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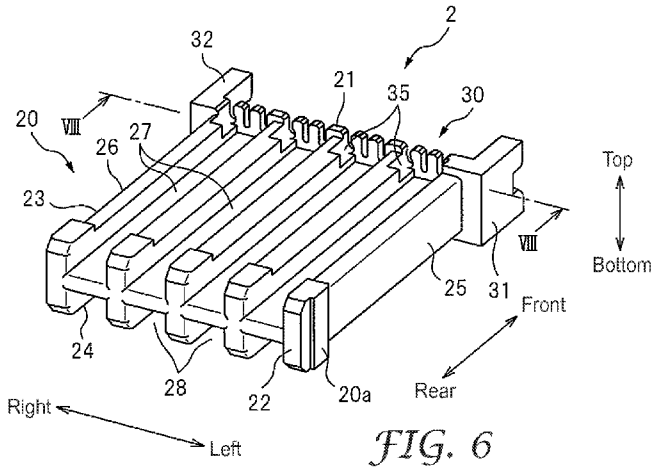

FIG. 6

(57) **Abstract**: A cable organizer (2) includes a front end (21) and a rear end (22), a top surface (23) and a bottom surface (24), a front wall (30) provided extending along the front end (21), first and second shoulder portions (31, 32) provided extending forward from both left and right end portions of the front wall (30), and a plurality of first groove portions (27) formed in the top surface (23) from the rear end (22) to the front wall (30). Each of the first groove portions (27) extends to a plurality of second groove portions (33, 34) formed in the front wall (30). Furthermore, the first groove portions (27) are capable of receiving a plurality of electrical wires (11, 13). The configuration is such that when a substrate (4) is engaged with the front wall (30) and a plurality of electrical wires (11, 13) is received by the first groove portions (27), the respective electrical wires (11, 13) pass through mutually different second groove portions (33, 34) among the plurality of second groove portions (33, 34), and extend to electrical wire connection portions (47a, 47b, 48) provided on the top surface of the substrate (4) so as to correspond to each of the plurality of electrical wires (11, 13).

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CABLE ORGANIZER AND CABLE ASSEMBLY

FIELD OF INVENTION

The present invention relates to a cable organizer used in a cable connector having a plurality of electrical wires for signal conductors and ground conductors, and a cable assembly.

BACKGROUND ART

In recent years, in conjunction with the popularization of miniaturized electrical devices having large capacity storage devices, there has been a rise in the demand for cable connectors which have a large number of electrical wires for signal conductors and ground conductors, and which are capable of high speed transmission. Given there is the desire to miniaturize this kind of cable connector, it becomes necessary to densely conductively connect signal conductors and ground conductors.

For example, Patent Document 1 discloses a cable connector having an organizer panel in which a signal conductor receiving hole through which a plurality of signal conductors pass and a ground conductor receiving hole through which a ground conductor passes are opened at different heights; and whereby the signal conductors and the ground conductor are positioned, and a conductive connection to a substrate is provided.

PRIOR ART DOCUMENTS

Patent Documents

Patent Document 1: Japanese Unexamined Patent Application Publication No. 2009-76375

SUMMARY OF THE INVENTION

Problem to be Solved by the Invention

However, in the cable connector disclosed in the above mentioned Patent Document 1, the signal conductor receiving hole and the ground conductor receiving hole are opened at different heights in the organizer panel; thus increasing the height of the organizer panel and it tends to be difficult to reduce the size of the cable connector.

An object of the present invention is to provide a cable organizer and a cable assembly by which the size of the cable connector can be easily reduced.

Means to Solve the Problem

One aspect of the present invention is a cable organizer including a front end and a rear end opposite thereto; a top surface and a bottom surface opposite thereto; a front wall provided extending along the front end, and that engages with the rear end of a substrate; first and second shoulder portions provided extending forward from both left and right end portions of the front wall and that engage, respectively, with both left and right side surfaces on the rear end portion of the substrate; and a plurality of first groove portions formed in the top surface from the rear end to the front wall, and each of said plurality of first groove portions extending to a plurality of second groove portions formed in the front

wall so as to correspond to each of the plurality of first groove portions. In such a cable organizer, each of the first groove portions can receive a plurality of electrical wires; and when the substrate engages with the front wall and said first groove portions receive the plurality of electrical wires, each of said plurality of electrical wires passes through mutually different second groove portions among the plurality of second groove portions, and extends to electrical wire connection portions provided on the top surface of the substrate so as to correspond to the plurality of electrical wires.

Further, another aspect of the invention is a cable assembly having the above mentioned cable organizer, a substrate engaging the front wall of the cable organizer; and a plurality of signal conductors and a ground conductor which are received by each of the plurality of first groove portions of the cable organizer.

EFFECT OF THE INVENTION

According to the present invention, providing a plurality of first groove portions capable of receiving a plurality of electrical wires and a plurality of second groove portions formed in a front wall and which corresponds to the first groove portions in the cable organizer allows a plurality of electrical wires to be arranged in a line in a left to right direction, and facilitates miniaturization of the cable connector.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a perspective view illustrating an entire configuration of a cable assembly according to an embodiment of the present invention.

FIG. 2 is a partial exploded perspective view of the cable assembly in FIG. 1.

FIG. 3A is a top view of the cable assembly in FIG. 1.

FIG. 3B is a side view of the cable assembly in FIG. 1.

FIG. 3C is a bottom view of the cable assembly in FIG. 1.

FIG. 4 is a cross-sectional view along the line IV-IV in FIG. 1 illustrating an internal configuration of a cable.

FIG. 5 is a cross-sectional view illustrating the internal configuration of an individual cable in FIG. 4.

FIG. 6 is a perspective view illustrating a configuration of a cable organizer according to an embodiment of the present invention.

FIG. 7 is a perspective view illustrating the configuration of a cable organizer according to the embodiment of the present invention.

FIG. 8 is a partial cross-sectional view along the line VIII-VIII in FIG. 6.

FIG. 9 is a perspective view of a modified example for the cable assembly in FIG. 1.

FIG. 10 is a perspective view of a configuration of an insulation block in FIG. 9.

FIG. 11 is a perspective view of another modified example for the cable assembly in FIG. 1.

FIG. 12 is cross-sectional view exemplifying the main components in the cable organizer when adapted for use with another type of individual cable.

DETAILED DESCRIPTION OF THE INVENTION

Embodiments of the present invention will be explained below with reference to FIGS. 1 to 12. FIG. 1 is a perspective view illustrating an entire configuration of a cable assembly 100 according to an embodiment of the present invention. FIG. 2 is a partial exploded perspective view of the cable assembly 100 in FIG. 1 (a substrate). The surrounding of the cable assembly 100 is covered by a shell (not illustrated) constituted by, for example, a conductive material such as metal to configure a small cable connector (for example, an external mini-SAS connector) capable of high-speed transmission. This kind of cable connector contains multiple large diameter signal conductors and ground conductors that are suitable for high speed transmission (for example, AWG#28, AWG#26, and AWG#24). Therefore, it is desirable that the signal conductors and ground conductor are densely arranged (densified) in the cable assembly 100.

Hereinafter, as illustrated in the drawings, a length direction, a width direction, and a height direction of the cable assembly 100 are respectively defined as a front rear direction, a left right direction, and a top bottom direction. The configuration of each component will be explained in accordance with this definition. These directions are merely for providing an easily understandable explanation as a matter of convenience, and are not meant as a limitation of the actual direction. The front rear direction corresponds to a direction in which the cable connector is inserted and removed. FIG. 1 is a view of the cable assembly 100 when viewed diagonally from above; and FIG. 2 is a view of the cable assembly 100 when viewed diagonally from below.

As illustrated in FIGS. 1 and 2, the cable assembly 100 includes a cable 1 having a plurality of individual cables 10 (here eight); a cable organizer 2 that arranges the plurality of individual cables 10; and a substrate 4 to which each of the individual cables 10 is electrically connected. In addition, here the configuration of the individual cables 10 is mutually identical; however the configuration may also be non-identical.

FIG. 3A to FIG. 3C are respectively a top view, a side view, and a bottom view of the cable assembly 100. As illustrated in FIG. 3A to FIG. 3C, the individual cables 10 pass through the cable organizer 2 to be separated and arranged into top and bottom rows. That is, four individual cables 10 on an upper side of the cable organizer 2 (hereinafter referred to as a top cable group 101) and four individual cables 10 on a lower side of the cable organizer 2 are respectively arranged in a line in the left right direction (hereinafter referred to as a bottom cable group 102).

FIG. 4 is a cross-sectional view along the line IV-IV in FIG. 1 illustrating an internal configuration of the cable 1. As illustrated in FIG. 4, a ring shaped external shielding layer 6 is disposed on an inner side of a ring shaped outer skin layer 5 in the cable 1 with a plurality of individual cables 10 (here eight) further arranged in a circumferential direction on an inner side of the external shielding layer 6. An inclusion 7 is disposed between the external shielding layer 6 and the individual cables 10 and fills in the gaps between the individual cables 10, 10.

For example, polyvinyl chloride (PVC) may be used as a component material for the outer skin layer 5. Furthermore, olefin materials, or an insulating braided sleeve may also be used. The external shielding layer 6 is a layer constituted by a conductive material and acts as an electrical shielding. Therefore, for example, a combination of material braided with tin-plated annealed copper wire, and a

polyester film with aluminum pasted thereon may be used as the component material for the shielding layer. Moreover, either of these materials may be used, or, for example, a polyester film with copper pasted thereon, or copper foil may also be used. Further, for example, jute, paper, yarn or plastic made string may be used as the component material for the inclusion 7. Moreover, a binder may be provided on the inner side of the external shielding layer 6 to wrap around the inclusion 7.

As preprocessing, at a tip end portion of the cable 1, the outer skin layer 5 and the external shielding layer 6 are peeled off to expose the external shielding layer 6 from the outer skin layer 5 and expose the eight individual cables 10 from the external shielding layer 6. Among the plurality of individual cables 10, the upper four individual cables 10 constitute the top cable group 101, and the lower four individual cables 10 constitute the bottom cable group 102.

FIG. 5 is a cross-sectional view illustrating an example of an internal configuration of the individual cable 10. As illustrated in FIG. 5, the individual cable 10 has a pair of signal wires 15 respectively constituted by a pair of signal conductors 11 and a pair of insulating bodies 12 that covers the circumference of each of the signal conductors 11; a single strand of a ground conductor 13, and an inner shielding 14 that wraps around all of the insulating bodies 12 and the ground conductor 13. Furthermore, the signal conductor 11 has an outer diameter that is suitable for high-speed transmission (for example, a diameter of approximately 0.3 mm). This outer diameter is substantially equal to the outer diameter of the ground conductor 13.

