



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
26.11.2003 Bulletin 2003/48

(51) Int Cl.7: **H01R 13/627**

(21) Application number: **03011076.1**

(22) Date of filing: **20.05.2003**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IT LI LU MC NL PT RO SE SI SK TR**
Designated Extension States:
AL LT LV MK

(72) Inventor: **Nakamura, Keiichi,**
Sumitomo Wiring Systems, Ltd.
Yokkaichi-city, Mie 510-8503 (JP)

(74) Representative: **Müller-Boré & Partner**
Patentanwälte
Grafinger Strasse 2
81671 München (DE)

(30) Priority: **22.05.2002 JP 2002148202**
29.05.2002 JP 2002155936

(71) Applicant: **Sumitomo Wiring Systems, Ltd.**
Yokkaichi-City, Mie, 510-8503 (JP)

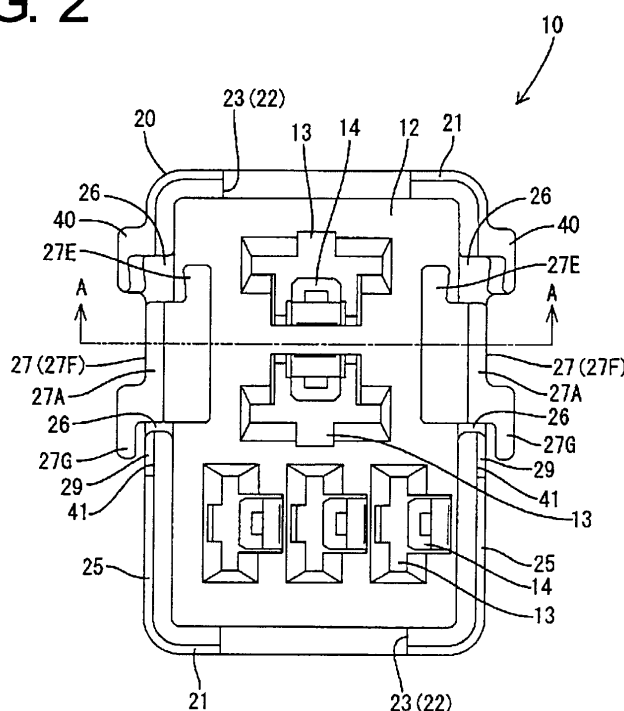
(54) **A connector**

(57) To provide a connector which can avoid becoming larger as a whole while preventing the excessive resilient deformation of resilient locking pieces.

A connector 10 is provided with a receptacle 20 into which a relay 50 is insertable through an insertion opening formed in the front surface of the receptacle 20. A resilient locking piece 27 engageable with the relay 50 to prevent the detachment of the relay 50 is provided

between a pair of slits 26 formed in the receptacle 20 to extend backward from the front end thereof. Further, the receptacle 20 is provided with an excessive deformation preventing portion 40 which can be brought into abutment against the resilient locking piece 27 to prevent the excessive resilient deformation of the resilient locking piece 27 when the resilient locking piece 27 is resiliently deformed.

FIG. 2



Description

[0001] The present invention relates to a connector connectable with an electrical and/or electronic part such as a relay, a fuse, a resistor, a processor or the like.

[0002] A relay mounting portion having a relay mounting construction disclosed in Japanese Unexamined Patent Publication No. 9-35605 is known as the one corresponding to this type of connector. As shown in FIGS. 14 and 15, a relay mounting portion 1 is such that a relay 5 is fittable between a pair of outer walls 2, and two pairs of resilient locking pieces 3 stand from a bottom wall 4 inside the outer walls 2 while being spaced apart from the outer walls 2. A locking claw 7 engageable with a locking projection 6 provided on the relay 5 is formed at the leading end of each resilient locking piece 3. The resilient locking pieces 3 are resiliently deformed outward in the process of inserting the relay 5 into the relay mounting portion 1, and resiliently return to engage the locking claws 7 with the locking projection 6 upon moving over the locking projection 6. In this way, the relay 5 is prevented from detachment from the relay mounting portion 1. Further, the outer walls 2 prevent the excessive resilient deformation of the resilient locking pieces 3 since being located at such positions as to be brought into abutment against the resilient locking pieces 3 when the resilient locking pieces 3 are resiliently deformed outward.

[0003] Since the outer walls 2 separate from the resilient locking pieces 3 are provided outside the resilient locking pieces 3 while being spaced apart from the resilient locking pieces 3 in the relay mounting portion 1 corresponding to the prior art connector, the relay mounting portion 1 tends to be large as a whole. Although such a problem can be solved by deleting the outer walls 2, it is not reasonable because a function of preventing the excessive resilient deformation of the resilient locking pieces 3 is lost.

