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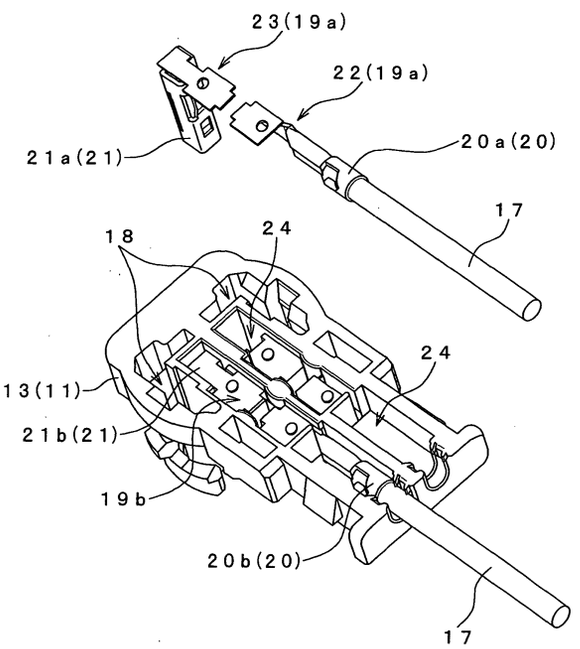
(54) Electrical connecting device

(57) A pair of connecting terminals (19) are electrically connected by connecting an end (20) of each connecting terminal to a bare end part of a coated conductive wire (17) and by connecting an opposite end (21) thereof to each of a pair of to-be-connected terminals. A plug connector component (11) supports the pair of connecting terminals (19) and is fitted to the socket connector component. A noise removing portion (25) includes at least one surface-mountable electromagnetic wave noise filter (25) and is disposed such that at least a part thereof is overlapped with at least one of the pair of connecting terminals (19). The electrical connecting device (1) including the pair of connecting terminals (19), the plug connector component (11), and the noise removing portion (25) is connected to the socket connector component supporting the pair of to-be-connected terminals.

FIG. 6



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Description

Technical Field

[0001] The present invention relates to an electrical connecting device that includes a pair of connecting terminals, a plug connector component supporting the connecting terminals, and a noise removing portion and that is connected to a socket connector component supporting a pair of to-be-connected terminals.

Background Art

[0002] Conventionally, a device disclosed in Japanese Published Unexamined Patent Application No. 2002-33153 (hereinafter, referred to as "Patent Document 1") is known as an electrical connecting device that includes a pair of connecting terminals, a plug connector component supporting the connecting terminals, and a noise removing portion used to remove electromagnetic wave noises and that is connected to a socket connector component supporting a pair of to-be-connected terminals. The electrical connecting device disclosed in Patent Document 1 is a plug connector that is connected to a socket connector in order to realize an ignition circuit of a detonator of an automobile airbag gas generator. This electrical connecting device includes a pair of electric contacts (i.e., a pair of connecting terminals), a connector housing (i.e., a plug connector component) supporting the electric contacts, and a ferrite member (i.e., a noise removing portion) used to remove electromagnetic wave noises. Patent Document 1 additionally discloses that an induction coil may be used instead of the ferrite member.

[0003] However, if a ferrite member is used as the noise removing portion as in the electrical connecting device disclosed in Patent Document 1, the ferrite member will serve as a thick member with which the periphery of the connecting terminals is covered. Therefore, a problem resides in the fact that the plug connector component supporting the connecting terminals together with the ferrite member is liable to be thickened and enlarged. Another problem resides in the fact that, if an induction coil is used as the noise removing portion, a restriction on the linear dimension of the induction coil itself will easily cause an increase in the linear dimension of the plug connector component supporting the induction coil together with the connecting terminals.

Disclosure of Invention

[0004] The present invention has been made in consideration of the foregoing circumstances, and it is an object of the present invention to provide an electrical connecting device in which a plug connector component is made compact by easing dimensional restrictions caused by disposing a noise removing portion, thus leading to a size reduction of the electrical connecting device.

[0005] The present invention is concerned with an electrical connecting device that is connected to a socket connector component supporting a pair of to-be-connected terminals.

[0006] To achieve the object, the present invention has the following features. In other words, the present invention has the following features in the form of each individual feature or in the form of a suitable combination of the features.

[0007] A first feature in the electrical connecting device of the present invention to achieve the object is that the electrical connecting device includes a pair of connecting terminals that are electrically connected by connecting an end of each connecting terminal to a bare end part of a coated conductive wire and by connecting an opposite end thereof to each of the pair of to-be-connected terminals, a plug connector component that supports the pair of connecting terminals and that is fitted to the socket connector component, and a noise removing portion that includes at least one surface-mountable electromagnetic wave noise filter and that is disposed such that at least a part thereof is overlapped with at least one of the pair of connecting terminals.

[0008] According to this structure, the noise removing portion, which is to remove noises by using a surface-mountable electromagnetic wave noise filter, can have a large reduction in thickness and in size. Additionally, since the thin, small-sized noise removing portion is disposed so that at least a part of the noise removing portion is overlapped with at least one of the pair of connecting terminals, these are prevented from being disposed widely, and the noise removing portion is disposed while utilizing a space in the plug connector component with great efficiency. Therefore, since a thick member, such as a ferrite member, or a long member, such as an induction coil, is not used, the plug connector component can be made compact by easing a dimensional restriction caused by disposing the noise removing portion, and the electrical connecting device can be reduced in size.

[0009] A second feature in the electrical connecting device of the present invention is that the connecting terminal disposed to overlap the noise removing portion consists of a one-end-side part that is connected to a bare end part of the coated conductive wire and an opposite-end-side part that is connected to the to-be-connected terminal and that the electromagnetic wave noise filter is connected in series between the one-end-side part and the opposite-end-side part.

[0010] According to this structure, since the noise removing portion is disposed such that the electromagnetic wave noise filters are connected in series between the one-end-side part and the opposite-end-side part of the connecting terminal, the noise removing portion can be restrained from being widely disposed, and the plug connector component can be made compact while utilizing a space in the plug connector component with

higher efficiency.

[0011] A third feature in the electrical connecting device of the present invention is that the plug connector component is provided with at least one positioning portion that supports the noise removing portion in such a way as to sandwich the noise removing portion from both sides thereof between the one-end-side part and the opposite-end-side part.

[0012] According to this structure, the noise removing portion can be stably supported in the plug connector component by employing a simple structure in which the positioning portion sandwiching the noise removing portion from both sides thereof is disposed in the plug connector component.

[0013] A fourth feature in the electrical connecting device of the present invention is that the noise removing portion further includes at least one substrate that supports the electromagnetic wave noise filter and that the electromagnetic wave noise filter is connected to the connecting terminal via the substrate.

