tail portions 51. Therefore,

there is substantially no possibility of (electrical) short-circuiting occurring between the circuit board 31 and the outer circumferential-side shield portions 56, or between the circuit board 60 (the circuit pattern thereof) and the outer circumferential-side shield portions 56, and between the outer circumferential-side shield portions 56 and the tail portions 51 of the receptacle contacts 50 via the aforementioned solder applied to the tail portions 51 and/or minute foreign particles adhered to the mounting surfaces of the circuit boards 31 and 60 or the tail portions 51.

[0049] When the plug connector 15 and the receptacle connector 35 are mutually connected, sometimes a technician may intentionally make static electricity which has flowed to the plug connector 15 from his/her hands, etc., flow to the aforementioned ground pattern of the circuit board 60 from the outer circumferential-side shield portions 56 by bringing the plug-side metal fittings 28 of the plug connector 15 into contact with the outer circumferential-side shield portions 56. In the present embodiment, the distance from the outer circumferential-side shield portions 56 of the shells 55 to the tail portions 51 of the receptacle contacts 50 is small, as described above. However, since the receptacle insulator 36 is provied with the lower shield portions 38a2 and 38b2 that are positioned between the tail portions 51 and the outer circumferential-side shield portions 56, respectively, the possibility of static electricity that has flowed to the outer circumferential-side shield portions 56 from the plug connector 15 being discharged to the tail portions 51 from the outer circumferential-side shield portions 56 is small.

[0050] Therefore, the possibility of electronic components, etc., which are connected to the circuit board 60 (and the circuit board 31), being damaged by electrostatic discharge, when static electricity that has traveled to the outer circumferential-side shield portions 56 is discharged to the receptacle contacts 50 (and the aforementioned circuit pattern of the circuit board 60), is small.

[0051] Although the present invention has been described based on each of the above illustrated embodiments, the present invention is not limited solely to these particular embodiments; various modifications to the above illustrated embodiments are possible.

[0052] For instance, it is possible to omit the upper shield portions 38a1 and 38b1 from the receptacle insulator 36 as shown in the first modified embodiment shown in FIG 10A, and it is possible to omit the lower shield portions 38a2 and 38b2 from the receptacle insulator 36 as shown in the second modified embodiment shown in FIG 10B.

[0053] In addition, as shown in the third modified embodiment shown in FIG. 11, each shell 55' can be formed as two members: split-shells 55A and 55B that are split in the leftward and rightward directions (or formed of more than two members). Additionally, though not shown in the drawings, each shell 55 can be formed of a plurality of members which are separated in the upward and downward directions.

[0054] Furthermore, one of the front and rear shells 55 (55') can be omitted.

[0055] Furthermore, the outer circumferential-side shield portions 56 can be embedded in the receptacle insulator 36.

[0056] In addition, it is possible to provide the plug insulator 16 (first insulator) of the plug connector 15 (first connector) with shells (conductive members) and to not provide the receptacle insulator 36 (second insulator) of the receptacle connector 35 (second connector) with shells (conductive members) (in this modified embodiment, the circuit board 31, the circuit board 60, each upper shield portion 38a1 and each lower shieldportion 38a2 correspond to the "first circuit board", the "second circuit board", the "first shield portion" and the "second shield portion", respectively). In this case, it is desirable to provide the plug insulator 16 with an outer peripheral wall which is positioned on the outer circumferential side of the projecting fitting portion 18, to make the width of this outer peripheral wall (between the front and rear surfaces thereof) in the forward and rearward directions greater than the width of the receptacle insulator 36, to fit the outer peripheral wall 38 (which corresponds to the projecting fitting portion mentioned in the claims) of the receptacle insulator 36 into the fitting recess formed on the plug insulator 16 between the projecting fitting portion 18 and the aforementioned outer peripheral wall, and to position the shells provided on the plug insulator 16 on the outer circumferential side of the plug contacts 25 (first contacts) and the receptacle contacts 50 (second contacts). In other words, it is essential to have the plug contacts 25 and the receptacle contacts 50 surrounded by the shells (to position the plug contacts 25 and the receptacle contacts 50 on the inside of the shells) in an engaged state between the plug connector 15 and the receptacle connector 35 (in which the contact portions 26 that are provided as the first contact portions are in contact with the resilient contact portions 53 that are provided as the second contact portions) .