[0004] Furthermore, as shown in FIG. 24, a connector of this type has been conventionally comprised of a receptacle 101 into which a relay (not shown) is fittable through an opening formed in the front surface thereof, and a terminal accommodating portion 102 continuously extending backward from the back surface of the receptacle 101 for accommodating terminal fittings (not shown), and resilient locking pieces 104 each having a locking claw 103 at its leading end are resiliently deformably provided at a surrounding wall of the receptacle 101. Window holes 105 used to grip the relay are formed in the surrounding wall of the receptacle 101 by cutting. When the relay is fitted through the opening of the receptacle 101, it is inserted while resiliently deforming the resilient locking pieces 104 outward. When the relay is inserted to a proper position, the resilient locking pieces 104 resiliently return to their original positions to engage the locking claws 103 with the rear end surface of the relay with respect to its inserting direction, with the result that the relay is so locked as not to come out. Such a

connector for relay is disclosed, for example, in Japanese Unexamined Patent Publication No. 9-35605.

[0005] In the case of the above prior art connector, upon detaching the relay for maintenance or other reason, the locking claws 103 are held by fingers to resiliently deform the resilient locking pieces 104 outward and a rear part of the relay is held by other fingers while maintaining the above state. Thereafter, the relay is pulled and detached from the receptacle 101. However, since the relay needs to be pulled with a considerably large force to disconnect relay terminals and the terminals fittings, the operation is sometimes difficult. Thus, there has been a demand for improvement in operability. It has been also difficult to precisely judge whether or not the relay is connected at a proper position in the receptacle 101.

[0006] The invention was developed in view of the above problems and an object thereof is to provide a connector having an improved operability.

[0007] This object is solved according to the invention by the features of the independent claims. Preferred embodiments are subject of the dependent claims.

[0008] According to the invention, there is provided a connector, comprising:

a receptacle into which a terminal-provided electrical/electronic part such as a relay is at least partly insertable through an insertion opening formed in the front surface of the receptacle,
at least one resilient locking piece formed between a pair of slits formed in the receptacle and engageable with the electrical/electronic part to prevent the detachment of the electrical/electronic part, and
at least one excessive deformation preventing portion provided at the receptacle for preventing the excessive resilient deformation of the resilient locking piece by being brought substantially into abutment against the resilient locking piece when the resilient locking piece is resiliently deformed.

[0009] According to a preferred embodiment of the invention, the resilient locking piece formed between a pair of slits formed in the receptacle to extend substantially backward from the front end of the receptacle.

[0010] Accordingly, there is provided a connector which can avoid becoming larger as a whole while preventing the excessive resilient deformation of a resilient locking piece, thus increasing operability.

[0011] According to a further preferred embodiment, there is provided a connector, comprising:

a receptacle into which a terminal-provided electrical part such as a relay is insertable through an insertion opening formed in the front surface of the receptacle,
a resilient locking piece formed between a pair of slits formed in the receptacle to extend backward from the front end of the receptacle and engageable

with the electrical part to prevent the detachment of the electrical part, and
 an excessive deformation preventing portion provided at the receptacle for preventing the excessive resilient deformation of the resilient locking piece by being brought into abutment against the resilient locking piece when the resilient locking piece is resiliently deformed.

[0012] The resilient locking piece is provided between the pair of slits formed in the receptacle to extend backward from the front end of the receptacle, and the excessive deformation preventing portion for preventing the excessive resilient deformation of the resilient locking piece is also provided at the receptacle. Since both the resilient locking piece and the excessive deformation preventing portion are provided at the receptacle, the enlargement of the connector as a whole can be avoided.

[0013] Preferably, the excessive deformation preventing portion is formed to bulge out so as to cover the outer side of one slit.

[0014] Further preferably, the resilient locking piece includes a main body provided with a locking claw for locking the electrical part substantially at a proper connection position in the receptacle, and

an inner projection bulges out substantially in widthwise direction (or in a direction substantially lying in the plane of the resilient locking piece or of the wall in which the resilient locking piece are provided) from the main body, preferably has an extended locking surface substantially in flush with a locking surface of the locking claw and can be brought substantially into abutment against the inner surface of the excessive deformation preventing portion after passing the one slit when the resilient locking piece is resiliently deformed outward or away from the electric/electronic part or the receptacle.

[0015] The inner projection bulges out in widthwise direction from the main body of the resilient locking piece and can be brought substantially into abutment against the inner surface of the excessive deformation preventing portion after passing the slit when the resilient locking piece is resiliently deformed outward. Thus, the outward excessive resilient deformation of the resilient locking piece can be prevented. Further, since the inner projection has the extended locking surface substantially in flush with the locking surface of the locking claw, an area of engagement of the locking claw with the electrical/electronic part is increased, with the result that the electrical/electronic part can be strongly locked.

[0016] Most preferably, the resilient locking piece includes a main body provided with a locking claw for locking the electrical/electronic part at a proper connection position in the receptacle, and

an outer projection bulges out substantially in widthwise direction (or in a direction substantially lying in the plane of the resilient locking piece or of the wall

in which the resilient locking piece are provided) from the main body, is formed to at least partly cover the outer side of one slit, preferably the other slit as the one covered by the excessive deformation preventing portion, and can be brought substantially into abutment against the outer surface of the receptacle as the excessive deformation preventing portion when the resilient locking piece is resiliently deformed inward.

