US012388197B2

(12) **United States Patent**
Tanaka

(10) **Patent No.: US 12,388,197 B2**
(45) **Date of Patent: Aug. 12, 2025**

(54) **CONNECTOR**

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(21) Appl. No.: **18/142,716**

(22) Filed: **May 3, 2023**

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(30) **Foreign Application Priority Data**

Jul. 1, 2022 (JP) 2022-107108

(51) **Int. Cl.**
H01R 4/2433 (2018.01)
H01R 13/42 (2006.01)
H01R 13/502 (2006.01)

(52) **U.S. Cl.**
CPC ***H01R 4/2433*** (2013.01); ***H01R 13/42*** (2013.01); ***H01R 13/502*** (2013.01)

(58) **Field of Classification Search**
CPC H01R 4/2433; H01R 13/42; H01R 13/502
USPC 439/417, 404
See application file for complete search history.

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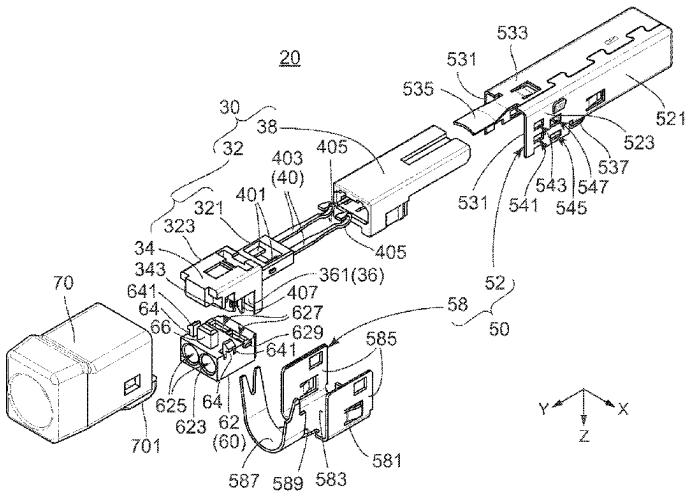
(57) **ABSTRACT**

A locator of a connector is attached to a shell so that it is moveable from a first position to a second position. The shell is made of metal, and each of side wall portions thereof is provided with a first aperture and a second aperture. The locator is provided with protruding portions. When the locator is positioned at the first position, each of the protruding portions is in the first aperture. When the locator is positioned at the second position, the protruding portion is in the second aperture. The shell is made of metal, so that it has predetermined strength even if the first aperture and the second aperture are provided therein. Since the first aperture and the second aperture pierce the side wall portion in a width direction, the protruding portions of the locator are visible. Thus, a position of the locator can be grasped.

16 Claims, 13 Drawing Sheets



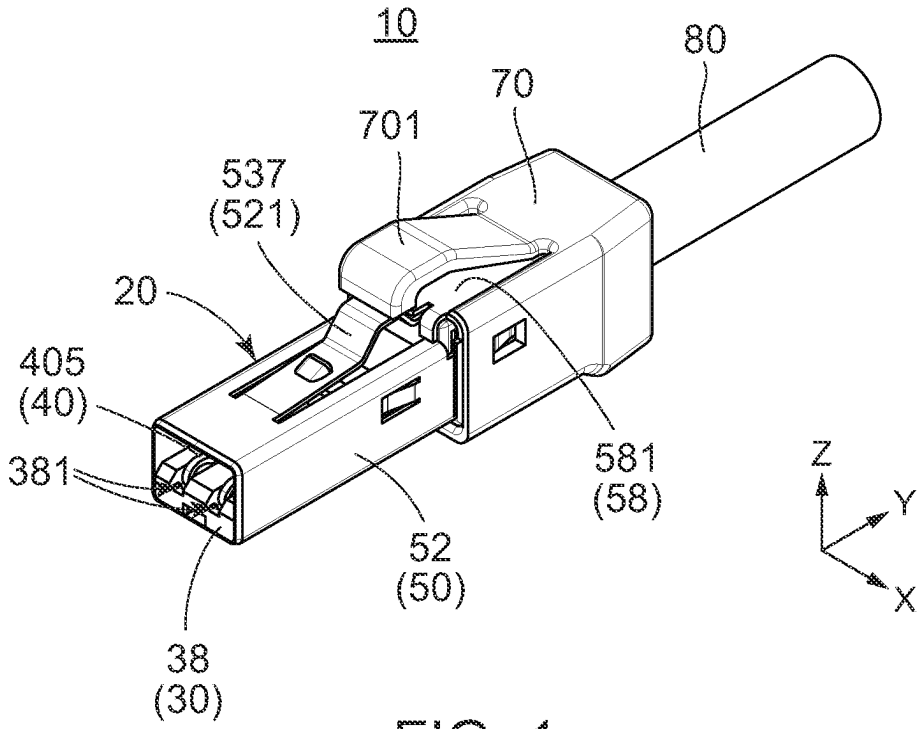


FIG. 1

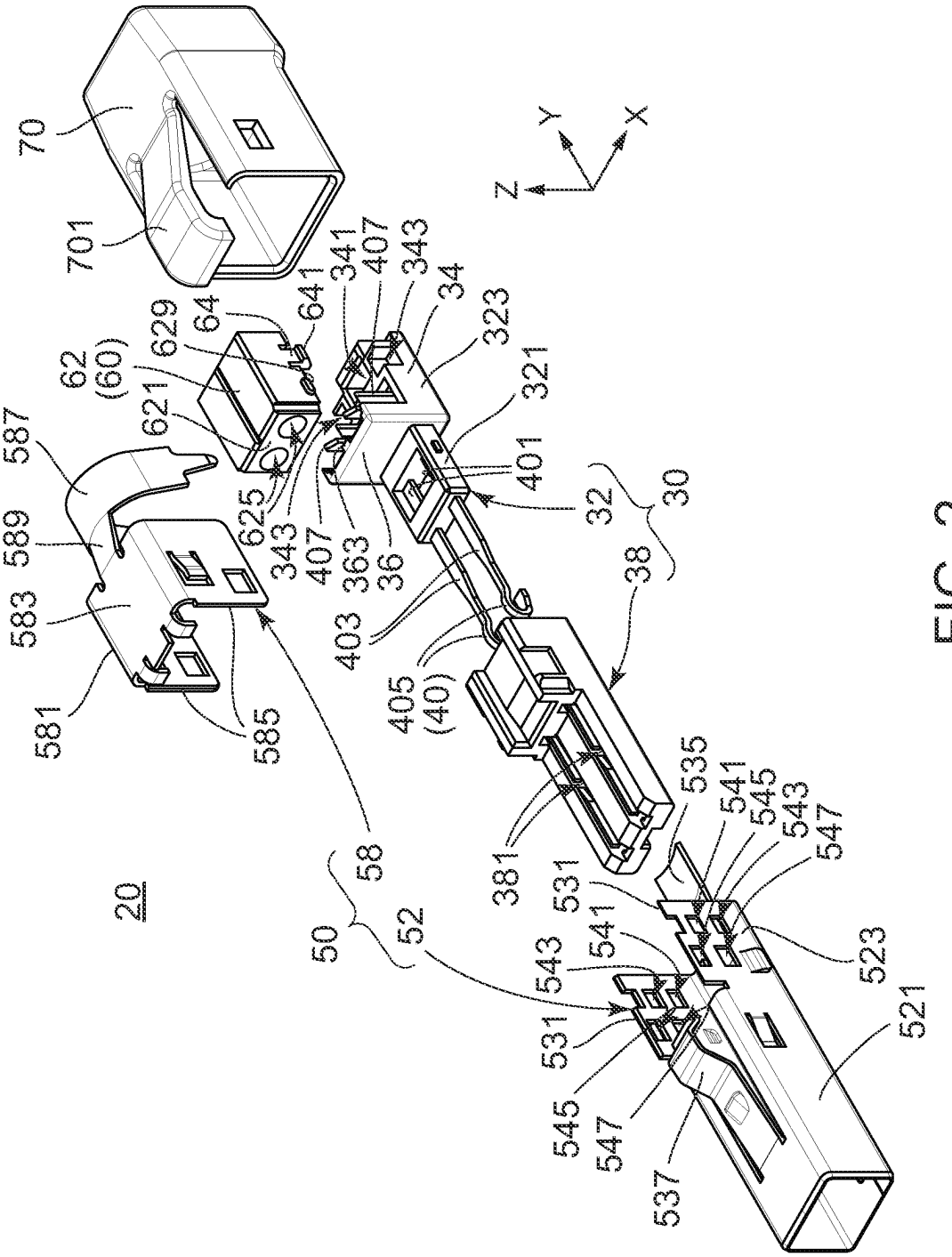

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FIG. 2

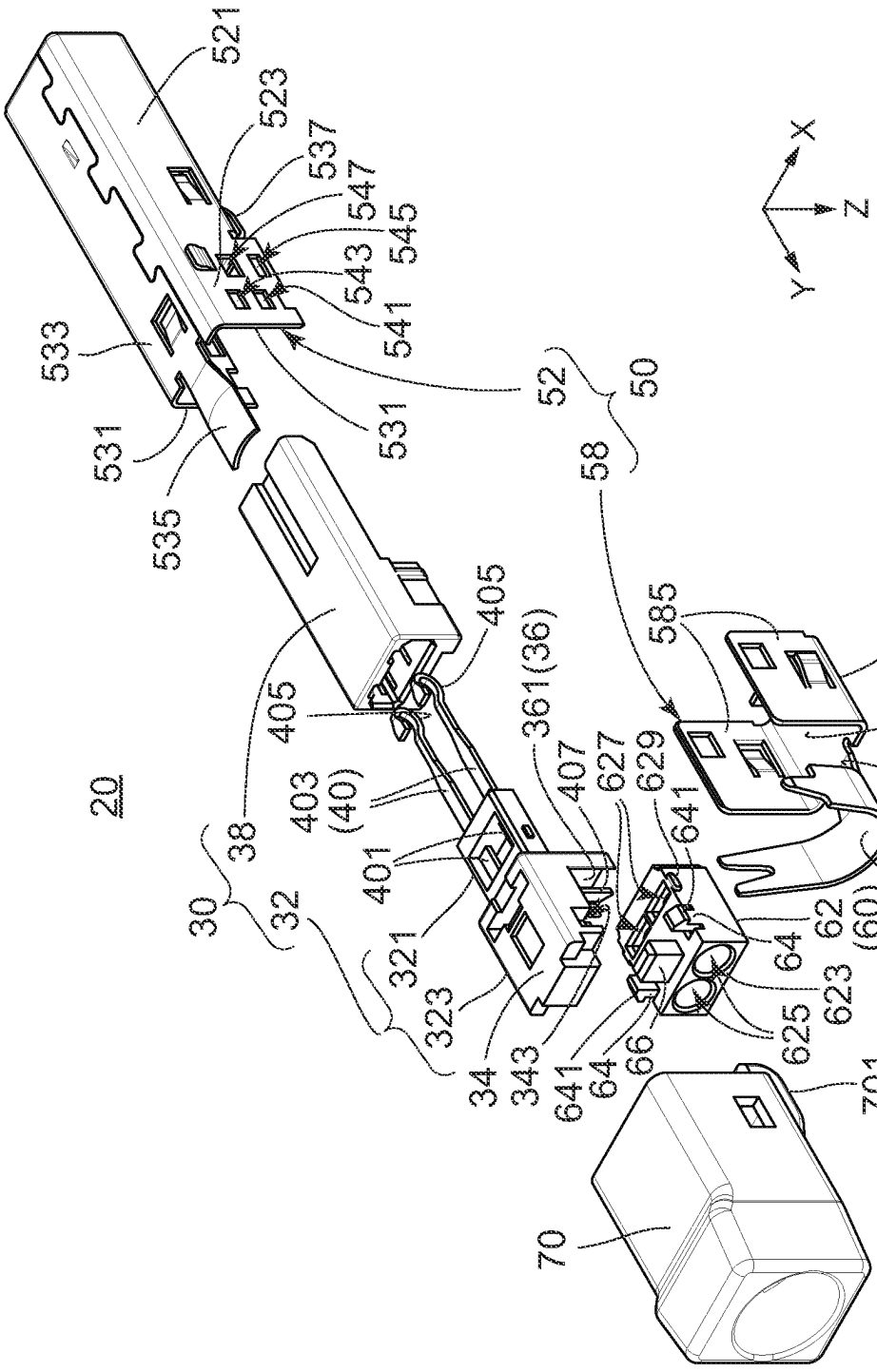
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FIG. 3