[0057] Additionally, the base material of each shell can be made of resin, and the surface of this base material (resin) can be plated or coated with a conductive material.

[0058] Additionally, one of the plug connector 15 and the receptacle connector 35 can be connected, using a right angle (RA) connection, to the associated circuit board. In this case, the shells are positioned on the outer circumferential side of the other of the plug connector 15 and the receptacle connector 35 (which is connected, using a straight (ST) connection, to the associated circuit board), while these shells and the circuit board on the said other connector side are brought close to each other in the board thickness direction of the said other circuit board.

[0059] Additionally, the first circuit board and the second circuit board that are not rigid boards (e.g., made as FPCs (flexible printed circuit boards) can be connected to the plug connector 15 and the receptacle connector 35.

INDUSTRIAL APPLICABILITY

[0060] The connector according to the present invention can effectively reduce the possibility of short-circuiting and electrical discharge occurring between the conductive member and the circuit board and/or between the conductive member and the contacts upon the first connector and the second connector being mutually connected, even when the entire connector is made low in profile.

REFERENCE SIGN LIST

[0061]

10 Connector
15 Plug connector (First connector)(Second connector)
16 Plug insulator (First insulator)(Second insulator)
17 Top plate portion
18 Projecting fitting portion
19 Engaging recess
21 Contact fixing groove
22 Metal fitting member fixing recess
25 Plug contact (First contact)(Second contact)
26 Contact portion (First contact portion)(Second contact portion)
27 Tail portion
28 Metal fitting
29 Tail portion
31 Circuit board (Second circuit board)(First circuit board)
35 Receptacle connector (First connector)(Second connector)
36 Receptacle insulator (First insulator)(Second insulator)
37 Bottom plate portion
38 Outer peripheral wall
38a Front wall
38a1 Upper shield portion (Conductive-member shield portion)(First shield portion)(Second shield portion)
38a2 Lower shield portion (Conductive-member shield portion)(First shield portion)(Second shield portion)
38b Rear wall
38b1 Upper shield portion (Conductive-member shield portion)(First shield portion)(Second shield portion)
38b2 Lower shield portion (Conductive-member shield portion)(First shield portion)(Second shield portion)
39 Projecting engaging portion
40 Fitting recess
42 Contact fixing groove
43 Deformation allowing groove
50 Receptacle contact (First contact)(Second contact)
51 Tail portion
52 Fixed portion
53 Resilient contact portion (First contact portion)(Second contact portion)
55 55' Shell (Conductive member)
55A 55B Split-shell
56 Outer circumferential-side shield portion
57 Fixed portion
58 Tail portion
60 Circuit board (First circuit board) (Second circuit board)

Claims

1. A connector comprising:

a first connector including a first insulator which has an annular outer peripheral wall and a fitting recess formed inside said outer peripheral wall, a plurality of first contacts which are supported by said first insulator and each have a first contact portion that is positioned in said fitting recess and a tail portion that is mountable to a circuit pattern of said first circuit board, and a conductive member supported by said first insulator; and
a second connector including a second insulator which has an annular pro jecting fitting port ion capable of being fitted into said fitting recess, and a plurality of second contacts which are supported by said second insulator, are mountable to a circuit pattern of said second circuit board and each have a second contact portion which comes in contact with said first contact portion when said projecting fitting portion is fitted into said fitting recess,

wherein said conductive member is positioned between said first circuit board and said second circuit board when said first contacts and said second contacts are mounted to said circuit pattern of said first circuit board and said circuit pattern of said second circuit board, respectively, and
wherein said outer peripheral wall includes a conductive-member shield portion which is positioned between said conductive member and said first circuit board together with said tail portion and/or between said second circuit board and said conductive member.