[0017] The outer projection bulges out in widthwise direction from the main body of the resilient locking piece and can be brought into abutment against the outer surface of the receptacle as the excessive deformation preventing portion when the resilient locking piece is resiliently deformed inward. Thus, the inward excessive resilient deformation of the resilient locking piece can be prevented.

[0018] According to the invention, there is further provided a connector, in particular according to one of the preceding embodiments, comprising a housing including a terminal accommodating portion accommodating one or more terminal fittings, and a receptacle and into which a terminal-provided electrical/electronic part such as a relay is at least partly insertable to electrically connect the one or more terminal fittings and respective terminals of the electrical/electronic part,

wherein at least one hole through which the front surface and/or front edge of the electrical/electronic part with respect to inserting direction can be seen is formed at a position of a surrounding wall of the receptacle near the terminal. Thus, there is provided a connector in which an electric/electronic part such as a relay can be detached with good operability and whether or not the electric/electronic part such as the relay is connected at a substantially proper position can be preferably judged.

[0019] According to a preferred embodiment of the invention, there is provided a connector, comprising a housing including a terminal accommodating portion accommodating terminal fittings, and a receptacle which is open substantially forward at the front surface of the terminal accommodating portion and into which a terminal-provided electrical part such as a relay is insertable to electrically connect the terminal fittings and terminals of the electrical part,

wherein a hole through which the front surface of the electrical part with respect to inserting direction can be seen is formed at a position of a surrounding wall of the receptacle near the terminal accommodating portion.

[0020] Since the hole through which the front surface and/or the edge portion of the electrical part with respect to inserting direction can be seen is formed at the position of the surrounding wall of the receptacle near or adjacent to the terminal accommodating portion, the electrical/electronic part can be detached from the receptacle, for example, by at least partly inserting a jig through this hole, thrusting it between the front surface of the electrical/electronic part with respect to inserting direction and the front surface of the terminal accommodating

portion and successively forcibly displacing it. Thus, a series of operations can be performed with good operability. Further, whether or not the electrical/electronic part is connected at a proper position can be preferably judged or detected by seeing the position of the front surface of the electrical part with respect to inserting direction through this hole.

[0021] Preferably, the electrical/electronic part is inserted up to a position where the electrical/electronic part can substantially abut against the front surface of the terminal accommodating portion, and at least one insertion opening through which a detaching jig is at least partly insertable to detach the electrical/electronic part is so formed in the surrounding wall of the terminal accommodating portion preferably as to be open in the front surface of the terminal accommodating portion and substantially communicate with the hole.

[0022] Since the insertion opening through which the detaching jig for the electrical part is insertable is so formed as to be open in the front surface of the terminal accommodating portion and communicate with the hole, the electrical part can be lifted by the jig and easily detached from the receptacle if the jig is inserted through this insertion opening and successively forcibly displaced. In such a case, the jig can be prevented from damaging the electrical part during insertion since being inserted through the insertion opening without interfering with the electrical part.

[0023] Further preferably, the receptacle is formed at the front end of the terminal accommodating portion via a stepped portion, the electrical/electronic part is inserted up to a position where the electrical/electronic part can substantially abut against the front surface of the terminal accommodating portion, and preferably such a pedestal as to serve as a supporting point of the detaching jig operated or pivoted to detach the electrical/electronic part projects at or near a part of the stepped portion located in or adjacent to the hole.

[0024] Since such a pedestal as to serve as a supporting point of the detaching jig operated to detach the electrical part is formed at the part of the stepped portion located in the hole, the electrical/electronic part can be easily lifted by placing an operating portion of the jig on the pedestal and forcibly displacing the jig with the pedestal as a supporting point of leverage. Thus, operability is good. Further, by taking advantage of leverage action, the electrical/electronic part can be easily detached only by exerting a small force.

[0025] Most preferably, at least one pedestal which bulges out on a portion of the terminal accommodation portion near the hole can serve as a supporting point of a detaching jig operated to detach the electric/electronic part.

[0026] Thus, the leverage of the detaching jig is supported thus further improving the operability of the connector.

[0027] These and other objects, features and advantages of the present invention will become more appar-

ent upon reading of the following detailed description of preferred embodiments and accompanying drawings. It should be understood that even though embodiments are separately described, single features thereof may be combined to additional embodiments.