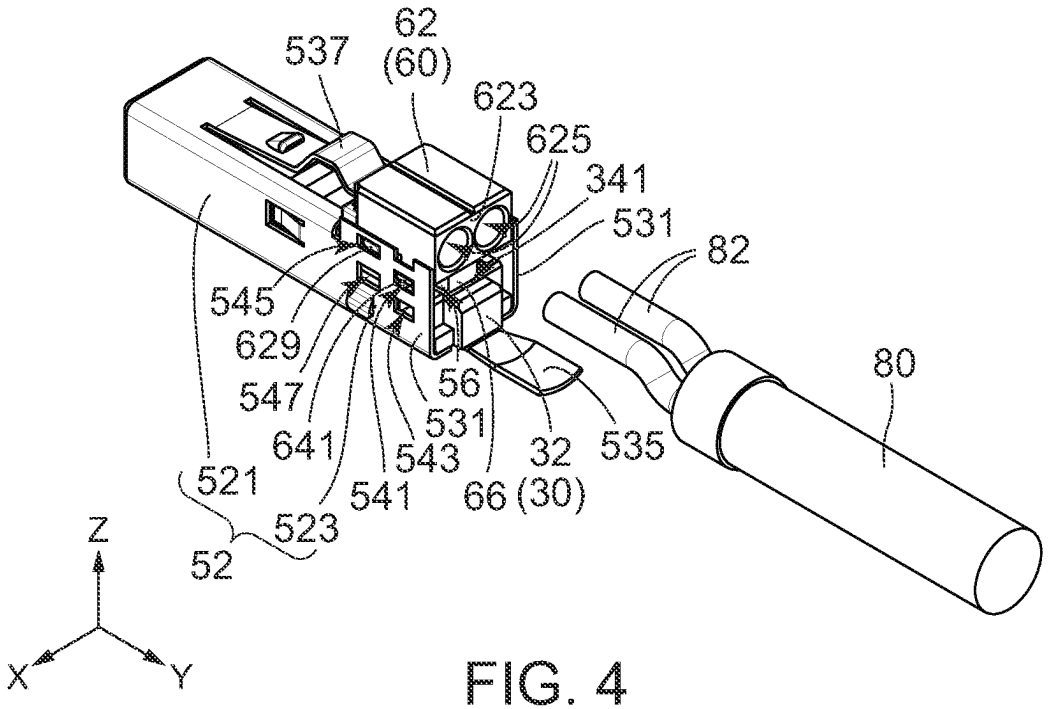
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FIG. 4

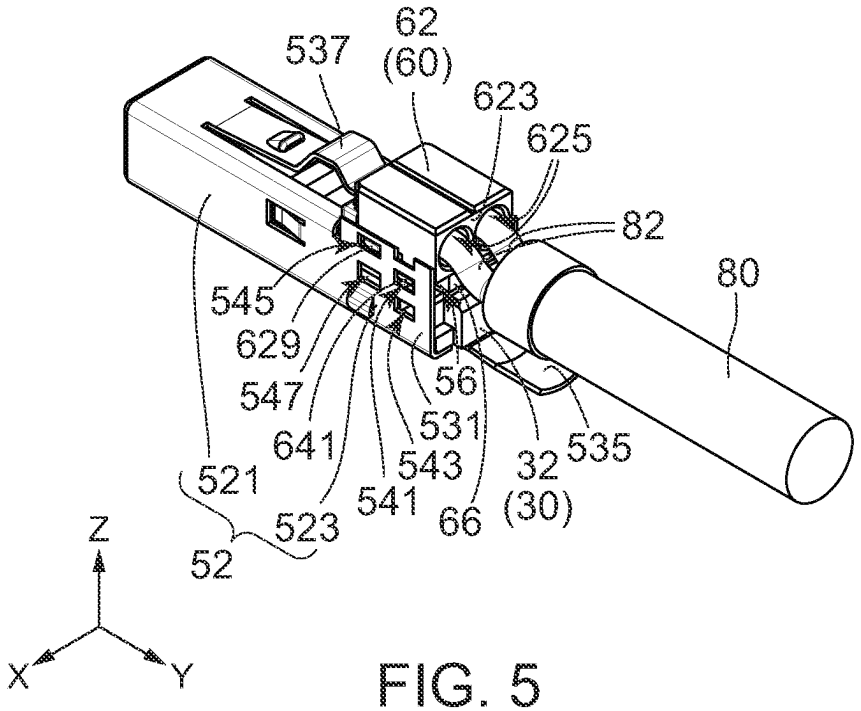
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FIG. 5

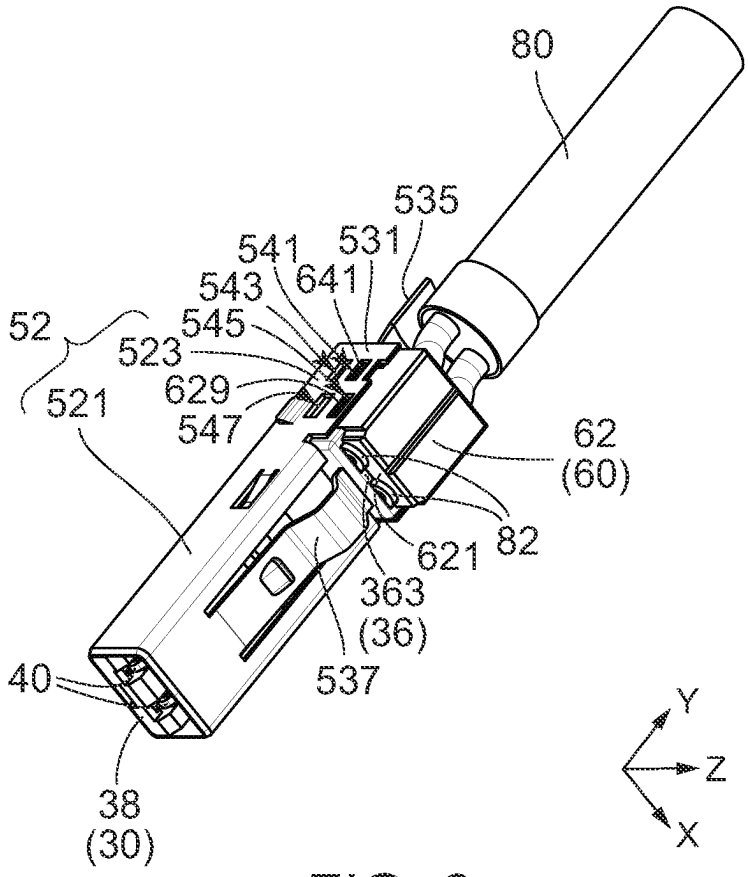
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FIG. 6

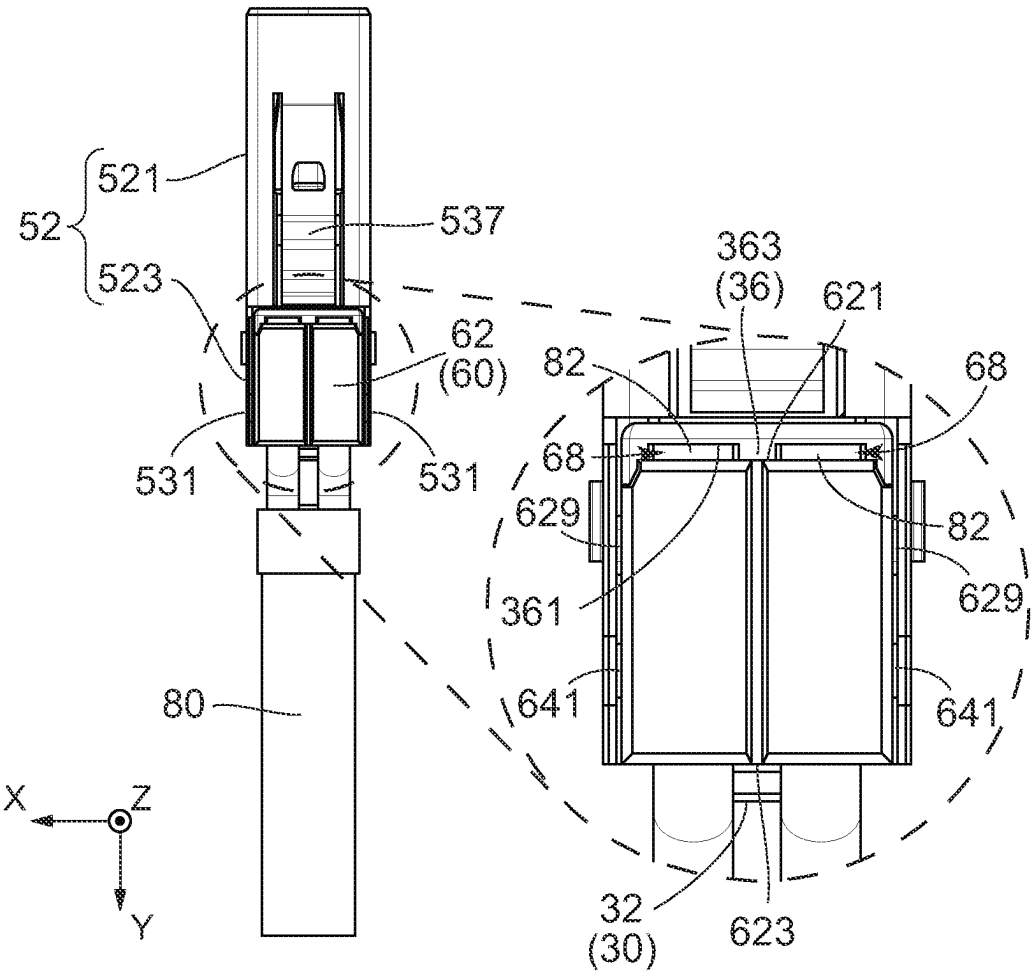
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FIG. 7

