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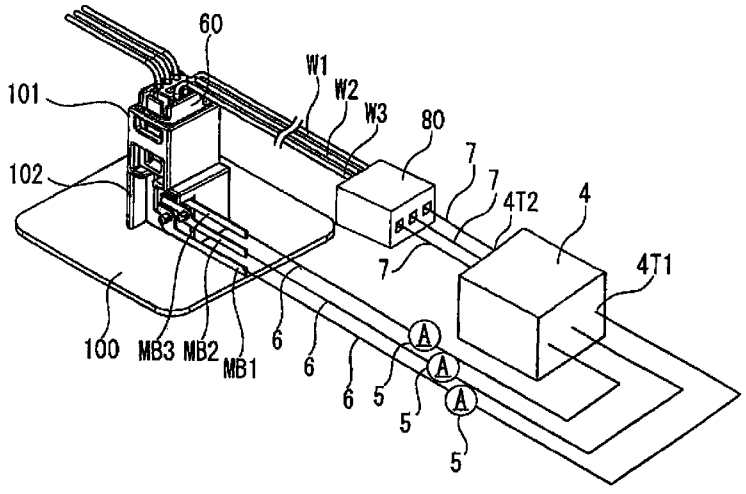
(54) Title: COVERED ELECTRIC WIRE CONTINUITY CHECKING METHOD AND CONTINUITY CHECKING APPARATUS THEREFOR

Fig. 4



(57) Abstract: A continuity checking method for a covered electric wire includes following steps. In a step of laying, one end portion of a covered electric wire to be checked is laid in an electric wire holder (60) having an opening. In a step of inserting, a checking terminal is inserted into the opening. The checking terminal removes an insulation cover of the covered electric wire so as to contact a core wire of the covered electric wire. In a step of applying, electric current is applied (4) between the checking terminal and the other end portion (80) of the covered electric wire to check a continuity of the covered electric wire which is mounted in the electric wire holder.

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DESCRIPTION

COVERED ELECTRIC WIRE CONTINUITY CHECKING METHOD AND CONTINUITY CHECKING APPARATUS THEREFOR

Technical Field

The present invention is related to continuity checking of a covered electric wire for a vehicle interior illumination apparatus and more particularly to a continuity checking method for a covered electric wire making up a wiring harness which is provided in an electric wire holder which has no conducting component and a continuity checking apparatus therefor.

Background Art

It is known to make electric contact with electric wires accommodated in a connector which has no conducting component in an interior thereof by use of a press-contact member (refer to PTL1). According to the invention of PTL1, an insulator connecting portion of a flat electric wire at an end portion excluding a terminal tip portion thereof is cut along a longitudinal direction over a predetermined range so as to form a press-contact portion A in which spacing between individual insulated conductors can be adjusted in a transverse direction. An insulator displacement connection connector is made up of a connector housing in which press-contact metallic contacts including corresponding press-contact blades B are mounted and a housing which is placed over the connector housing. After the press-contact blades B are press fitted on the insulated conductors at the press-contact portion A, an end treatment is applied to the flat electric wire in which

the end portion of the flat electric wire is folded back so as to extend along an external surface of the cover.

Citation List

[Patent Literature]

[PTL1] JP-A-2004-165055

Summary of Invention

Technical Problem

With the connector housing of PTL1, there is a problem that the press-contact metallic contacts including the press-contact blades B become unnecessary when the electric wire can be press fitted to mating connector terminals.

Additionally, to check the continuity of the flat electric wire, the preparatory work needs to be carried out in which the insulator connecting portion at the end portion is cut along the longitudinal direction over the predetermined range.

It is therefore one advantageous aspect of the present invention to provide a continuity checking method in which a continuity checking can be performed on an electric wire accommodated in an electric wire holder having no conducting component without removing an insulation cover of the electric wire. An additional object of the invention is to provide a connector housing for a connector for use in the continuity checking which obviates the necessity of inclusion of a press-contact blade in an interior thereof.

Solution to Problem

According to one advantage of the invention, there is provided a continuity

checking method for a covered electric wire, comprising:

laying one end portion of a covered electric wire to be checked in an electric wire holder having an opening;

inserting a checking terminal into the opening, the checking terminal configured to remove an insulation cover of the covered electric wire so as to contact a core wire of the covered electric wire; and

applying electric current between the checking terminal and the other end portion of the covered electric wire to check a continuity of the covered electric wire which is mounted in the electric wire holder.

According to another advantage of the invention, there is provided a continuity checking apparatus for a covered electric wire comprising:

an electric wire holder inserting portion into which a covered electric wire holder is inserted; and

a checking terminal, provided at a bottom portion of the electric wire holder inserting portion so as to be erected upwards, and configured to remove an insulation cover of the covered electric wire so as to contact a core wire of the covered electric wire,

wherein the electric wire holder includes an inner holder and a cover having an opening which is placed over the inner holder, and

wherein the checking terminal contacts the core wire when the checking terminal is inserted into the opening in a state where the electric wire holder is inserted into the electric wire holder inserting portion.

The checking terminal may be a press-contact blade configured to cut the insulation cover when the checking terminal is inserted into the opening.

The checking terminal may be a probe configured to penetrate the insulation

cover when the checking terminal is inserted into the opening.

Advantageous Effects of Invention

According to the invention, since the continuity checking can be performed on the covered electric wire without removing the insulation cover thereof, the continuity checking can easily be performed on the covered electric wire provided in the covered electric wire holding having no conducting component.

Further, since the continuity checking is performed easily when a wiring harness is completed, a similar continuity checking on a completed product can be omitted.

Additionally, when this covered electric wire holder is finally installed in a vehicle interior illumination apparatus, the load is reduced which is applied to a press-contact blade on the side of the vehicle interior illumination apparatus when the press-contact blade is press fitted on a core of the covered electric wire within the covered electric wire holder in a biting fashion.

Further, the problem inherent in the connector housing of PTL1 in which the press-contact metallic contacts become unnecessary is not caused.

Furthermore, the continuity checking can be performed more easily through the piercing of the probe.

Brief Description of Drawings

Figs. 1A to 1C show perspective views and a sectional view which depict a covered electric wire holder which is used in a continuity checking of the invention. Fig. 1A is a perspective view of the covered electric wire holder showing a state before constituent parts are fitted together, Fig. 1B is a perspective view of an inner holder in

which covered electric wires are laid, and Fig. 1C is a vertical sectional view of the inner holder taken along the line B-B and seen in a direction indicated by arrows B in Fig. 1B.

Figs. 2A to 2C show perspective views depicting a method for mounting electric wires in a connector which is assembled to a vehicle interior illumination apparatus shown in Fig. 10A by use of an electric wire laying jig conceived separately by the applicant of this patent application. Fig. 2A is a perspective view showing a state before the connector is assembled to the electric wire laying jig, Fig. 2B is a perspective view showing a state in which the connector is temporarily fixed on the electric wire laying jig, and Fig. 2C is a perspective view showing a state before the covered electric wires are mounted in the covered electric wire holder.

Figs. 3A to 3C show perspective views depicting an electric wire laying procedure for laying the covered electric wires in the covered electric wire holder by use of the electric wire laying jig. Fig. 3A is a perspective view showing a state immediately before the covered electric wires are assembled into the covered electric wire holder, Fig. 3B is a perspective view showing a state in which the covered electric wires are temporarily fixed in the holder, and Fig. 3C is a perspective view showing a state in which the covered electric wires are completely mounted in the covered electric wire holder.

Fig. 4 is a concept diagram of a continuity checking apparatus which utilizes a continuity checking apparatus of the invention.

Fig. 5 is a perspective view depicting continuity checking press-contact blades which are used in the continuity checking apparatus shown in Fig. 4.

Fig. 6A is a front view of the continuity checking apparatus shown in Fig. 4, and Fig. 6B is a sectional view taken along the line C-C and seen in a direction

indicated by arrows C in Fig. 6A.

Figs. 7A and 7B show drawings depicting a state in which the covered electric wire holder in which the covered electric wires are mounted is fitted in a first connector of the vehicle interior illumination apparatus. Fig. 7A is a vertical sectional view showing the vicinity of the fitting portion where the covered electric wire holder fits in the first connector, and Fig. 7B is an enlarged view of the fitting portion.

Figs. 8A to 8D show a continuity checking apparatus according to a second embodiment of the invention. Fig. 8A is a perspective view showing a state before a covered electric wire holder is inserted into the continuity checking apparatus, Fig. 8B is a perspective view showing a state in which the holder is completely inserted into the continuity checking apparatus, Fig. 8C is a bottom view of the continuity checking apparatus shown in Fig. 8B, and Fig. 8D is a sectional view taken along the line E-E and seen in a direction indicated by arrows E in Fig. 8C.

Fig. 9 is an exploded perspective view depicting the vehicle interior illumination apparatus to which the invention is applied.

Figs. 10A and 10B show drawings depicting a state in which a covered electric wire holder having no conducting component incorporated therein is mounted in the vehicle interior illumination apparatus shown in Fig. 9. Fig. 10A is a perspective view of a rear side of the vehicle interior illumination apparatus depicting a state before the covered electric wire holder according to the invention is fitted in the first connector, and Fig. 10B is a perspective view of the rear side of the vehicle interior illumination apparatus depicting a state in which the covered electric wire holder is completely fitted in the first connector.

Fig. 11A is a plan view of the vehicle interior illumination apparatus as seen from the rear side of the vehicle interior illumination apparatus in Fig. 10B, and Fig.

11B is a sectional view of the vehicle interior illumination apparatus taken along the line D-D in Fig. 11A which is an enlarged view of a press-contact blade portion.

Figs. 12A to 12C show drawings depicting a state in which a busbar and a metallic fixture of the vehicle interior illumination apparatus are mounted in the vehicle interior illumination apparatus. Fig. 12A is a perspective view of a rear side of the vehicle interior illumination apparatus showing a state before the busbar and the metallic fixture are mounted, Fig. 12B is a perspective view of the rear side of the vehicle interior illumination apparatus showing a state in which the busbar and the metallic fixture are completely mounted, and Fig. 12C is an enlarged view of a portion denoted by reference character A in Fig. 12B.

Figs. 13A to 13C show drawings depicting a state in which a switch of the vehicle interior illumination apparatus is mounted in the vehicle interior illumination apparatus. Fig. 13A is a perspective view of the rear side of the vehicle interior illumination apparatus showing a state before the switch is mounted, Fig. 13B is a perspective view of the rear side of the vehicle interior illumination apparatus as seen from a right end, showing a state in which the switch is are completely mounted, and Fig. 13C is a perspective view showing the rear side of the vehicle interior illumination apparatus as seen from a left end, showing the state in which the switch is completely mounted.

Figs. 14A and 14B show drawings depicting a state in which a switch knob of the vehicle interior illumination apparatus is mounted in the vehicle interior illumination apparatus. Fig. 14A is a front perspective view showing a state before the switch knob is mounted, and Fig. 14B is a front perspective view showing a state in which the switch knob is completely mounted.

Figs. 15A and 15B show drawings depicting a state in which a bulb (an electric

lamp) of the vehicle interior illumination apparatus is mounted in the vehicle interior illumination apparatus. Fig. 15A is a front perspective view showing a state before the bulb is mounted, and Fig. 15B is a front perspective view showing a state in which the bulb is completely mounted.

Figs. 16A and 16B show drawings depicting a state in which a lens of the vehicle interior illumination apparatus is mounted in the vehicle interior illumination apparatus. Fig. 16A is a front perspective view showing a state before the lens is mounted, and Fig. 16B is a front perspective view showing a state in which the lens is completely mounted.

Description of Embodiments

A vehicle interior illumination apparatus will briefly be described by reference to the drawings in which vehicle interior illumination apparatus a covered electric wire holder with covered electric wires to which a continuity checking method of the invention is applied is mounted.

Fig. 9 is an exploded perspective view of a vehicle interior illumination apparatus to which the invention is applied. In Fig. 9, the vehicle interior illumination apparatus 10 is mounted in a bulkhead panel (a ceiling panel) which defines a passenger compartment of a vehicle and briefly includes a substantially rectangular lens 20, a longitudinally elongated switch knob 30, a substantially rectangular housing 40 and a busbar 50.

A bulb accommodation compartment 41 is formed in the housing 40 on a front side 40F thereof, and a bulb 41B, which is a light source, is assembled in a central portion of the bulb accommodation compartment 41. A switch accommodation compartment 42 is provided in a side portion of the housing 40, and the switch knob

30 is assembled into the switch accommodation compartment 42 from the front side 40F so as to slide therein.

Additionally, a first connector 43 is provided at one end portion of the housing 40 so as to project endways of the housing 40. A covered electric wire holder 60 (Fig. 10A) in which covered electric wires W which make up a wiring harness are fixed in place is fitted in the first connector 43.

Figs. 10A and 10B show drawings depicting a state in which the covered electric wire holder having no conducting component incorporated therein is mounted in the vehicle interior illumination apparatus shown in Fig. 9, of which Fig. 10A shows a state before the covered electric wire holder is fitted in the first connector and Fig. 10B shows a state in which the covered electric wire holder is completely fitted in the first connector. When the covered electric wire holder is fitted in the first connector, press-contact blades 51 (which will be described later) incorporated in the first connector press fit on the covered electric wires mounted in the covered electric wire holder so that electric contacts are automatically made therebetween.