FIG. 1 is a side view of a connector according to one embodiment of the invention,

FIG. 2 is a front view of the connector,

FIG. 3 is a section along A-A of FIG. 2,

FIG. 4 is a section of the connector in the process of inserting a relay,

FIG. 5 is a front view of the connector in the state of FIG. 4,

FIG. 6 is a section of the connector after the insertion of the relay,

FIG. 7 is a front view of the connector in the state of FIG. 6,

FIG. 8 is a section of the connector upon withdrawing the relay,

FIG. 9 is a front view of the connector in the state of FIG. 8,

FIG. 10 is a side view of a detecting jig for electrical connection check,

FIG. 11 is a plan view of the detecting jig,

FIG. 12 is a side view showing a process of inserting the detecting jig,

FIG. 13 is a section of the connector when the detecting jig reaches a detecting position,

FIG. 14 is a perspective view of a prior art connector,

FIG. 15 is a section of the prior art connector,

FIG. 16 is a perspective view of a connector according to a second embodiment of the invention,

FIG. 17 is a side view of the connector,

FIG. 18 is a plan view of the connector,

FIG. 19 is a horizontal section of the connector,

FIG. 20 is a side view partly in section showing a state before and after a relay is connected,

FIG. 21 is an enlarged section of an essential portion showing a state where a jig is operated to detach the relay,

FIG. 22 is a perspective view of a connector according to a third embodiment of the invention,

FIG. 23 is a perspective view of a connector according to another embodiment of the invention, and

FIG. 24 is a perspective view of a prior art connector.

[0028] Hereinafter, preferred embodiments of the present invention is described with reference to the accompanying drawings.

<First Embodiment>

[0029] A first embodiment in which the present invention is applied to a connector for a relay (as a preferred electric and/or electronic element) to be used in a vehi-

cle is described with reference to FIGS. 1 to 13. Identified by 10 is a connector. This connector 10 is comprised of a terminal accommodating portion 12 for accommodating one or more female terminal fittings 11 (see FIG. 12, unillustrated in other figures) and a receptacle 20 provided before or adjacent to the terminal accommodating portion 12 and substantially in the form of a rectangular tube opening forward.

[0030] One or more cavities 13 are formed to penetrate the terminal accommodating portion 12 substantially along longitudinal direction, and the female terminal fittings 11 are at least partly insertable therinto. The cavities 13 of this embodiment are arranged at one or more stages, preferably at three upper, middle and lower stages in FIG. 2. There are a total of e.g. five cavities 13, one at each of the upper and middle stages and three transversely arranged substantially side by side at the lower stage. A resiliently deformable locking portion 14 is formed preferably in each cavity 13 and engageable with the female terminal fitting 11 to lock it.

[0031] The receptacle 20 is formed to have such shape and size that a relay 50 (as a preferred electric/electronic element) is at least partly insertable therinto through an insertion opening formed in the front surface of the receptacle 20. The relay 50 at least partly mountable into this receptacle 20 is substantially in the form of a rectangular parallelepiped as a whole and one or more relay terminals 51 project at the bottom surface thereof at positions substantially corresponding to the female terminal fittings 11 inserted into the cavities 13.

[0032] Each of opposite walls 21 provided at the top and bottom of the receptacle 20 in FIG. 2 is cut in U-shape at its front end to form a recess or groove 22. As described in more detail next, each recess 22 is provided with guiding edges or edge portions 23 (a pair of left and right or lateral guiding edges 23 in FIG. 3) for guiding the insertion of a detecting jig 60 for checking an electrical connection, and stopping edges 24 with which an engaging projection 63 of the detecting jig 60 comes substantially into contact to stop the detecting jig 60 is provided at an end position of each guiding edge 23.

[0033] Here, the construction of the detecting jig 60 is briefly described. As shown in FIGS. 10 and 11, the detecting jig 60 is comprised of an operable portion 61, preferably substantially in the form of a rectangular parallelepiped, and a main body 62 extending forward (or toward the connector 10) from the front surface of the operable portion 61. The main body 62 has the outer surfaces of its rear portion, preferably of its rear half, shaped such that the rear portion, preferably the rear half, is at least partly fittable into the receptacle 20 with the outer surfaces thereof held substantially in close contact with the inner surfaces of the receptacle 20. The engaging projection 63 which can be brought substantially into sliding contact with the corresponding recess 22 of the receptacle 20 projects from each of the left and right or lateral side surfaces of the rear portion/half. One or more detecting pins 64 engageable with the respec-

tive locking portions 14 in the cavities 13 project from the front surface of the main body 62, and one or more electrically conductive connection detecting pins 66 which are shorter than the detecting pins 64 and can be brought into contact with the female terminal fittings 11 project near the respective detecting pins 64. Each detecting pin 64 is provided with a leading-end flat portion 65, which is at least partly insertable into an insertion space Q defined between the locking portion 14 and the inner surface of the cavity 13 when the locking portion 14 is engaged with the female terminal fitting 11 at a proper insertion position (see FIG. 13).

[0034] Next, the functions of the detecting jig 60 are described. First, as shown in FIG. 12, the operable portion 61 is or can be gripped or manipulated to at least partly insert the detecting jig 60 into the receptacle 20 through the insertion opening and push it to the back of the receptacle 20 while holding the engaging projections 63 substantially in sliding contact with the guiding edges 23. As shown in FIG. 13, when the leading-end flat portions 65 of the detecting pins 64 reach positions where they are at least partly inserted into the insertion spaces Q, the front end surfaces of the engaging projections 63 come substantially into contact with the stopping edges 24 of the recesses 22 and the connection detecting pin(s) 66 come(s) substantially into abutment against the leading ends of the female terminal fitting(s) 11, thereby being electrically connectable with the female terminal fitting(s) 11.