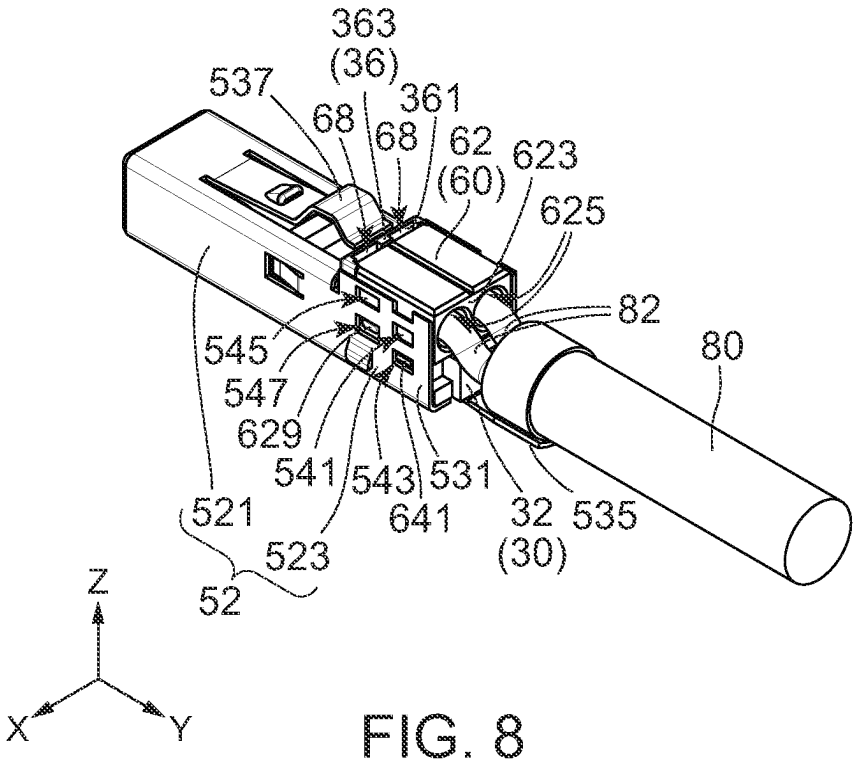
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FIG. 8

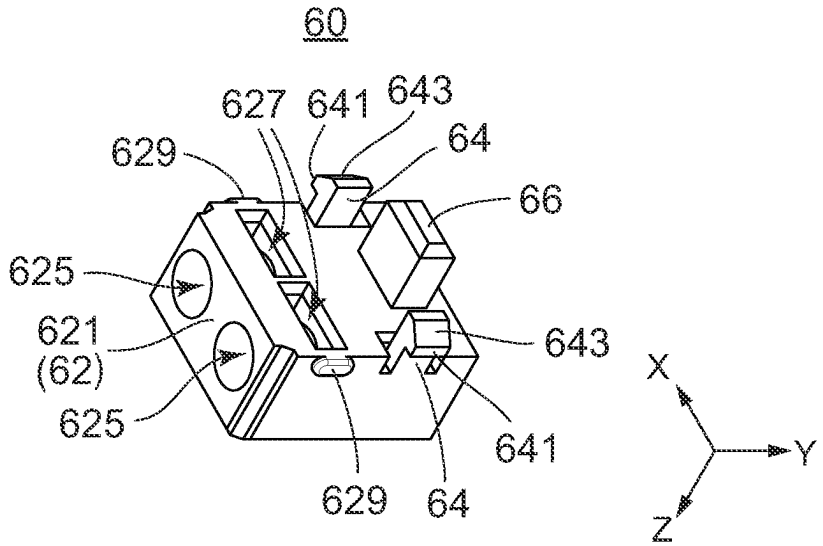
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FIG. 9

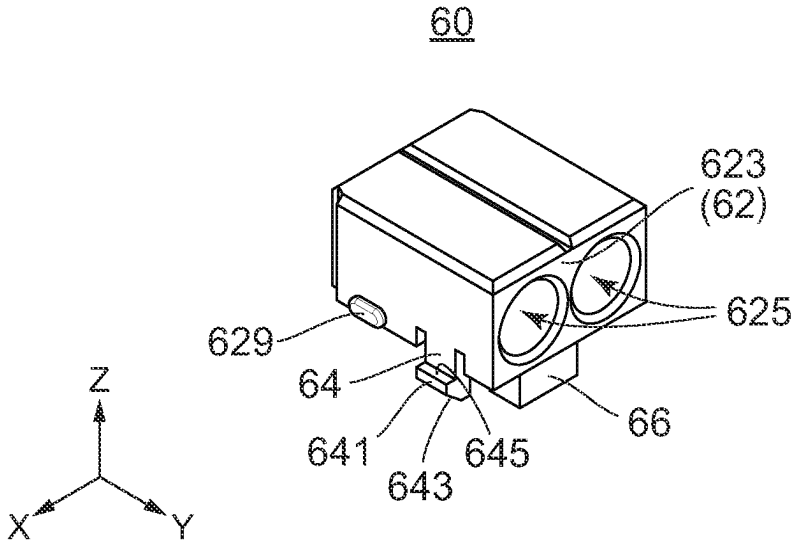
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FIG. 10

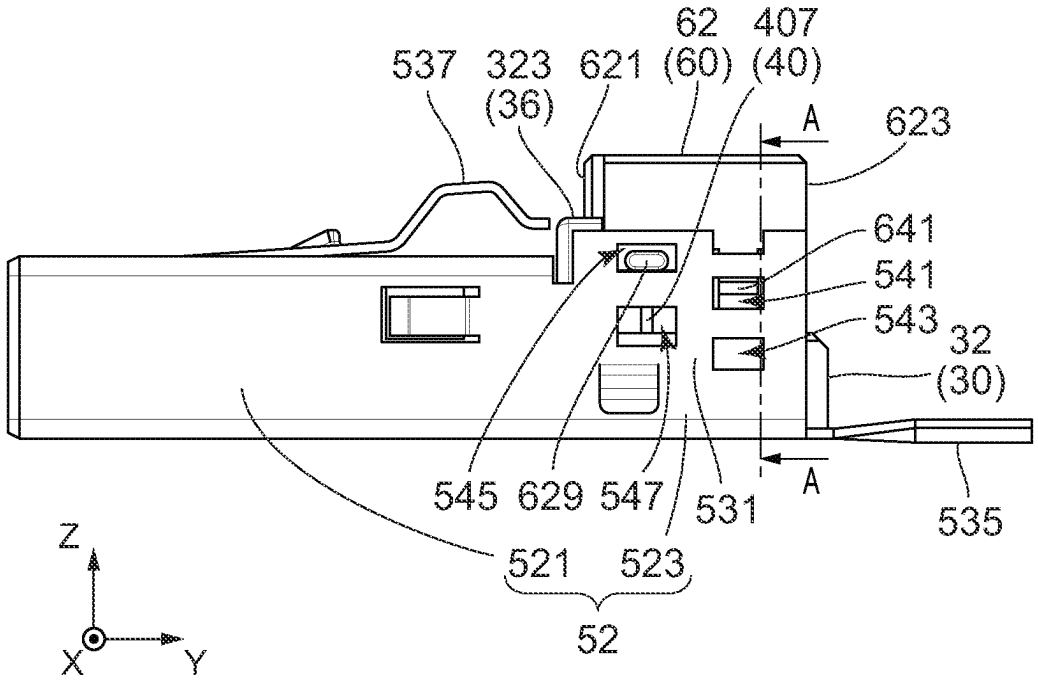
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FIG. 11

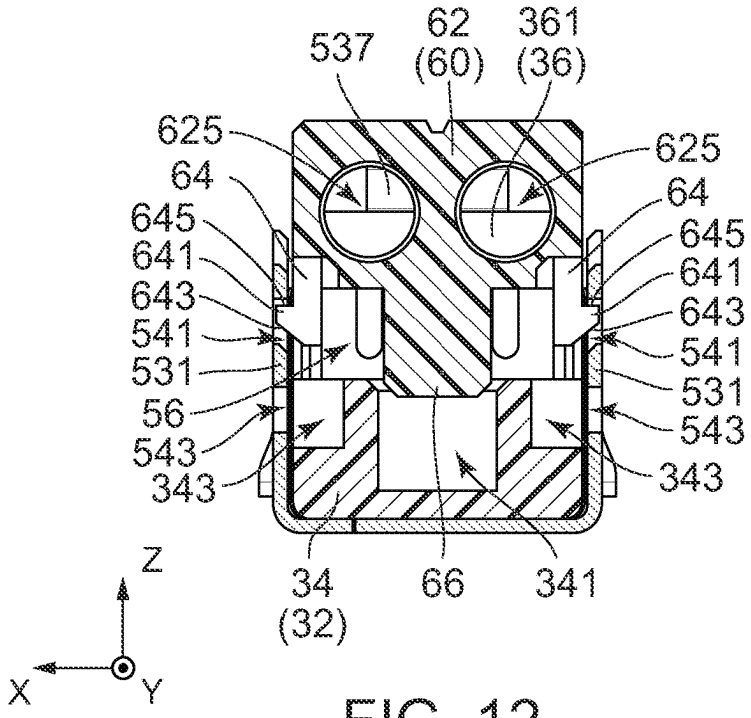
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FIG. 12