[0014] According to this structure, since the electromagnetic wave noise filter is connected to the connecting terminal via the substrate, the electromagnetic wave noise filter can be stably supported. Additionally, since the substrate can be formed more thinly than a ferrite member and can be formed to be shorter than an induction coil, the plug connector component can be made compact.

[0015] A fifth feature in the electrical connecting device of the present invention is that the electrical connecting device is used as an electrical connecting device for a squib used for ignition by applying an electric current to a gas generator in an automobile airbag system.

[0016] A space provided for an electrical connecting device for a squib used for ignition by applying an electric current to a gas generator in an automobile airbag system is narrow and is subjected to various dimensional restrictions. However, the narrow disposition space can be effectively utilized by using the small-sized, compact electrical connecting device.

[0017] The above-mentioned object, other objects, features, and advantages of the present invention will become apparent from reading the following description with the accompanying drawings.

Brief Description of Drawings

[0018]

FIG. 1 is a perspective view showing an electrical connecting device according to a first embodiment of the present invention.

FIG. 2 is a side view of the electrical connecting device of FIG. 1.

FIG. 3 is a front view of the electrical connecting device of FIG. 1.

FIG. 4 is a perspective view showing a state in which a retainer component is detached in the electrical connecting device of FIG. 1.

FIG. 5 is a perspective view showing a state in which an upper housing is detached in the electrical connecting device of FIG. 1.

FIG. 6 is an exploded perspective view showing a lower housing and a pair of connecting terminals in the electrical connecting device of FIG. 1.

FIG. 7 is a perspective view showing a state in which the pair of connecting terminals are supported by the lower housing in the electrical connecting device of FIG. 1.

FIG. 8 shows an electrical connecting device according to a second embodiment of the present invention, being a perspective view showing a state in which the upper housing is detached.

FIG. 9 is a perspective view showing a noise removing portion of the electrical connecting device of FIG. 8.

FIG. 10 shows a modification of the electrical connecting device according to the first embodiment, being a perspective view showing a state in which the pair of connecting terminals are supported by the lower housing.

FIG. 11 shows a modification of the electrical connecting device according to the first embodiment, being a perspective view showing a state in which the upper housing is detached.

Best Mode for Carrying Out the Invention

[0019] The best mode for carrying out the present invention will be hereinafter described with reference to the accompanying drawings. The present invention is suitable for a case in which it is applied as an electrical connecting device for a squib used for ignition by applying an electric current to a gas generator in an automobile airbag system, and embodiments of this case are described. However, the present invention can be widely applied and can be applied to many different environments and to various objects.

(First embodiment)

[0020] FIG. 1 is a perspective view seen from above an electrical connecting device 1 according to a first embodiment of the present invention, FIG. 2 is a side view of the electrical connecting device 1, and FIG. 3 is a front view of the electrical connecting device 1 . As shown in FIG. 1 to FIG. 3, the electrical connecting device 1 is constructed in the form of a plug that is connected to a socket connector component (not shown) in the form of a socket, and includes a plug connector component 11.

[0021] The plug connector component 11 is made of a nonconductive, resinous material. This plug connector component 11 is provided with a substantially rectangular main body formed by superposing an upper housing 12 and a lower housing 13 on each other, a projection

14 that protrudes out substantially vertically from the lower housing 13 downward, and a pair of legs 15 that protrude out substantially in parallel with the projection 14 at both sides thereof. A pair of connecting terminals that are connected to a pair of conductive wires 17 and 17 are contained in the upper and lower housings (12 and 13) and in the projection 14. A retainer component 16 is fixedly inserted into and engaged with the plug connector component 11 from above the upper housing 12.

[0022] The electrical connecting device 1 is fitted to a socket connector component, not shown, and is electrically and mechanically connected thereto. The socket connector component is provided with an opening, into which the projection 14 of the plug connector component 11 is fitted. When fitted, the pair of connecting terminals contained in the plug connector component 11 are respectively connected to a pair of to-be-connected terminals, such as pins, (not shown) that are supported by the socket connector component. Further, when fitted, a convex part 15a formed on the leg 15 is engaged with a concave part formed in the opening of the socket connector component, and, by pushing the retainer component 16 from above, a convex part 16a formed on the retainer component 16 is also engaged with the concave part formed in the opening of the socket connector component.

[0023] The conductive wires 17 and 17 are connected to an airbag control system, not shown, on the side opposite the electrical connecting device 1. The socket connector component is provided as a part of an airbag ignition device (i.e., squib) not shown. When the electrical connecting device 1 is fitted to the socket connector component and is mechanically and electrically connected thereto, a sufficient quantity of electrical energy is given there via the conductive wires 17 and 17 in response to a command emitted from the airbag control system, thus enabling the combustion of the squib. A gas generation substance is ignited by this combustion, and an air bag is inflated.

[0024] FIG. 4 is a perspective view showing a state in which the retainer component 16 is detached, and FIG. 5 is a perspective view showing a state in which the upper housing 12 is detached. As shown in FIG. 4 and FIG. 5, a groove 18 into which the retainer component 16 is inserted is formed in the plug connector component 11.

[0025] As shown in FIG. 5, a pair of connecting terminals 19 (19a and 19b) are supported in the plug connector component 11. FIG. 6 is an exploded perspective view of the lower housing 13 and the pair of connecting terminals 19, and FIG. 7 is a perspective view showing a state in which the pair of connecting terminals 19 are supported by the lower housing 13. As shown in FIG. 6 and FIG. 7, in the pair of connecting terminals 19, one end side 20 (20a and 20b) is connected to a bare end part of a coated conductive wire 17, and an opposite end side 21 (21a and 21b) is brought into contact with each of a pair of to-be-connected terminals (not shown) that are supported by a socket connector component (not shown), and thereby is electrically connected thereto. The pair of connecting terminals 19 are fitted into a concave part 24 formed in the plug connector component 11 and are supported there.

[0026] One (19a) of the pair of connecting terminals 19 can be divided into a one-end-side part 22 having a one end side 20a and an opposite-end-side part 23 having an opposite end side 21a. The one-end-side part 22 is formed to be substantially linear, and is pressed and connected to the bare end part of the coated conductive wire 17. On the other hand, the opposite-end-side part 23 is formed almost like the capital letter L, and its part protruding downward is connected to the to-be-connected terminal. The other connecting terminal 19b is integrally constructed such that the one end side 20b and the opposite end side 21b are contiguous to each other.

[0027] As shown in FIG. 5, the noise removing portion 25 is disposed to be overlapped with a part of the other connecting terminal 19a when viewed planarly. The noise removing portion 25 is to be incorporated into the electrical connecting device 1 as a means for removing electromagnetic wave noises. In an airbag system constructed in an automobile, a noise removing function of the noise removing portion 25 prevents a noise electric current from flowing to the squib and causing an accidental explosion because of various electromagnetic waves from the outside, such as those from electric wires, from various automobile electronic devices, from radios, or from cellular telephones.