[0035] On the contrary, when the female terminal fitting 11 is insufficiently inserted without being engaged with the locking portion 14, the leading-end flat portion 65 of the detecting pin 64 has the leading end surface thereof substantially abutted against the locking portion 14, thereby hindering any further insertion of the detecting jig 60. Thus, the front end surfaces of the engaging projections 63 do not come into contact with the stopping edges 24 of the recesses 22. Neither is/are the connection detecting pin(s) 66 electrically connectable with the female terminal fitting(s) 11 without reaching the leading end(s) of the female terminal fitting(s) 11. In this way, whether or not the female terminal fittings 11 are properly inserted can be detected by an electrical connection check by means of the connection detecting pin(s) 66. Such a detection can be also made by seeing the contact state of the engaging projections 63 with the stopping edges 24 from outside.

[0036] Each of opposite walls 25 of the receptacle 20 located at position different from the opposite walls 22 (and at the left and right in FIG. 2) is formed with a pair of slits 26 extending backward from the front end thereof. A resilient locking piece 27 integrally or unitarily formed at the receptacle 20 and engageable with the relay 50 to prevent the detachment of the relay 50 from the receptacle 20 is provided between each pair of the slits 26. Each resilient locking piece 27 includes a main body 27F, and a locking claw 27A engageable with the rear end surface or a rear stepped surface of the relay

50 (as seen in an insertion direction of the relay 50 into the receptacle 20) when the relay 50 is located at a proper connection position (when the relay 50 is accommodated to a substantially proper depth in the receptacle 20) projects inward from the leading end of the main body 27F. A slanted surface 27B for guiding the relay 50 and/or the resilient deformation of the resilient locking piece 27 is provided on the upper surface of each locking claw 27A.

[0037] An inner projection 27E bulges out in widthwise direction WD (or in a direction substantially lying in the plane of the resilient locking piece 27 or of the wall in which the resilient locking piece 27 are provided) at the inner side of each main body 27F. This inner projection 27E has an extended locking surface 27H (see FIG. 6) substantially in flush with a locking surface of the locking claw 27A at least partly engageable with the relay 50, thereby increasing an area of engagement of the locking claw 27A with the relay 50 by a hatched portion shown in FIG. 7. The inner projections 27E are normally located inside the slits 26 (upper slits in FIG. 2). When the resilient locking pieces 27 are resiliently deformed outward, the inner projections 27E first pass the slits 26 and come into abutment against the inner surfaces of the receptacle 20 as the resilient locking pieces 27 are further resiliently deformed. The receptacle 20 against which the inner projections 27E can be brought into abutment forms excessive deformation preventing portions 40, and areas of the receptacle 20 along the slits 26 (upper slits in FIG. 2) are extended outward and bulged to substantially cover the outer sides of the slits 26 and/or the inner projections 27E. The excessive deformation preventing portions 40 of this embodiment are provided preferably over the substantially entire length of the slits 26 and cover only the outer sides of the slits 26 without covering the outer sides of the main bodies 27F. Each excessive deformation preventing portion 40 is formed with a slanted surface 40A for escaping the corresponding inner projection 27E to make the relay 50 withdrawable (see FIG. 8).

[0038] Further, an outer projection 27G bulges out in widthwise direction WD (or in a direction substantially lying in the plane of the resilient locking piece 27 or of the wall in which the resilient locking piece 27 are provided) at the outer side of each main body 27F. This outer projections 27G preferably are substantially in the form of a rectangular flat plate and integrally or unitarily (at least partly) overlap the leading ends of the resilient locking pieces 27 from outside (see FIG. 1), and at least partly cover the outer sides of the slits 26 (lower slits in FIG. 2). The outer projections 27G come substantially into abutment against the outer surfaces of the receptacle 20 which serve as excessive deformation preventing portions 41 when the resilient locking pieces 27 are resiliently deformed inward. The outer surfaces of the receptacle 20 as the excessive deformation preventing portions 41 are recessed at positions where the outer projections 27 come substantially into abutment, there-

by forming recesses 29. The recesses 29 are formed to remove molding pins for forming the outer projections 27G and useful in improving the strength of the molding pins.

[0039] Next, the functions of this embodiment are described. First, the relay 50 is at least partly inserted through the insertion opening of the receptacle 20. In the inserting process of the relay 50, the one or more resilient locking pieces 27 are brought into substantially sliding contact with the outer surfaces of the relay 50 while being resiliently deformed outward (see FIGS. 4 and 5). When the relay terminals 51 reach substantially proper connection positions where they are connected with the female terminal fitting(s) 11 in the receptacle 20, the resilient locking pieces 27 are resiliently restored to engage the locking claws 27 with the rear end surface or a rear side of a stepped portion of the relay 50 like hooks (see FIG. 6).