The ground conductor 13 is disposed to be in contact with the outer peripheral surface of the pair of insulating bodies 12 as well as the inner peripheral surface of the inner shielding 14. The positional relationship between the signal conductor 11 and the ground conductor 13 in each of the individual cables 10 is mutually equivalent. That is, in either of the top cable group 101 and the bottom cable group 102, the ground conductor 13 in each of the individual cables 10 is respectively at the middle in the left right direction of the pair of signal conductors 11, and positioned above the pair of signal conductors 11.

As the component materials for the signal conductor 11, for example, tin plated annealed copper wire may be used. Furthermore, an annealed copper wire with no plating or a copper alloy may also be used; and the tin plating may be replaced with silver plating. Additionally, a material that is plated aluminum or iron may also be used. The signal conductor 11 may be twisted or may be a single wire. Further, for example, olefins such as polyethylene, or polypropylene may be used as the component materials for the insulator 12. Fluorine materials such as polytetrafluoroethylene (PTFE), ethylene tetrafluoroethylene copolymer (ETFE), fluorinated ethylene propylene (FEP), or perfluoroalkoxy copolymer (PFA) may also be used. The goal is to use a material having a low dielectric constant or dielectric loss. The insulator 12 may be a foamed material with an insulating filler kneaded therein.

To facilitate extraction of the ground wire, the ground conductor 13 is a metal wire that runs longitudinally along the length direction of the cable 10, which may have as the component material, for example, a tin-plated annealed copper wire. The inner shielding 14 is a laminate which integrates a metal layer which is electrically connected to the ground conductor 13, and an insulating skin coating layer outward of the metal layer. For example, a copper foil laminated with PET film, or an aluminum deposited PET film may be used as the component material. Moreover, a metal layer composed of

copper foil, and an insulating skin coating layer composed of PET film may be provided independently. Furthermore, PVC may be used in place of the PET film.

As preprocessing, at the tip end portion of each of the individual cables 10, the inner shielding 14 and insulator 12 are peeled off to expose the insulator 12 and the ground conductor 13 from the inner shielding 14, and exposing the signal conductor 11 from the insulator 12. Herewith and as illustrated in FIG. 2, a plurality of signal conductors 11 and ground conductors 13 protrude forward from the front surface of the cable organizer 2. At this time, the protrusion length is adjusted so that the tip end portions of the ground conductors 13 are positioned further forward than the tip end portions of the signal conductors 11. With the ground conductor 13 protruding forward, an insulating tube 16 is installed on the ground conductor 13 to insulate the ground conductor 13 from the signal conductor 11 forward of a front wall 30.

The cable organizer 2 regulates positions in the front rear direction and left right direction of the signal conductor 11 and the ground conductor 13. FIG. 6 and FIG. 7 are each perspective views of a configuration of the cable organizer 2 alone. As illustrated in FIGS. 6 and 7, the cable organizer 2 has a front end 21 and a rear end 22, a top surface 23 and a bottom surface 24, and left and right side surfaces 25, 26. The cable organizer 2 includes a cable receiving portion 20 having a substantially rectangular shape as a whole, and a front wall 30 provided extending along the front end 21 in the left right direction. For example, the cable organizer 2 may be formed integrally via resin molding and shaped to be symmetrical in the top bottom direction with an electrically insulating resin as the component material. Moreover, it is preferable that the cable organizer 2 be made from a heat resisting resin.

The front wall 30 protrudes further outward in the left right direction than the left and right side surfaces 25, 26 of the cable receiving portion 20, and protrudes further outward in the top bottom direction than the top and bottom surfaces 23, 24 of the cable receiving portion 20. On the front surface of the front wall 30, a pair of shoulder portions 31, 32 are provided extending forward from both left and right end portions. Recesses 31a, 32a are formed respectively in the front rear direction on the left and right inside surfaces at the center in the top bottom direction of the shoulder portions 31, 32. And a recess 30a is formed in the front surface at the center in the top bottom direction of the front wall 30 spanning the recesses 31a to 32a and extending the entire left right direction. The recesses 30a to 32a are made to join together with the rear end portion of the substrate 4.

On the top and bottom surfaces 23, 24 of the cable receiving portion 20, slot shaped first groove portions 27, 28 respectively corresponding to the number of individual cables 10 (here four) are provided extending in the front rear direction from the rear end 22 to the front wall 30. The plurality of first groove portions 27, 28 extends in the left right direction with equal intervals. A width of the first groove portions 27, 28 is substantially equal to the left right direction length of an individual cable 10 while a depth is substantially equal to the top bottom direction length of an individual cable 10. The first groove portions 27, 28 respectively receive the individual cables 10 in the top cable group 101 and the bottom cable group 102.

In the rear end portion of the cable receiving portion 20, a protrusion 20a that protrudes in the top bottom direction and the left right direction is provided. As illustrated in FIG. 3B, the height of the top and bottom end surfaces of the protrusion 20a is substantially equal to the height of the top and

bottom end surfaces of the front wall 30 and the shoulder portions 31, 32. Additionally a recess 20b is formed in the cable receiving portion 20 between the protrusion 20a, and the front wall 30 and shoulder portions 31, 32. After the first groove portions 27, 28 each receive the individual cables 10, an insulating tape (not illustrated) is wound around the entire periphery of the recess 20b to fix the individual cables 10. Providing the recess 20b prevents the insulating tape from protruding from the top and bottom end surfaces and the left and right side surfaces of the cable organizer 2. Further, this regulates the position for attaching the insulating tape, facilitating the attachment of the insulating tape.

As shown in FIG. 7, a pair of grooves 33 (referred to as signal conductor grooves) for receiving a pair of signal conductors 11, and a groove 34 (referred to as a ground conductor groove) for receiving a ground conductor 13 are respectively provided in the front wall 30 on the front surface of the cable receiving portion 20, passing completely through the front wall 30 in the front rear direction. The grooves 33, 34 are formed from a top edge 30b or a bottom edge 30c of the front wall 30 in the top bottom direction, and depths of the groove 33 and the groove 34 in the top bottom direction are mutually identical. Further, the grooves 33, 34 are provided to correspond with each of the first groove portions 27, 28 and constitute a second groove portion.

The pair of signal conductor grooves 33 is provided to coincide with the position of the signal conductor 11 in the individual cable 10 received by the first groove portions 27, 28. That is, the pair of signal conductor grooves 33 is located at the extension of the pair of signal conductors 11, and juxtaposed in the left right direction. The width of the signal conductor groove 33 is substantially equal to the width of the signal conductor 11, and is such that is possible to insert the signal conductor 11, from above or below the first groove portions 27, 28 to the bottom portion of the groove 33 without folding or bending the signal conductor 11.

In contrast, the ground conductor groove 34 is provided on the left and right side (in this case the right side) of the pair of signal conductor grooves 33. A bulging portion 34a, bulging toward the right side, is formed on an inlet side of each of the ground conductor groove 34 (the top and bottom edge 30b, 30c side) such that the width on the inlet side is less than the width on the inner side of the groove 34. The bottom portion of the groove 34 is an arc shape that has substantially the same shape as the insulating tube 16 (refer to FIG. 1) installed on the ground conductor 13. Further, the insulating tube 16 pushed into further inner side of the groove 34 than the bulging portion 34a while allowing the insulating tube 16 to elastically deform in a radial direction. When the insulating tube 16 is pushed into the inner side of the groove 34, the bulging portion 34a constrains the positioning of the insulating tube 16 in the top bottom direction and functions to keep the ground conductor 13 from slipping out of the groove.

As illustrated in FIG. 5, the ground conductor 13 of the individual cable 10 is positioned at the center in the left right direction and above the left and right signal conductors 11. Therefore, in the state where the individual cable 10 is received by the first groove portion 27, the position in the left right direction of the ground conductor 13 and the ground conductor groove 34 differs; namely, the ground conductor groove 34 is positioned further right side than the ground conductor 13. In this embodiment, the cable receiving portion 20 is configured as follows to facilitate insertion of such a ground conductor 13 into the ground conductor groove 34.

FIG. 8 is a partial cross-sectional view along the line VIII-VIII in FIG. 6 illustrating a

configuration of the front end portion of the cable receiving portion 20. For reference, in a portion of FIG. 8, a signal wire 15 (signal conductor 11 and insulator 12), the ground conductor 13, and the insulating tube 16 arranged in the cable organizer 2 are respectively indicated by solid lines.

As illustrated in FIG. 3A, FIG. 6, and FIG. 8, guide grooves 35 are respectively provided on the top surface 23 of the cable receiving portion 20 rearward of each of the ground conductor grooves 34. The depth of the guide grooves 35 is less than the first groove portion 27 and the left side surface spans to the front end portion of the first groove portion 27; and the first groove portion 27 and the ground conductor groove 34 are linked by way of the guide groove 35. Herewith, at the front end portion of the cable receiving portion 20, a ground conductor 13 in the top cable group 101 is bent to the right and then forward along the guide groove 35. Thereby the ground conductor 13 passes above the insulator 12 on the right side, and is guided to the ground conductor groove 34 while maintaining its insulation from the signal conductor 11; thereby facilitating the insertion of the ground conductor 13 into the ground conductor groove 34 on the top surface side of the cable organizer 2.

Whereas, as illustrated in FIG. 3C and FIG. 8, guide grooves 36 are respectively provided on the bottom surface 24 of the cable receiving portion 20 rearward of each of the ground conductor grooves 34. The guide groove 36 is deeper than the first groove portion 28 and formed extending to the vicinity of the left side signal conductor groove 33. The first groove portion 28 and ground conductor groove 34 are linked by way of the guide groove 36. Herewith, at the front end portion of the cable receiving portion 20, a ground conductor 13 in the bottom cable group 102 is bent to the right and downward and then forward along the guide groove 35. Thereby the ground conductor 13 passes above the insulator 12 on the right side (between the insulator 12 and the cable organizer 2), and is guided to the ground conductor groove 34 while maintaining its insulation from the signal conductor 11; thereby facilitating the insertion of the ground conductor 13 into the ground conductor groove 34 on the bottom surface side of the cable organizer 2.