Referring back to Fig. 9, a metallic clip 44 (Fig. 9) is fixed to the other or opposite end portion of the housing 40 to the end portion where the first connector 43 is provided for mounting the vehicle interior illumination apparatus 10 in the bulkhead panel which defines the passenger compartment of the vehicle therewith. A switch 42R (Figs. 11A and 11B), which is linked with the switch knob 30 for operation, is assembled into the switch accommodation compartment 42 from a rear side of the housing 40. The busbar 50 (Fig. 9), which is a circuitry for electrically connecting the switch 42R and the bulb 41B, is fixedly assembled to the rear side of the housing 40. The press-contact blades 51 (Fig. 9) are disposed at one end of the busbar 50 so as to be parallel to each other in a vertical direction. The press-contact blades 51 are

then fixedly mounted within the first connector 43.

Next, the electric connection by the press-contact blades 51 will be described by reference to Figs. 11A and 11B.

Fig. 11A is a plan view of the vehicle interior illumination apparatus as seen from a rear side of the vehicle interior illumination apparatus in Fig. 10A, and Fig. 11B is a sectional view of the vehicle interior illumination apparatus taken along the line D-D in Fig. 11A. In Figs. 11A and 11B, the covered electric wire holder 60 in which the covered electric wires W are fixed in place fits in the first connector 43. The switch 42R and the busbar 50 are fixed to the rear side of the housing 40, and the press-contact blades 51 (Fig. 9) of the busbar 50 are fixed to the first connector 43. Although the covered electric wire holder 60 incorporates therein no conducting component, when the covered electric wire holder 60 is inserted into the first connector 43 to fit therein as shown in Fig. 11B, the press-contact blades 51 enter an interior of the covered electric wire holder 60 from an opening therein and then bite directly into the covered electric wires W so that electric connection is made between the covered electric wires W and the press-contact blades 51. In the invention, an opening is provided in the covered electric wire holder 60 through which the press-contact blades 51 are inserted.

Figs. 12A to 12C show drawings depicting a state in which the busbar and the metallic fixture of the vehicle interior illumination apparatus are mounted in the vehicle interior illumination apparatus. Fig. 12A is a perspective view of a rear side of the vehicle interior illumination apparatus showing a state before the busbar and the metallic fixture are mounted, Fig. 12B is a perspective view of the rear side of the vehicle interior illumination apparatus showing a state in which the busbar and the

metallic fixture are completely mounted, and Fig. 12C is an enlarged view of a portion denoted by reference character A in Fig. 12B.

In Figs. 12A to 12C, the metallic clip 44 is brought into engagement with an engagement groove 44R (Fig. 12A) which is provided on an end face of the housing 40 which is opposite to an end face where the first connector 43 (Figs. 11A and 11B) is provided so as to be fixed in place therein, and the busbar 50 is fixedly mounted on the rear side of the housing 40 so as to extend thereover entirely. The busbar 50 is temporarily fixed to the rear side of the housing 40 by plural projections 40T (Fig. 12C) which are formed on the rear side and thereafter is fixed thereto by use of a fusion bonding method in which distal ends of the projections 40T are fused.

Figs. 13A to 13C show drawings depicting a state in which the switch of the vehicle interior illumination apparatus is mounted in the vehicle interior illumination apparatus, in which Fig. Fig. 13A is a perspective view of the rear side of the vehicle interior illumination apparatus depicting a state before the switch is mounted, Fig. 13B is a perspective view of the rear side of the vehicle interior illumination apparatus as seen from a right end, depicting a state in which the switch is completely mounted, and Fig. 13C is a perspective view depicting the rear side of the vehicle interior illumination apparatus as seen from a left end, showing the state in which the switch is completely mounted. The switch 42R is mounted in the switch accommodation compartment 42 provided in the housing 40 from the rear side of the housing 40 so as to be fixed in place therein.

Figs. 14A and 14B show drawings depicting a state in which the switch knob of the vehicle interior illumination apparatus is mounted in the vehicle interior illumination apparatus, of which Fig. 14A is a front perspective view showing a state in which the switch knob is mounted, and Fig. 14B is a front perspective view showing a

state in which the switch knob is completely mounted. The switch knob 30 is mounted slidably within the switch accommodation compartment 42 from the front side 40F of the housing 40 so as not only to be linked with the switch 42R for operation but also to cover the switch accommodation compartment 42 so that an interior of the compartment is concealed thereby.

Figs. 15A and 15B show drawings depicting a state in which the bulb of the vehicle interior illumination apparatus is mounted in the vehicle interior illumination apparatus, of which Fig. 15A is a front perspective view showing a state before the bulb is mounted, and Fig. 15B is a front perspective view showing a state in which the bulb is completely mounted. The bulb 41B is mounted substantially in the central portion of the bulb accommodation compartment 41 from the front side 40F of the housing 40 for electric connection with the busbar 50.

Figs. 16A and 16B show drawings depicting a state in which the lens of the vehicle interior illumination apparatus is mounted in the vehicle interior illumination apparatus, of which Fig. 16A is a front perspective view showing a state before the lens is mounted, and Fig. 16B is a front perspective view showing a state in which the lens is completely mounted. The lens 20 is mounted on the housing 40 from the front side 40F thereof so as to cover and conceal the housing 40 as a result of plural engagement pieces 20S which are formed at both sides of the lens 20 in positions lying at substantially longitudinal ends of the lens 20 being brought into engagement with engagement projections 40S which are formed on both lateral side faces of the housing 40 in positions lying at substantially longitudinal ends of the housing 40. As this occurs, an opening portion 21 formed in the lens 20 is brought into contact with lateral side faces and end faces of the switch knob 30.

Thus, the description is completed of the overall configuration of the vehicle

interior illumination apparatus to which the invention is applied and the main constituent parts thereof.

Next, the configuration of the covered electric wire holder 60 which is used together with a continuity checking method of the invention will be described by reference to Figs. 1A to 1C. Figs. 1A to 1C show perspective views which depict the covered electric wire holder 60. Fig. 1A is a perspective view of the holder 60 showing a state before an inner holder and a cover are fitted together, and Fig. 1B is a perspective view of the holder 60 showing a state in which covered electric wires are laid. The covered electric wire holder 60 includes an inner holder 61 and a cover 62 which is connected with an end portion of the inner holder 61 via a flexible hinge 61H. Plural grooves 63 along which covered electric wires W are laid are formed on the inner holder 61 so as to extend along a top portion and both lateral side portions of the inner holder 61. Locks 61R are formed on the inner holder 61, and fitting locks 62R are formed on the cover 62 which are brought into engagement with the locks 61R when the cover 62 is placed on the inner holder 61. Referring to Fig. 1A, a cover inserting portion 61K is formed at a lower edge portion of the inner holder 61. The inner holder 61 and the cover 62 are integrated together via the flexible hinge 61H which is formed integrally with the cover 62 by a distal end of the flexible hinge 61H being inserted into the cover inserting portion 61K. Additionally, a lock beak 61B is present on an external side of the inner holder 61. This lock beak 61B is brought into engagement with a locking portion 43B (refer to Fig. 7A) of the first connector 43 which is a mating connector in which the covered electric wire holder 60 fits.

The cover 62 is built into a substantially U-shaped structure in vertical section, and therefore, a cover opening preventive rib 62S is formed on the cover 62 which connects portions of leg portions of the rib 62S which lie near distal ends of the leg

portions so as to prevent the opening of the leg portions when the cover 62 is placed over the inner holder 61. In Fig. 1A, openings 62K are formed in a lower end of the cover 62 at respective checking locations for the covered electric wires W1, W2, W3 which are laid at the top portion of the inner holder 61 so that the covered electric wires W1, W2, W3 are not concealed but stay visible and accessible when the cover 62 is placed over the inner holder 61. In addition, shapes of the openings 62K are not limited.

As shown in Figs. 1B and 1C, the three grooves 63 are formed on the inner holder 61 so as to extend in parallel over top and lateral side surfaces thereof. The covered electric wires W1, W2, W3 are individually laid in these grooves 63. The grooves 63 have a width which is slightly narrower than the outside diameter of the covered electric wires W1, W2, W3. Therefore, strains put on the covered electric wires W1, W2, W3 are relieved by bendability inherent in the covered electric wires W1, W2, W3 and being held in the inner holder 61.

After the covered electric wires W1, W2, W3 have been laid on the inner holder 61, the cover 62 is placed over the inner holder 61, and the cover 62 then fits on the inner holder 61, whereby the covered electric wire holder (second connector) 60 is completed to which the covered electric wires are attached.

Figs. 2A to 2C show drawings depicting a method used for mounting the covered electric wires on to the connector which is assembled to the vehicle interior illumination apparatus shown in Fig. 11A by utilizing an electric wire laying jig which is conceived separately by the applicant of this patent application. Fig. 2A is a perspective view showing a state before the connector is assembled to an electric wire laying jig, Fig. 2B is a perspective view showing a state in which the connector is temporarily fixed on the electric wire laying jig, and Fig. 2C is a perspective view

showing a state before the covered electric wires are mounted on the covered electric wire holder.

In Fig. 2A, a covered electric wire holder support 71 is provided on the electric wire laying jig 70 in a position lying on a center line and near one edge portion of the electric wire laying jig 70, and the inner holder 61 and the cover 62 of the covered electric wire holder 60 are placed on the covered electric wire holder support 71. Of the covered electric wire holder support 71, a support for the inner holder 61 is denoted by reference numeral 71A, and a support for the cover 62 is denoted by reference numeral 71B. Additionally, a holder positioning projection 71T is provided on the inner holder support 71A so as to project upwards therefrom. Further, positioning pins 72 of two types (pins 72A and pins 72B) are provided on the electric wire laying jig 70 so as to be erected therefrom.

One of the two types of positioning pins 72 is made up of two third connector positioning pins 72A for positioning a third connector 80. These pins 72A are provided side by side at another edge portion of the electric wire laying jig 70 so as to be spaced apart with a gap corresponding to the width of the covered electric wire defined therebetween.

The other of the two types of positioning pins 72B is made up of plural electric wire positioning pins 72B for positioning the covered electric wires, and these four electric wire positioning pins 72B are disposed individually near four corners of the electric wire laying jig 70. The number of the positioning pins 72B is four in Figs. 2A to 2C.

The plural covered electric wires W which are aligned vertically extend in a horizontal direction from the third connector which is fixed by the third connector positioning pins 72A, and the covered electric wires W are caused to turn around

lateral sides of the individual electric wire positioning pins 72B so as to change the direction in which they extend through 90 degrees while kept aligned vertically, thereby making it possible to lay the covered electric wires so that they follow the side edge portions of the electric wire laying jig 70 while being bent accordingly at the four corners thereof. The number of the covered electric wires W is three in Fig. 2C.

Next, referring to Figs. 2A to 3C, a method will be described for laying the covered electric wires in the covered electric wire holder by utilizing the electric wire laying jig described above.

In a first step of the covered electric wire laying or assembling method, the inner holder 61 of the covered electric wire holder 60 is carried to be positioned directly above the holder positioning projection 71T (refer to Fig. 2A).

In a second step, the inner holder 61 is lowered in a direction indicated by a thick white arrow outlined with a black solid line in Fig. 2A and is then placed on the holder positioning projection 71T so that the covered electric wire holder 60 is temporarily fixed on to the support 71 (refer to Fig. 2B).

In a third step, the third connector 80 to which the plural covered electric wires W are attached is carried above the electric wire laying jig 70. As this occurs, ends of the three covered electric wires W which lie to face the third connector 80 are positioned directly above the pair of third connector positioning pins 72A, 72A, and the remaining portions of the three covered electric wires W are positioned so as to extend across the electric wire laying jig 70 thereabove in a straight line (Fig. 2C).

In a fourth step, the whole of the third connector 80 with the covered electric wires W is lowered as they are in a direction indicated by a thick white arrow outlined with a black solid line in Fig. 2C. Then, firstly, the third connector 80 is brought into abutment with external sides of the third connector positioning pins 72A, 72A (Fig. 2C),

and root portions of the covered electric wires W which lie at the third connector 80 are caused to be held between the third connector 3 positioning pins 72A, 72A (Fig. 3A). The external sides with which the third connector 80 is brought into abutment are sides lying opposite to the electric wire laying jig 70.

Next, in a fifth step, the three vertically aligned covered electric wires W which extend from the third connector 80 are caused to pass sequentially around the lateral sides of the two electric wire positioning pins 72B, 72B which are provided on a third connector positioning pin 72A side of the electric wire laying jig 70 to change the direction in which they extend so as to be brought to near the inner holder support 71A.

Following this, in a sixth step, the individual covered electric wires W are inserted into the plural grooves 63 formed on the top portion of the inner holder 61 which is being temporarily fixed on the inner holder support 71A in the way described above.

Further, in a seventh step, the covered electric wires W are caused to pass sequentially around the lateral sides of the two remaining electric wire positioning pins 72B, 72B to change the direction in which they extend so that the covered electric wires W are led out from an opposite side of the electric wire laying jig 70 to the side where the third connector positioning pins 72A are provided (Fig. 3A).