[0040] The relay 50 is withdrawn from the receptacle 20 by being disengaged from the locking claws 27A and being pulled out of the receptacle 20. Specifically, as shown in FIG. 8, the locking claws 27A are held e.g. by fingers and pushed wider apart in directions of arrows S to free the relay 50 in withdrawing direction Z. At this time, the resilient locking pieces 27 may be resiliently deformed beyond their resiliency limit since the operation is done in particular by an operator's feeling. However, in this embodiment, the inner projections 27E can come substantially into abutment against the inner surfaces (slanted surfaces 40A) of the excessive deformation preventing portions 40 (receptacle 20), thereby hindering any further displacement of the resilient locking pieces 27. Thus, the excessive outward resilient deformation of the resilient locking pieces 27 can be securely prevented.

[0041] In the case that the resilient locking pieces 27 are resiliently deformed inward, the outer projections 27G can come substantially into abutment against the outer surfaces of the receptacle 20 as the excessive deformation preventing portions 41, thereby hindering any further displacement of the resilient locking pieces 27. Thus, the excessive inward resilient deformation of the resilient locking pieces 27 can also be securely prevented.

[0042] Although the outer walls 2 are provided at the outer sides of the resilient locking pieces 3 while being spaced therefrom in the prior art relay mounting portion 1 (see FIG. 15), the resilient locking pieces 27 and the excessive deformation preventing portions 40, 41 are all integrally or unitarily formed at or on the receptacle 20 in this embodiment. Thus, the enlargement of the connector as a whole can be avoided unlike the prior art.

[0043] Since the inner projections 27E preferably have the extended locking surfaces 27H substantially in flush with the locking surfaces of the locking claws 27A, the areas of engagement of the locking claws 27A with the relay 50 are increased by the width of the extended locking surfaces 27H, with the result that the relay 50

can be securely and strongly locked. Further, unlike the prior art relay mounting portion 1, the outer surfaces of the resilient locking pieces 27 are not completely covered by the excessive deformation preventing portions 40. Thus, a degree of resilient deformation of each resilient locking piece 27 can be seen from outside. In other words, if the resilient locking pieces 27 are seen not to be resiliently deformed, the properly mounted state of the relay 50 can be advantageously judged. Conversely, if the resilient locking pieces 27 are seen to be resiliently deformed, the relay 50 can be advantageously judged to be partly mounted without the locking claws 27A being precisely engaged with the relay 50.

[0044] Accordingly, to provide a connector having an improved operability which can avoid becoming larger as a whole while preventing the excessive resilient deformation of resilient locking pieces, a connector 10 is provided with a receptacle 20 into which a relay 50 or other electric/electronic part or element such as a fuse, a resistor, etc. is at least partly insertable through an insertion opening formed in the front surface of the receptacle 20. At least one resilient locking piece 27 engageable with the relay 50 to prevent the detachment of the relay 50 is provided between a pair of slits or recesses 26 formed in the receptacle 20 to extend substantially backward from the front end thereof or substantially along the insertion direction of the relay 50. Further, the receptacle 20 is provided with an excessive deformation preventing portion 40 which can be brought substantially into abutment against the resilient locking piece 27 to prevent the excessive resilient deformation of the resilient locking piece 27 when the resilient locking piece 27 is resiliently deformed.

<Other Embodiments>

[0045] The present invention is not limited to the above described and illustrated embodiments. For example, the following embodiments are also embraced by the technical scope of the present invention as defined by the claims. Beside the following embodiments, various changes can be made without departing from the scope and spirit of the present invention as defined by the claims.

(1) A mating part to be connected with the connector is not limited to a relay. It may be, for example, a fuse, a resistor and/or any terminal-provided electrical or electronic part.

(2) The excessive deformation preventing portions for preventing the inward excessive resilient deformation of the resilient locking pieces may not be necessarily in the form of recesses, and may be formed on the substantially same planes as the other outer surfaces of the receptacle.

(3) The excessive deformation preventing portions for preventing the inward excessive resilient deformation of the resilient locking pieces may not be

necessarily provided, i.e. the resilient locking pieces may not be provided with the outer projections.

<Second Embodiment>

[0046] A second preferred embodiment of the present invention is described with reference to FIGS. 16 to 21. A connector 120 connectable with a relay 10 is illustrated in this embodiment.

[0047] The relay 110 (as a preferred electric/electronic part) is made e.g. of a synthetic resin substantially into a short rectangular column shape as a whole, and one or more, preferably a plurality of substantially tab-shaped relay terminals 111 (see phantom lines in FIG. 19) project from the bottom or mating surface of the relay 110.

[0048] On the other hand, the connector 120 is provided with a housing 121 made e.g. of a synthetic resin. The housing 121 is comprised of a terminal accommodating portion 122 preferably substantially in the form of a rectangular tube for at least partly accommodating one or more terminal fittings (not shown) and a receptacle 123 which is so formed at the front or mating surface of the terminal accommodating portion 122 as to be slightly larger than the terminal accommodating portion 122 and into which the relay 110 is at least partly insertable through an opening formed in the front surface thereof.