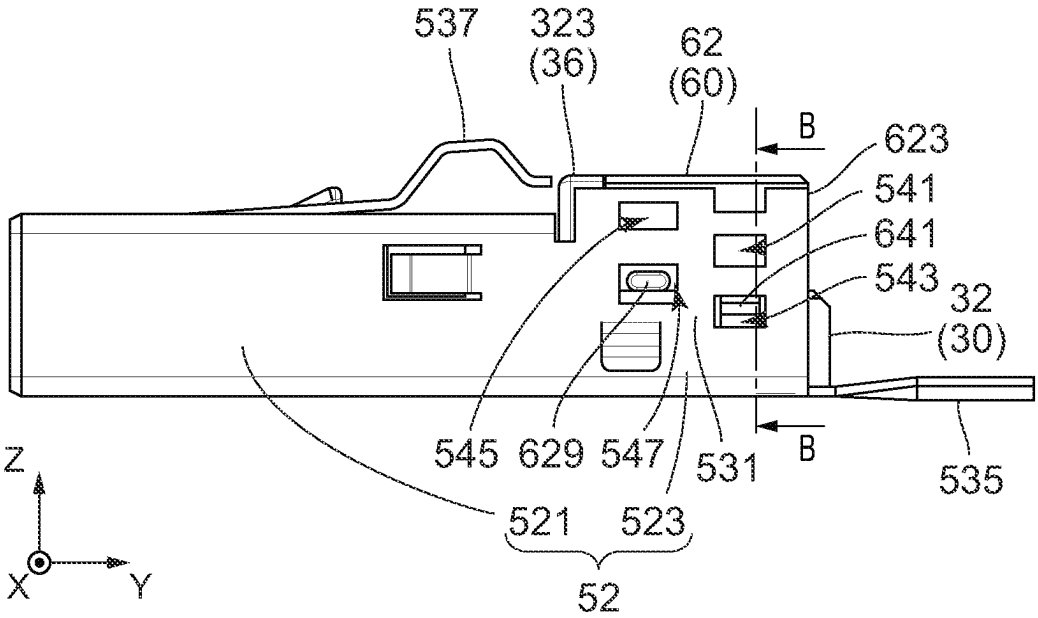
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FIG. 13

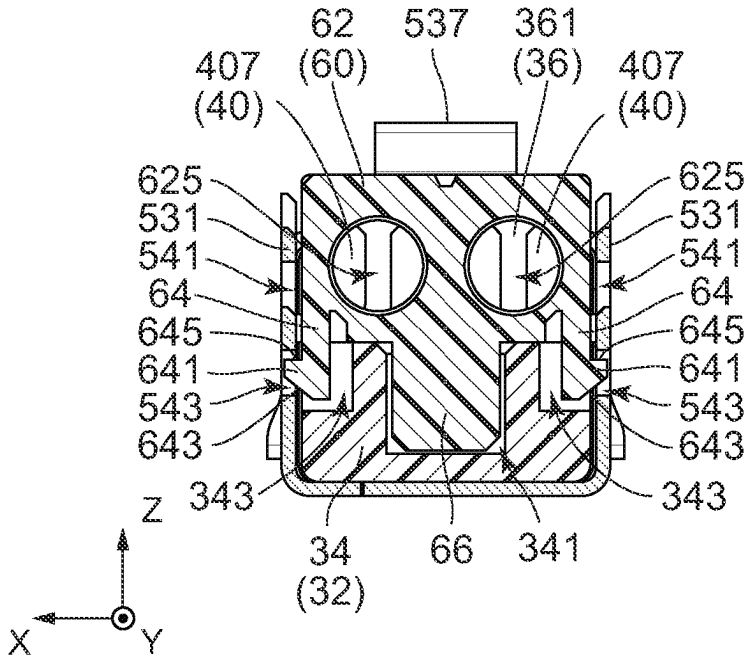
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FIG. 14

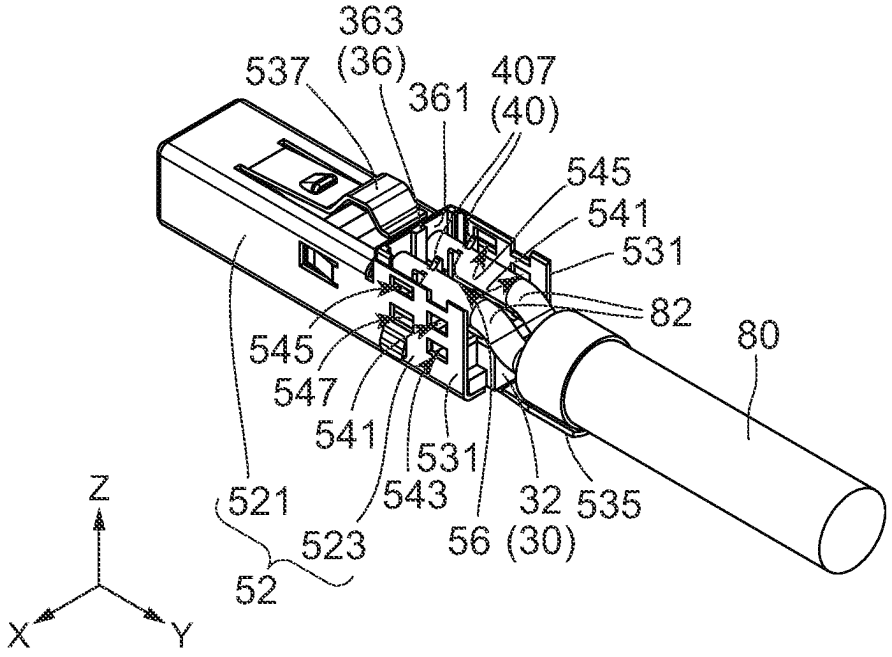
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FIG. 15

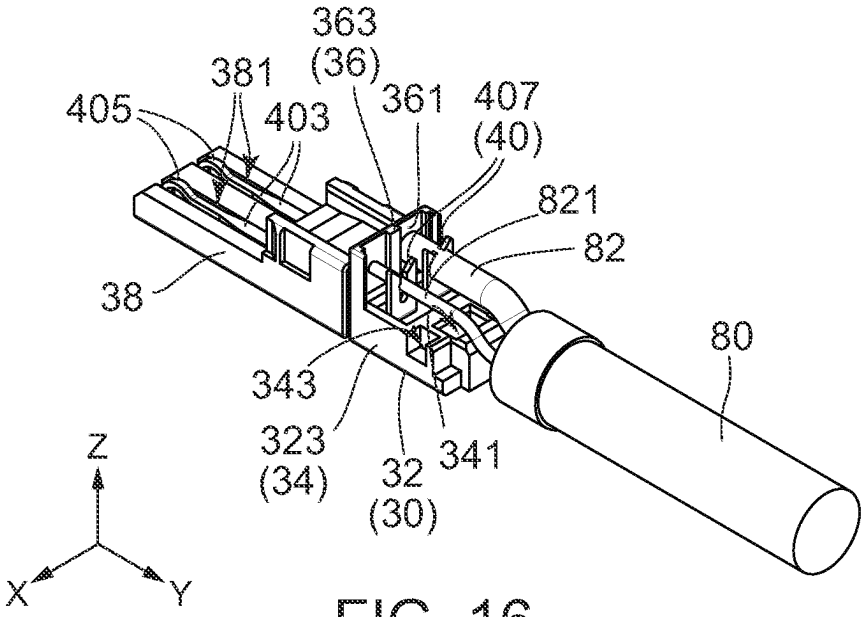
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FIG. 16

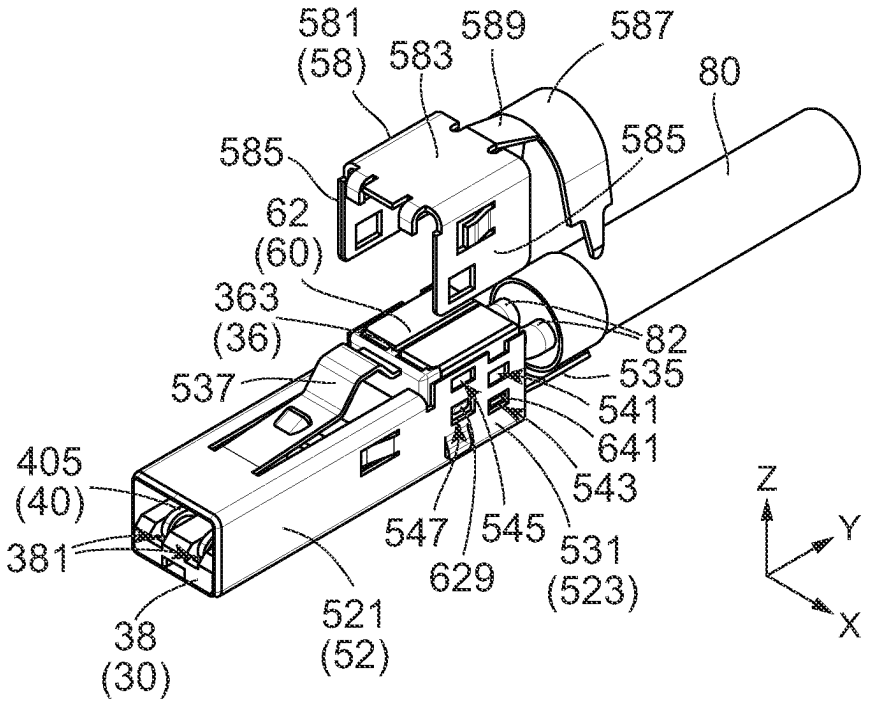
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FIG. 17

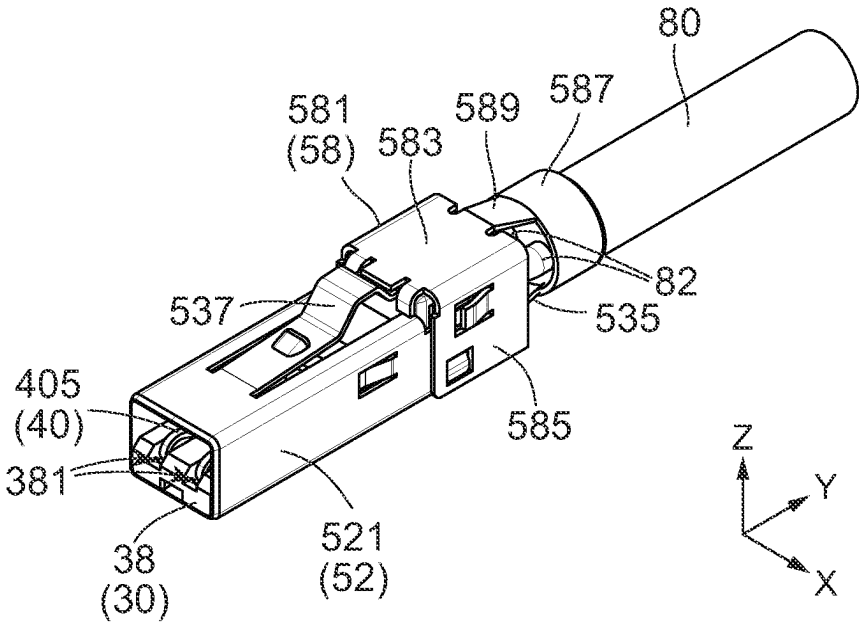
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FIG. 18