In a eighth step, when the other or free end portions of the three vertically aligned covered electric wires W which extend from the third connector 80 are pulled strongly in a direction indicated by an arrow F shown in Fig. 3B, loosening in the covered electric wires W is mitigated by the electric wire positioning pins 72B. The direction indicated by the arrow F indicates an opposite direction to the third connector 80. Additionally, the covered electric wires W which are loosely laid in the plural

grooves 63 on the inner holder 61 are then firmly fixed in the corresponding grooves 63 (Fig. 3B).

Then, in ninth step, the cover 62 which is fixed in place on the cover support 71B is removed from the cover support 71B and is turned to the inner holder support 71A side at the hinge portion 61H (refer to Figs. 1A to 1C) so as to be placed over the inner holder 61 which is being temporarily fixed to the inner holder support 71A, whereby the two members are fitted together. As this occurs, as shown in Fig. 3C, the covered electric wire holder 60 to which the covered electric wires are attached is completed.

In this way, by use of the electric wire laying jig 70, the loosening in the covered electric wires W can be eliminated, and the covered electric wires W can be mounted accurately in the covered electric wire holder.

Referring to Fig. 4, a continuity checking apparatus according to the invention will be described which is used to check a disconnection in the covered electric wires W1, W2, W3 of the covered electric wire holder 60 with the covered electric wires which is obtained in the way described above and an arrangement of the electric wires and further a connection at crimped portions within the connector 80. Fig. 4 is a concept diagram of a continuity checking system which utilizes the continuity checking apparatus of the invention. In Fig. 4, the continuity checking apparatus 100 according to the invention includes an electric wire holder inserting portion 101, a continuity checking press-contact blade erecting portion 102 which is situated below the electric wire holder inserting portion 101, and continuity checking press-contact blades M1, M2, M3. Further, the continuity checking apparatus 100 includes a power supply 4, meters (ammeters) 5 and electric wires 6 which are added externally thereto. Conductive metallic pieces MB1, MB2, MB3 which include the continuity checking

press-contact cutting plates M1, M2, M3 (refer to Fig. 5) at distal ends thereof and one end 4T1 of the power supply 4 are connected together via the corresponding meters (ammeters) 5 by the electric wires 6, while the other end 4T2 of the power supply 4 is connected to the third connector 80 at the other ends of the covered electric wires W1, W2, W3 which are target for continuity checking, whereby the continuity checking system is constructed.

Following this, the continuity checking press-contact blades M1, M2, M3, the electric wire holder inserting portion 101 and the continuity checking press-contact blade erecting portion 102 will be described.

In the first embodiment, the continuity checking press-contact blades M1, M2, M3 are used as checking terminals. Here, the continuity checking press-contact blades M1, M2, M3 which are used in the continuity checking apparatus 100 shown in Fig. 4 will be described. Fig. 5 is a perspective view of the continuity checking press-contact blades M1, M2, M3. The individual continuity checking press-contact blades M1, M2, M3 are made by bending the respective elongated conductive metallic pieces MB1, MB2, MB3. The press-contact blades M1, M2, M3 each have a bifurcated fork-like shape such as a tuning fork and are formed at distal ends of the conductive metallic pieces MB1, MB2, MB3, respectively. The press-contact blades M1, M2, M3 have the same turning fork-like shape. Although they are disposed at the same height (the direction of a Z axis in rectangular coordinates), the press-contact blades M1, M2, M3 are offset slightly from each other in the direction of X and Y axes. Inner edges of the bifurcated portion of each of the press-contact blades M1, M2, M3 are formed into a blade-like configuration, and the press-contact blades M1, M2, M3 bite into the insulated electric wires W1, W2, W3 at the inner edges by cutting insulation covers thereof so as to establish an electric connection

therebetween.

Fig. 6A is a front view of the continuity checking apparatus shown in Fig. 4, and Fig. 6B is a sectional view taken along the line C-C and seen in a direction indicated by arrows C in Fig. 6A. The electric wire holder inserting portion 101 is a receptacle having an interior space into which the covered electric wire holder 60 is inserted in which the portions of the insulated electric wires W1, W2, W3 to be checked which lie near the end portions thereof are laid. The erecting portion 102 where the continuity checking press-contact blades M1, M2, M3 (refer to Fig. 5) are erected is formed in a bottom portion of the receptacle. The continuity checking press-contact blades M1, M2, M3 used as checking terminals are provided so as to be erected along an insertion direction of the covered electric wire holder into the electric wire holder inserting portion.

Then, when the covered electric wire holder 60 is inserted into the interior of the electric wire holder inserting portion 101 with the openings 62K (refer to Fig. 3C) in the cover 62 oriented downwards, the continuity checking press-contact blades M1, M2, M3 enter the corresponding openings 62K to cut the insulation covers of the covered electric wires W1, W2, W3 which reside in the openings 62K and then press fit on core conductor wires C1, C2, C3 which are situated in the centers of the covered electric wires W1, W2, W3, whereby the continuity checking press-contact blades M1, M2, M3 and the core conductor wires C1, C2, C3 are electrically connected to each other. In Fig. 6B, a state is depicted in which the continuity checking press-contact blade M1 of the continuity checking press-contact blades M1, M2, M3 enters the opening 62K to press fit on the core conductor wire C1 of the covered electric wire W1. The reason that only the continuity checking press-contact blade M1 is depicted is that only the continuity checking press-contact blade M1 exists in the section.

Therefore, it is understood that the other continuity checking press-contact blades M2, M3 are situated in sections which lie ahead of or behind the section shown in Fig. 6B.

Thus, according to the invention, the continuity checking press-contact blades M1, M2, M3 are electrically connected to the core conductor wires C1, C2, C3, respectively only by inserting the covered electric wire holder 60 with the openings according to the invention into the electric wire holder inserting portion 101 of the continuity checking apparatus 100 according to the invention. Therefore, the invention is useful since no labor hour has to be spent cutting the insulation covers.

Then, to check the covered electric wires W1, W2, W3 for continuity,

Firstly, the covered electric wire holder 60 in which the covered electric wires W1, W2, W3 are mounted is inserted into the electric wire holder inserting portion 101 of the continuity checking apparatus 100 shown in Fig. 4 from thereabove with the openings 62K in the holder oriented downwards.

On the other hand, electric wires 7 extending from the other end 4T2 of the power supply 4 are inserted into terminals within the third connector 80 (refer to Fig. 3C) which is attached to the other ends of the covered electric wires W1, W2, W3.

By so doing, the continuity checking press-contact blades M1, M2, M3 enter the corresponding openings 62K in the cover 62 of the covered electric wire holder 60 and bite into the covered electric wires W1, W2, W3 to be brought into contact with the core conductor wires C1, C2, C3, respectively, whereby a closed circuitry is formed in which the continuity checking press-contact blades M1, M2, M3 each include the power supply 4 and the meter (ammeter) 5.

Then, scales on the meters 5 which are pointed by pointers thereof are read.

In case there exists no disconnection somewhere along the length of the covered electric wires W1, W2, W3 to be checked through the meters 5, an electric

current flows to the meters (ammeters) 5, as a result of which the pointers of the meters 5 swing largely, whereby it is understood that there is no "disconnection."

On the contrary, in case there exists a disconnection somewhere along the length of any of the covered electric wires W1, W2, W3 to be checked through the meters 5, no electric current flows to the corresponding meter 5, as a result of which the pointer of the meter 5 does not swing, whereby it is understood that there exists a disconnection somewhere along the length of the covered electric wire to which the meter 5 is connected.

In this way, it is determined that the covered electric wires pass the checking by verifying the fact that the respective pointers of the meters 5 swing. Although the ammeters are used as the meters 5 in this embodiment, voltmeters may be used in place of the ammeters. Additionally, light emitting diodes may be used in place of the meters 5. In this case, it is determined that the covered electric wires pass the checking when it is confirmed that the light emitting diodes emit light.

Figs. 7A and 7B show drawings depicting a state in which the covered electric wire holder (the second connector) in which the covered electric wires which are determined to pass the checking utilizing the continuity checking apparatus shown in Figs. 6A and 6B are mounted is fitted in the first connector of the vehicle interior illumination apparatus, of which Fig. 7A is a vertical sectional view showing the vicinity of the fitting portion where the covered electric wire holder fits in the first connector, and Fig. 7B is an enlarged view of the fitting portion.

The covered electric wires W1, W2, W3 which passed the continuity checking are laid in the covered electric wire holder 60, and the cover 62 having the openings 62K formed therein is placed to cover the whole of the holder. On the other hand, the press-contact blades 51 positioned at the distal end of the busbar are incorporated in

the housing 40 of the vehicle interior illumination apparatus. Then, the press-contact blade 51 provided in the housing 40 enters the covered electric wire holder 60 from the opening 62K in the cover 62 and bites into the covered electric wire W1 to press fit on the core conductor wire C1 thereof, as shown in Fig. 7B.

Additionally, the lock beak 61B on the covered electric wire holder 60 is in engagement with the engagement portion 43B on the casing 40 so as to prevent the dislocation of the covered electric wire holder 60 from the mating connector.

An inside diameter of the bifurcated portion of each of the continuity checking press-contact blades M1, M2, M3 is referred to as T1 (Fig. 6B), and an side diameter of a bifurcated portion of each of the press-contact blades 51 in the first connector 43 which is incorporated in the vehicle interior illumination apparatus is referred to as T2 (Fig. 7B). The inside diameters T1, T2 are set so that T1>T2.

Additionally, the inside diameters T1 of the continuity checking press-contact blades M1, M2, M3 are sized so as to compress the core conductor wires C1, C2, C3 thereof. Therefore, the core conductor wires C1, C2, C3 are compressed more by the bifurcated portions having the inside diameter T2 of the press-contact blades 51 than by those of the continuity checking press-contact blades M1, M2, M3. By adopting this configuration, the press-contact blades 51 are allowed to bite further into the cuts made in the core conductor wires by the continuity checking press-contact blades M1, M2, M3, so as to press fit thereon in an ensured fashion. Consequently, by satisfying the relation above, the press-contact blades 51 are not affected by the cuts made in the core conductor wires C1, C2, C3 by the continuity checking press-contact blades M1, M2, M3. The insulation cover of the covered electric wire W1 has already been cut and broken once by the continuity checking press-contact blade M1, and therefore, the load applied to the holder when it fits in the connector is

reduced.

Thus, the description of Embodiment 1 in which the press-contact blades are used as the checking terminals is completed.

Figs. 8A to 8D show a continuity checking apparatus according to Embodiment 2 of the invention where no press-contact blade is used, in which Fig. 8A is a perspective view showing a state before a covered electric wire holder 60 is inserted into the continuity checking apparatus according to Embodiment 2, Fig. 8B is a perspective view showing a state in which the holder is completely inserted into the continuity checking apparatus, Fig. 8C is a bottom view of the continuity checking apparatus shown in Fig. 8B, and Fig. 8D is a sectional view taken along the line E-E and seen in a direction indicated by arrows E in Fig. 8C.

In Figs. 8A to 8D, the continuity checking apparatus 110 according to Embodiment 2 includes an electric wire holder inserting portion 111 into which a covered electric wire holder 60 is inserted in which insulated electric wires W1, W2, W3 to be checked are laid. Additionally, continuity checking probes P1, P2, P3 (probes) are erected in a bottom portion of the electric wire holder inserting portion 111 so as to be offset from each other in an X-Y plane.

Then, when the covered electric wire holder 60 is inserted into the electric wire holder inserting portion 111 with an end where openings 62K are formed in a cover 62 oriented downwards, the continuity checking probes P1, P2, P3 enter the corresponding openings 62K and bite into the covered electric wires W1, W2, W3 which lie in the corresponding openings 62K. The continuity checking probes P1, P2, P3 further bite into core conductor wires C1, C2, C3 whereby the continuity checking probes P1, P2, P3 and the core conductor wires C1, C2, C3 are electrically connected to each other.

In this way, according to Embodiment 2 of the invention, the continuity checking can be performed by utilizing the continuity checking probes P1, P2, P3 in place of the press-contact blades. In other words, the continuity checking probes P1, P2, P3 are used as the checking terminals in the second embodiment. Therefore, the invention is useful since the continuity checking can be performed easily due to no press-contact resistance being generated which would be generated when the press-contact blades are used.

According to the invention, the continuity checking can be performed without removing the insulation covers of the covered electric wires, and therefore, the continuity checking can easily be performed on the covered electric wires which are laid in the covered electric wire holder having no conducting component.

Further, the continuity checking can be performed on the electric wires making up the wiring harness which is not yet connected to electric equipment, and therefore, a similar checking to be performed on a completed product can be omitted.

In addition, when the covered electric wire holder is finally mounted in the vehicle interior illumination apparatus, the load is reduced under which the covered electric wire holder fits in the connector of the vehicle interior illumination as a result of the press-contact blades on the vehicle interior illumination apparatus side biting into the core conductor wires in the covered electric wire holder.

Further, the continuity checking can easily be performed through piecing of the continuity checking probes.