Next the configuration of the substrate 4 will be explained. As illustrated in FIG. 3A to FIG. 3C, the substrate 4 is a substantially square, flat printed circuit board including a top surface 41 and a bottom surface 42. As illustrated in FIG. 2, in the rear end portion 43 of the substrate 4, an insertion portion 44 that corresponds to the recesses 30a to 32a of the cable organizer 2 is provided. As illustrated in FIG. 1, the insertion portion 44 is inserted into the recesses 30a to 32a. The left and right side surfaces and rear end surface of the insertion portion 44 abuts with the bottom portion of the recesses 30a to 32a, to thereby regulate the position of the substrate 4 with respect to the cable organizer 2.

As illustrated in FIG. 3A and FIG. 3C, the substrate 4 includes a plurality of conductive interconnections 45 (partially omitted) formed in a specific pattern on respectively the top surface 41 and the bottom surface 42 thereof. Further, a plurality of pads 46 (referred to as connector pads) is formed at equal intervals in the left right direction on the front end portion of the interconnections 45; the pads become the contact points for the connectors on the component that will receive the cable. Four sets of left-right pair of pads 47a, 47b (respectively referred to as a signal conductor pad; and with the top and bottom together, eight sets) are formed at equal intervals in the left right direction on the rear end portion of the interconnection 45. The pads 47a, 47b correspond to the positions of the signal conductors 11 protruding from the front wall 30, and are the contact points for the signal conductor 11. The signal

conductor pads 47a, 47b are respectively connected to the connector pad 46 via the left-right pair of interconnections 45a, 45b.

There are respectively four sets of interconnections 45a, 45b on the top and bottom surfaces 41, 42 and the interval between each set of interconnections 45a, 45b in the left right direction is reduced in front of the signal conductor pad 47a, 47b. Thereby increasing the opening in the left right direction between a first set of interconnections 45a, 45b and a second set of interconnections 45a, 45b adjacent thereto. The positions of the ground conductors 13 protruding from the front wall 30 are made to correspond these openings where, pads 48 (referred to as a ground conductor pad) are formed. The pads 48 are the contact point with the ground conductor 13. Disposing a ground conductor pad 48 in front of the signal conductor pad 47a, 47b allows a ground conductor pad 48 of a satisfactory size to be formed in the limited space on the substrate 4, and facilitates the soldering of the ground conductor 13. Finally, the signal conductor pads 47a, 47b and the ground conductor pad 48 respectively constitute a signal conductor connection portion and a ground conductor connection portion.

Next, an example of the procedure for assembling a cable assembly 100 will be explained. First, the first groove portions 27, 28 in the cable organizer 2 receive the plurality of individual cables 10 constituting the top cable group 101 and the bottom cable group 102 while the ground conductor 13 and the signal conductor 11 of the individual cables 10 are exposed. With the plurality of individual cables 10 received by the first groove portions 27, 28, the front end surface of the insulator 12 surrounding the signal conductors 11 is made to abut with the rear end surface of the front wall 30. This regulates the position in the front rear direction of the individual cables 10 with respect to the cable organizer 2 and inserts the left-right pair of signal conductors 11 respectively into the left-right pair of signal conductor grooves 33. As illustrated in FIG. 2, the signal conductors 11 protrude from the front wall 30.

At this time, the ground conductors 13 in the top cable group 101 are folded upward once to install an insulating tube 16 on the ground conductor 13. Further, as illustrated in FIG. 8, the ground conductors 13 are bent to the right, passed above the insulator 12 on the right side and guided to the guide grooves 35. The insulating tubes 16 and the ground conductors 13 are bent forward, and the insulating tubes 16 is pushed into the inner part of the bulging portion 34a in the ground conductor groove 34. Herewith, as illustrated in FIG. 2, the ground conductors 13 in the top cable group 101 protrude from the front wall 30.

Whereas, when the individual cables 10 are being received by the first groove portion 28, the ground conductors 13 in the bottom cable group 102 are bent to the left and downward. Herewith, the ground conductors 13 pass above and to the right side of the insulator 12 on the right side along the guide grooves 36, and protrude downward. In this state, the insulating tubes 16 are installed on the ground conductor 13. Furthermore, the insulating tubes 16 and the ground conductors 13 are bent forward, and the insulating tubes 16 are pushed into the inner part of the bulging portion 34a in the ground conductor groove 34. Herewith, as illustrated in FIG. 2, the ground conductors 13 in the bottom cable group 102 protrude from the front wall 30.

In this case, the signal conductors 11 and the ground conductors 13 are respectively positioned in and held by the front wall 30 of the cable organizer 2. Therefore, in front of the front wall 30, the left-right pair of signal conductors 11 and the ground conductor 13 are mutually disposed with a

prescribed interval. Accordingly, this prevents signal conductors 11, and a signal conductor 11 and a ground conductor 13 from coming into contact, and thereby facilitates soldering of the signal conductors 11 and the ground conductors 13 to the substrate 4. Additionally, arranging the signal conductors 11 and the ground conductor 13 in an individual cable 10 in a line in the cable organizer 2 suppresses the variation in the characteristic impedance of the individual cable 10.

After the cable receiving grooves 27, 28 receive the individual cables 10, an insulating tape may be wound around the recess 20b (refer to FIG. 3) before installing the insulating tubes 16 on the ground conductors 13 to fix the individual cables 10 to the cable organizer 2. This facilitates the installation of the insulating tube 16 on the ground conductors 13 in the top cable group 101 and the bottom cable group 102.

After the signal conductors 11 and the ground conductors 13 are respectively inserted into the signal conductor grooves 33 and the ground conductor grooves 34, as illustrated in FIG. 2, the insertion portion 44 of the substrate 4 is engaged with and fix to the recesses 30a to 32a of the cable organizer 2. Further, the first groove portion 27, 28 may receive the individual cables 10, and the signal conductors 11 and the ground conductors 13 may be inserted into the grooves 33, 34 after the substrate 4 is engaged with and fixed to the cable organizer 2. The shoulder portions 31, 32 are respectively provided on both left and right end portions of the front wall 30, and the recesses 30a to 32a are formed in the front surface of the front wall 30 as well as the left and right inside surfaces of the shoulder portions 31, 32. Therefore, affording the substrate 4 wider fitting dimensions, and allowing accurate and stable fixing of the substrate 4 to the cable organizer 2.

Thereafter, the signal conductors 11 and the ground conductors 13 are soldered to the signal conductor pads 47a, 47b and the ground conductor pads 48, respectively. The ground conductor pad 48 is provided in front of the signal conductor pad 47a, 47b; therefore the surface area for the pads 47a, 47b, 48 may be ensured while densely disposing the pads 47a, 47b, 48 on the substrate 4. Soldering the signal conductors 11 and the ground conductors 13 to the substrate 4 is thereby simplified, and allows for miniaturization of the cable assembly 100. The assembly of the cable assembly 100 is therewith complete.

According to the present embodiment, the following actions and effects can be exhibited.

(1) The cable organizer 2 includes a front end 21 and a rear end 22, a top surface 23 and a bottom surface 24, a front wall 30 provided extending along the front end 21, shoulder portions 31, 32 extending forward from both left and right end portions of the front wall 30 and with which both left and right side surfaces of a rear end portion of a substrate 4 are respectively engaged, and first groove portions 27, 28 formed respectively in the top surface 23 and the bottom surface 24 from the rear end 22 to the front wall 30. Each of the first groove portions 27, 28 extends to a plurality of second groove portions (signal conductor grooves 33, and ground conductor grooves 34) formed in the front wall 30. Accordingly, when the first groove portions 27, 28 receive the individual cables 10, the signal conductors 11 and the ground conductor 13 in each of the individual cables 10 pass mutually different signal conductor grooves 33 and the ground conductor groove 34, extending to the pads (signal conductor pads 47a, 47b, and a ground conductor pad 48) on the substrate 4 engaged with the shoulder portions 31, 32.

Hereby, the signal conductors 11 and the ground conductor 13 can be positioned at the same

height by the grooves 33, 34 in the front wall 30. And each of the signal conductors 11 and the ground conductor 13 may be arranged in a line in the left right direction from the front wall 30 to the pads 47a, 47b, 48. For this reason, the height of the cable organizer 2 may be suppressed, and the signal conductors 11 and the ground conductor 13 may be densely arranged on the substrate 4 with accurate positioning, allowing for miniaturization of the cable connector. In other words, for example, in a configuration where a ground conductor 13 is arranged to overlap with a signal conductor 11, the ground conductor 13 is positioned higher, and the cable organizer becomes larger in the height direction. However, with this embodiment, the signal conductor 11 and ground conductor 13 are arranged in line at substantially the same height, thereby allowing suppress of the height of the cable organizer 2. Additionally, the signal conductors 11 and the ground conductor 13 extend to the pads 47a, 47b, 48 while still having a comparatively large diameter; therefore the deterioration of the high-speed signal transmission characteristics may be suppressed.

(2) The left-right pair of signal conductor grooves 33, and the ground conductor groove 34 are juxtaposed in a row in the left right direction on the front wall 30 in front of each of the first groove portions 27, 28. The left-right pair of signal conductors 11 and the ground conductor 13 are respectively received by the grooves 33, 34, to be arranged in a line in front of the front wall 30. Herewith, the multiple signal conductors 11 and the ground conductor 13 may be efficiently arranged with a prescribed interval, and thus suitable for use in multi-core cable connectors.

(3) The ground conductor groove 34 is disposed on the left and right sides of the left-right pair of signal conductor grooves 33, while providing guide grooves 35, 36 that guide the ground conductor 13 to the ground conductor groove 34 rearward of the front wall 30 of the cable organizer 2. Herewith, the ground conductor 13, which is positioned between the left-right pair of signal conductors 11, may be guided to the ground conductor groove 34 without problem via the guide grooves 35, 36.

(4) Signal conductor pads 47a, 47b to which the front end portion of the signal conductors 11 is connected, and a ground conductor pad 48 to which the front end portions of the ground conductor 13 is connected are provided on the substrate 4; and an insulating tube 16 is installed on the ground conductor 13. Herewith, when the signal conductors 11 and the ground conductors 13 are densely arranged on the substrate 4, favorable insulation between the signal conductors 11 and the ground conductor 13 at the space between the front wall 30 and the ground conductor pad 48 can be ensured.

(5) The ground conductor pad 48 is provided further forward than the signal conductor pads 47a, 47b, thereby allowing the pads 47a, 47b, 48 of a sufficient size to be formed, and allowing simple and reliable soldering of the signal conductors 11 and the ground conductor 13 to the pads 47a, 47b, 48.