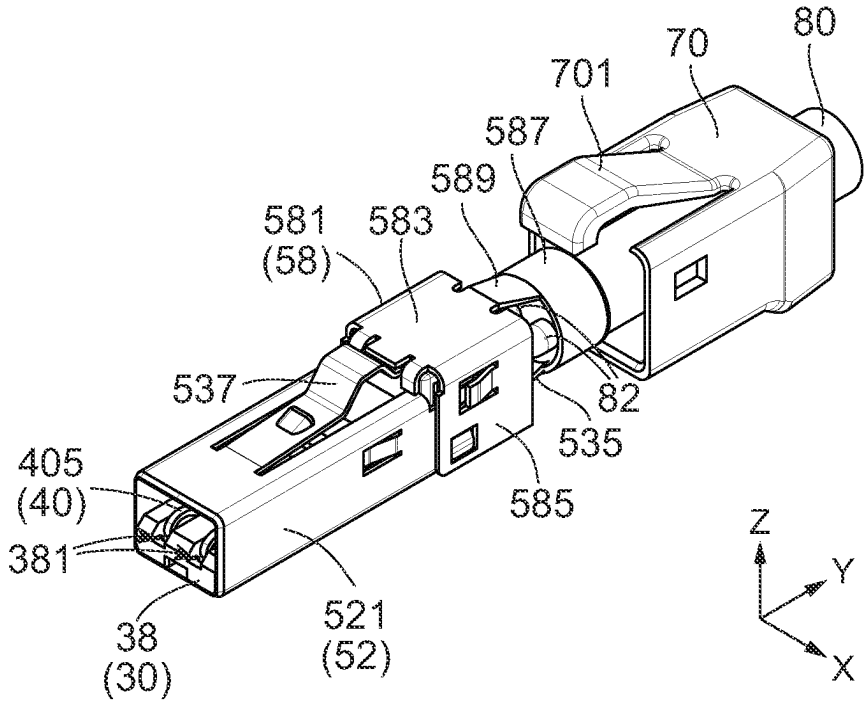
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FIG. 19

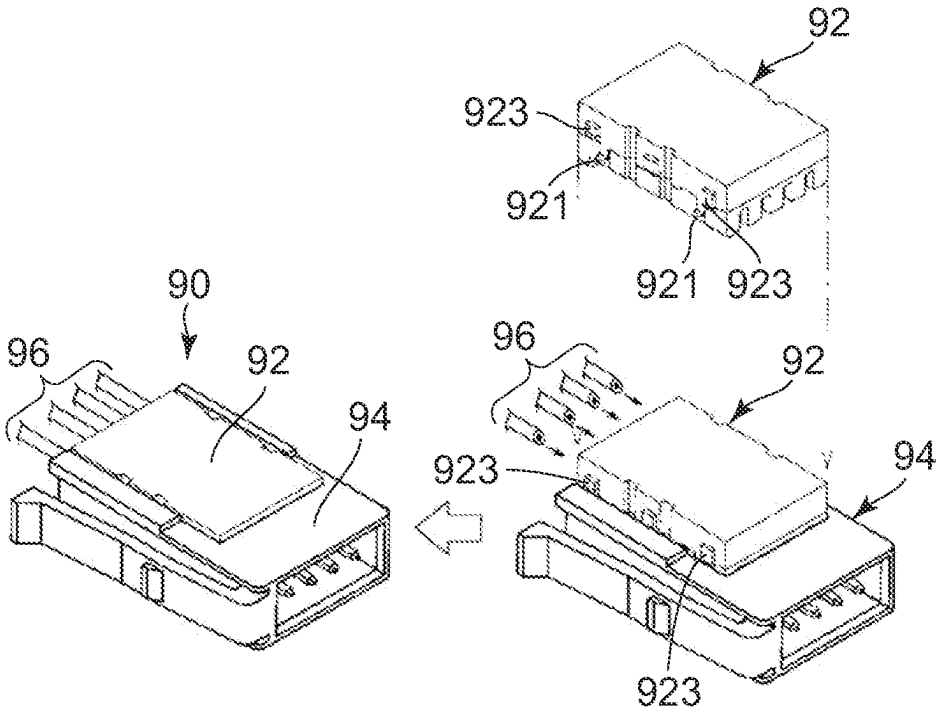

FIG. 20
PRIOR ART

CONNECTOR

CROSS REFERENCE TO RELATED APPLICATIONS

This application is based on and claims priority under 35 U.S.C. § 119 to Japanese Patent Application No. JP2022-107108 filed Jul. 1, 2022, the contents of which are incorporated herein in their entirety by reference.

BACKGROUND OF THE INVENTION

This invention relates to a connector, particularly, to a connector having a structure in which an electric wire and a terminal are connected to each other by moving a locator.

JP 2006-236855 A (Patent Document 1) discloses a connector for insulation displacement connection (IDC).

Referring to FIG. **20**, a connector 90 of Patent Document 1 is provided with an electric wire holding block (or a locator) **92** and a contact block (or a housing) **94**. The contact block **94** holds IDC terminals (not shown) which protrude in a receiving portion (not shown) for receiving an electric wire holding block **92**. The electric wire holding block **92** is formed with holding apertures (not shown) for respectively holding electric wires **96** and receiving grooves (not shown) for respectively receiving the IDC terminals.

As shown in FIG. **20**, the electric wire holding block **92** is provided with temporal stop protruding portions **921** and projections **923**. The electric wire holding block **92** can be held at a temporal stop position of the contact block **94** by use of the temporal stop protruding portions **921**. The electric wire holding block **92** can be also held at a pushed position of the contact block **94** by use of the projections **923**.

As understood from FIG. **20**, in a state that the electric wire holding block **92** is held at the temporal stop position of the contact block **94**, end portions of the electric wires **96** can be respectively inserted into the holding apertures (not shown) of the electric wire holding block **92**. When the electric wire holding block **92** is pushed into the receiving portion (not shown) of the contact block **94** from the above-mentioned state, the IDC terminals (not shown) and the electric wires **96** are electrically connected to one another. In addition, the electric wire holding block **92** is held at the pushed position of the contact block **94** by functions of the projections **923**.

In the connector 90 of Patent Document 1, it is difficult to check whether the electric wire holding block **92** is positioned at the pushed position of the contact block **94**. Accordingly, in the connector 90 of Patent Document 1, sometimes the electric wires **96** comes off from the IDC terminals when the connector 90 is used.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a connector in which connection reliability is improved by making a position of a locator identifiable.

The present invention can certainly grasp a position of a locator by making it possible to see a protruding portion provided to the locator through a first aperture and a second aperture. The present invention also ensures strength by providing the first aperture and the second aperture in a metal shell.

In detail, one aspect of the present invention provides a connector which is attachable to an electric wire. The connector is mateable with a mating connector provided with a mating terminal. The connector comprises a housing, at least one terminal, a shell and a locator. The terminal is held by the housing. The terminal has a contact portion which is brought into contact with the mating terminal when the connector is mated with the mating connector and a connection portion to be connected to the electric wire. The shell is made of metal and has two side wall portions which are located apart from each other in a width direction. Each of the side wall portions is provided with a first aperture and a second aperture. The first aperture and the second aperture pierce the side wall portion in the width direction and are located apart from each other in a first direction perpendicular to the width direction. The locator is attached to the shell so that the locator is movable from a first position to a second position in the first direction. The locator is provided with a first end face, a second end face, a receiving aperture, an admitting portion and two protruding portions. The first end face and the second end face are located on both ends of the locator in a second direction which is perpendicular to the width direction and intersects with the first direction. The receiving aperture pierces the locator from the second end face to the first end face and is receivable an end of the electric wire. The admitting portion communicates with the receiving aperture and allows the connection portion to be moved therein when the locator is moved. The protruding portions correspond to the side wall portions, respectively. Each of the protruding portions protrudes outward in the width direction. When the locator is positioned at the first position, each of the protruding portions is positioned in the first aperture of the side wall portion corresponding thereto. When the locator is positioned at the second position, each of the protruding portions is positioned in the second aperture of the side wall portion corresponding thereto while the connection portion is positioned in the receiving aperture in part.

Another aspect of the present invention provides a connector attached electric wire which comprises the connector as mentioned above. The connector is attached to the electric wire.

In the connector of one aspect of the present invention, the locator is attached to the shell so that the locator is moveable from the first position to the second position. The shell is made of metal, and each of the side wall portions is provided with a first aperture and a second aperture which pierce therethrough in the width direction. The locator is provided with the protruding portions protruding outward in the width direction. When the locator is positioned at the first position, each of the protruding portions is positioned in the first aperture of the side wall portion corresponding thereto. When the locator is positioned at the second position, each of the protruding portions is positioned in the second aperture of the side wall portion corresponding thereto. Since the shell is made of metal, it has predetermined strength even in a state the first aperture and the second aperture are provided therein. Since the first aperture and the second aperture pierce the side wall portion corresponding thereto, the protruding portions of the locator are visible. Accordingly, the position of the locator can be grasped.

An appreciation of the objectives of the present invention and a more complete understanding of its structure may be had by studying the following description of the preferred embodiment and by referring to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view showing a connector attached electric wire according to an embodiment of the present invention.

FIG. **2** is an exploded, perspective view showing the connector included in the connector attached electric wire of FIG. **1**.

FIG. **3** is another exploded, perspective view showing the connector of FIG. **2**.

FIG. **4** is a perspective view showing a main portion of the connector included in the connector attached electric wire of FIG. **1** and insulated wires. In the main portion of the connector, a locator is positioned at a first position. The main portion of the connector and the insulated wires are separated from each other.

FIG. **5** is a perspective view showing the main portion of the connector and the insulated wires of FIG. **4**. In the main portion of the connector, the locator is positioned at the first position. The insulated wires are inserted into receiving apertures of the locator in part.

FIG. **6** is another perspective view showing the main portion of the connector and the insulated wires of FIG. **5**.

FIG. **7** is a plane view showing the main portion of the connector and the insulated wires of FIG. **5**. The locator and the vicinity thereof are shown in expanded fashion.

FIG. **8** is yet another perspective view showing the main portion of the connector and the insulated wires of FIG. **5**. In the main portion of the connector, the locator is positioned at a second position.

FIG. **9** is a perspective view showing the locator included in the connector of FIG. **3**.

FIG. **10** is another perspective view showing the locator of FIG. **9**.