Furthermore, although PTL1 has the problem that the press-contact metallic contacts become unnecessary, the problem is not generated by the invention.

The above-mentioned embodiment is merely a typical example of the present invention, and the present invention is not limited to the embodiment. That is, the

present invention can be variously modified and implemented without departing from the essential features of the present invention. For example, the press-contact blade and the checking probe are used as the checking terminal in the first and second embodiments, any other types of checking terminal configured to remove the insulation cover of the covered electric wire by insertion can used for the invention.

The present application is based on Japanese Patent Application No. 2011-094360 filed on April 20, 2011, the contents of which are incorporated herein by way of reference.

Industrial Applicability

In accordance with a continuity checking method according to the invention, a continuity checking can be performed on an electric wire accommodated in an electric wire holder having no conducting component without removing an insulation cover of the electric wire.

Reference Signs List

10 vehicle interior illumination apparatus

20 lens

30 switch knob

40 housing

41 bulb accommodation compartment

41B bulb

42 switch accommodation compartment

42R switch

43 first connector

43B locking portion

44 metallic clip

50 busbar

51 press-contact blade

60 covered electric wire holder

61 inner holder

61B lock beak

61H flexible hinge

61K cover inserting portion

62 cover

62K opening

62R fitting lock

62S cover opening preventive rib

70 electric wire laying jig

71A inner holder support

71B cover support

80 third connector

4 power supply

4T1 one end portion

4T2 the other end portion5 meter (ammeter)

6, 7 electric wire

100, 110 continuity checking apparatus

101, 111 electric wire holder inserting portion

102 continuity checking press-contact blade erecting portion

C1, C2, C3 core conductor wire

M1, M2, M3 continuity checking press-contact blade

W1, W2, W3 covered electric wire

P1, P2, P3 continuity checking probe

CLAIMS

1. A continuity checking method for a covered electric wire, comprising:

laying one end portion of a covered electric wire to be checked in an electric wire holder having an opening;

inserting a checking terminal into the opening, the checking terminal configured to remove an insulation cover of the covered electric wire so as to contact a core wire of the covered electric wire; and

applying electric current between the checking terminal and the other end portion of the covered electric wire to check a continuity of the covered electric wire which is mounted in the electric wire holder.

2. The continuity checking method according to claim 1, wherein

the checking terminal is a press-contact blade configured to cut the insulation cover by the inserting.

3. The continuity checking method according to claim 1, wherein

the checking terminal is a probe configured to penetrate the insulation cover by the inserting.

4. A continuity checking apparatus for a covered electric wire comprising:

an electric wire holder inserting portion into which a covered electric wire holder is inserted; and

a checking terminal, provided at a bottom portion of the electric wire holder inserting portion so as to be erected upwards, and configured to remove an insulation

cover of the covered electric wire so as to contact a core wire of the covered electric wire,

wherein the electric wire holder includes an inner holder and a cover having an opening which is placed over the inner holder, and

wherein the checking terminal contacts the core wire when the checking terminal is inserted into the opening in a state where the electric wire holder is inserted into the electric wire holder inserting portion.

5. The continuity checking apparatus according to claim 4, wherein

the checking terminal is a press-contact blade configured to cut the insulation cover when the checking terminal is inserted into the opening.

6. The continuity checking apparatus according to claim 4, wherein

the checking terminal is a probe configured to penetrate the insulation cover when the checking terminal is inserted into the opening.