[0028] The noise removing portion 25 is formed of surface-mountable electromagnetic wave noise filters. In detail, the connecting terminal 19a consisting of the one-end-side part 20a and the opposite-end-side part 21a is disposed to be overlapped with the noise removing portion 25, and the electromagnetic wave noise filters, which constitute the noise removing portion 25, are connected in series between the one-end-side part 20a and the opposite-end-side part 21a.

[0029] For example, chip ferrite beads or chip inductors (coils) can be used as the surface-mountable electromagnetic wave noise filters 25. Since these electromagnetic wave noise filters connected in series between the one-end-side part 20a and the opposite-end-side part 21a serve as a large impedance against high-frequency electromagnetic wave noises, a noise electric current can be prevented from being passed through the pair of connecting terminals 19.

[0030] The noise removing portion 25 is supported in such a way as to be sandwiched by the positioning portions 26 formed on the plug connector component 11 from both sides thereof. The positioning portion 26 is placed at a corresponding position between the one-end-side part 22 and the opposite-end-side part 23 of the connecting terminal 19a in the lower housing 13. The formation of the positioning portion 26 makes it possible to stably support the noise removing portion 25 with a simple structure in the plug connector component 11.

[0031] According to the electrical connecting device

1 described above, the noise removing portion 25, which is to remove noises by the surface-mountable electromagnetic wave noise filters, can be greatly reduced in thickness and in size. Additionally, the thin, small-sized noise removing portion 25 is disposed such that at least a part of the noise removing portion 25 is overlapped with at least one of the pair of connecting terminals. Therefore, in all of the width direction, longitudinal direction, and thickness direction of the plug connector component 11, the noise removing portion 25 is restrained from being widely disposed, and is disposed while utilizing a space in the plug connector component 11 with high efficiency. Therefore, since a thick member, such as a ferrite member, or a long member, such as an induction coil, is not used, a dimensional restriction caused by disposing the noise removing portion can be eased, and the plug connector component can be made compact, thus realizing a size reduction of the electrical connecting device.

[0032] Additionally, according to the electrical connecting device 1, the noise removing portion 25 is connected in series between the one-end-side part 22 and the opposite-end-side part 23 of the connecting terminal 19a, and hence the noise removing portion 25 can be more advantageously restrained from being widely disposed in the width direction of the plug connector component 11, and a space in the plug connector component 11 can be utilized more efficiently.

(Second embodiment)

[0033] FIG. 8 shows an electrical connecting device 2 according to a second embodiment of the present invention, and is a perspective view corresponding to FIG. 5 of the electrical connecting device 1 according to the first embodiment. The electrical connecting device 2 includes a plug connector component 27, a pair of connecting terminals 29 (29a and 29b), and a noise removing portion 30, and is structured in the same way as the electrical connecting device 1 (in FIG. 8, only a lower housing 28 of the plug connector component 27 is shown) . However, the electrical connecting device 2 is different from the electrical connecting device 1 in the structure of the connecting terminals 29 and the noise removing portion 30.

[0034] In the electrical connecting device 2, the pair of connecting terminals 29 are integrally formed such that one end side that is connected to the conductive wire 17 and an opposite end side that is connected to the to-be-connected terminal (not shown) are contiguous to each other both in one connecting terminal 29a and in the other connecting terminal 29b.

[0035] FIG. 9 is a perspective view of the noise removing portion 30. As shown in FIG. 8 and FIG. 9, the noise removing portion 30 of the electrical connecting device 2 includes a surface-mountable electromagnetic wave noise filter 31 and a substrate 32 supporting the noise filter 31. The electromagnetic wave noise filter 31 is formed of, for example, a chip capacitor, and is connected to the connecting terminal 29 in parallel therewith through a circuit printed on the substrate 32 (in FIG. 8 and FIG. 9, the circuit is printed on the reverse side of the substrate 32). This parallel connection of the chip capacitor 31 makes it possible to prevent a noise electric current from flowing to a squib through the pair of connecting terminals 29 because of high-frequency electromagnetic wave noises.

[0036] The substrate 32 has through holes 33 and 33. Pins 34 and 34 that protrude upward at the opposite end side of the connecting terminal 29 are inserted into the through holes 33 and 33, respectively, and are joined thereto, for example, by soldering. The substrate 32 further has a hole 35. The substrate 32 is stably supported in the lower housing 28 by allowing a convex part 36 that protrudes upward from the lower housing 28 to pass through the hole 35.

[0037] According to the thus structured electrical connecting device 2, the electromagnetic wave noise filter 31 is connected to the connecting terminal 29 via the substrate 32, and hence the electromagneticwave noise filter 31 can be stably supported. Additionally, since the substrate 32 can be formed thinner than a ferrite member and can be formed to be shorter than an induction coil, the plug connector component can be made compact.

[0038] Although the present invention has been described in conjunction with the preferred embodiments, many modifications and variations will be apparent from reading and understanding the foregoing description as a matter of course, and the present invention is intended to embrace all such modifications, variations, and equivalents that fall within the spirit and scope of the appended Claims.

[0039] For example, the following modifications may be carried out.

[0040] The surface-mountable ferrite bead, inductor, and capacitor have been mentioned as a noise removing portion in the above-mentioned embodiments, but, without being limited to these, various surface-mountable electromagnetic wave noise filters can be used. For example, a three-terminal capacitor or an EMI filter may be connected in series between the one-end-side part and the opposite-end-side part of the connecting terminal (in this case, these must be grounded). Alternatively, it is permissible to use a surface-mountable electromagnetic wave noise filter that is constructed by an arbitrary combination of coils, capacitors, and resistors.

[0041] Although the noise removing portion 25 is disposed to be overlapped with only one (19a) of the pair of connecting terminals 19 in the first embodiment, the noise removing portion 25 may be disposed to be overlapped not only with the connecting terminal 19a but also with the other connecting terminal 19b. FIG. 10 and FIG. 11 show modifications in a case in which the noise removing portion (electromagnetic wave noise filter) 25 is overlapped also with the other connecting terminal

19b. FIG. 10 is a perspective view corresponding to FIG. 7, and FIG. 11 is a perspective view corresponding to FIG. 5.

[0042] As shown in FIG. 10, in this modification, not only the connecting terminal 19a but also the other connecting terminal 19b is divided into a one-end-side part 37 and an opposite-end-side part 38. As shown in FIG. 11, an electromagnetic wave noise filter 25a (25) is connected in series to the connecting terminal 19a between the one-end-side part 22 and the opposite-end-side part 23, and an electromagnetic wave noise filter 25b (25) is connected in series to the other connecting terminal 19b between the one-end-side part 37 and the opposite-end-side part 38. The noise removing capability can be much improved by providing a plurality of electromagnetic wave noise filters in this way. A plurality of electromagnetic wave noise filters 25 may be connected in series by further dividing the connecting terminal 19a or 19b.