[0049] As shown in FIG. 19, one or more, preferably a plurality of cavities 140 are formed to penetrate the terminal accommodating portion 122 substantially along longitudinal direction, and one or more female terminal fittings (not shown) can be at least partly accommodated therein. A resiliently deformable locking portion 130 is formed in each cavity 140 and engageable with the female terminal fitting to lock it.

[0050] The receptacle 123 has such a depth that the relay 110 can be at least partly accommodated therein, and window holes 123B used or usable to grip or hold the relay 110 are formed at the front sides of substantially opposed side walls 123A of its surrounding walls preferably at four sides e.g. by cutting. The remaining opposed side walls 123C of the surrounding walls of the receptacle 123 are provided with resilient locking pieces 123D for locking the relay 110 so as not to come out.

Each resilient locking piece 123D preferably substantially in the form of a cantilever is preferably formed by making slits 123E at the opposite sides thereof as shown in FIG. 18, and the leading end thereof is resiliently deformable inward and outward of the receptacle 123. A locking claw 123F projects inward from the leading end of each resilient locking piece 123D. Further, a slanted guiding surface 123G for guiding the relay 110 and/or the deformation of the resilient locking piece 123D is formed at the leading end surface of each locking claw 123F. Excessive deformation preventing portions 123H for preventing the excessive resilient deformation of the resilient locking pieces 123D are formed to bulge out along the edges of the slits 123E so as to

at least partly cover the outer sides of the slits 123E. Preferably, the excessive deformation preventing portions 123H project from an edge portion of the respective slit 123E so as to be substantially step-shaped, wherein the leading end portion thereof is arranged in substantially the same plane as the respective side wall 123C.

[0051] The side walls 123A of the receptacle 123 formed with the window holes 123B are substantially continuous with the front ends of the side walls of the terminal accommodating portion 122 via stepped portions 123J. The inner surfaces of the stepped portions 123J preferably are substantially in flush and continuous with the front surface of the terminal accommodating portion 122 and function as contact surfaces 123Q with which the relay 110 inserted in an inserting direction ID into the receptacle 123 comes substantially into contact. The relay 110 is fitted until coming into contact with the contact surfaces 23Q.

[0052] At a position of one or more, preferably each, side wall 123A near or adjacent the terminal accommodating portion 122A, a hole 123K is formed to cut or transverse preferably also a part of the corresponding stepped portion 123J present there. The front surface and/or an edge portion of the terminal accommodating portion 122 and that of the inserted relay 110 (or a border portion between the electric/electronic part 110 and a bottom surface of the receptacle 123 and/or a front portion of the terminal accommodating portion 122) can be at least partly seen through the holes 123K. As shown in FIG. 19, the hole 123K is also formed in one side wall 123C of the receptacle 123 where the resilient locking piece 123D is provided.

[0053] A pedestal or projection 123M which bulges out and serves as a supporting point of a detaching jig 170 operated to detach the relay 110 is formed at a part of each stepped portion 123J at least partly located in the hole 123K. The pedestal 123M preferably is substantially in the form of a column as a whole and spaced away from the other part of the stepped portion 123J, and this clearance substantially communicates with the hole 123K. Further, the height of the pedestal 123M is set lower than that of the other part of the stepped portion 123J, and the leading end thereof with respect to height direction has its front portion obliquely cut to form a slanted guiding surface 123N.

[0054] The relay 110 is at least partly inserted in the inserting direction ID into the receptacle 123 of the connector 120 from a mating side (left side in FIG. 20). The edges of the front surface of the relay 110 come substantially into contact with the guiding surfaces 123D of the locking claws 123F of the resilient locking pieces 123D and push them, whereby the relay 110 is pushed while resiliently deforming the resilient locking pieces 123D outward.

[0055] When the relay 110 is pushed in the inserting direction ID to a position where it comes substantially into abutment against the front surface of the terminal

accommodating portion 122 and the inner surfaces of the stepped portions 123J, i.e. pushed to a proper connection position, the resilient locking pieces 123D are at least partly resiliently restored to engage the locking claws 123F with the rear surface (or with the rear portion of a stepped portion) of the relay 110 with respect to its inserting direction to lock the relay 110. During this time, the one or more relay terminals 111 at least partly enter the corresponding cavities 140 to be connected with the respective female terminal fittings accommodated therein.

[0056] In this case, the contact of the front surface of the relay 110 and that of the terminal accommodating portion 122 can be seen through the holes 123K, whereby judgment can be made as to whether or not the relay 110 is properly connected in the receptacle 123. Thus, the relay 110 can be prevented from staying at a depth of incomplete connection.