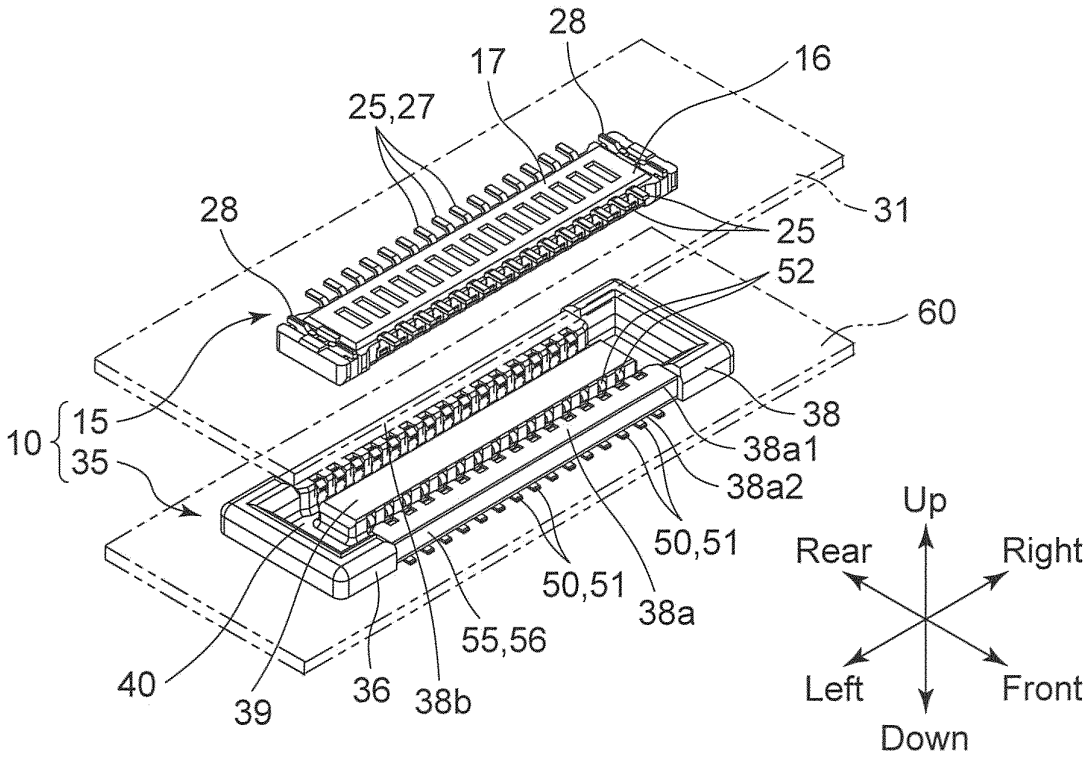
2. The connector according to claim 1, wherein said conductive-member shield portion comprises:

a first shield portion positioned between said conductive member and said first circuit board together with said tail portion; and
a second shield portion positioned between said

second circuit board and said conductive member.

3. The connector according to claim 1 or 2, wherein said conductive member comprises an outer peripheral-side shield member which covers an outer peripheral surface of said outer peripheral wall.

Fig. 1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38
38a1
38a2
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50,51
38a
55,56
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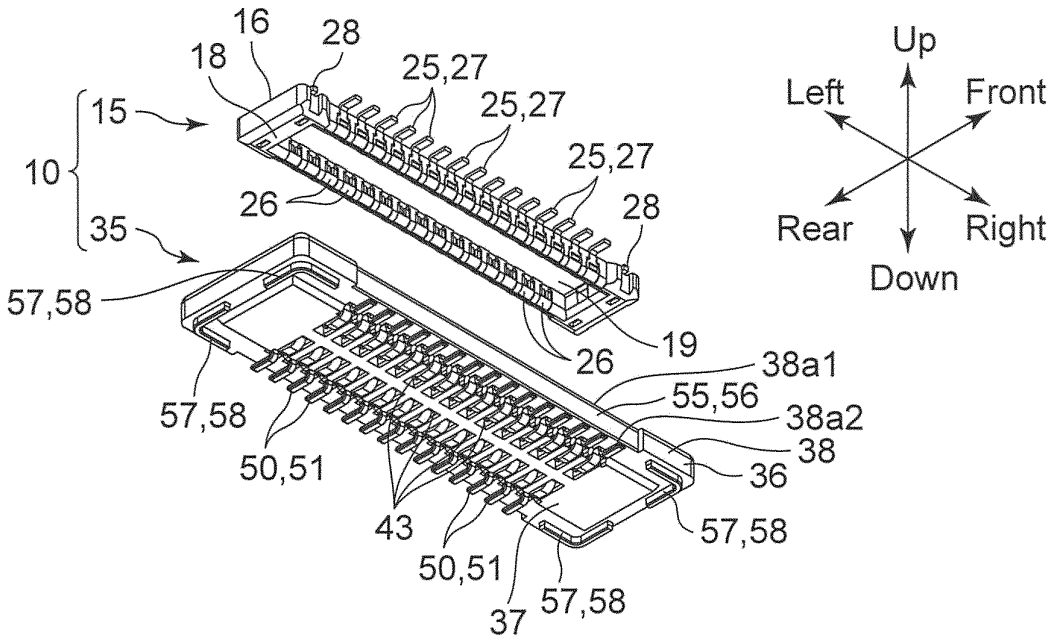
39
36
38b
Up
Rear
Right
Left
Front
Down