(6) The cable organizer 2, which is a single component, has a cable receiving portion 20 and a front wall 30, and the cable organizer 2 functions to hold each of the individual cables 10, and position the signal conductor 11 and the ground conductor 13. Accordingly, for example, if a bending force acts on the cable 1 in the top bottom direction, the bending stress acting on the signal conductor 11 at the tip end portion of the insulator 12 may be reduced. As a result, this prevents the disconnection of a signal conductor 11 or a ground conductor 13, and the detachment of the solder, thereby maintaining a stable state of conductive connection. In this regard, for example, if a holding component that holds an individual cable 10, and a positioning component that positions the signal conductor 11 and the ground

conductor 13 are separately provided, when a bending force in the top bottom direction acts on the cable 1, the holding component deforms with respect to the positioning component, and this tends to increase the bending stress that acts on the signal conductor 11 and the ground conductor 13.

Moreover, in the above mentioned embodiment, an insulating tube 16 is installed on a ground conductor 13 to ensure insulation between a signal conductor 11 and a ground conductor 13 in the interval between the front wall 30 and the ground conductor pad 48. However, the configuration of insulation portion is not limited to thereto. FIG. 9 is a modified example of FIG. 1, and is a perspective view of the cable assembly 100 illustrating another configuration of the insulation portion. In FIG. 9, instead of installing an insulating tube 16 on the ground conductor 13, an insulation block 50 formed from insulating material is disposed on the top surface 41, and bottom surface 42 of the substrate 4, respectively.

FIG. 10 is a perspective view illustrating a configuration of the insulation block 50 disposed on the top surface 41. Furthermore, though omitted from the drawing, the configuration of the insulation block 50 disposed on the bottom surface 42 is identical to FIG. 10. As illustrated in FIG. 10, the insulation block 50 has a substantially square panel portion 51 extending in the left right direction and a plurality of legs 52 (here five) that protrude downward from the bottom surface of the panel portion 51. The width of the panel portion 51 in the left right direction is equal to the width of the inside of the left and right shoulder portions 31, 32 in the cable organizer 2. The plurality of legs 52 is disposed in the left right direction with equal intervals, and a space portion 53 having a U-shaped cross-section is formed between the legs 52 and the panel portion 51. On the top surface of the panel portion 51, a plurality of groove portions 54 (here four) is provided corresponding to the position of the ground conductor groove 34 on the front wall 30, and provided extending in the front rear direction.

The insulation block 50 is positioned and disposed on the inside of the shoulder portions 31, 32 on the substrate in the left right direction, after soldering the signal conductor 11 to the signal conductor pad 47a, 47b on the substrate. Additionally, a rear end surface of the insulation block 50 is made to abut with the front surface of the front wall 30. The insulation block 50 is then positioned and disposed in the front rear direction. In this manner, with the insulation block 50 being disposed, the signal conductor pads 47a, 47b are positioned downward of the space portion 53. Whereas, the ground conductor 13 is received by the groove portion 54 on the top surface of the insulation block, is positioned by the groove portion 54 and is extended in front of the insulation block 50. The ground conductor 13 is then soldered to the ground conductor pad 48 in this state. Herewith, the left-right pair of signal conductors 11 and the ground conductor 13 may be reliably insulated via the insulation block 50 on the substrate 4.

FIG. 11 is a perspective view of the cable assembly 100 illustrating another configuration of the insulation portion. In FIG. 11, an insulating tape 55 is wound around the four ground conductors 13 on the top surface side and on the bottom surface side respectively of the substrate 4. The insulating tape 55 insulates the ground conductor 13. As illustrated in FIG. 11, the tip end portion of the ground conductor 13 protrudes forward from the insulating tape 55, and the tip end portion is soldered to the ground conductor pad 48. In this manner, if an insulating tape 55 is used, the ground conductor 13 may be easily insulated between the front wall 30 and the ground conductor pad 48.

Moreover, in the above mentioned embodiments, respectively, on the top surface 23 and the bottom surface 24 of the cable organizer 2, a plurality of first groove portions 27, 28 capable of receiving

the signal conductor 33 and the ground conductor 34 (a plurality of electrical wires) constituting an individual cable 10, and a plurality of second groove portions 33, 34 formed in the front wall 30 to correspond to the first groove portions 27, 28, and capable of respectively receiving a plurality of signal conductors 33 and a ground conductor 34 are provided. That is, a plurality of first groove portions 27 (a first plurality of first groove portions) and a plurality of second groove portions 33, 34 (a first plurality of second groove portions) are provided on the top surface 23 of the cable organizer 2 so that each of the first groove portions 27 receives a signal conductor 11 and a ground conductor 13 (a first plurality of electrical wires); while a plurality of first groove portions 28 (a second plurality of first groove portions) and a plurality of second groove portions 33, 34 (a second plurality of second groove portions) are provided on the bottom surface 24 of the cable organizer 2 so that each of the first groove portions 28 receives a signal conductor 11 and ground conductor 13 (a second plurality of electrical wires). However, the configuration of the cable organizer 2 is not limited thereto, for example, the first groove portions and the second groove portions may be provided on only the top surface 23, or on only the bottom surface 24. Additionally, the first groove portions 27, 28 are formed as slot-shaped but the first groove portion need not be limited to this configuration. For example, projections may be provided on a flat surface at equal intervals in the left right direction so that recesses between adjacent projections configure the first groove portion.

The shoulder portions 31, 32 (first and second shoulder portions) are not limited to the above described configuration as long as the shoulder portions are provided extending forward from both left and right end portions of the front wall 30 and the shoulder portions respectively engage with both left and right side surfaces on the rear end portion of the substrate 4. There is no need to limit the signal conductor groove 33 and the ground conductor groove 34 to the above described configuration as long as the signal conductor groove 33 and the ground conductor groove 34 are configured so that when the substrate 4 engages with the front wall 30 and the individual cable 10 having a signal conductor 11 and a ground conductor 13 are received by the first groove portions 27, 28, each of the signal conductor 11 and ground conductor 13 pass through mutually different second groove portions 33, 34 to extend to the pads 27a, 27b, 28 (electrical wire connection portion). Although a ground conductor groove 34 is disposed on the left and on the right sides of the signal conductor groove 33, the grooves 33, 34 may be disposed in other ways.

Although three groove portions (signal conductor grooves 33 and a ground conductor groove 34) are formed in the front wall 30 to correspond to each of the first groove portions 27, 28, the number of second groove portions may be modified in accordance with the number of electrical wires inside an individual cable 10. In the above mentioned embodiment, an individual cable 10 is configured to include two signal conductors 11 and one ground conductor 13. However, the individual cable 10 need not be limited to this configuration, and for example, may include two signal conductors 11 and two ground conductors 13. In this case, it is not necessary to insulate mutual ground conductors 13; therefore, for example, as illustrated in FIG. 12, the two ground conductors 13 may be received by the same ground conductor groove 34. Further, although the signal conductors 11 and the ground conductor 13 which are plurality of the electrical wires are received by the first groove portions 27, 28 as an individual cable 10, as long as insulation is maintained between each of the wires, the plurality of wires

may be received by the first groove portions 27, 28 as is.

In the above mentioned embodiment, guide grooves 35, 36 are provided rearward of the front wall 30 in the cable organizer 2. There is no need to limit the configuration of the guide portion to the above mentioned configuration as long as the guide portion guides the ground conductor 13 to the ground conductor groove 34. A plurality of signal conductor pads 47a, 47b (signal conductor connection portions) connected to the front end portion of a pair of signal conductors 11, and a ground conductor pad 48 (ground conductor connection portion) connected to the front end portion of a ground conductor 13 are provided on the substrate 4; and the ground conductor pad 48 is disposed further forward than the signal conductor pads 47a, 47b on the substrate 4. However, there is no need to limit the signal conductor connection portions and the ground conductor connection portion to this configuration. In the above mentioned embodiment, the signal conductor 11 and the ground conductor 13 are arranged in a line in the cable organizer 2; however the cable organizer of the present invention may be applied in the same manner when arranging other electrical wires.

The explanation given above is merely one example, and as long as the characteristics of the present invention are not lost, the present invention is not limited to the above embodiments and modified example. Anything that maintains, is replaceable or obviously replaces the identity of the invention is included in the constituents of the embodiments and modified example. In other words, other configurations conceived within the scope of the technical conception of the present invention are contained within the scope of the present invention. In addition, the embodiments and modified example given above may be freely used in combination either alone or in plural form.

Reference Numerals

1…Cable

2…Cable organizer

4…Substrate

10…Individual cable

11…Signal conductor

13…Ground conductor

16…Insulating tube

21…Front end

22…Rear end

23…Top surface

24…Bottom surface

27,28…First groove portion

30…Front wall

31, 32…Shoulder portion

33…Signal conductor groove (second groove portion)

34…Ground conductor groove (second groove portion)

35,36…Guide groove

47a,47b…Signal conductor pad (signal conductor connection portion)

48…Ground conductor pad (ground conductor connection portion)

100…Cable assembly

The following is a list of items of the present disclosure:

Item 1 is a cable organizer comprising: a front end and a rear end opposite thereto;

a top surface and a bottom surface opposite thereto;

a front wall provided extending along the front end, and that engages with a rear end portion of a substrate;

first and second shoulder portions provided extending forward from both left and right end portions of the front wall and that engage, respectively, with both left and right side surfaces on the rear end portion of the substrate; and

a plurality of first groove portions formed in the top surface from the rear end to the front wall, each of said plurality of first groove portions extending to a plurality of second groove portions formed in the front wall so as to correspond to said first groove portions; wherein

each of the plurality of first groove portions can receive a plurality of electrical wires; and when the substrate engages with the front wall and said first groove portions receive the plurality of electrical wires, each of said plurality of electrical wires passes through mutually different second groove portions among the plurality of second groove portions, and extends to electrical wire connection portions provided on the top surface of the substrate so as to correspond to each of the plurality of electrical wires.

Item 2 is the cable organizer according to item 1, wherein: the plurality of first groove portions formed in the top surface is a first plurality of first groove portions, the plurality of second groove portions formed corresponding to each of said plurality of first groove portions is a first plurality of second groove portions, and the plurality of electrical wires that can be received by each of the first plurality of first groove portions is a first plurality of electrical wires;

the cable organizer further comprises a second plurality of first groove portions formed in the bottom surface from the rear end to the front wall, each of said first groove portions extending to a second plurality of second groove portions formed in the front wall so as to correspond to said first groove portions;

each of the second plurality of first groove portions can receive a second plurality of electrical wires; and when the substrate engages with the front wall and said first groove portions receive the second plurality of electrical wires, each of said second plurality of electrical wires passes through mutually different second groove portions among the second plurality of second groove portions, and extends to electrical wire connection portions provided on the bottom surface of the substrate so as to correspond to each of the second plurality of electrical wires.