FIG. **11** is a side view showing the main portion of the connector of FIG. **4**. The locator is positioned at the first position.

FIG. **12** is a cross-sectional view showing the main portion of the connector of FIG. **11**, taken along A-A line.

FIG. **13** is another side view showing the main portion of the connector of FIG. **4**. The locator is positioned at the second position.

FIG. **14** is a cross-sectional view showing the main portion of the connector of FIG. **13**, taken along B-B line.

FIG. **15** is a perspective view showing the main portion of the connector and

the insulated wires of FIG. **8**. The locator is omitted in the figure.

FIG. **16** is another perspective view showing the main portion of the connector and the insulated wires of FIG. **8**. The locator and a first shell are omitted in the figure. In one of the insulated wires, an insulating coating thereof is removed in part.

FIG. **17** is another perspective view showing the connector attached electric wire of FIG. **1**. A hood is omitted in the figure. A second shell is not yet attached to the first shell.

FIG. **18** is a perspective view showing the connector attached electric wire of FIG. **17**. The second shell is attached to the first shell.

FIG. **19** is yet another perspective view showing the connector attached electric wire of FIG. **1**. The hood is not yet attached to the shell.

FIG. **20** is a view showing an insulation displacement connection connector disclosed in Patent Document 1.

While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof are shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that the drawings and detailed description thereto are not intended to limit the invention to the particular form disclosed, but on the contrary, the intention is to cover all modifications, equivalents and alternatives falling within the spirit and scope of the present invention as defined by the appended claims.

DETAILED DESCRIPTION

Referring to FIG. **1**, a connector attached electric wire **10** according to one embodiment of the present invention has a connector **20** and a cable **80**. In the present embodiment, the cable **80** has two insulated wires **82** (electric wires: see FIG. **4**), and the connector **20** is attached to one ends of the insulated wires **82**. However, the present invention is not limited thereto. The connector **20** may be a connector to be connected to at least one electric wire.

The connector **20** shown in FIG. **1** is mateable with and detachable from a mating connector (not shown), which is provided with mating terminals (not shown), in a front-rear direction. In the present embodiment, the front-rear direction is a Y-direction. A negative Y-direction is directed forward while a positive Y-direction is directed rearward. Moreover, in the present embodiment, the connector **20** is a plug connector for Single Pair Ethernet. However, the present invention is not limited thereto. The present invention is also applicable to any connector other than the connector for Single Pair Ethernet. In addition, the present invention is applicable to any connector, such as an inter-connector, other than the plug connector.

Referring to FIGS. **2** and **3**, the connector **20** is provided with a housing **30**, at least one terminal **40**, a shell **50**, a locator **60** and a hood **70**. In the present embodiment, the housing **30** consists of a first housing **32** and a second housing **38**. Moreover, in the present embodiment, the at least one terminal **40** is two in number. Furthermore, in the present embodiment, the shell **50** consists of a first shell **52** and a second shell **58**. However, the present invention is not limited thereto. The housing **30** may consist of a single member. The at least one terminal **40** may be one or three or more in number. The shell **50** may consist of a single member. The hood **70** is not essential in the present invention.

As shown in FIGS. **2** and **3**, the terminals **40** are arranged in a width direction perpendicular to the front-rear direction. In the present embodiment, the width direction is an X-direction. Each of the terminals **40** is formed of a single metal sheet and has a held portion **401**, a supporting portion **403**, a contact portion **405** and a connection portion **407**. However, the present invention is not limited thereto. Each of the terminals **40** is not particularly limited in shape, provided that it has the contact portion **405** and the connection portion **407**, wherein the contact portion **405** is brought into contact with the mating terminal (not shown) when the connector **20** is mated with the mating connector (not shown), and wherein the connection portion **407** is connected to the insulated wire **82**. For example, the terminal **40** may be a terminal of a compression type.

As understood from FIGS. **2** and **3**, the held portion **401** of the terminal **40** is held by the housing **30** at least in part. In the present embodiment, the held portion **401** is held by the first housing **32** in part.

As shown in FIGS. **2** and **3**, the supporting portion **403** of the terminal **40** extends forward in the front-rear direction from the held portion **401**. The supporting portion **403** supports the contact portion **405**. In the present embodiment, the contact portion **405** is a part of a surface of the supporting portion **403**. The supporting portion **403** is resiliently deformable. By resilient deformation of the supporting portion **403**, the contact portion **405** is movable in at least an

up-down direction perpendicular to both the front-rear direction and the width direction. In the present embodiment, the up-down direction is a Z-direction. A positive Z-direction is directed upward while a negative Z-direction is directed downward.

As understood from FIGS. **2** and **3**, the connection portion **407** of the terminal **40** extends from the held portion **401** in a first direction perpendicular to the width direction. Here, the first direction is a movable direction of the locator **60** as mentioned later. In the present embodiment, the first direction is identical with the up-down direction. However, the present invention is not limited thereto. Provided that after-mentioned movement of the locator **60** is allowed, the first direction may be tilted with respect to the up-down direction.

As understood from FIGS. **2** and **3**, in the present embodiment, the connection portion **407** of the terminal **40** is an insulation displacement connection piece having a forked shape. However, the present invention is not limited thereto. The connection portion **407** may be a piercing piece with which the insulated wire **82** is pierced.

As understood from FIGS. **2** and **3**, the first housing **32** has a front portion **321** and a rear portion **323**. The rear portion **323** has a base portion **34** and a front wall **36**. The front wall **36** extends upward from a front-end portion of the base portion **34**. The front portion **321** protrudes forward from the base portion **34**. The supporting portions **403** of the terminals **40** extend forward from the front portion **321**. The base portion **34** is provided with a guide portion **341** and two recesses **343**. The guide portion **341** is a hole which is opened upward and has a bottom. The guide portion **341** receives and guides an after-mentioned guided portion **66** of the locator **60**. The recesses **343** are located outward of the guide portion **341** in the width direction. Each of the recesses **343** is opened upward and outward in the width direction. The recesses **343** receive after-mentioned supporting portions **64** of the locator **60** in part and allow resilient deformation of the supporting portions **64**. The connection portions **407** of the terminals **40** are located between the front wall **36** and the guide portion **341** in the front-rear direction. In the present embodiment, the first housing **32** is made of insulating resin and integrally molded with the terminals **40**. However, the present invention is not limited thereto. The terminals **40** may be held by the first housing **32** in any other way, such as press-fitting.

As understood from FIGS. **2** and **3**, the second housing **38** is attached to the first housing **32** and forms the housing **30** together with the first housing **32**. The second housing **38** is made of insulating resin which is same as or different from that of the first housing **32**. The second housing **38** accommodates the front portion **321** of the first housing **32** therein when attached to the first housing **32**. The second housing **38** is provided with accommodating grooves **381** which accommodate the supporting portions **403** of the terminals **40**, respectively, at least in part. When the second housing **38** is attached to the first housing **32**, the contact portions **405** of the terminals are located outward of the accommodating grooves **381** of the second housing **38**. In the present embodiment, the contact portion **405** of each of the terminals **40** is a part of the surface of the supporting portion **403** of the terminal **40** and oriented upward. With this structure, the contact portion **405** of the terminal **40** is contactable with the mating terminal (not shown) provided to the mating connector when the connector **20** is mated with the mating connector (not shown).

As shown in FIGS. **2** and **3**, the first shell **52** has a front portion **521** and a rear portion **523**. The front portion **521** has a generally square tube shape long in the front-rear direction. The front portion **521** is provided with a locking arm **537** on a side of an upper surface thereof.

As shown in FIGS. **2** and **3**, the rear portion **523** of the first shell **52** is opened upward. In detail, the rear portion **523** of the first shell **52** has two side wall portions **531** which are located apart from each other in the width direction and a bottom portion **533** which couples the side wall portions **531** to each other. The bottom portion **533** is provided with an electric wire supporting portion **535** extending rearward in the front-rear direction. The first shell **52** is made of metal. In the present embodiment, the first shell **52** is made by use of a single metal sheet. By use of the metal sheet, the shell **52** can obtain necessary and sufficient strength.

As shown in FIGS. **2** and **3**, each of the side wall portions **531** of the first shell **52** is provided with a first aperture **541**, a second aperture **543**, a third aperture **545** and a fourth aperture **547**. However, the third aperture **545** and the fourth aperture **547** are not essential in the present invention. In detail, when supplementary protruding portions **629** mentioned later do not exist, the third aperture **545** and the fourth aperture **547** are not essential.

Referring to FIGS. **11** and **13** in addition to FIGS. **2** and **3**, the first aperture **541**, the second aperture **543**, the third aperture **545** and the fourth aperture **547** pierce the side wall portion **531** in which they are formed in the width direction. The first aperture **541** and the second aperture **543** are apart from each other in the first direction. In the present embodiment, the first aperture **541** and the second aperture **543** are apart from each other in the up-down direction. Similarly, the third aperture **545** and the fourth aperture **547** are apart from each other in the first direction.

As shown in FIGS. **11** and **13**, the first aperture **541** and the third aperture **545** are located apart from each other in a second direction which is perpendicular to the width direction and intersects with the first direction. In the present embodiment, the second direction is the front-rear direction. In the present embodiment, the first aperture **541** and the third aperture **545** are apart from each other in the front-rear direction and in the up-down direction. Similarly, the second aperture **543** and the fourth aperture **547** are apart from each other in the second direction. In the present embodiment, the second aperture **543** and the fourth aperture **547** are apart from each other in the front-rear direction and in the up-down direction. Additionally, as shown in FIG. **11**, the third aperture **545** and the fourth aperture **547** overlap with the connection portion **407** of the terminal **40** in the second direction. This is for expanding a distance between the connection portion **407** and the side wall portion **531** as much as possible.

As understood from FIG. **4**, the first shell **52** accommodates almost the whole of the housing **30** therein. The side wall portions **531** of the first shell **52** extend so that they almost reach a rear end of the first housing **32** in the front-rear direction. Moreover, the side wall portions **531** of the first shell **52** extend so that they almost reach an upper end of the front wall **36** of the first housing **32** (see FIG. **6**) in the up-down direction. Thus, a space sandwiched between the side wall portions **531** of the first shell **52** is formed behind the front wall **36** of the first housing **32**. The space forms an accommodation portion **56** for accommodating the locator **60**. In detail, referring to FIG. **15** in addition to FIG. **4**, the front wall **36** of the first housing **32** has a receiving surface **361** intersecting with the second direction. The receiving surface **361** and the side wall portions **531** of the first shell **52** form the accommodation portion **56** for accommodating the locator **60**.