Fig. 2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38a2
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50,51
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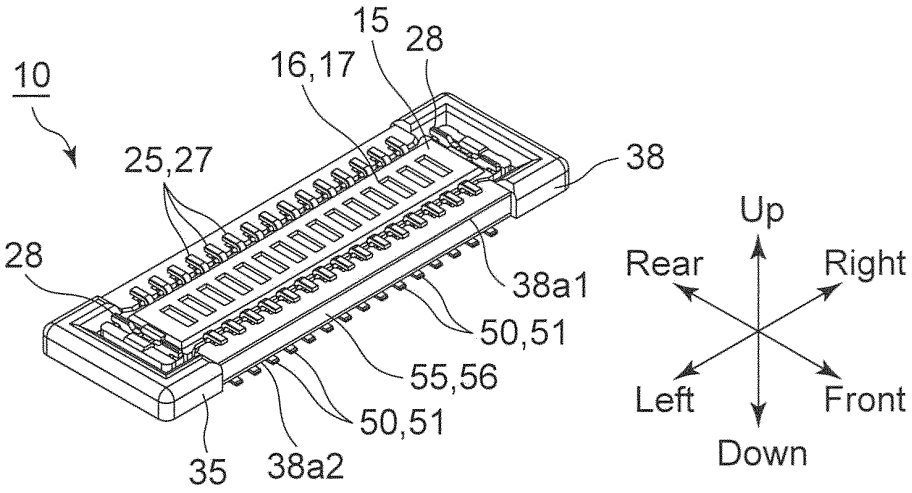
Up
Left
Front
Rear
Right
Down

Fig. 3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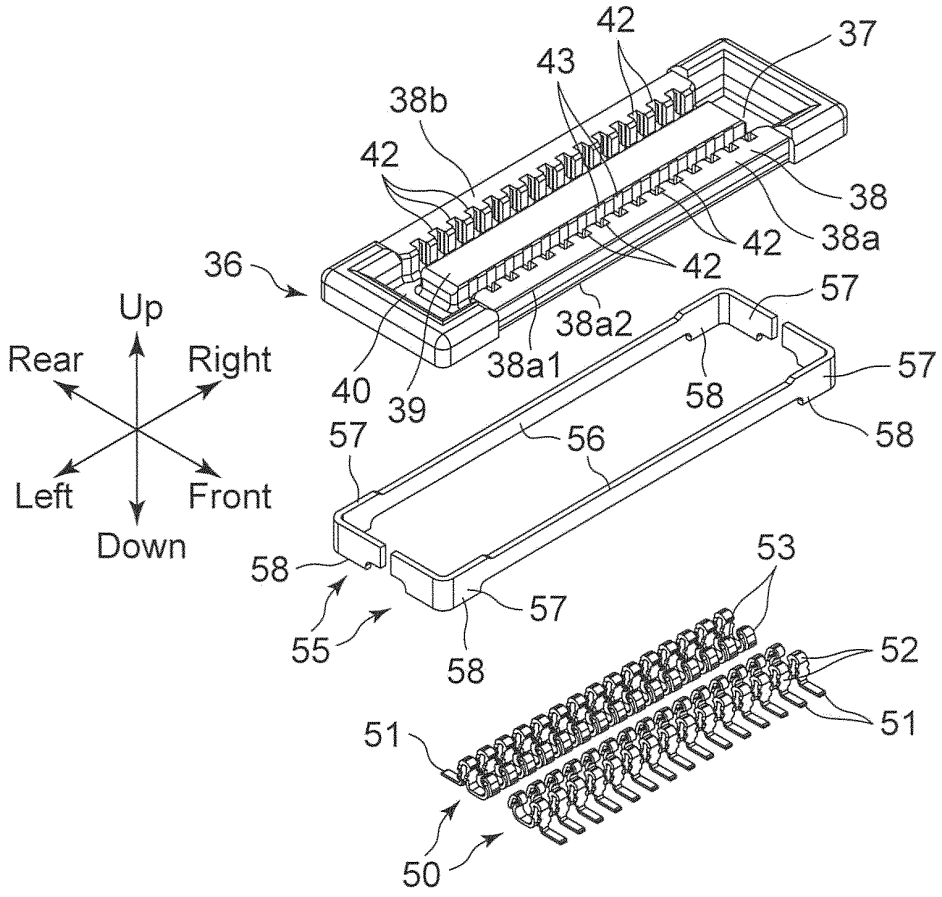
38a2
Up
Rear
Right
Left
Front
Down