Fig. 1A

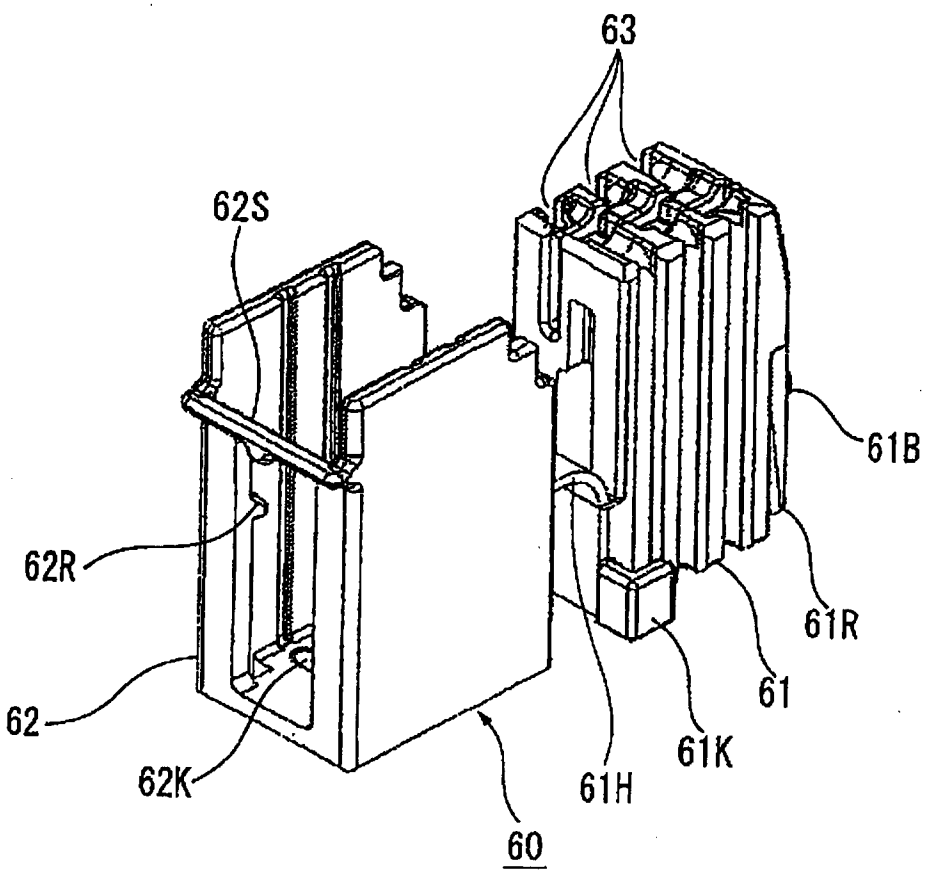


Fig. 1B

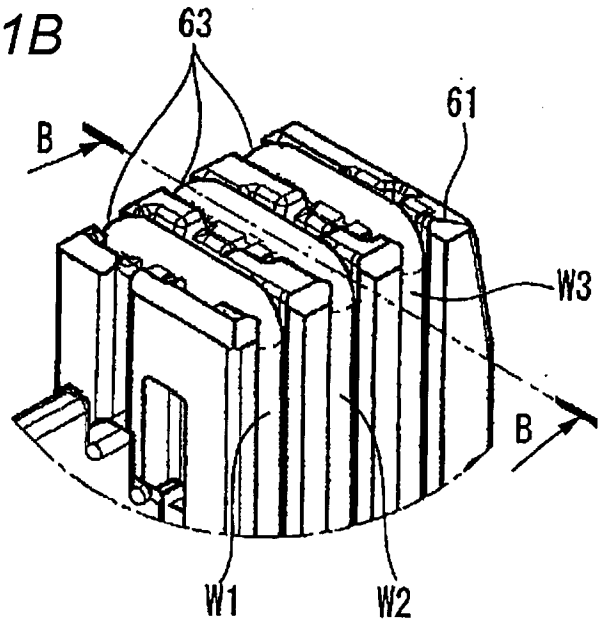


Fig. 1C

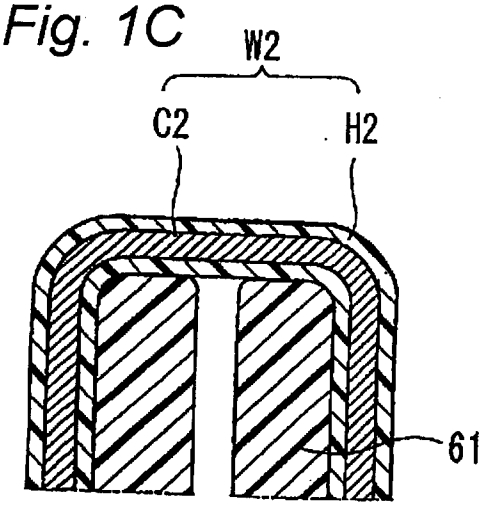


Fig. 2A

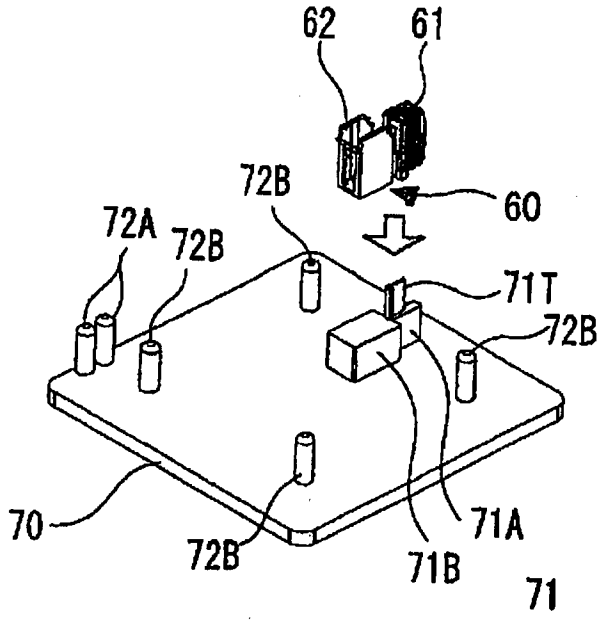


Fig. 2B

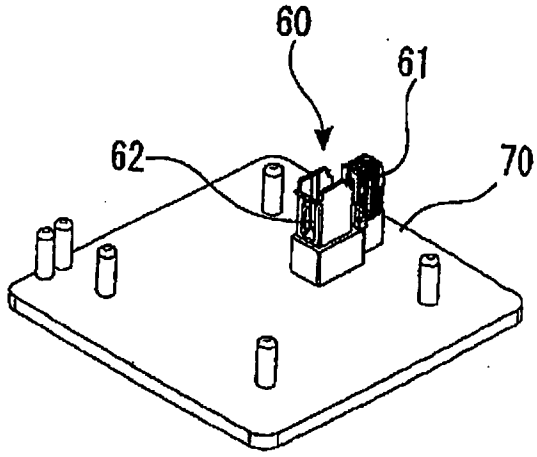


Fig. 2C

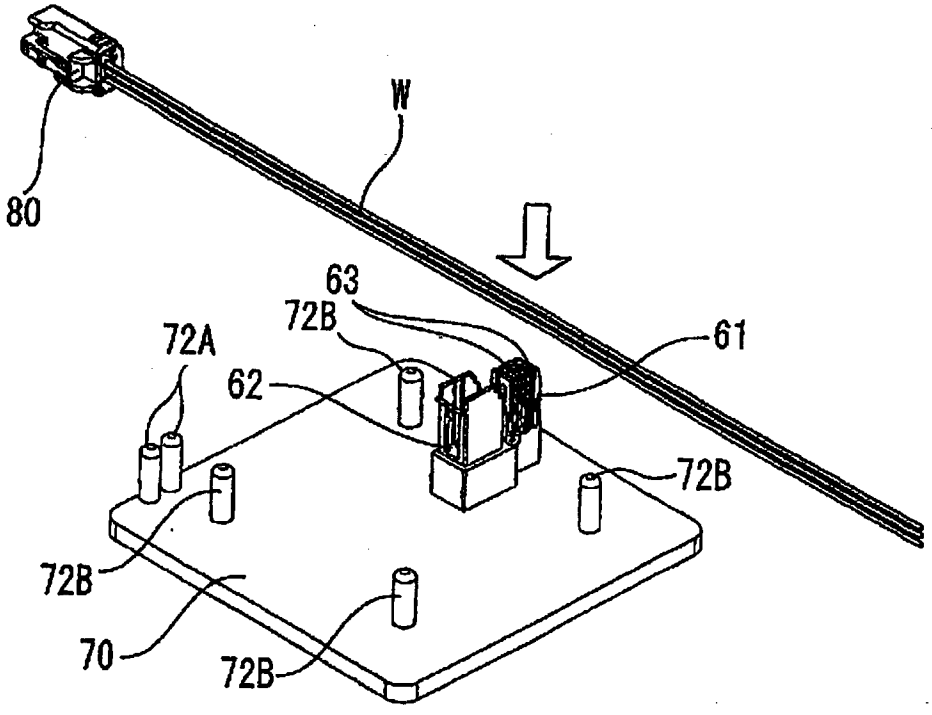


Fig. 3A

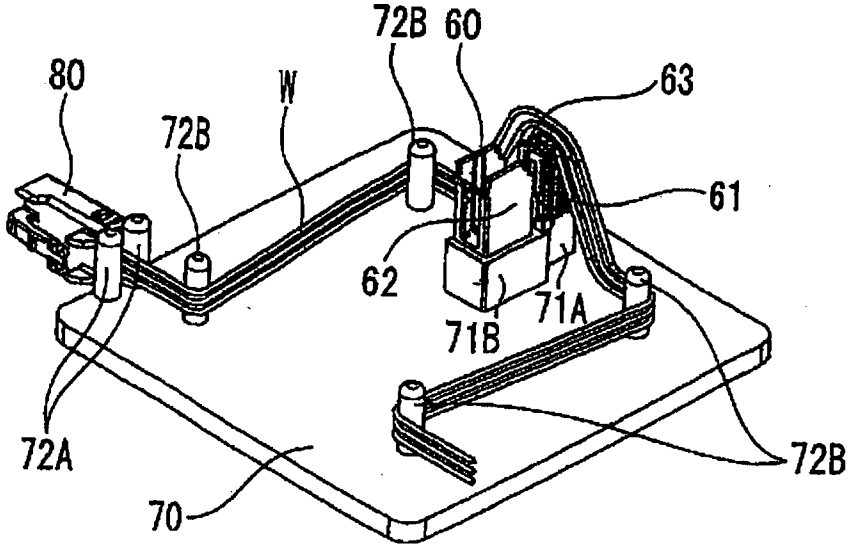

72B
60
80
W
63
72B
61
62
71A
71B
72A
72B
70

Fig. 3B

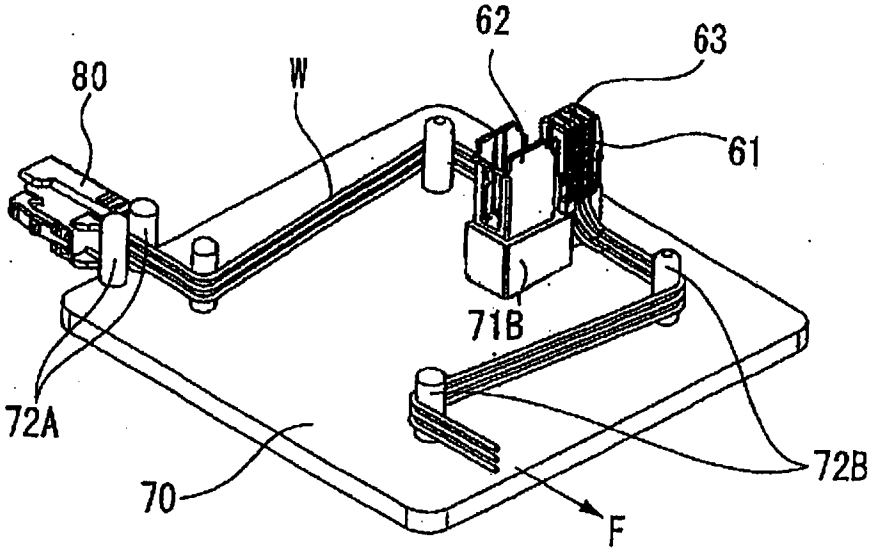

62
63
80
W
61
71B
72A
72B
70
F

Fig. 3C

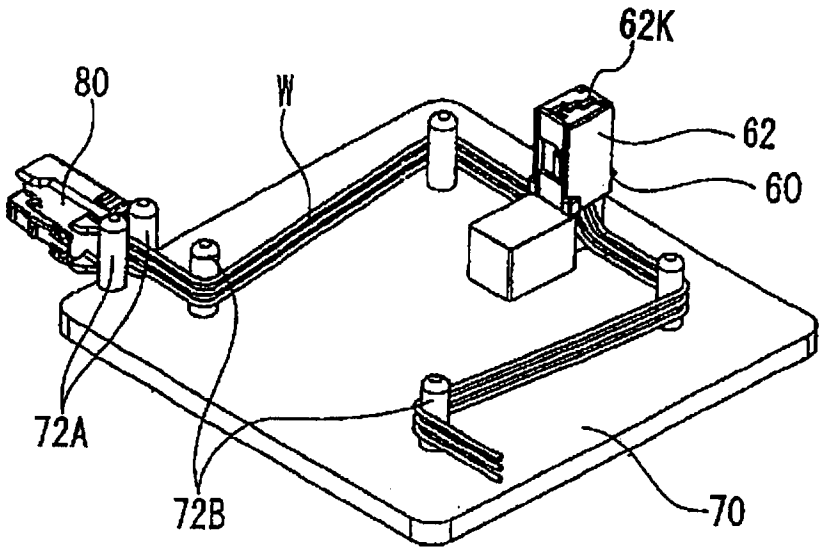


Fig. 4

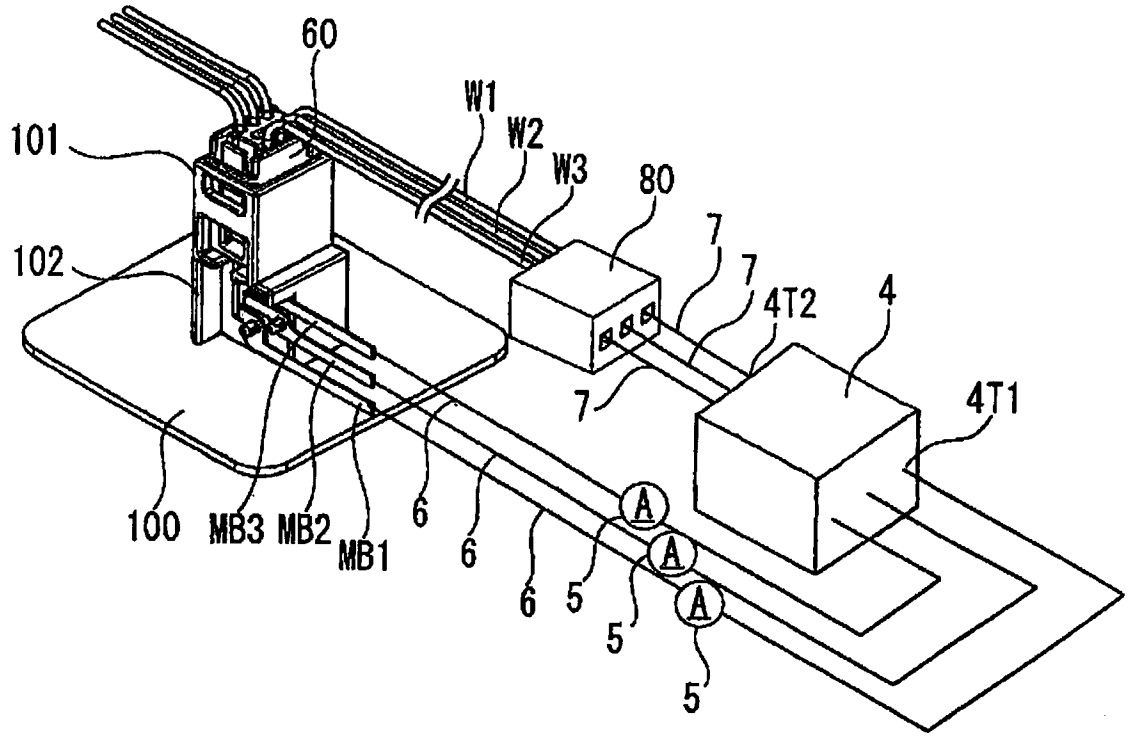


Fig. 5

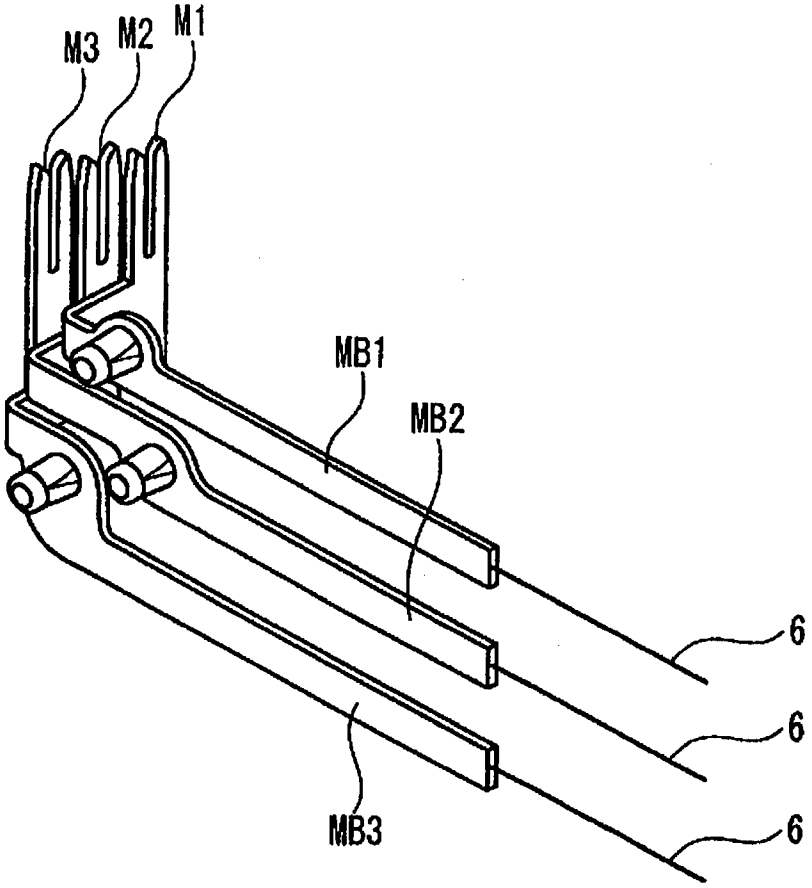


Fig. 6A

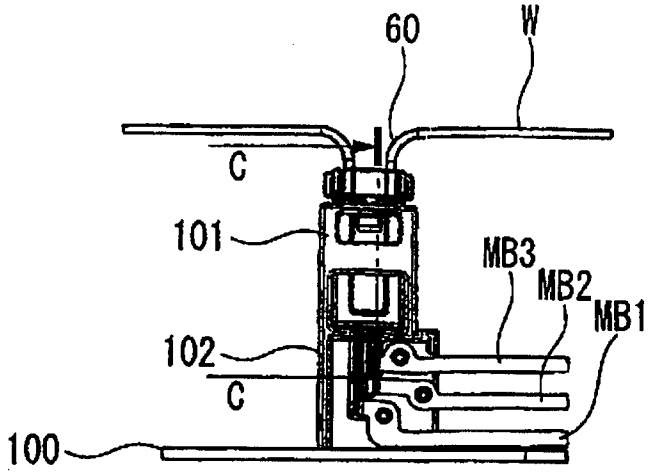


Fig. 6B

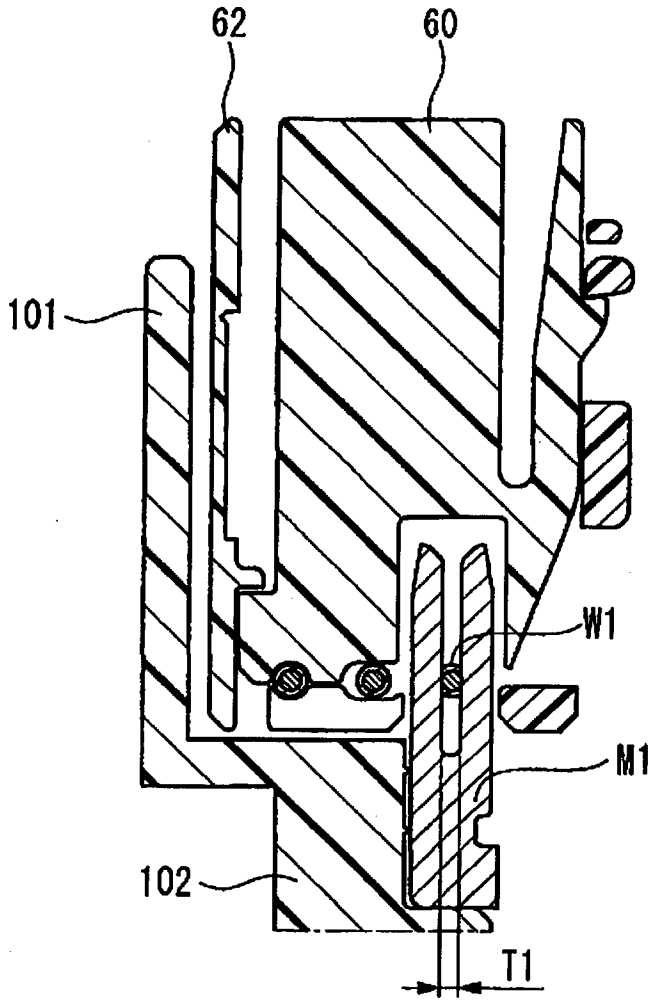


Fig. 7A