As shown in FIGS. **9** and **10**, the locator **60** has a main portion **62** having an almost rectangular parallelepiped shape, the supporting portions **64** and the guided portion **66**. The locator **60** is formed from insulating resin. The supporting portions **64** are located on both ends of the main portion **62** in the width direction and extend in the first direction from the main portion **62**. The guided portion **66** extends in the first direction from a lower surface of the main portion **62**. In the present embodiment, each of the supporting portions **64** and the guided portion **66** extends downward. The locator **60** is provided with a first end face **621**, a second end face **623**, two receiving apertures **625**, two admitting portions **627**, two protruding portions **641** and two supplementary protruding portions **629**. The first end face **621**, the second end face **623**, the receiving apertures **625**, the admitting portions **627** and the supplementary protruding portions **629** are provided to the main portion **62** of the locator **60**. The protruding portions **641** are provided to the supporting portions **64** of the locator **60**, respectively. In other words, the supporting portions **64** of the locator **60** correspond to and support the protruding portions **641**, respectively. However, the present invention is not limited thereto. Each of the number of the receiving apertures **625** and the number of the admitting portions **627** depends on the number of the terminals **40**. Moreover, the supplementary protruding portions **629** are not essential in the present invention.

As understood from FIGS. **9** and **10**, the first end face **621** and the second end face **623** of the locator **60** are located on both ends of the locator **60** in the second direction. In the present embodiment, the first end face **621** and the second end face **623** are located at a front end and a rear end of the main portion **62** of the locator **60**, respectively.

As understood from FIGS. **9**, **10**, **12** and **14**, the receiving apertures **625** of the locator **60** pierce the main portion **62** from the second end face **623** to the first end face **621**. Moreover, as understood from FIGS. **4** and **5**, each of the receiving apertures **625** has an internal diameter which can receive an end of the insulated wire **82**. In the present embodiment, each of the receiving apertures **625** has a round shape when viewed in the front-rear direction. However, the present invention is not limited thereto. The shape of the receiving aperture **625** may be any shape other than the round shape, such as an elliptic shape, an oval shape or a polygonal shape. Moreover, the shape and the size of the receiving aperture **625** in the first end face **621** may be different from the shape and the size of the receiving aperture **625** in the second end face **623**, respectively. For example, the size of the receiving aperture **625** in the second end face **623** may be larger than the size of the receiving aperture **625** in the first end face **621**. Furthermore, the receiving apertures **625** may communicate with each other in a plane perpendicular to the front-rear direction.

As understood from FIG. **9**, the admitting portions **627** of the locator **60** correspond to the receiving apertures **625**, respectively. Moreover, as understood from FIG. **3**, the admitting portions **627** correspond to the connection portions **407** of the terminals **40**, respectively. Each of the admitting portions **627** is opened downward and communicates with the receiving aperture **625** corresponding thereto. The admitting portion **627** has a size which can receive the connection portion **407** and which allows movement of the locator **60** therein.

As understood from FIGS. **9** and **10**, each of the protruding portions **641** of the locator **60** is supported by the supporting portion **64** corresponding thereto and protrudes outward in the width direction. The supporting portion **64** is resiliently deformable, and the protruding portion **641** is movable at least in the width direction because of resilient deformation of the supporting portion **64**. The protruding portion **641** has an inclined surface **643** and an upper surface **645**. In the present embodiment, the inclined surface **643** is a surface parallel to the front-rear direction and intersecting with the up-down direction. The inclined surface **643** is oriented downward in the up-down direction and outward in the width direction. Moreover, in the present embodiment, the upper surface **645** is a surface perpendicular to the up-down direction. The upper surface **645** is oriented upward. However, the present invention is not limited thereto. The upper surface **645** of the protruding portion **641** may intersect obliquely with the up-down direction to some extent.

As understood from FIGS. **12** and **14**, a size of the inclined surface **643** of the protruding portion **641** is larger than a size of the side wall portion **531** of the shell **50** in the width direction. With this structure, when the locator **60** is moved from a first position to a second position, the protruding portions **641** are easy to go out from the first apertures **541**. On the other hand, a size of the upper surface **645** is equal to or slightly larger than the size of the side wall portion **531** of the shell **50**. With this structure, if the locator **60** receives an upward force, the protruding portions **641** are hard to go out from the first apertures **541** when they are positioned in the first apertures **541**, and they are hard to go out from the second apertures **543** when they are positioned in the second apertures **543**.

As understood from FIGS. **9** and **10**, the supplementary protruding portions **629** protrude outward in the width direction from side surfaces of the main portion **62**. Moreover, the supplementary protruding portions **629** are located apart from the protruding portions **641** in the second direction. In the present embodiment, the supplementary protruding portions **629** are located forward of the protruding portions **641** in the front-rear direction. In the present embodiment, the supplementary protruding portions **629** are located upward of the protruding portions **641** in the up-down direction. The protruding portions **641** mainly work to maintain a position of the locator **60** in the first direction, and the supplementary protruding portions **629** mainly work to keep an orientation of the locator **60**. In the present embodiment, a size of each of the supplementary protruding portions **629** is smaller than a size of each of the protruding portions **641**. Particularly in the width direction, a protruding amount of the supplementary protruding portion **629** is less than that of the protruding portion **641**.

As shown in FIGS. **4** to **8**, the locator **60** is attached to the shell **50**. In detail, the locator **60** is attached to the first shell **52** so that it is movable from the first position (FIGS. **4** to **7**) to the second position (FIG. **8**) in the first direction. As understood from FIGS. **11** to **14**, the locator **60** attached to the shell **50** is, at least in part, located in the accommodation portion **56** which is formed by the receiving surface **361** of the first housing **32** and the side wall portions **531** of the shell **50**. However, this shall not apply to the protruding portions **641** and the supplementary protruding portions **629**.

Moreover, the guided portion **66** of the locator **60** is, at least in part, located in the guide portion **341** of the first housing **32**. Furthermore, the connection portion **407** of each of the terminals **40** is, at least in part, located in the admitting portion **627** corresponding thereto (see FIG. **9**).

As understood from FIGS. **4** to **8**, the protruding portions **641** of the locator **60** correspond to the side wall portions **531** of the shell **50**, respectively. The supplementary pro-

truding portions **629** also correspond to the side wall portions **531** of the shell **50**, respectively.

As shown in FIGS. **11** and **12**, when the locator **60** is positioned at the first position, each of the protruding portions **641** is positioned in the first aperture **541** of the side wall portion **531** corresponding thereto. In addition, each of the supplementary protruding portions **629** is positioned in the third aperture **545** of the side wall portion **531** corresponding thereto.

As understood from FIG. **12**, when the locator **60** is positioned at the first position, a range occupied by each of the receiving apertures **625** of the locator **60** overlaps with a range occupied by the receiving surface **361** of the first housing **32** in the first direction. On the other hand, a part of the range occupied by the receiving aperture **625** of the locator **60** is located out of the range occupied by the receiving surface **361** of the first housing **32** in the first direction. In other words, when the receiving aperture **625** is viewed from behind, the receiving surface **361** and a state existing forward thereof are visible. In the meantime, in the present embodiment, the connection portion **407** of the terminal **40** is not visible in the receiving aperture **625**.

As understood from FIGS. **4** to **7**, when the locator **60** is positioned at the first position, the ends of the insulated wires **82** can be inserted into the receiving apertures **625**, respectively. As mentioned above, the range occupied by each of the receiving apertures **625** of the locator **60** overlaps with the range occupied by the receiving surface **361** of the first housing **32** in the first direction. Accordingly, the ends of the insulated wires **82** inserted in the receiving apertures **625** can be brought into abutment with the receiving surface **361** of the first housing **32**. On the other hand, the part of the range occupied by the receiving aperture **625** of the locator **60** is located out of the range occupied by the receiving surface **361** of the first housing **32**. Accordingly, as shown in FIG. **6**, the end of the insulated wire **82** is visible from a front or diagonal front thereof. In other words, it can be seen whether the insulated wires **82** are properly arranged with respect to the locator **60** or not.

As shown in FIG. **7**, in the present embodiment, the first end face **621** of the locator **60** is nearer to the receiving surface **361** of the housing **30** than the second end face **623** of the locator **60** in the second direction. In addition, there is a gap **68** between the first end face **621** of the locator **60** and the receiving surface **361** of the housing **30** in the second direction. In detail, the receiving surface **361** of the first housing **32** is formed with an elongated protrusion **363** which protrudes in the second direction and extends in the first direction, and the elongated protrusion **363** forms the gap **68** between the first end face **621** and the receiving surface **361**. Through the gap **68**, it can be seen whether the ends of the insulated wires **82** are properly arranged with respect to the locator **60** or not. In addition, the elongated protrusion **363** prevents the ends of the insulated wires **82** from being brought into contact with each other. Thus, the insulated wires **82** are prevented from being shorted to each other.

As understood from FIG. **13**, when the locator **60** is positioned at the second position, each of the protruding portions **641** is positioned in the second aperture **543** of the side wall portion **531** corresponding thereto. In addition, each of the supplementary protruding portions **629** is positioned in the fourth aperture **547** of the side wall portion **531** corresponding thereto. Movement of the locator **60** from the first position to the second position is carried out by moving the locator **60** along the first direction. In the present embodiment, pressing down moves the locator **60** from the first position to the second position. When the locator **60** is pressed down, the protruding portions **641** come out from the first apertures **541** and come into the second apertures **543** because of resilient deformation of the supporting portions **64**. The supplementary protruding portions **629** come out from the third apertures **545** and come into the fourth apertures **547** because of resilient deformation of at least one of the locator **60** and the first shell **52**.

As understood from FIGS. **13** and **14**, each of the protruding portions **641** is positioned in the second aperture **543** of the side wall portion **531** corresponding thereto, so that movement of the locator **60** from the second position to the first position is regulated. Moreover, each of the supplementary protruding portions **629** is positioned in the fourth aperture **547** of the side wall portion **531** corresponding thereto, so that inclination of the locator **60** is prevented or suppressed.

As understood from FIG. **14**, when the locator **60** is positioned at the second position, a range occupied by each of the receiving aperture **625** is covered by a range occupied by the receiving surface **361** in the first direction. In other words, when the receiving apertures **625** are viewed from behind, the state existing forward of the receiving surface **361** is invisible. Accordingly, when end portions of the insulated wires **82** are properly arranged with respect to the receiving apertures **625**, the ends of the insulated wires **82** are covered by the receiving surface **361** or close to and face the receiving surface **361**. Thus, the ends of the insulated wires **82** are protected by the front wall **36**.