Fig. 4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38b
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38a
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38a2
38a1
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Rear
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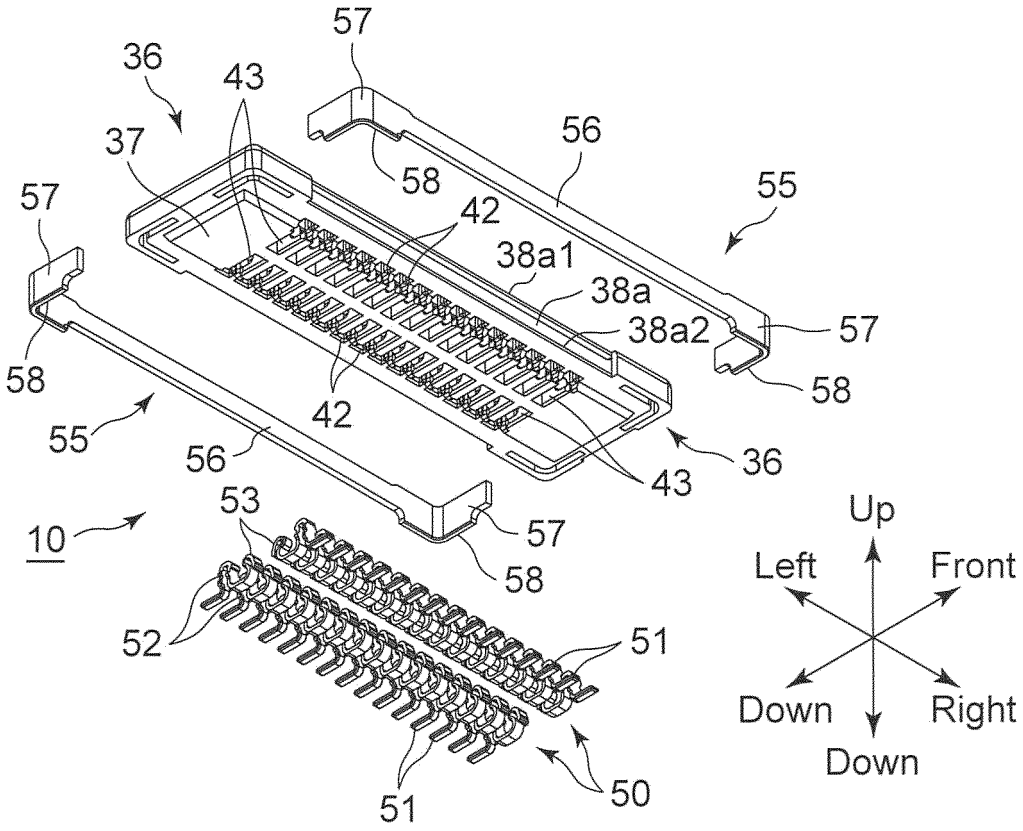
Left
Front
Down