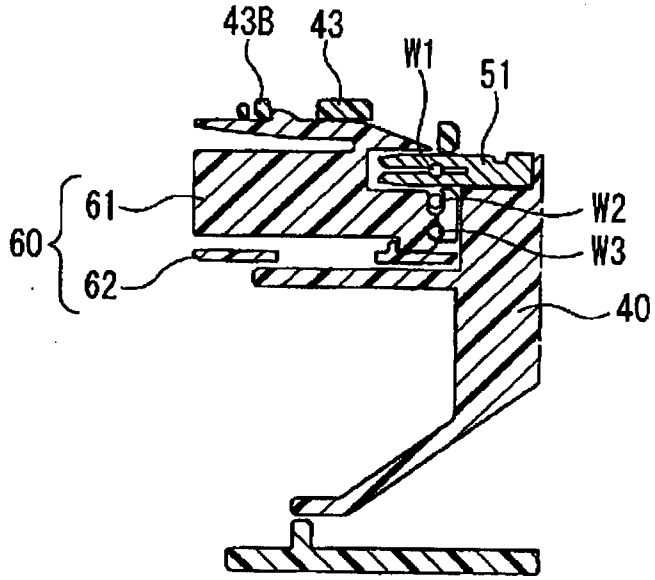


Fig. 7B

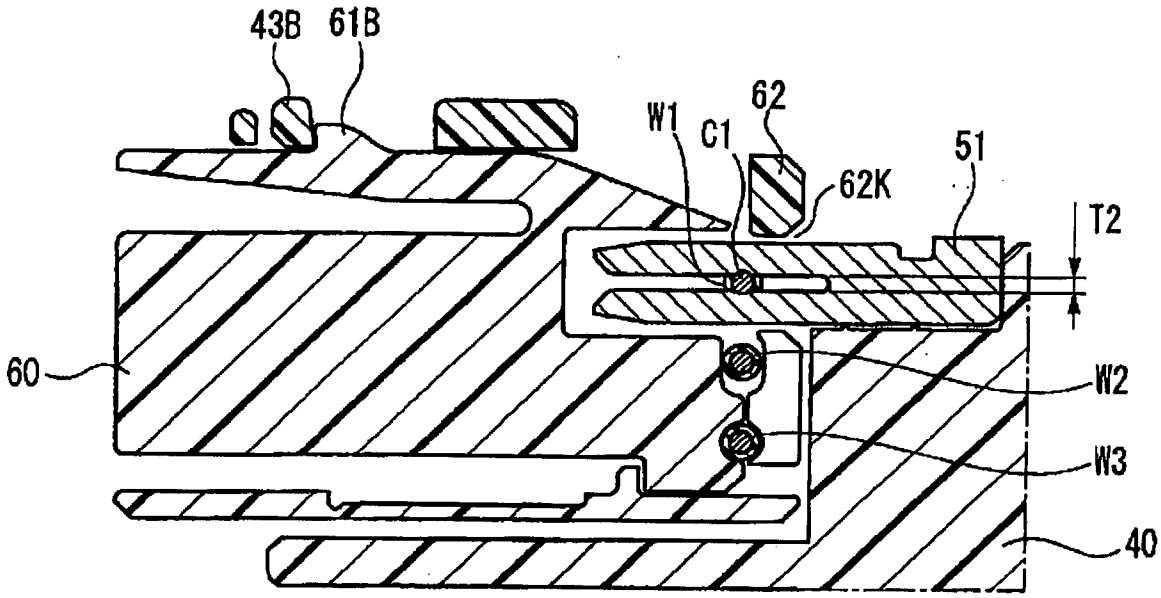


Fig. 8A

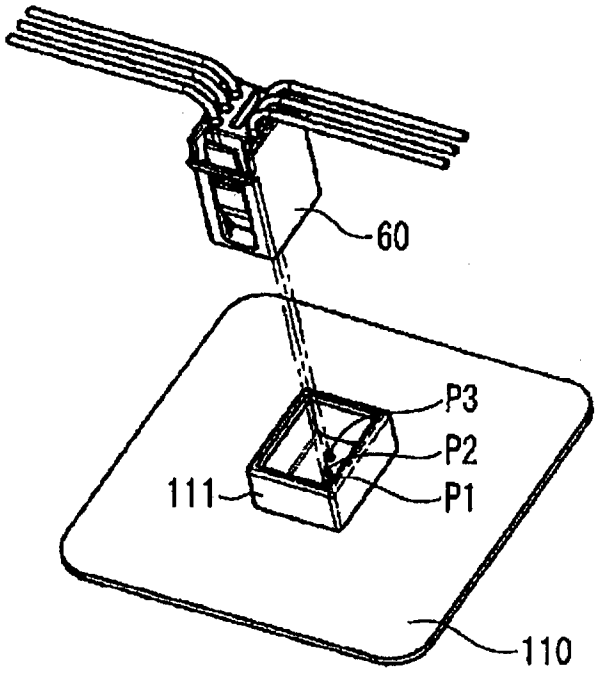


Fig. 8B

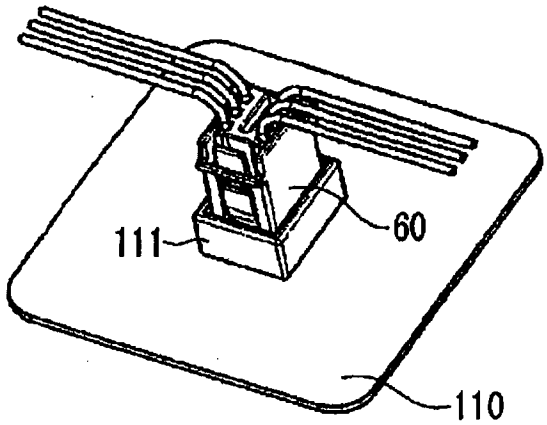


Fig. 8C

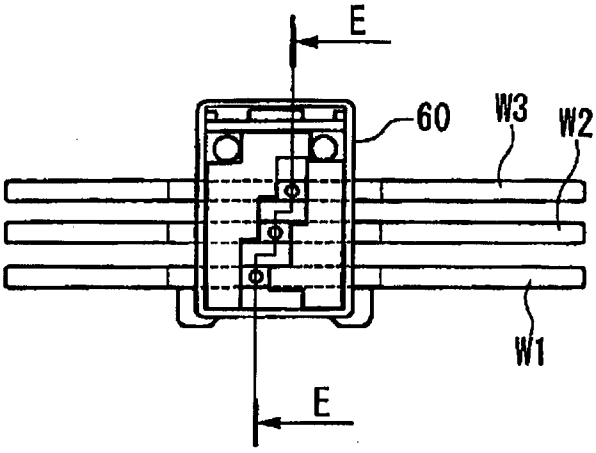


Fig. 8D

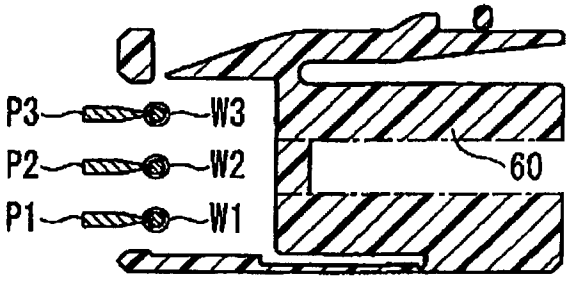


Fig. 9

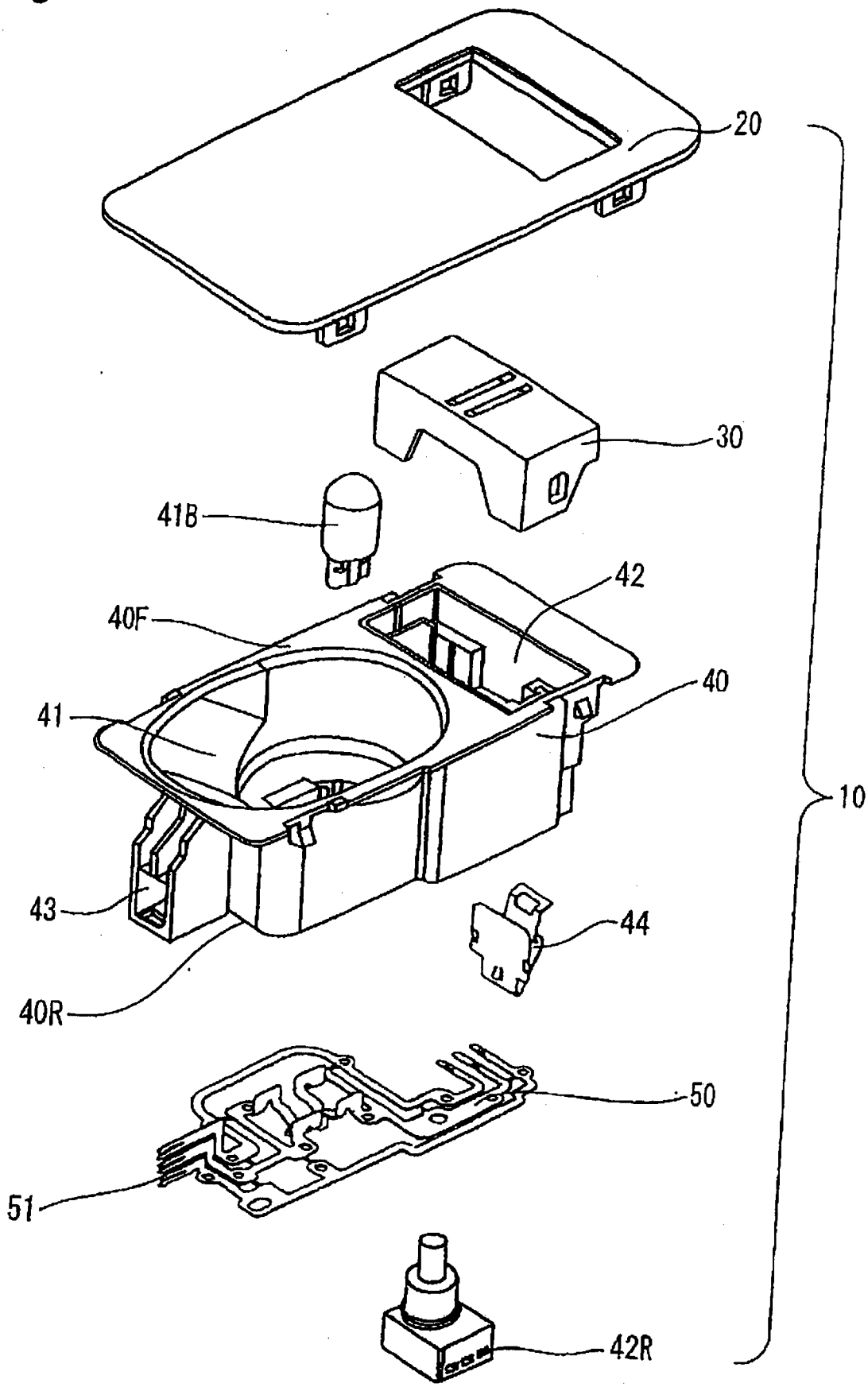


Fig. 10A

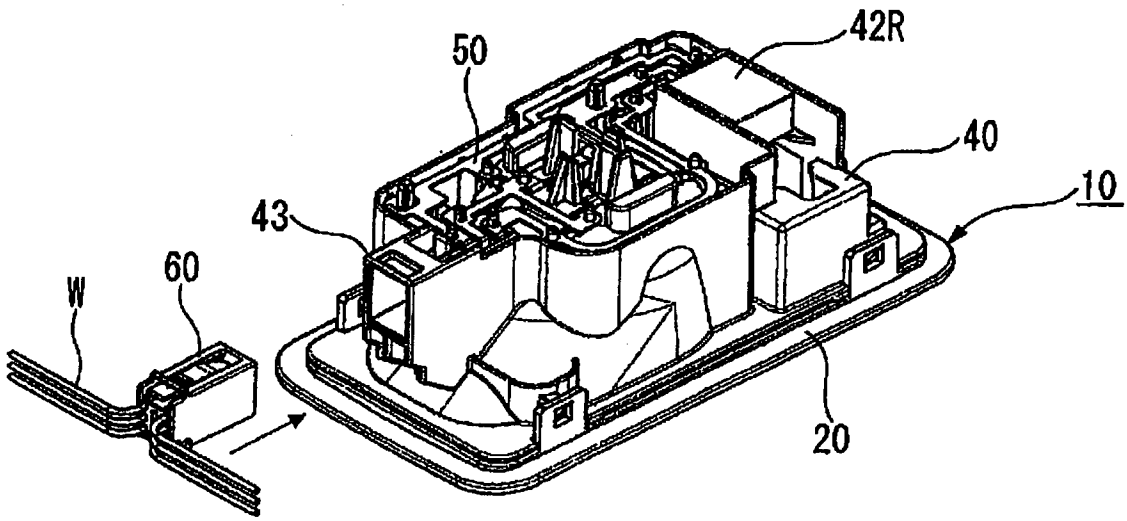


Fig. 10B

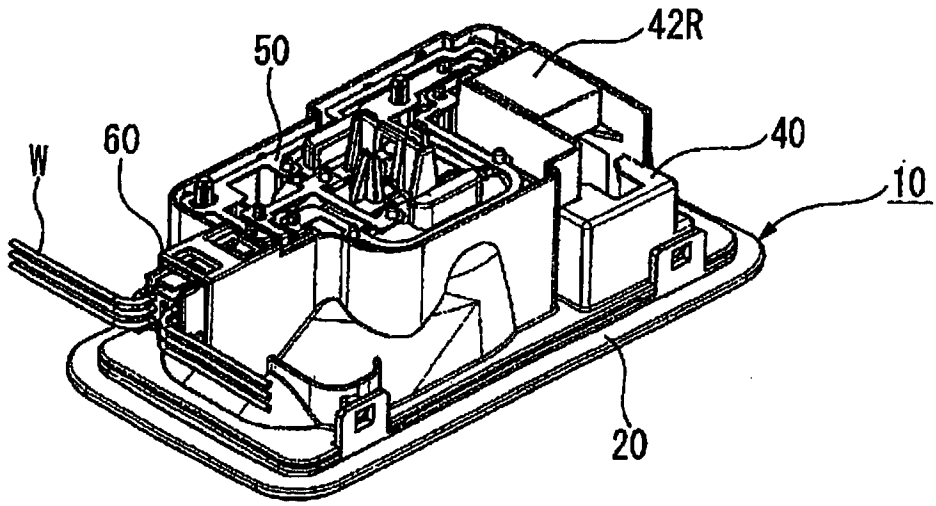


Fig. 11A

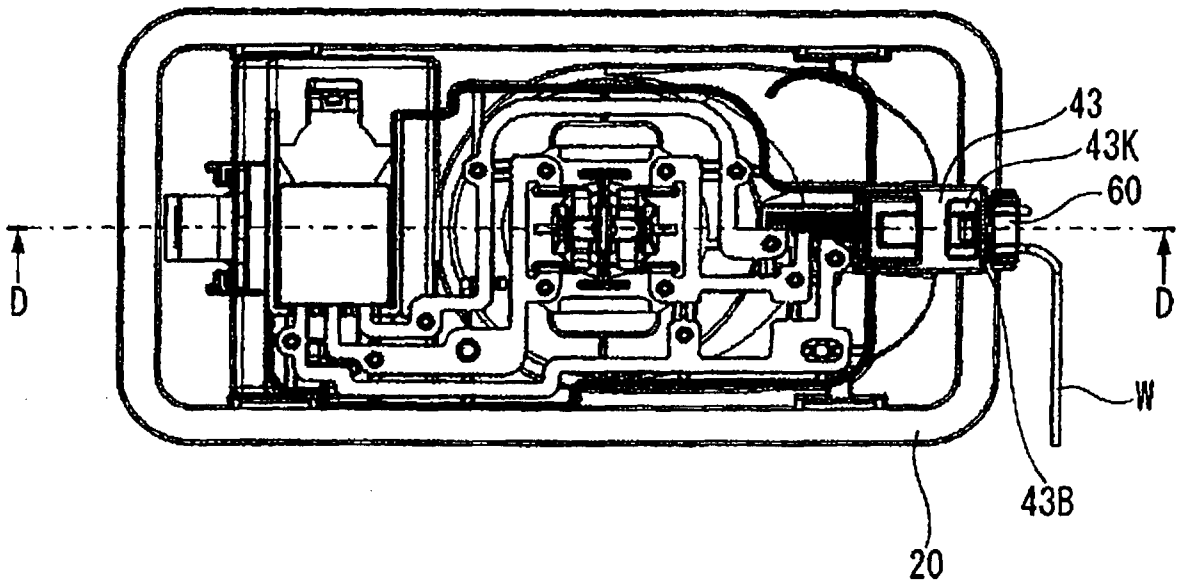


Fig. 11B

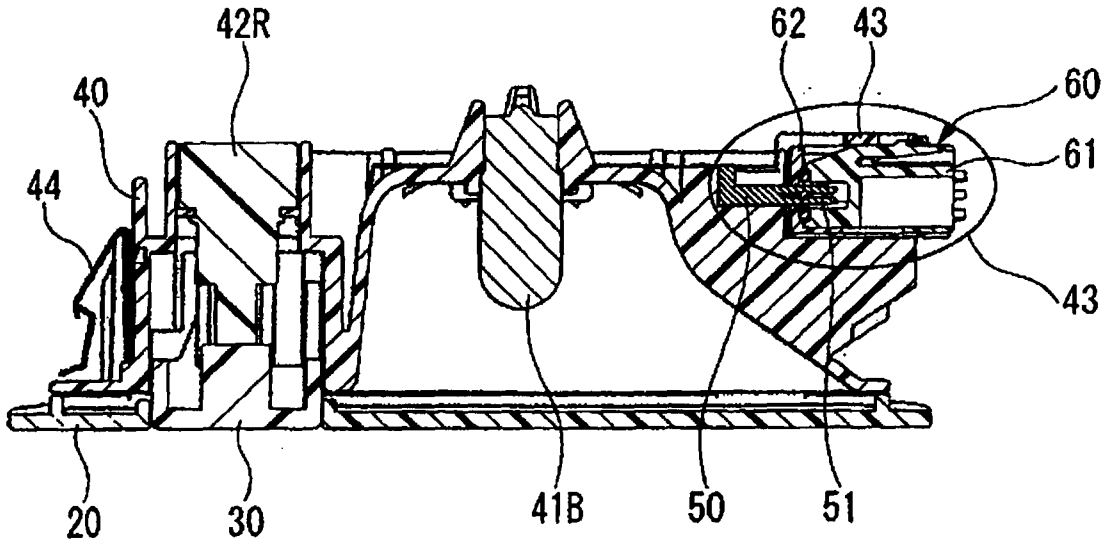


Fig. 12A

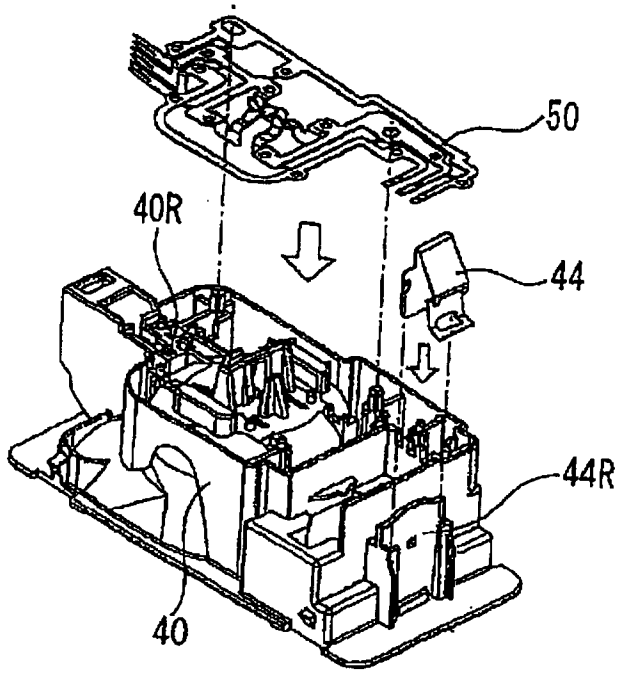


Fig. 12B

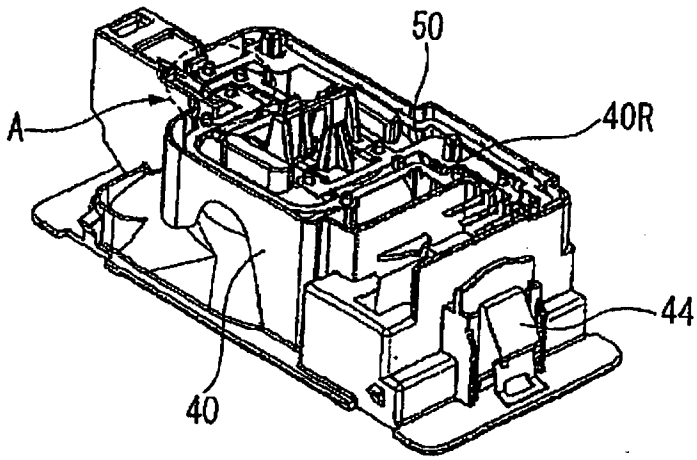


Fig. 12C

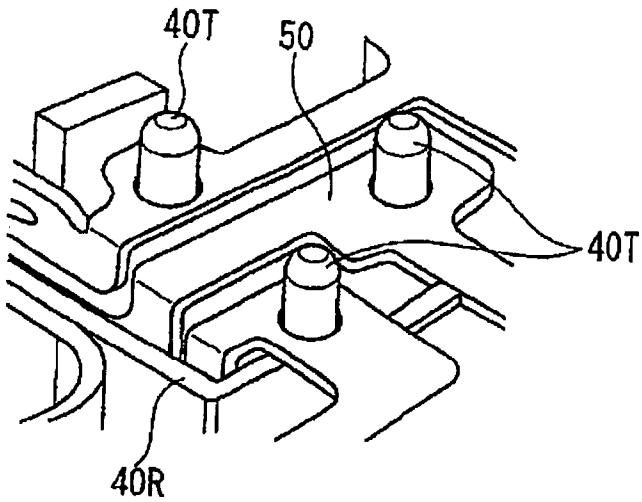


Fig. 13A

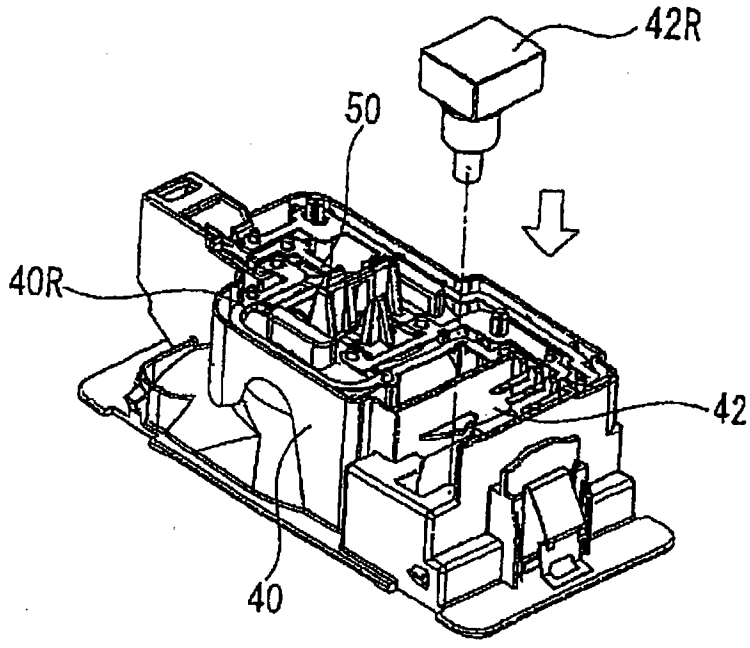