Item 3 is the cable organizer according to item1 or 2, wherein: the plurality of electrical wires includes two signal conductors and a ground conductor;

the plurality of second groove portions corresponding to each of the plurality of first groove portions include three groove portions for respectively receiving the two signal conductors and the ground conductor; and each of the plurality of first groove portions extends to the three groove portions.

Item 4 is a cable assembly comprising: a cable organizer described in any one of items 1 to 3;

a substrate engaging the front wall of the cable organizer; and

a plurality of signal conductors and a ground conductor received by each of the plurality of first groove portions of the cable organizer.

Item 5 is the cable assembly according to item 4, wherein: the plurality of second groove portions formed in the front wall of the cable organizer comprises a plurality of signal conductor groove portions and a ground conductor groove portion juxtaposed in a left right direction; and

the plurality of signal conductors and the ground conductor are respectively received by the plurality of signal conductor groove portions and the ground conductor groove portion, and arranged further forward than the front wall.

Item 6 is the cable assembly according to item 5, wherein: the plurality of signal conductors is a left-right pair of signal conductors extending in a front rear direction, the ground conductor is disposed between the left-right pair of signal conductors and extends in the front rear direction;

the ground conductor groove portion is disposed on left and right sides of the plurality of signal conductor groove portions; and

the cable organizer further includes a guide portion rearward of the front wall, the guide portion guiding the ground conductor to the ground conductor groove portion.

Item 7 is the cable assembly according to items 5 or 6, wherein: the plurality of signal conductors and the ground conductor are, respectively, two signal conductors and two ground conductors;

the plurality of signal conductor groove portions respectively receives the two signal conductors; and

the ground conductor groove portion is a single ground conductor groove portion that receives the two ground conductors.

Item 8 is the cable assembly according to any one of items 5 to 7, wherein: the substrate includes a plurality of signal conductor connection portions to which front end portions of the plurality of signal conductors are respectively connected, and a ground conductor connection portion to which the front end portion of the ground conductor is connected; and

the cable assembly further comprises an insulating portion between the front wall and the ground conductor connection portion that insulates the plurality of signal conductors from the ground conductor.

Item 9 is the cable assembly according to item 8, wherein the ground conductor connection portion is disposed further forward than the plurality of signal conductor connection portions.

What is Claimed Is:

1. A cable organizer comprising: a front end and a rear end opposite thereto;

a top surface and a bottom surface opposite thereto;

a front wall provided extending along the front end, and that engages with a rear end portion of a substrate;

first and second shoulder portions provided extending forward from both left and right end portions of the front wall and that engage, respectively, with both left and right side surfaces on the rear end portion of the substrate; and

a plurality of first groove portions formed in the top surface from the rear end to the front wall, each of said plurality of first groove portions extending to a plurality of second groove portions formed in the front wall so as to correspond to said first groove portions; wherein

each of the plurality of first groove portions can receive a plurality of electrical wires; and when the substrate engages with the front wall and said first groove portions receive the plurality of electrical wires, each of said plurality of electrical wires passes through mutually different second groove portions among the plurality of second groove portions, and extends to electrical wire connection portions provided on the top surface of the substrate so as to correspond to each of the plurality of electrical wires.

2. The cable organizer according to claim 1, wherein: the plurality of first groove portions formed in the top surface is a first plurality of first groove portions, the plurality of second groove portions formed corresponding to each of said plurality of first groove portions is a first plurality of second groove portions, and the plurality of electrical wires that can be received by each of the first plurality of first groove portions is a first plurality of electrical wires;

the cable organizer further comprises a second plurality of first groove portions formed in the bottom surface from the rear end to the front wall, each of said first groove portions extending to a second plurality of second groove portions formed in the front wall so as to correspond to said first groove portions;

each of the second plurality of first groove portions can receive a second plurality of electrical wires; and when the substrate engages with the front wall and said first groove portions receive the second plurality of electrical wires, each of said second plurality of electrical wires passes through mutually different second groove portions among the second plurality of second groove portions, and extends to electrical wire connection portions provided on the bottom surface of the substrate so as to correspond to each of the second plurality of electrical wires.

3. The cable organizer according to claim 1 or 2, wherein: the plurality of electrical wires includes two signal conductors and a ground conductor;

the plurality of second groove portions corresponding to each of the plurality of first groove portions include three groove portions for respectively receiving the two signal conductors and the ground conductor; and each of the plurality of first groove portions extends to the three groove portions.

4. A cable assembly comprising: a cable organizer described in any one of claims 1 to 3;

a substrate engaging the front wall of the cable organizer; and

a plurality of signal conductors and a ground conductor received by each of the plurality of first groove portions of the cable organizer.

5. The cable assembly according to claim 4, wherein: the plurality of second groove portions formed in the front wall of the cable organizer comprises a plurality of signal conductor groove portions and a ground conductor groove portion juxtaposed in a left right direction; and

the plurality of signal conductors and the ground conductor are respectively received by the plurality of signal conductor groove portions and the ground conductor groove portion, and arranged further forward than the front wall.

6. The cable assembly according to claim 5, wherein: the plurality of signal conductors is a left-right pair of signal conductors extending in a front rear direction, the ground conductor is disposed between the left-right pair of signal conductors and extends in the front rear direction;

the ground conductor groove portion is disposed on left and right sides of the plurality of signal conductor groove portions; and

the cable organizer further includes a guide portion rearward of the front wall, the guide portion guiding the ground conductor to the ground conductor groove portion.

7. The cable assembly according to claim 5 or 6, wherein: the plurality of signal conductors and the ground conductor are, respectively, two signal conductors and two ground conductors;

the plurality of signal conductor groove portions respectively receives the two signal conductors; and

the ground conductor groove portion is a single ground conductor groove portion that receives the two ground conductors.

8. The cable assembly according to any one of claims 5 to 7, wherein: the substrate includes a plurality of signal conductor connection portions to which front end portions of the plurality of signal conductors are respectively connected, and a ground conductor connection portion to which the front end portion of the ground conductor is connected; and

the cable assembly further comprises an insulating portion between the front wall and the ground conductor connection portion that insulates the plurality of signal conductors from the ground conductor.

9. The cable assembly according to claim 8, wherein the ground conductor connection portion is disposed further forward than the plurality of signal conductor connection portions.

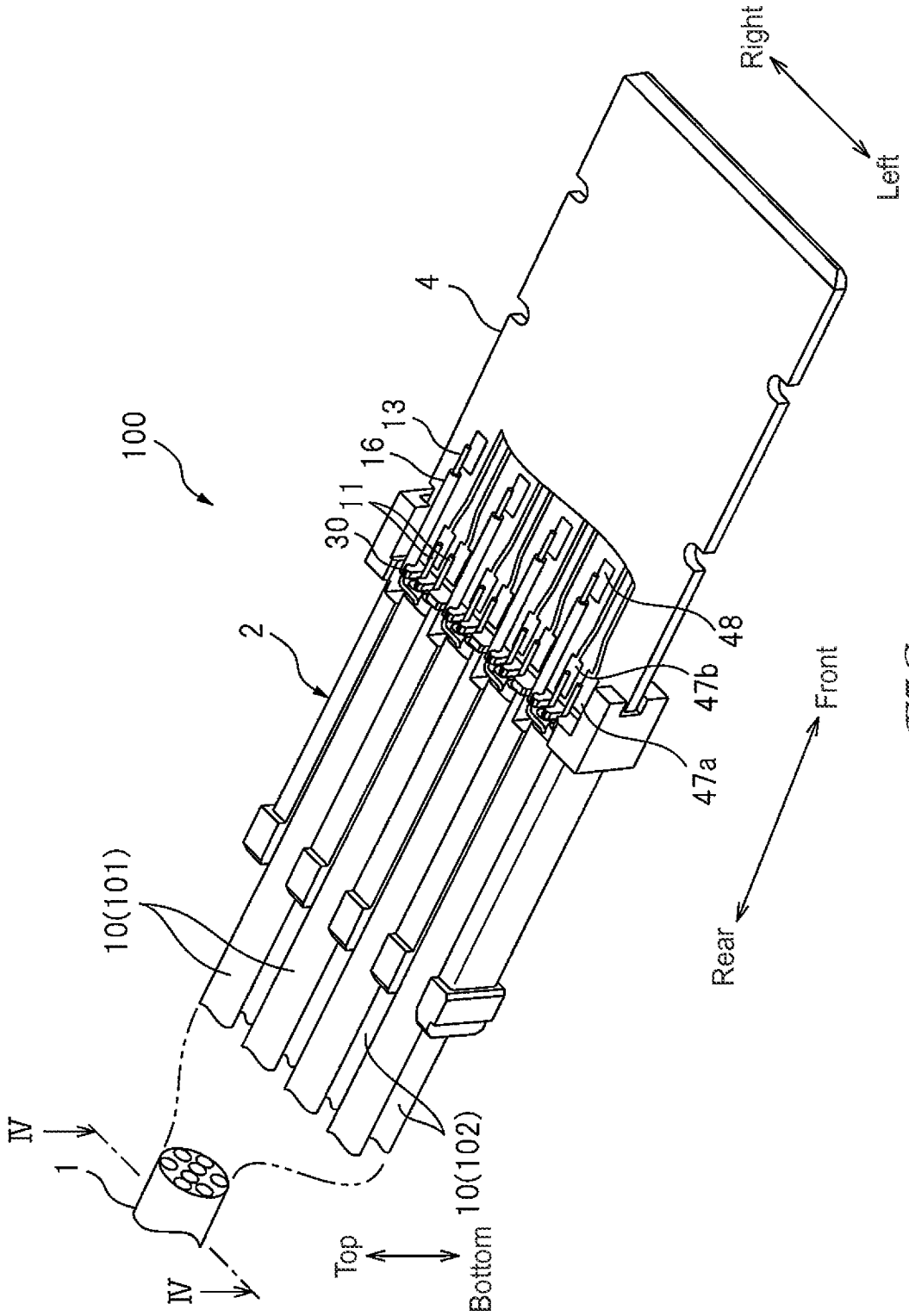
Right
Left
4
100
13
16
11
30
2
48
47b
47a
Front
Rear
10(101)
IV
1
IV
Top
Bottom
10(102)