Fig. 5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38a1
38a
38a2
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51
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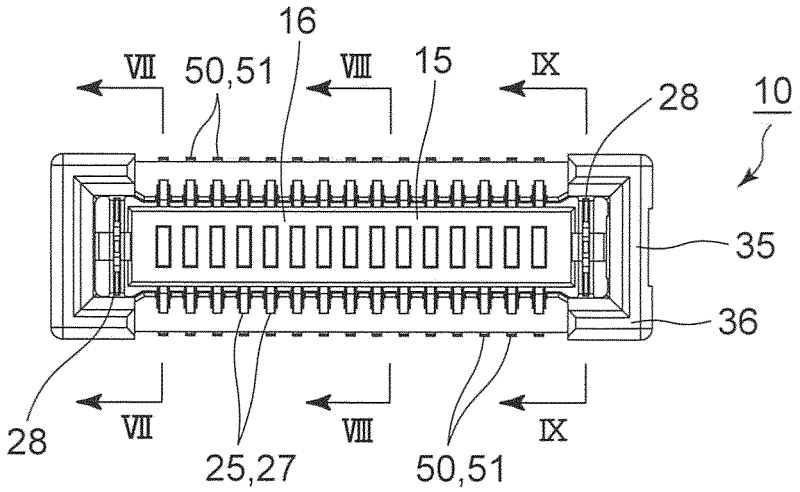
Up
Left
Front
Down
Right
Down

Fig. 6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VIII
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IX
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VIII
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IX