Industrial Applicability

[0043] As is apparent from the foregoing description, the electrical connecting device of the present invention is suitable for use especially as an electrical connecting device for a squib used for ignition by applying an electric current to a gas generator in an automobile airbag system. However, the electrical connecting device of the present invention can be applied more widely, and can be applied to many different environments and to various objects.

[0044] A pair of connecting terminals (19) are electrically connected by connecting an end (20) of each connecting terminal to a bare end part of a coated conductive wire (17) and by connecting an opposite end (21) thereof to each of a pair of to-be-connected terminals. A plug connector component (11) supports the pair of connecting terminals (19) and is fitted to the socket connector component. A noise removing portion (25) includes at least one surface-mountable electromagnetic wave noise filter (25) and is disposed such that at least a part thereof is overlapped with at least one of the pair of connecting terminals (19). The electrical connecting device (1) including the pair of connecting terminals (19), the plug connector component (11), and the noise removing portion (25) is connected to the socket connector component supporting the pair of to-be-connected terminals.

Claims

1. An electrical connecting device that is connected to a socket connector component supporting a pair of to-be-connected terminals, the electrical connecting device comprising:

   a pair of connecting terminals that are electrically connected by connecting an end of each connecting terminal to a bare end part of a coated conductive wire and by connecting an opposite end thereof to each of the pair of to-be-connected terminals;
   a plug connector component that supports the pair of connecting terminals and that is fitted to the socket connector component; and
   a noise removing portion including at least one surface-mountable electromagnetic wave noise filter, the noise removing portion disposed such that at least a part of the noise removing portion is overlapped with at least one of the pair of connecting terminals.

2. The electrical connecting device as set forth in Claim 1, wherein the connecting terminal disposed to overlap the noise removing portion consists of a one-end-side part that is connected to a bare end part of the coated conductive wire and an opposite-end-side part that is connected to the to-be-connected terminal, and wherein the electromagnetic wave noise filter is connected in series between the one-end-side part and the opposite-end-side part.

3. The electrical connecting device as set forth in Claim 2, wherein the plug connector component is provided with at least onepositioningportion that supports the noise removingportion in such a way as to sandwich the noise removing portion from both sides thereof between the one-end-side part and the opposite-end-side part.

4. The electrical connecting device as set forth in Claim 1, wherein the noise removing portion further includes at least one substrate that supports the electromagnetic wave noise filter, the electromagnetic wave noise filter being connected to the connecting terminal via the substrate.

5. The electrical connecting device as set forth in Claim 1, wherein being used as an electrical connecting device for a squib used for ignition by applying an electric current to a gas generator in an automobile airbag system.