FIG. 1

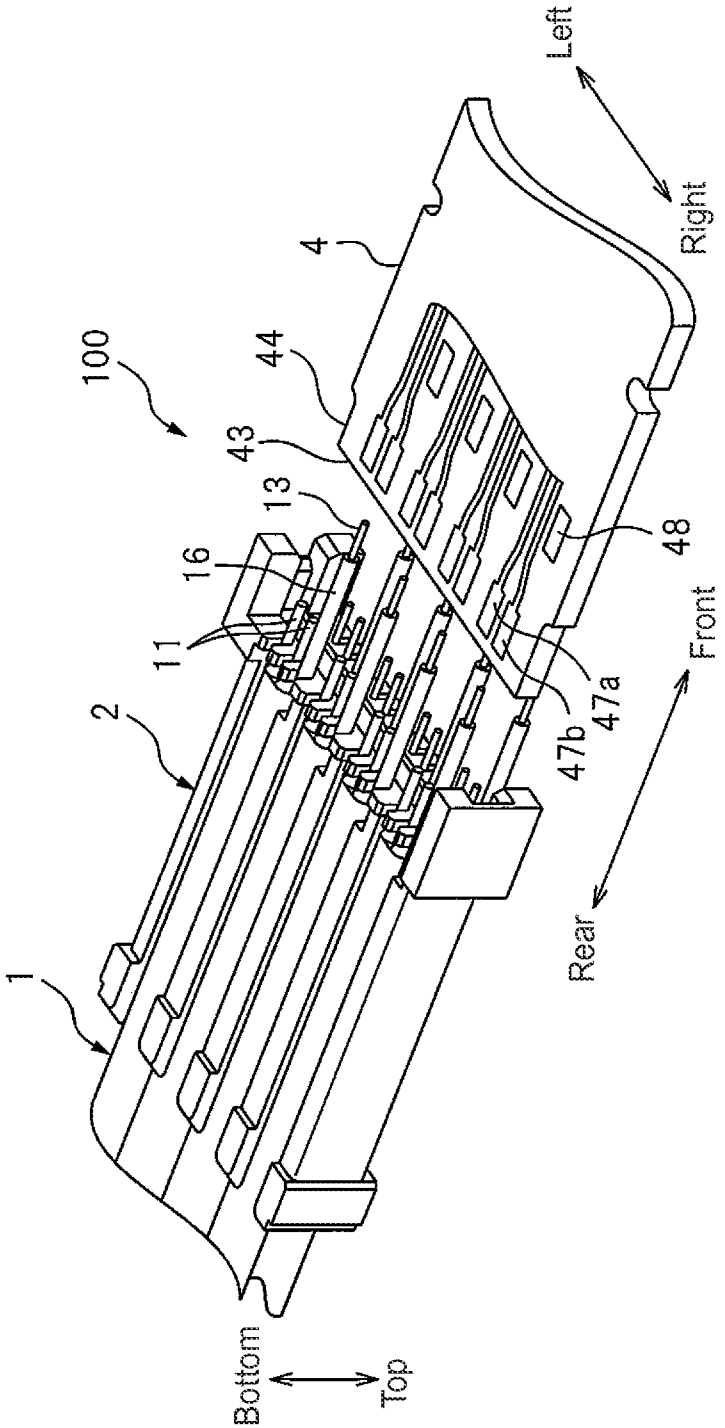
Left
Right
4
100
44
43
13
16
11
2
48
47a
47b
Front
Rear
1
Bottom
Top