Fig. 7

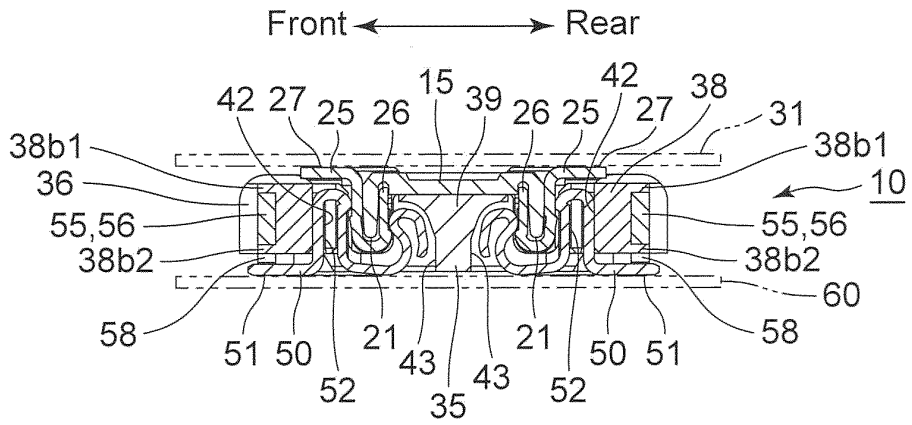


Fig. 8

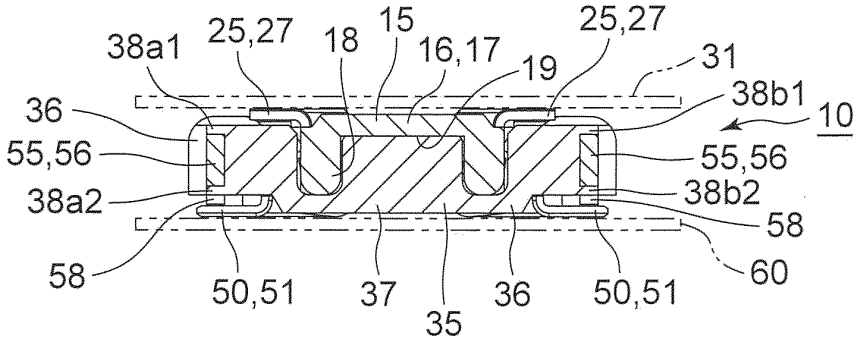


Fig. 9

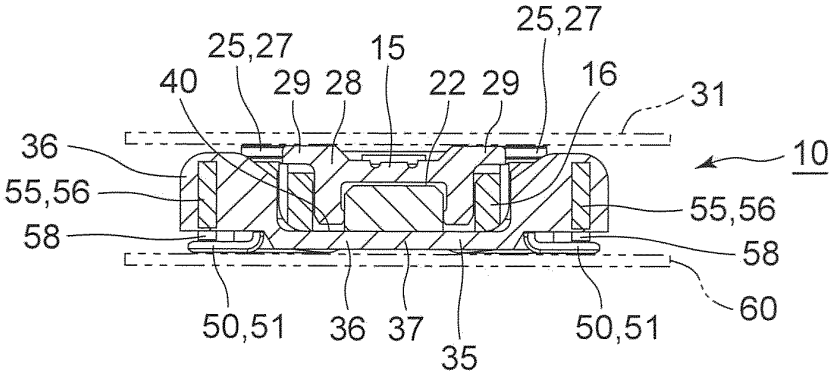


Fig. 10A

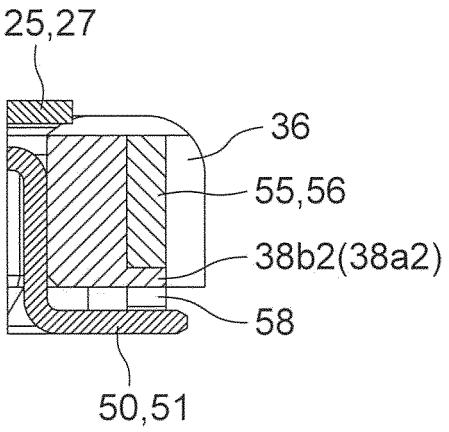


Fig. 10B

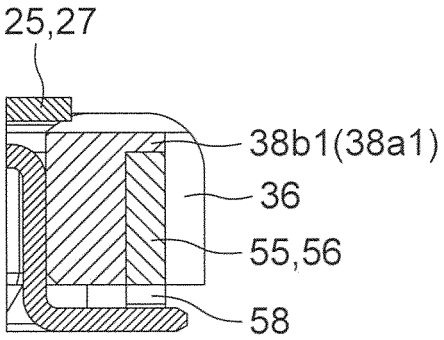
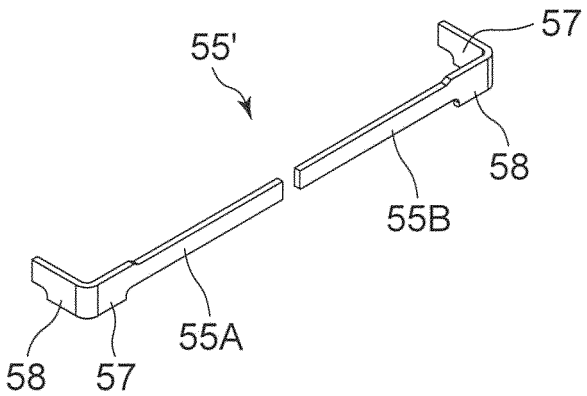


Fig. 11



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2014/070462

A. CLASSIFICATION OF SUBJECT MATTER
H01R12/73(2011.01)i, *H01R13/6594*(2011.01)i

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)
H01R12/73, H01R13/6594

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2014
Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2012-252785 A (Japan Aviation Electronics Industry Ltd.), 20 December 2012 (20.12.2012), paragraphs [0026] to [0034], [0041] to [0050], [0069]; fig. 1 to 9 (Family: none)	1,3
Y	JP 2008-108560 A (Iriso Electronics Co., Ltd.), 08 May 2008 (08.05.2008), paragraphs [0013] to [0021], [0023] to [0025], [0028]; fig. 1, 3, 6, 9 & WO 2008/050666 A1 & TW 200832830 A	1-3

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
16 September, 2014 (16.09.14)	21 October, 2014 (21.10.14)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2014/070462

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2005-071769 A (Japan Aviation Electronics Industry Ltd.), 17 March 2005 (17.03.2005), paragraphs [0022] to [0029], [0034] to [0043]; fig. 1, 3, 7, 11 (Family: none)	1-3
A	JP 2007-258001 A (Hirose Electric Co., Ltd.), 04 October 2007 (04.10.2007), paragraph [0022]; fig. 1 (Family: none)	1-3
A	JP 2013-140755 A (J.S.T. Mfg. Co., Ltd.), 18 July 2013 (18.07.2013), paragraphs [0032] to [0052]; fig. 2, 7 (Family: none)	1-3

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2013140755 A **[0010]**