As shown in FIG. **14**, when the receiving apertures **625** are viewed from behind in a case the locator **60** is positioned at the second position, the connection portions **407** of the terminals **40** are visible. This means that the connection portions **407** of the terminals **40** are positioned in the receiving apertures **625** in part when the locator **60** is positioned at the second position. In other words, when the locator **60** is moved from the first position to the second position in the state that the end portions of the insulated wires **82** are inserted in the receiving apertures **625**, the connection portions **407** are brought into pressure contact with the insulated wires **82**, respectively.

As understood from FIGS. **15** and **16**, when the locator **60** is moved from the first position to the second position, the connection portion **407** of each of the terminals **40** cuts an insulation coating of the insulated wire **82** and is brought into contact with a core wire **821**. In a case where the connection portion **407** is the insulation displacement connection piece, the insulated wire **82** receives a reaction force from the connection portion **407**, and the locator **60** might receive a force directed toward the first position. Even in such a case, the protruding portions **641** and the supplementary protruding portions **629** are positioned in the second apertures **543** and the fourth apertures **547**, respectively, as described above with reference to FIG. **13**, so that the locator **60** is prevented from being moved from the second position to the first position. Thus, electrical connection between each of the terminals **40** and the insulated wire **82** corresponding thereto is maintained. By seeing that the protruding portions **641** and the supplementary protruding portions **629** are positioned in the second apertures **543** and the fourth apertures **547**, respectively, it can be grasped that the locator **60** is positioned at the second position. At the same time, it can be ascertained that the connection portions **407** of the terminals **40** are electrically connected with the insulated wires **82**.

Referring to FIGS. **17** and **18**, the second shell **58** has a cover portion **581** which covers the locator **60** and the rear

portion **523** of the first shell **52**. The cover portion **581** has a top plate portion **583** and side plate portions **585**. In the present embodiment, the second shell **58** is provided with a swaging portion **587** holding the cable **80**. The swaging portion **587** is coupled with the cover portion **581** by means of a coupling portion **589** extending rearward in the front-rear direction from the top plate portion **583**. The second shell **58** is attached to the first shell **52** and covers the locator from above. The cover portion **581** covers the side wall portions **531** of the first shell **52** from the outside in the width direction. The cover portion **581** is fixed to the side wall portions **531**. In order to fix the cover portion **581** to the side wall portions **531**, the cover portion **581** is formed with window portions while each of the side wall portions **531** is formed with a cut-and-raised portion in the present embodiment. In addition, the swaging portion **587** is swaged to the cable **80** and the electric wire supporting portion **535** of the first shell **52**. Thus, the cable **80** or the insulated wires **82** are held by the swaging portion **587**.

Referring to FIG. **19**, the hood **70** is attached to the cable **80** in advance. The hood **70** is attached to the shell **50** so that it covers the second shell **58** after the second shell **58** is attached to the first shell **52**. In order to fix the hood **70** to the shell in the present embodiment, the hood **70** is formed with windows, and each of the side plate portions **585** of the second shell **58** is formed with a cut-and-raised portion. The hood **70** has an operation arm **701**. As shown in FIG. **1**, the operation arm **701** is positioned above the locking arm **537** in part when it is attached to the shell **50**.

As mentioned above, according to the present embodiment, that the locator **60** is positioned at the second position can be checked by seeing that the protruding portions **641** are positioned in the second apertures **543** of the first shell **52** during a manufacturing process of the connector **20**. When the locator **60** is positioned at the second position, it can be judged that the insulated wires **82** are properly connected to the connection portions **407** of the terminals **40**, and high connection reliability can be achieved. Moreover, the first shell **52** is made of metal, so that it has necessary and sufficient strength even if the third aperture **545** and the fourth aperture **547** are formed in each of the side wall portions **531** in addition to the first aperture **541** and the second aperture **543**.

Although the specific explanation about the present invention is made above with reference to concrete embodiments, the present invention is not limited thereto but susceptible of various modifications and alternative forms without departing from the spirit of the invention.

For example, although the first position of the locator **60** is located upward of the second position in the up-down direction in the aforementioned embodiment, the first position of the locator **60** may be located downward of the second position. In that case, the rear portion **523** of the first shell **52** is opened downward, and the connection portion **407** of each of the terminals **40** extends downward. In addition, the first aperture **541** is located downward of the second aperture **543**, and the third aperture **545** is located downward of the fourth aperture **547**. Nevertheless, the aforementioned embodiment is easier to assemble owing to a positional relationship between the locking arm **537** and the locator **60**.

Although the connector **20** is a straight type connector in which a mating direction thereof is identical with or parallel to an extending direction of the cable **80** in the aforementioned embodiment, the connector **20** may be a right-angled type connector in which the mating direction thereof is perpendicular to the extending direction of the cable **80**. In that case, the first direction is identical with the front-rear direction, and the second direction is identical with the up-down direction.

Although the guide portion **341** and the guided portion **66** only guide movement of the locator **60** in the aforementioned embodiment, they may be further provided with a locking mechanism which strengthens function for maintaining the locator **60** at the second position.

Although the first direction and the second direction are perpendicular to each other in the aforementioned embodiment, they may slightly intersect with each other provided that a space for movement of the locator **60** is secured.

Although the supplementary protruding portions **629** are provided on the side surfaces of the main portion **62** of the locator **60** in the aforementioned embodiment, they may be supported by supporting portions, respectively in the same manner as the protruding portions **641**. In addition, each of the supplementary protruding portions **629** may have a shape similar to that of the protruding portion **641**.

While there has been described what is believed to be the preferred embodiment of the invention, those skilled in the art will recognize that other and further modifications may be made thereto without departing from the spirit of the invention, and it is intended to claim all such embodiments that fall within the true scope of the invention.

What is claimed is:

1. A connector which is attachable to an electric wire, wherein:

the connector is mateable with a mating connector provided with a mating terminal;

the connector comprises a housing, at least one terminal, a shell and a locator;

the terminal is held by the housing;

the terminal has a contact portion which is brought into contact with the mating terminal when the connector is mated with the mating connector and a connection portion to be connected to the electric wire;

the shell is made of metal and has two side wall portions which are located apart from each other in a width direction;

each of the side wall portions is provided with a first aperture and a second aperture;

the first aperture and the second aperture pierce the side wall portion in the width direction and are located apart from each other in a first direction perpendicular to the width direction;

the locator is attached to the shell so that the locator is movable from a first position to a second position in the first direction;

the locator is provided with a first end face, a second end face, a receiving aperture, an admitting portion and two protruding portions;

the first end face and the second end face are located on both ends of the locator in a second direction which is perpendicular to the width direction and intersects with the first direction;

the receiving aperture pierces the locator from the second end face to the first end face and is receivable an end of the electric wire;

the admitting portion communicates with the receiving aperture and allows the connection portion to be moved therein when the locator is moved;

the protruding portions correspond to the side wall portions, respectively;

each of the protruding portions protrudes outward in the width direction;

when the locator is positioned at the first position, each of the protruding portions is positioned in the first aperture of the side wall portion corresponding thereto; and

when the locator is positioned at the second position, each of the protruding portions is positioned in the second aperture of the side wall portion corresponding thereto while the connection portion is positioned in the receiving aperture in part.

2. The connector as recited in claim **1**, wherein:

the connection portion is an insulation displacement connection piece which extends in the first direction and has a forked shape;

the locator has a main portion and two supporting portions extending in the first direction from the main portion;

the receiving aperture is provided in the main portion;

the supporting portions are resiliently deformable and correspond to the protruding portions, respectively;

each of the protruding portions is supported by the supporting portion corresponding thereto and movable at least in the width direction; and

when each of the protruding portions is positioned in the second aperture of the side wall portion corresponding thereto, movement of the locator from the second position to the first position is regulated.

3. The connector as recited in claim **1**, wherein:

the housing has a receiving surface intersecting with the second direction;

the receiving surface of the housing and the side wall portions of the shell form an accommodation portion which accommodates the locator;

when the locator is positioned at the second position, a range occupied by the receiving aperture is covered by a range occupied by the receiving surface in the first direction; and

when the locator is positioned at the first position, the range occupied by the receiving aperture overlaps with the range occupied by the receiving surface in the first direction while a part of the range occupied by the receiving aperture is out of the range occupied by the receiving surface in the first direction.

4. The connector as recited in claim **1**, wherein:

the housing has a receiving surface intersecting with the second direction;

the receiving surface of the housing and the side wall portions of the shell form an accommodation portion which accommodates the locator;

in the second direction, the first end face of the locator is closer to the receiving surface of the housing than the second end face of the locator is;

when the locator is positioned at the first position, the end of the electric wire inserted in the receiving aperture is able to be brought into abutment with the receiving surface; and

in the second direction, a gap is left between the first end face of the locator and the receiving surface of the housing.

5. The connector as recited in claim **1**, wherein:

each of the side wall portions of the shell is provided with a third aperture and a fourth aperture;

the third aperture and the fourth aperture pierce the side wall portion in the width direction and are located apart from each other in the first direction;

the first aperture and the third aperture are located apart from each other in the second direction;

the second aperture and the fourth aperture are located apart from each other in the second direction;

the locator is provided with two supplementary protruding portions;

the supplementary protruding portions correspond to the side wall portions, respectively;

each of the supplementary protruding portions protrudes outward in the width direction;

the supplementary protruding portions are located apart from the protruding portions in the second direction;

when the locator is positioned at the first position, each of the supplementary protruding portions is positioned in the third aperture of the side wall portion corresponding thereto; and

when the locator is positioned at the second position, each of the supplementary protruding portions is positioned in the fourth aperture of the side wall portion corresponding thereto.

6. The connector as recited in claim **5**, wherein the third aperture and the fourth aperture overlap with the connection portion of the terminal in the second direction.

7. The connector as recited in claim **1**, wherein:

the locator is provided with a guided portion extending in the first direction; and

the housing is provided with a guide portion which receives and guides the guided portion.

8. The connector as recited in claim **1**, wherein the shell is provided with a swaging portion which holds the electric wire.

9. A connector attached electric wire comprising the connector as recited in claim **1**, wherein the connector is attached to the electric wire.

10. A connector attached electric wire comprising the connector as recited in claim **2**, wherein the connector is attached to the electric wire.

11. A connector attached electric wire comprising the connector as recited in claim **3**, wherein the connector is attached to the electric wire.

12. A connector attached electric wire comprising the connector as recited in claim **4**, wherein the connector is attached to the electric wire.

13. A connector attached electric wire comprising the connector as recited in claim **5**, wherein the connector is attached to the electric wire.

14. A connector attached electric wire comprising the connector as recited in claim **6**, wherein the connector is attached to the electric wire.

15. A connector attached electric wire comprising the connector as recited in claim **7**, wherein the connector is attached to the electric wire.

16. A connector attached electric wire comprising the connector as recited in claim **8**, wherein the connector is attached to the electric wire.

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