FIG. 2

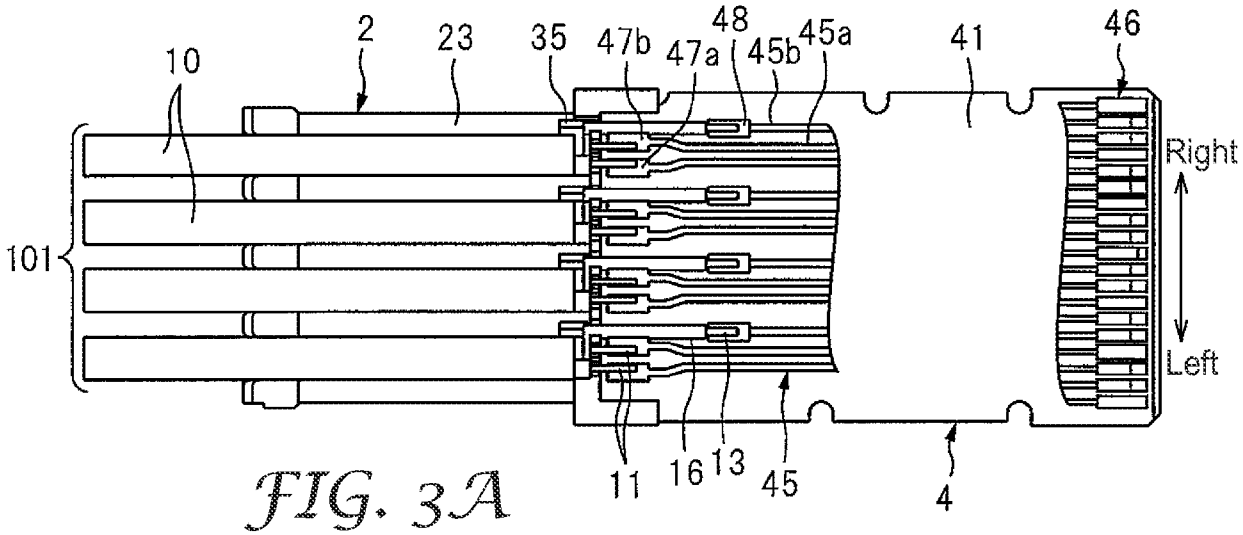

FIG. 3A

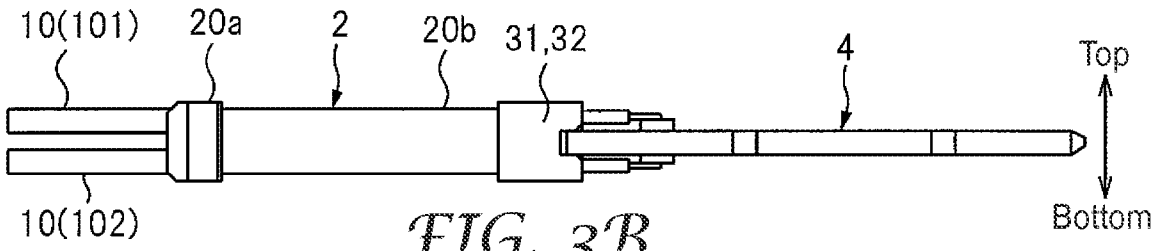

FIG. 3B

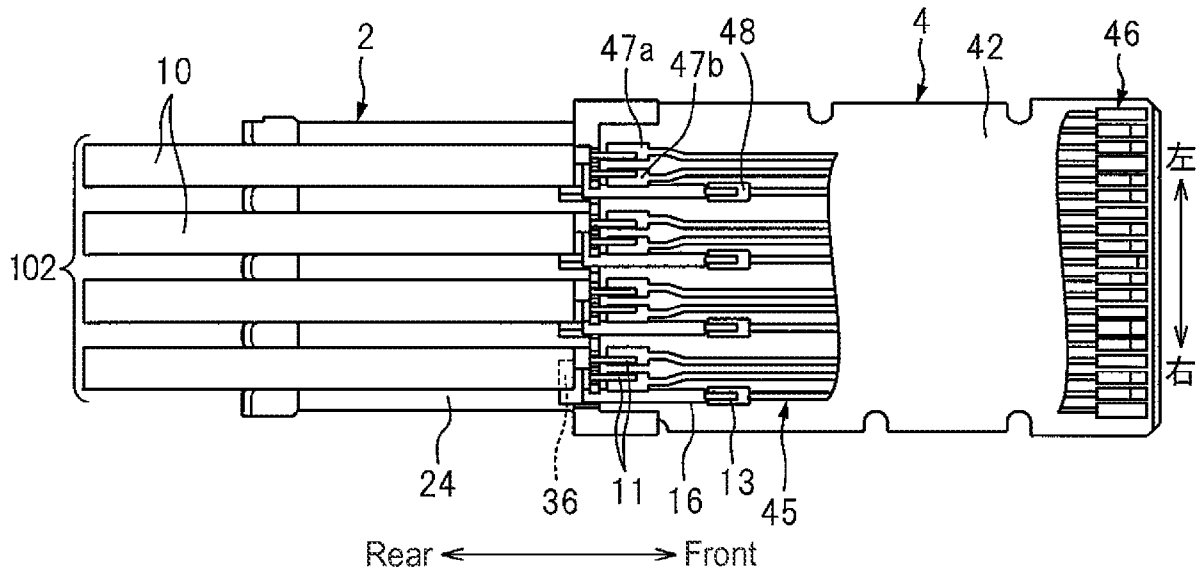

FIG. 3C

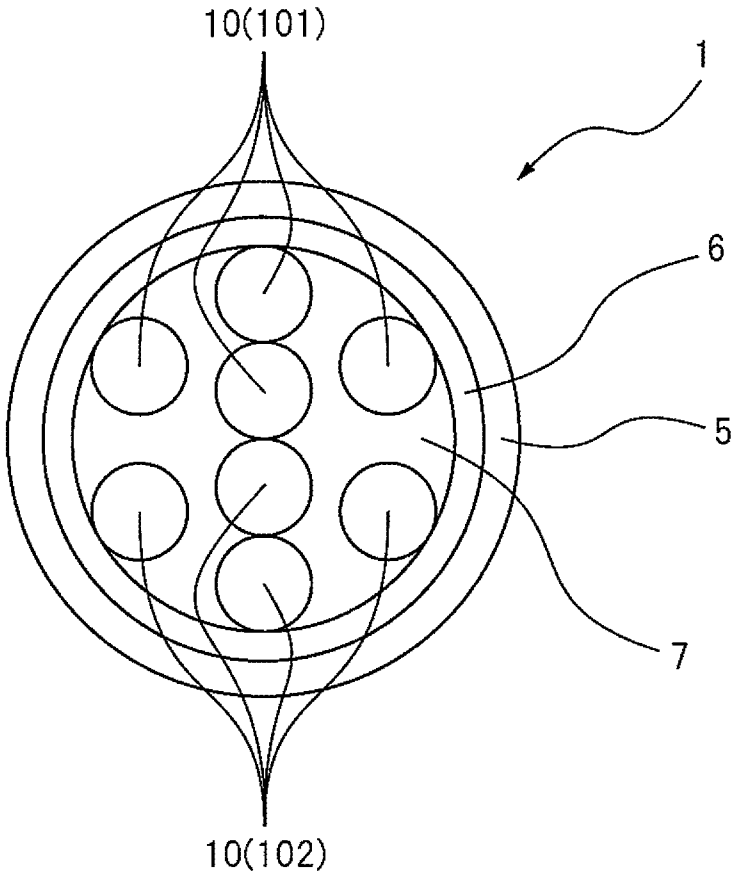

FIG. 4

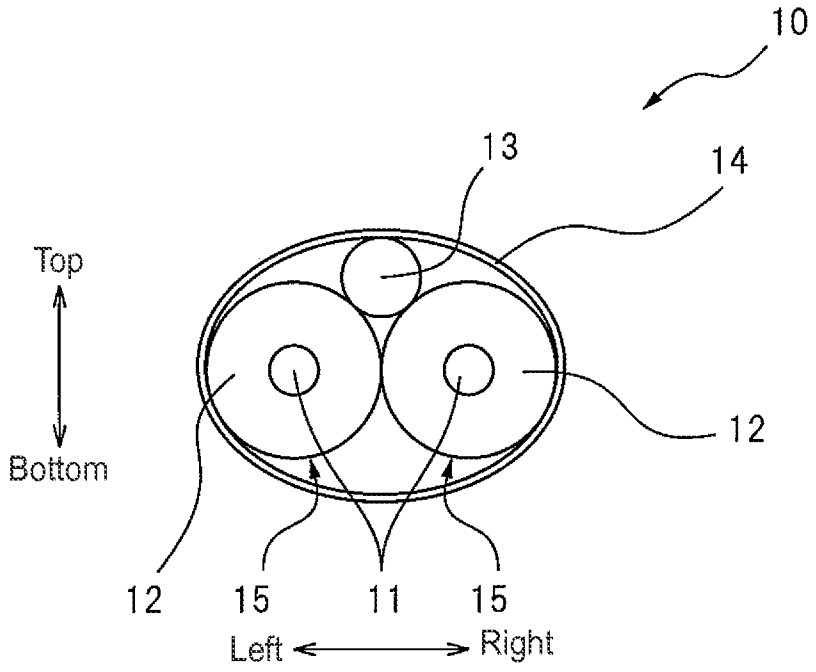

FIG. 5

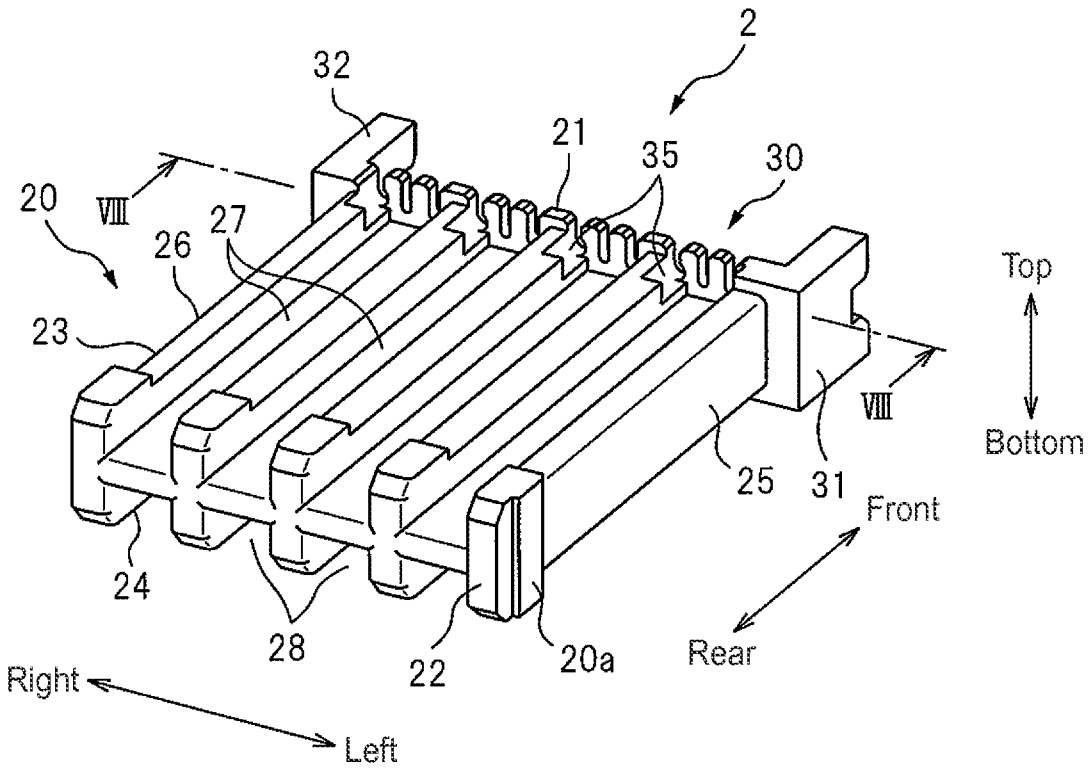
2
32
21
35
30
20
VIII
27
26
23
Top
Bottom
VIII
25
31
Front
24
28
22
20a
Rear
Right
Left

FIG. 6

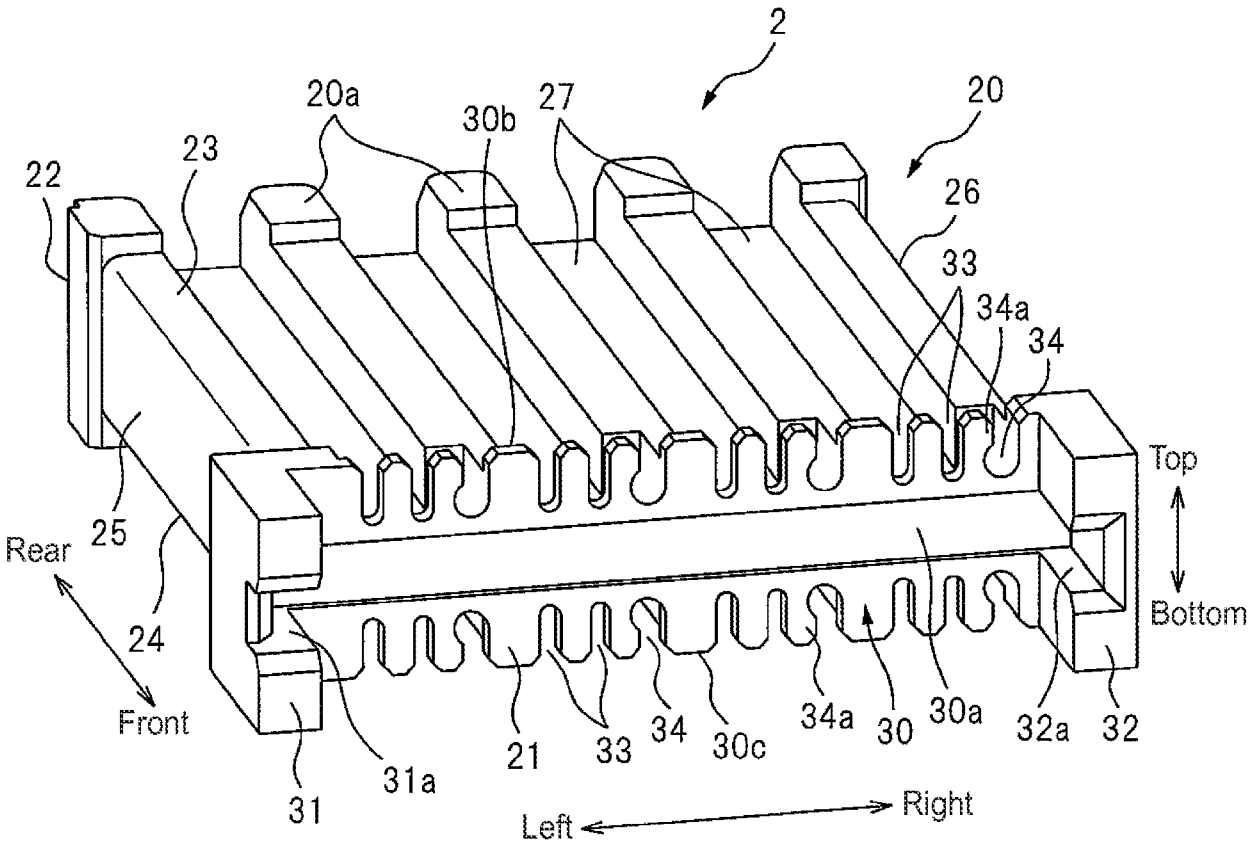
2
20a
30b
27
20
22
23
26
33
34a
34
Top
Bottom
Rear
25
24
Front
31
31a
21
33
34
30c
34a
30
30a
32a
32
Left
Right

FIG. 7

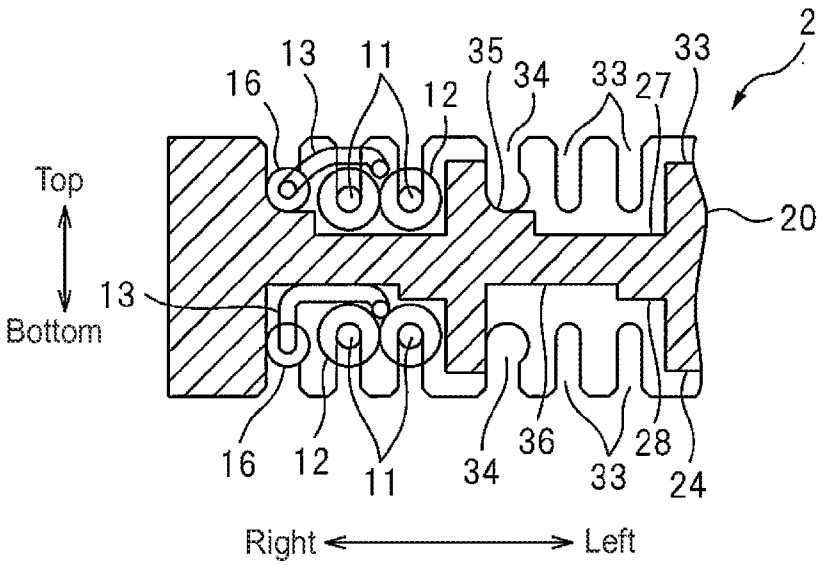
2
13
11
35
33
16
12
34
33
27
Top
Bottom
13
20
16
12
11
34
36
33
28
24
Right
Left