Fig. 13B

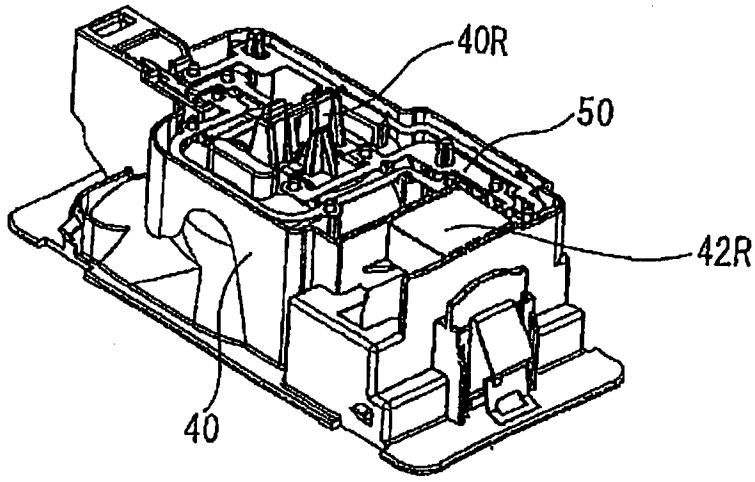


Fig. 13C

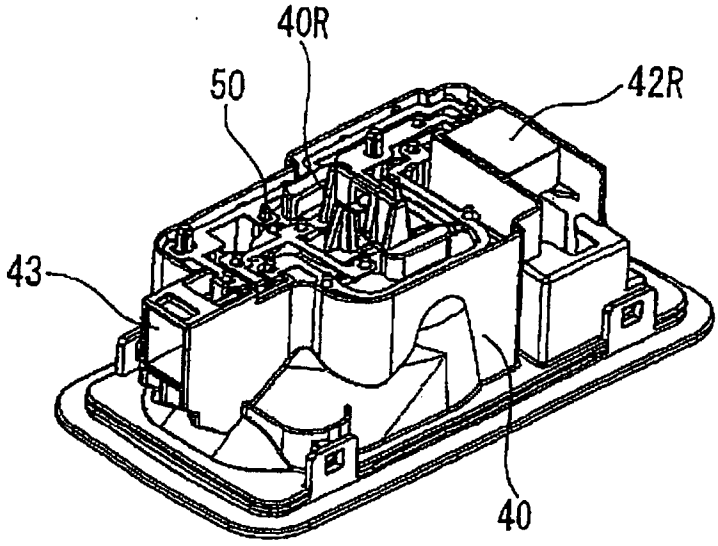


Fig. 14A

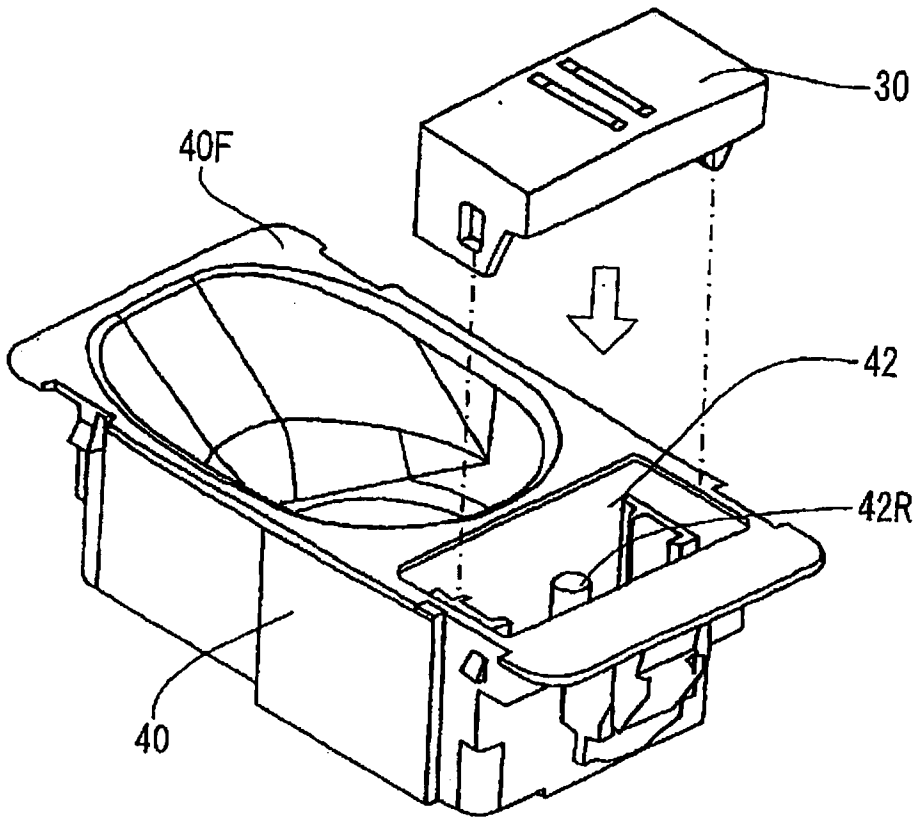


Fig. 14B

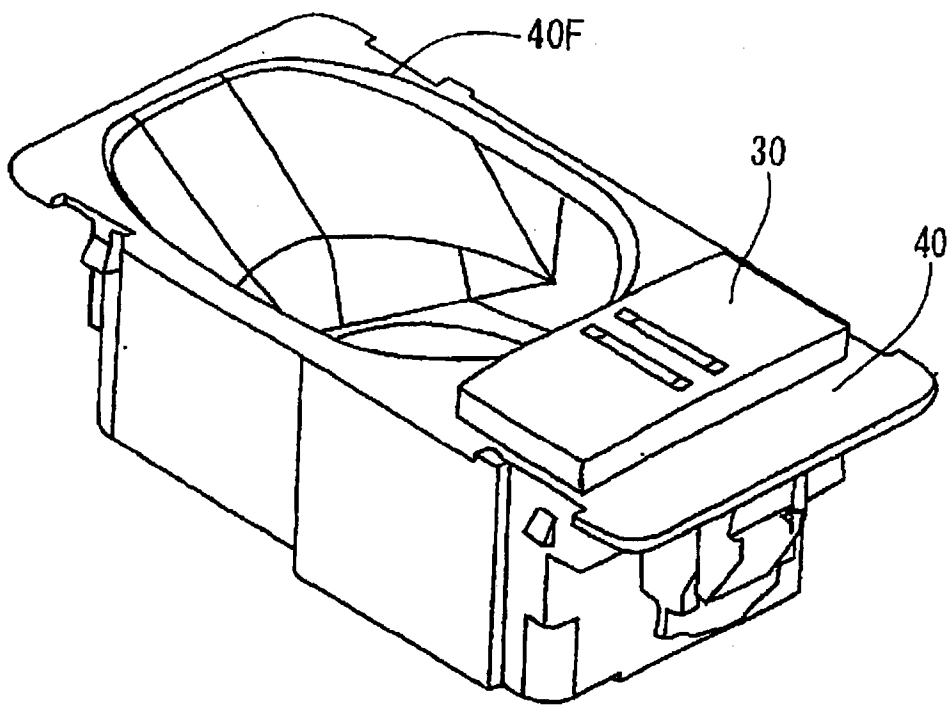


Fig. 15A

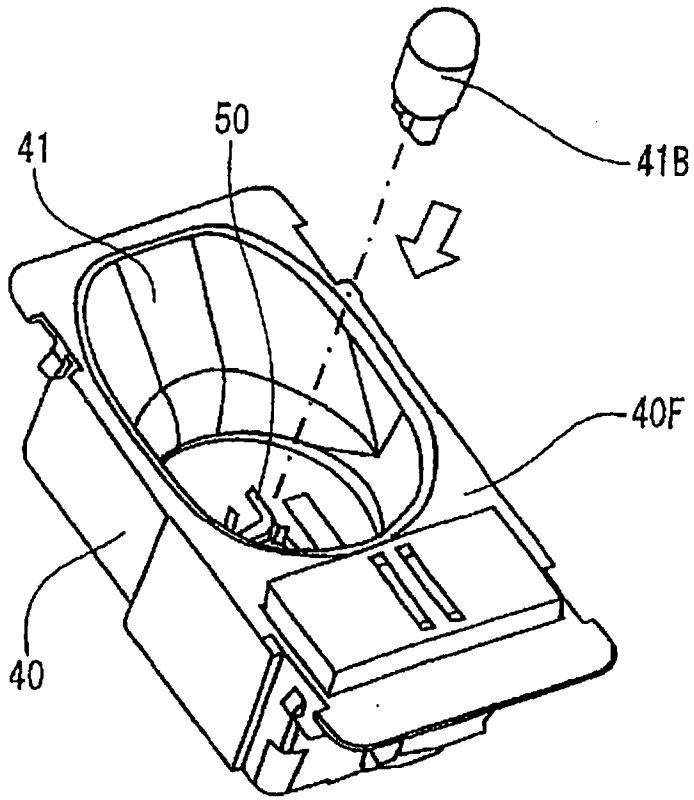


Fig. 15B

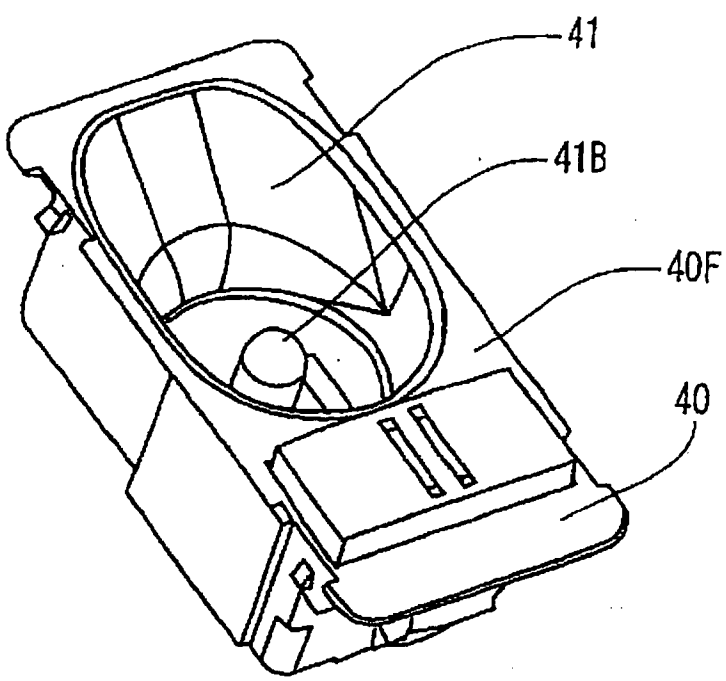


Fig. 16A

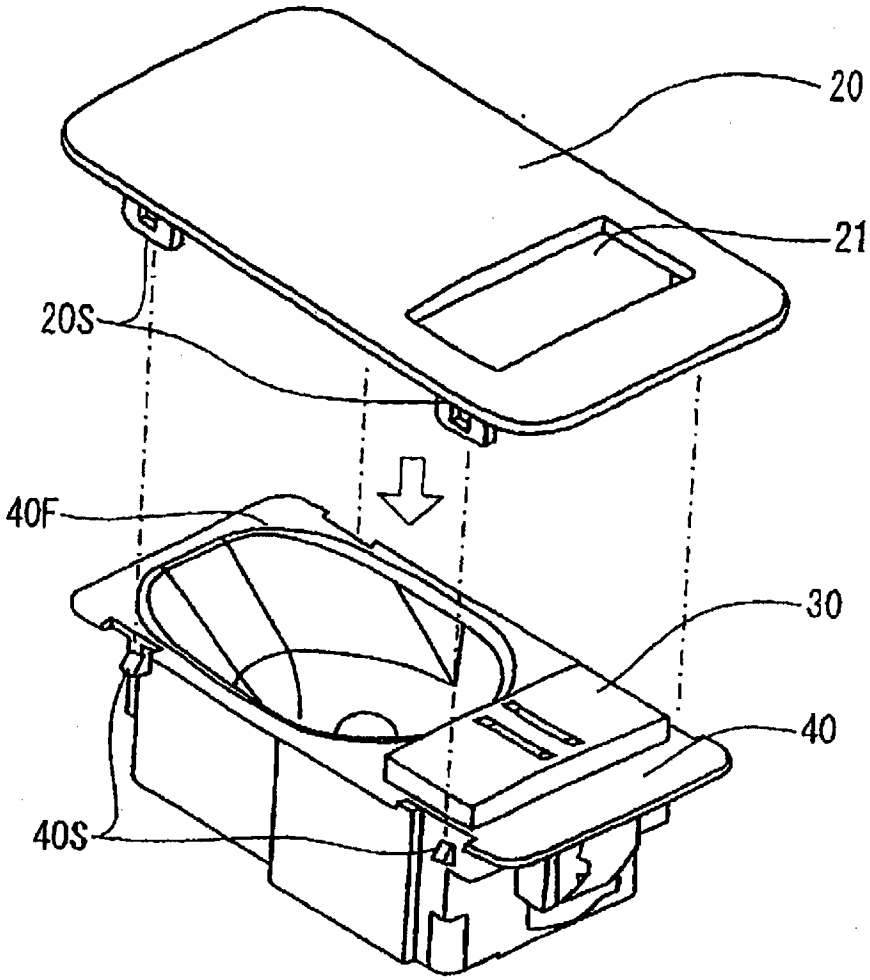
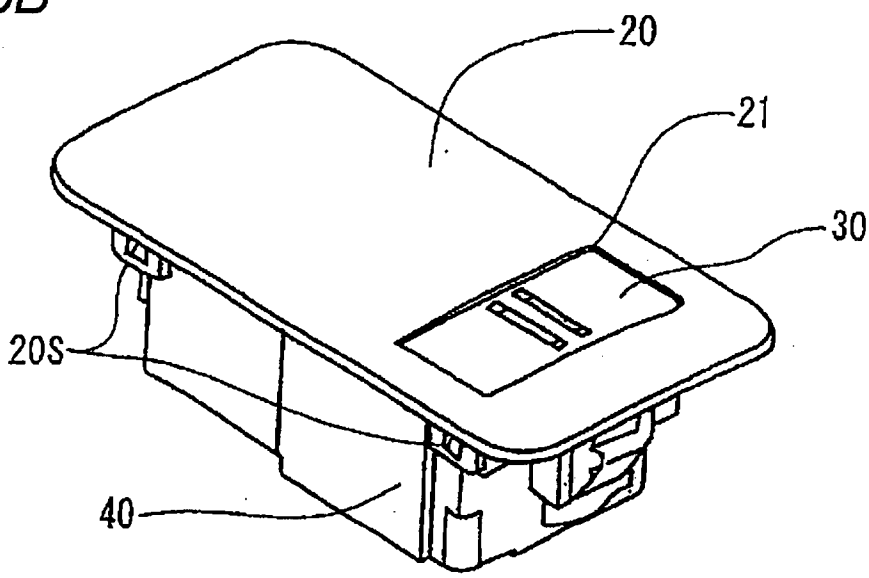


Fig. 16B



INTERNATIONAL SEARCH REPORT

International application No
PCT/JP2012/061299

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01R31/02 H01R4/24
ADD. G01R31/00

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 G01R

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 6 188 560 B1 (WAAS CHARLES W [US]) 13 February 2001 (2001-02-13) column 5, line 47 - column 10, line 4; figures 1-4	4,5 1-3,6
Y	US 5 417 583 A (ISHIZAKI SADAO [JP] ET AL) 23 May 1995 (1995-05-23) column 1, line 12 - column 2, line 54; figures 7a,7b	3,6
Y	US 5 247 259 A (MILLER MATTHEW T [US] ET AL) 21 September 1993 (1993-09-21) column 2, line 19 - column 3, line 45; figures 3,4	1-3
A	US 4 252 397 A (EIGENBRODE GEORGE T ET AL) 24 February 1981 (1981-02-24) abstract; figure 1	1,4

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

☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 August 2012	20/08/2012

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

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/JP2012/061299

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