FIG. 1

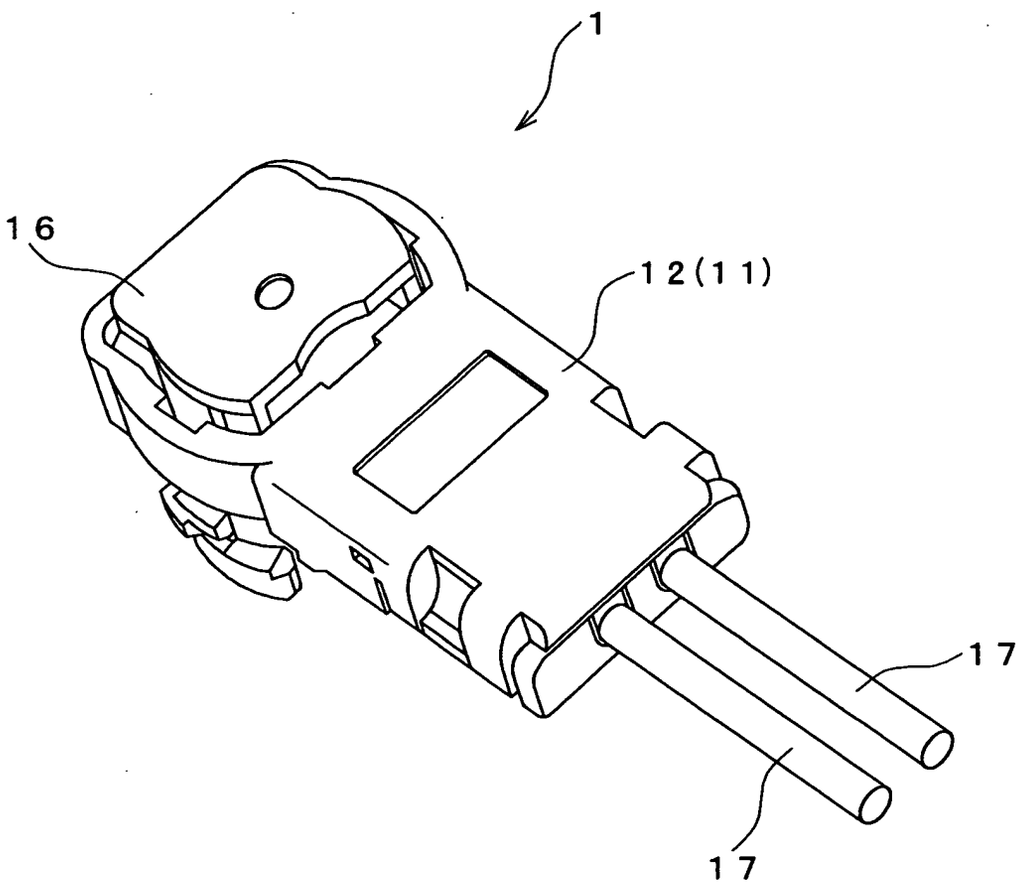


FIG. 2

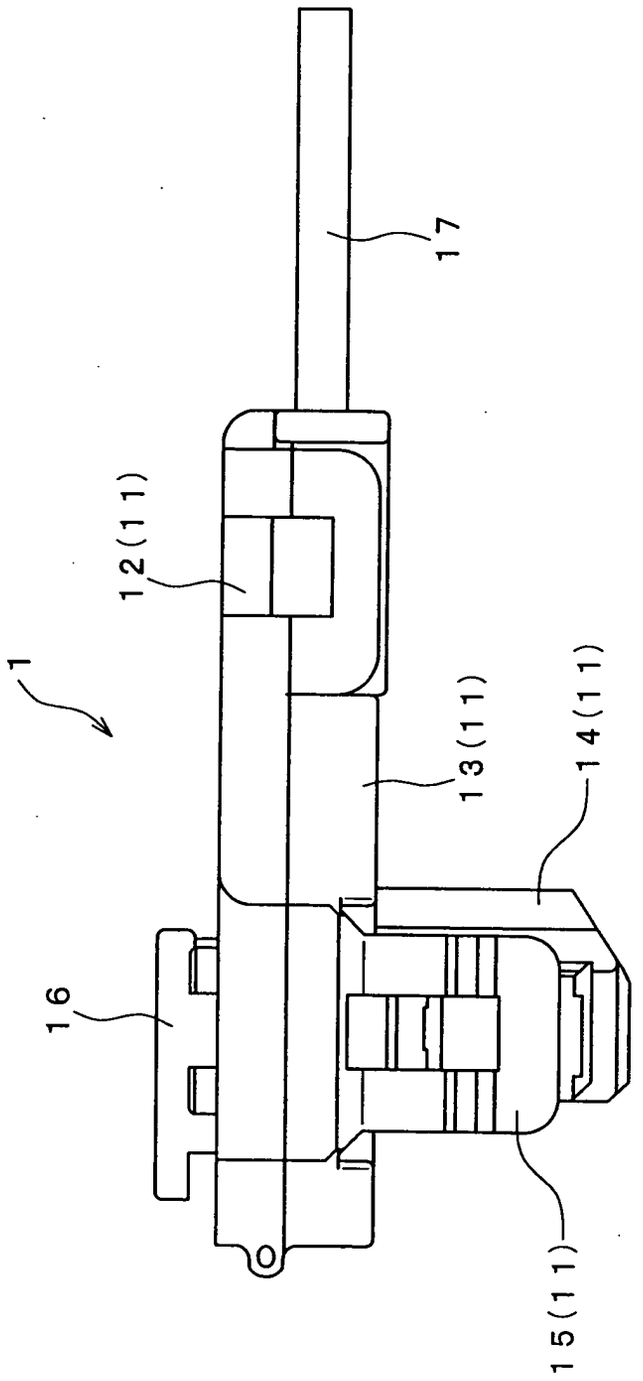


FIG. 3

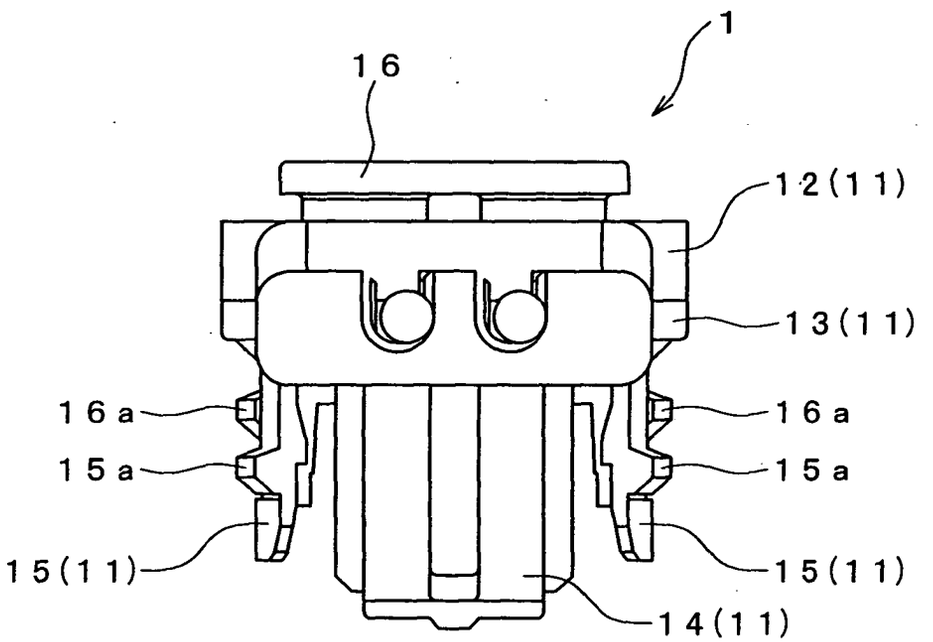


FIG. 4

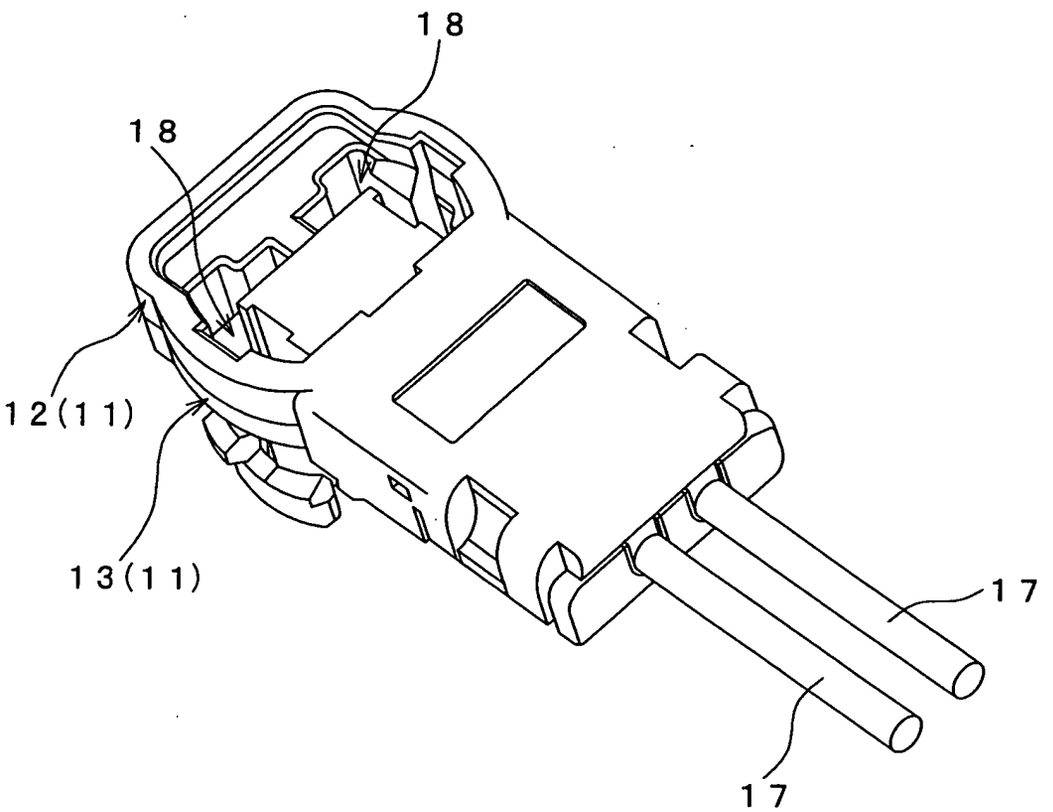


FIG. 5

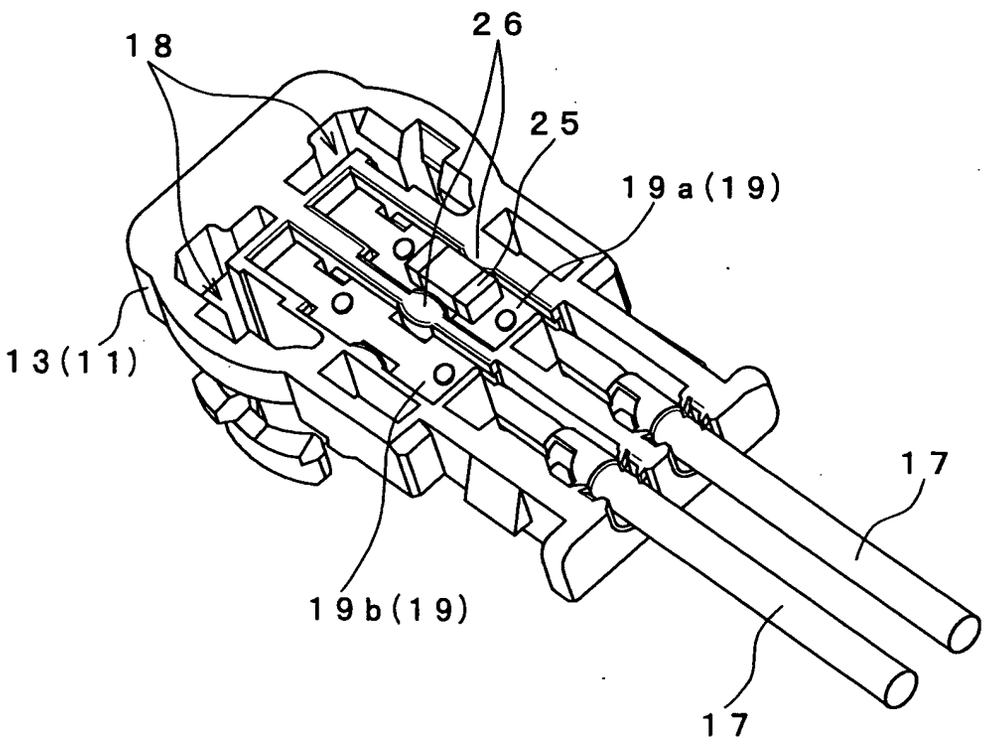


FIG. 6

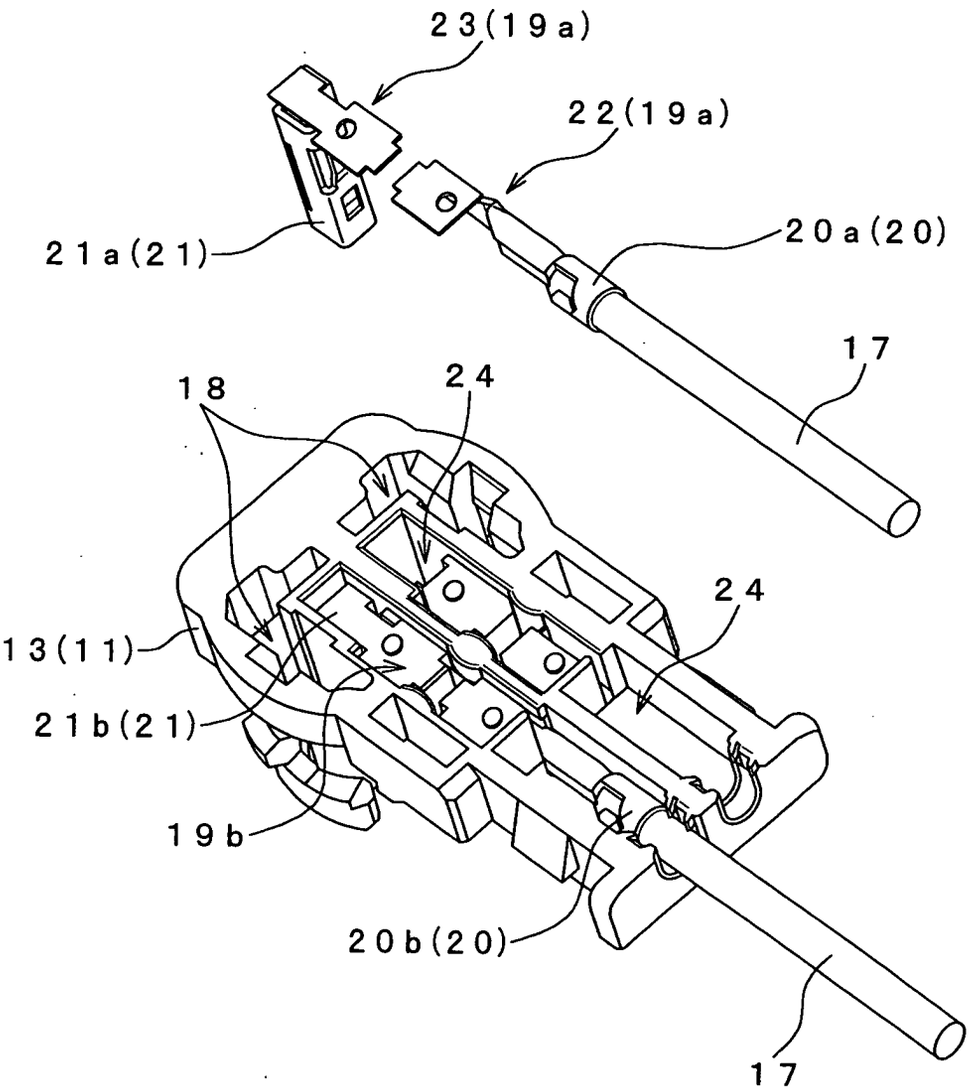


FIG. 7

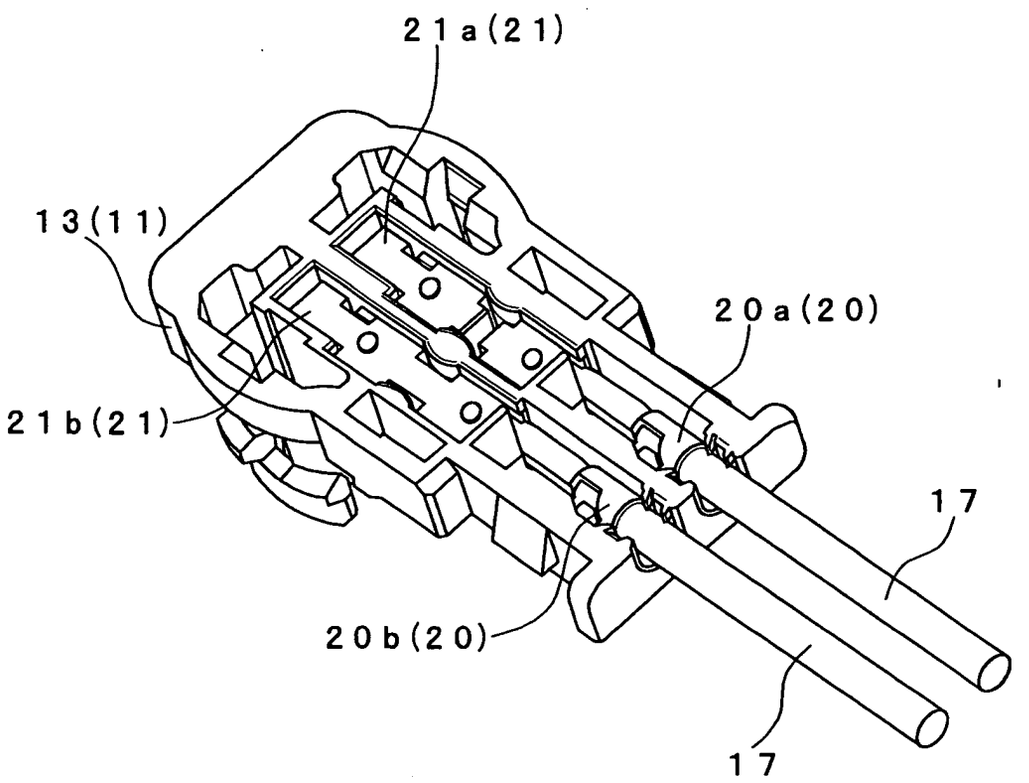


FIG. 8