FIG. 8

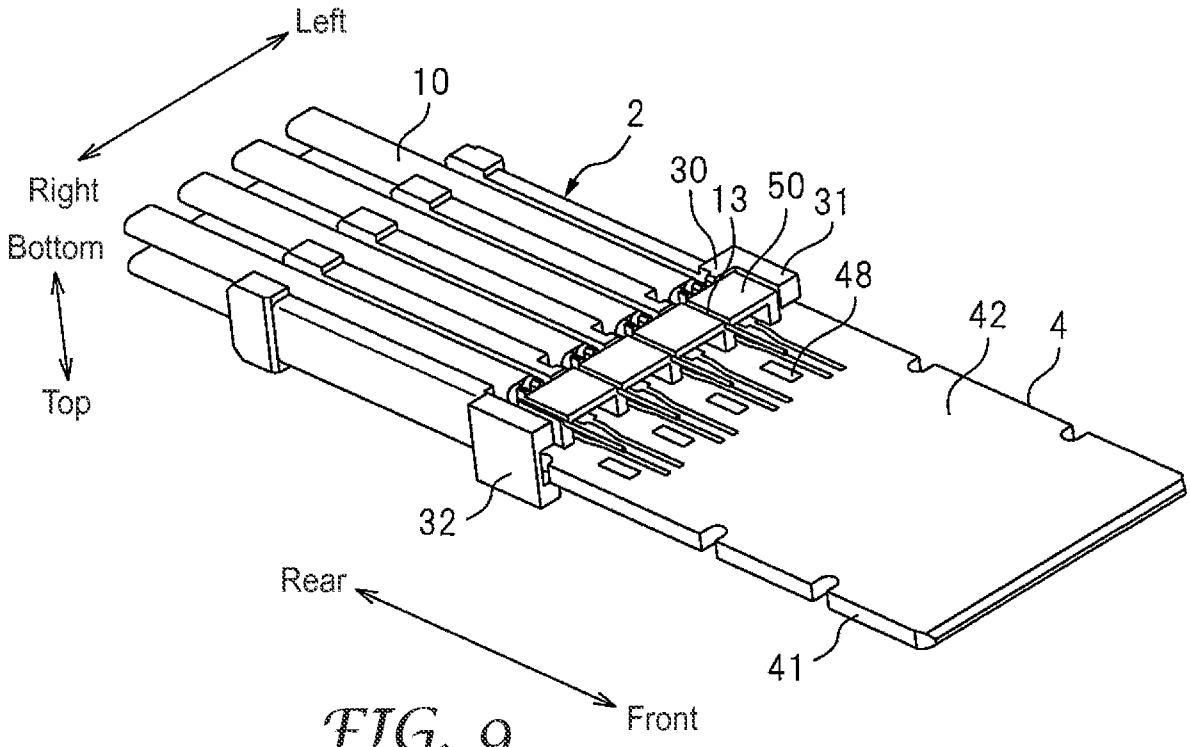
Left
Right
Bottom
Top
10
2
30
13
50
31
48
42
4
32
41
Rear
Front

FIG. 9

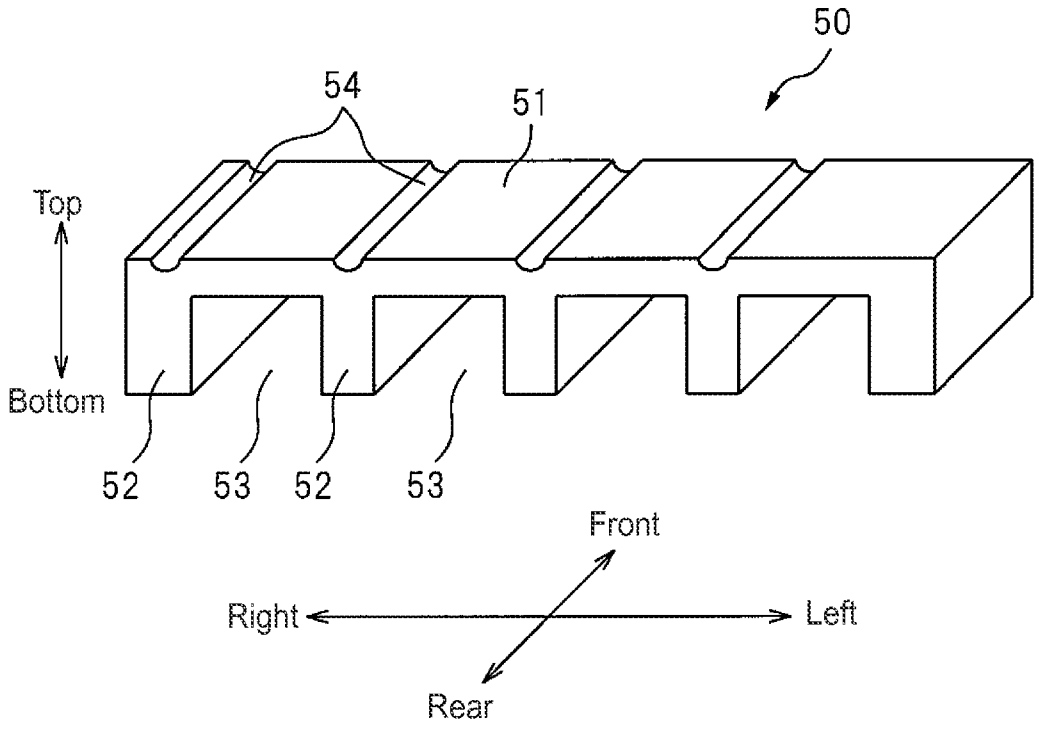
50
54
51
Top
Bottom
52
53
52
53
Front
Right
Left
Rear

FIG. 10

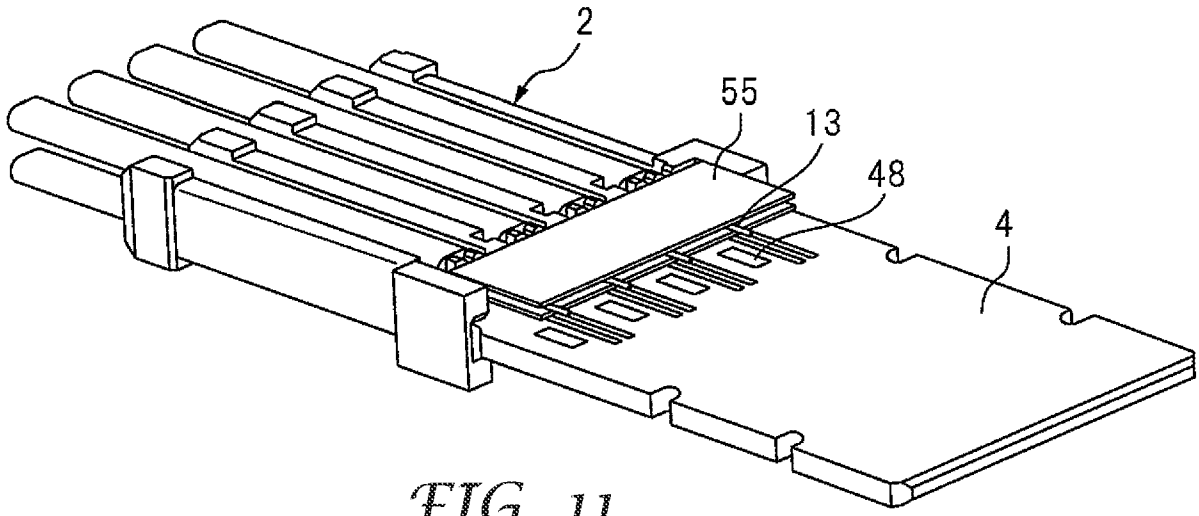

FIG. 11

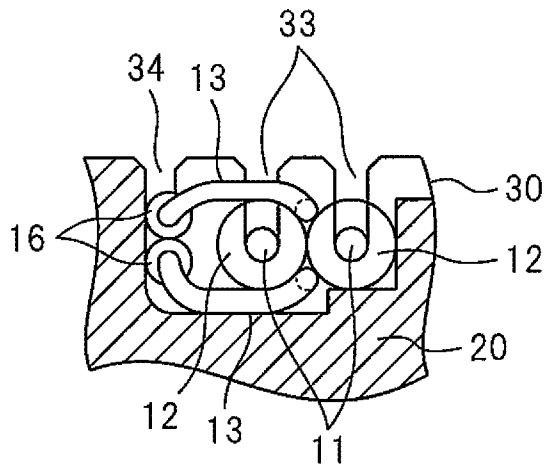

FIG. 12

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/076338

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01R12/57 H01R4/02
ADD. H01R13/6471

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)
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 practicable, 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.
X Y	US 2009/061695 A1 (KO DAVID TSO-CHIN [US] ET AL) 5 March 2009 (2009-03-05) figures 2,3,4,5,6	1-5,7 8,9
Y	WO 2009/039287 A2 (3M INNOVATIVE PROPERTIES CO [US]; KUWAHARA KENJI [JP]; ENDOH TOSHIROH) 26 March 2009 (2009-03-26) cited in the application figure 7	8,9
A	US 6 338 652 B1 (KO DAVID TSO-CHIN [US]) 15 January 2002 (2002-01-15) figure 2	1-9
A	US 6 273 753 B1 (KO DAVID TSO-CHIN [US]) 14 August 2001 (2001-08-14) figure 3	1-9

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[X] Further documents are listed in the continuation of Box C.

[X] 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 application or patent 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

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Date of the actual completion of the international search	Date of mailing of the international search report
3 March 2014	10/03/2014

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/076338

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2012/052699 A1 (MACDOUGALL ALAN [US]) 1 March 2012 (2012-03-01) figure 4	1-9
A	WO 2012/072968 A1 (VOLEX PLC [GB]; LIU YAOHSUAN; ZHU JIANGHUA [GB]; HUANG DONGHUA [CN]; W) 7 June 2012 (2012-06-07) figure 5A	1-9

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2013/076338

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2009061695 A1	05-03-2009	CN 201112824 Y	10-09-2008
		US 2009061695 A1	05-03-2009
WO 2009039287 A2	26-03-2009	CN 101803121 A	11-08-2010
		JP 4954001 B2	13-06-2012
		JP 2009076375 A	09-04-2009
		TW 200934009 A	01-08-2009
		US 2010210138 A1	19-08-2010
		US 2011059643 A1	10-03-2011
		WO 2009039287 A2	26-03-2009
US 6338652 B1	15-01-2002	NONE	
US 6273753 B1	14-08-2001	CN 2462570 Y	28-11-2001
		TW 467406 U	01-12-2001
		US 6273753 B1	14-08-2001
US 2012052699 A1	01-03-2012	NONE	
WO 2012072968 A1	07-06-2012	EP 2647268 A1	09-10-2013
		WO 2012072968 A1	07-06-2012