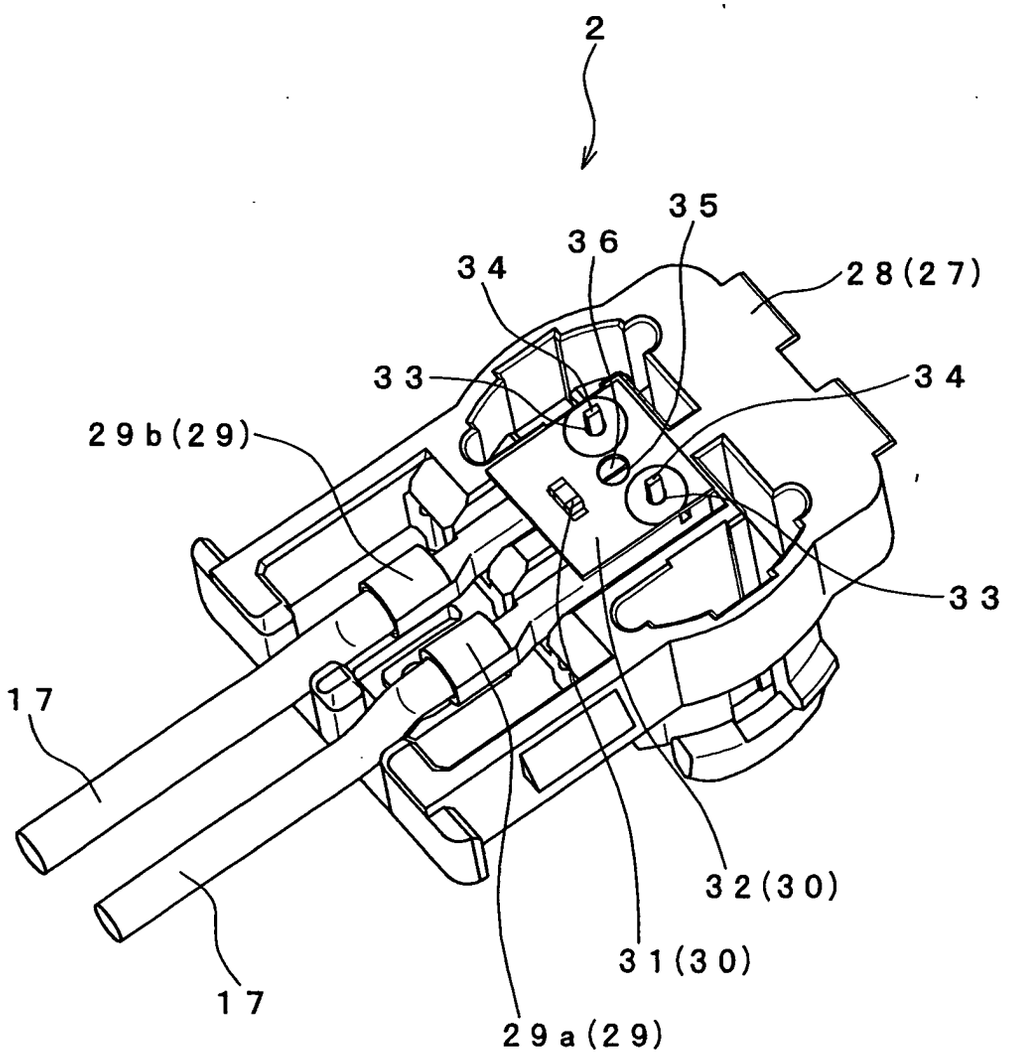


FIG. 9

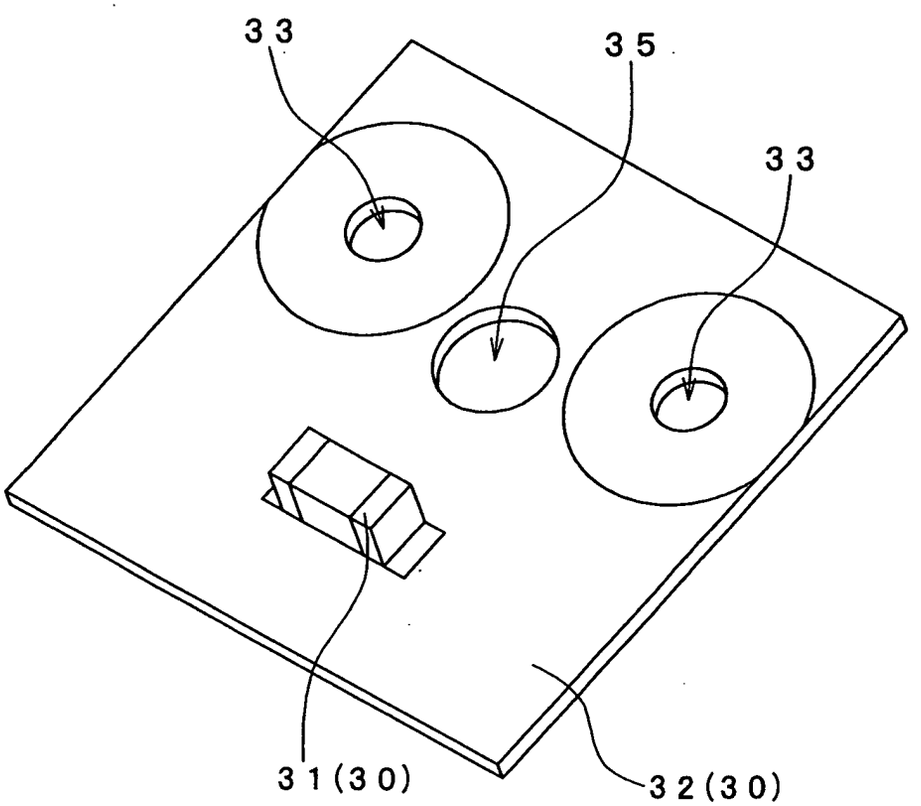


FIG. 10

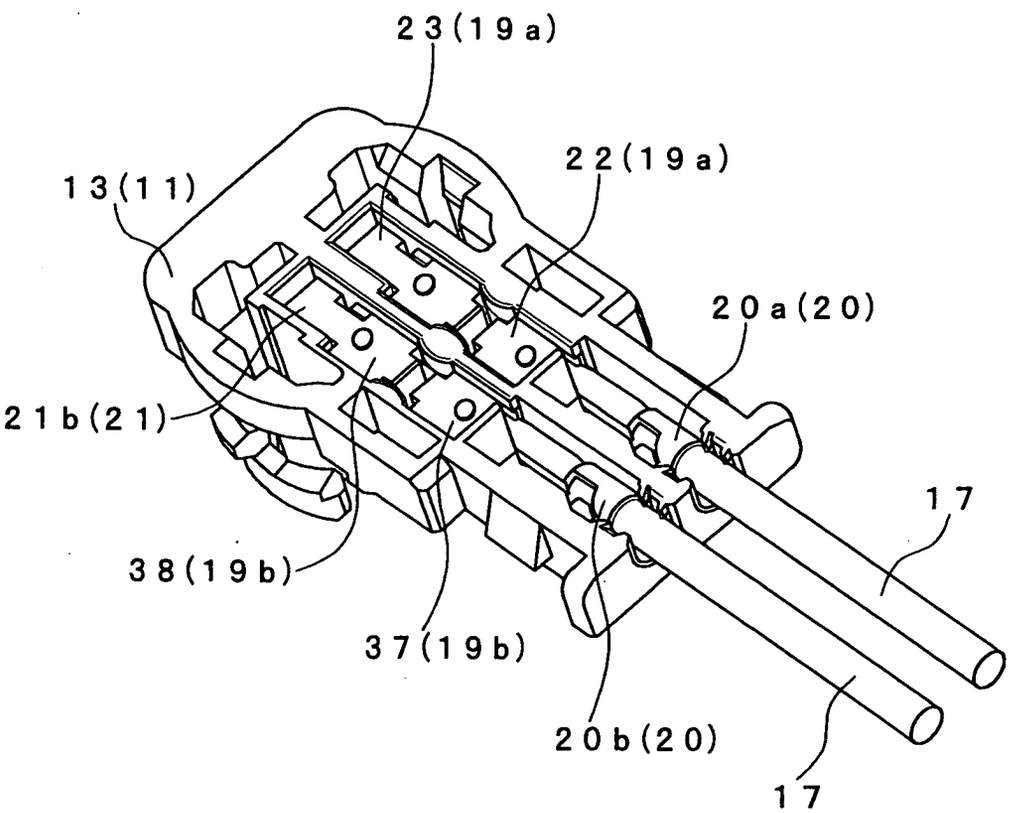
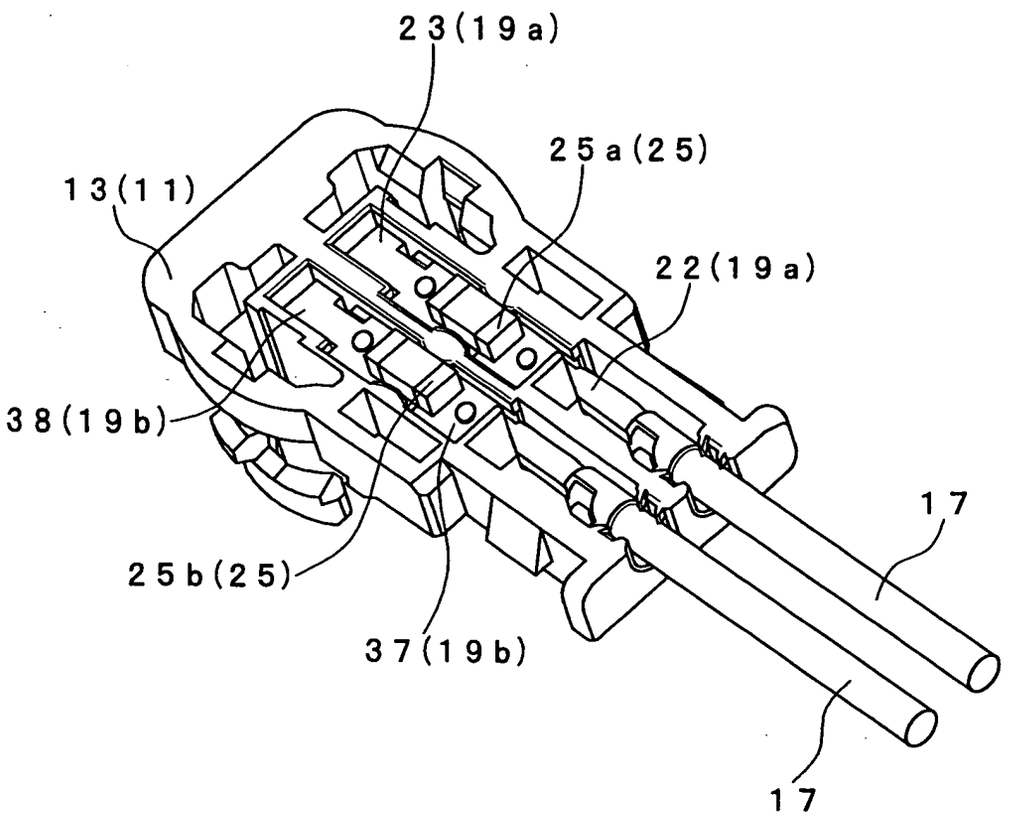


FIG. 11



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 00 1553

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X Y	DE 43 39 347 A1 (PETRI AG, 63743 ASCHAFFENBURG, DE; TAKATA-PETRI AG) 24 May 1995 (1995-05-24) * abstract * * column 1, line 39 - column 2, line 18 *	1,3-5 2	H01R13/66
Y	US 5 833 496 A (HOLLANDER ET AL) 10 November 1998 (1998-11-10) * abstract *	2	
X	US 6 623 275 B1 (PAVLOVIC SLOBODAN ET AL) 23 September 2003 (2003-09-23) * column 4, line 17 - line 65 *	1,3-5	
A	US 2003/073349 A1 (NAGAO MASASHI ET AL) 17 April 2003 (2003-04-17)		
P,X	US 2004/157494 A1 (WILLIAMSON GEORGE H ET AL) 12 August 2004 (2004-08-12) * paragraph [0031]; figure 5 *	1,3-5	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			H01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	22 April 2005	Bertin, M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
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