[0057] Further, in the case of detaching the relay 110 from the receptacle 123 for maintenance or other reason, the resilient locking pieces 123D are first resiliently deformed outward to disengage the locking claws 123F from the relay 110. In this state, the leading end of the detaching jig 170 (e.g. flat or minus screwdriver) for the relay 110 is or can be at least partly inserted into the hole 123K while being slid along the guiding surface 123N of the pedestal 123M and thrusts itself between the front surface of the relay 110 and that of the terminal accommodating portion 122. Subsequently, as shown in FIG. 21, the jig 170 is forcibly displaced or pivoted with the pedestal 123M as a supporting point of leverage, thereby lifting the relay 110 from the front surface of the terminal accommodating portion 122 or in a withdrawing direction. Then, the relay 110 is or can be gripped and pulled out e.g. by fingers. As a result, the relay 110 is or can be detached from the receptacle 123. Here, if the relay 110 is gripped and pulled out e.g. by fingers without using the jig 170, the relay 110 cannot be detached unless a strong pulling force is exerted. If the holes 123K as above are formed, the jig 170 can be at least partly inserted through the hole 123K, making it easier to detach the relay 110 using the jig 170.

[0058] Since the pedestal 123M is used as a supporting point of leverage or for the pivotal movement of the jig 170 when the jig 170 is operated, the detaching operation can proceed with good operability. Further, since the relay 110 can be detached with a small force due to leverage action, work loads can be reduced. Furthermore, the jig 170 can smoothly thrust itself between the front surface of the relay 110 and that of the terminal accommodating portion 122 by causing the leading end of the jig 170 to slide along the guiding surface 123N of the pedestal 123M.

[0059] Further, the jig 170 can be operated and the connection position of the relay 110 can be visually confirmed from three sides of the connector 120, i.e. from many angles by forming the holes 123K in two or more, e.g. three of the side walls 123A, 123C of the receptacle

123. Thus, the connector 120 can be used in a wider range of application.

<Third Embodiment>

[0060] Next, a third preferred embodiment of the present invention is described with reference to FIG. 22.

[0061] A connector 120A of this embodiment differs from the first embodiment in that insertion openings 155 used to at least partly insert a detaching jig 170 for a relay 110 (as a preferred electric/electronic part) are formed in a terminal accommodating portion 122. Since the other construction is substantially similar or the same as in the second embodiment, no description is given on the structure, functions and effects thereof by identifying it by the same reference numerals.

[0062] Although the pedestals 123M are used upon operating the detaching jig 170 for the relay 110 in the second embodiment, such pedestals 123M are not provided, the insertion openings 155 are instead formed at the front end of the terminal accommodating portion 122 (near the stepped portions 122J) preferably by cutting and the detaching jig 170 is at least partly inserted through these insertion openings 155 in this embodiment.

[0063] Specifically, the insertion openings 155 open in the front surface of the terminal accommodating portion 122 and substantially communicating with holes 123K are formed at the front ends of the surrounding walls of the terminal accommodating portion 122 in such a size that the leading end of the jig 170 is at least partly insertable therethrough. Thus, the jig 170 can be smoothly inserted through the insertion opening 155 without interfering with the relay 110. Therefore, the jig 170 can be prevented from damaging the relay 110 during the insertion.

[0064] Accordingly, to provide a connector in which a relay (as a preferred electric/electronic part) can be detached with good operability and whether or not the relay is connected at a proper position can be judged, a connector 120 is provided with a housing 121 including a terminal accommodating portion 122 and a receptacle 123 which is open forward at the front surface of the terminal accommodating portion 122 and into which a relay 110 is at least partly insertable. One or more holes 123K through which the front surface and/or an edge portion of the relay 110 with respect to inserting direction can be seen are formed at positions of the surrounding wall of the receptacle 123 near the terminal accommodating portion 122. A detaching jig 170 used to detach the relay 110 is insertable through the holes 123K.

<Other Embodiments>

[0065] The present invention is not limited to the above described and illustrated embodiments. For example, the following embodiments are also embraced by the technical scope of the present invention as de-

fined by the claims. Beside the following embodiments, various changes can be made without departing from the scope and spirit of the present invention as defined by the claims.

(1) A connector according to the present invention may be a connector 120B basically shaped as shown in FIG. 23 unless convenience in handling the connector upon operating the jig is required to a large extent. Specifically, the connector 120B is formed with such holes 123K, through which the front surface of the relay 110 can be seen, at positions of the receptacle 123 near the terminal accommodating portion 122, but includes neither the insertion openings 155 nor the pedestals 123M. In the connector of this embodiment, the jig 170 can be inserted through the hole 123K to detach the relay 110 and the substantially proper connection position of the relay 110 can be visually confirmed through the holes 123K.

(2) Although the holes are formed in three of the side walls of the receptacle in the foregoing embodiments, one, two or four walls (all walls) may be formed with the hole(s).

(3) The receptacle and the terminal accommodating portion may be substantially continuous and substantially in flush with each other without being coupled via the stepped portions.

(4) The present invention is also applicable to connectors in general with which fuses and other electrical/electronic parts are connectable.

LIST OF REFERENCE NUMERALS

[0066]

10	connector
20	receptacle
26	slit
27	resilient locking piece
27A	locking claw
27E	inner projection
27F	main body
27G	outer projection
27H	extended locking surface
40 (41)	excessive deformation preventing portion
50	relay

Claims

1. A connector (10; 120; 120A; 120B), comprising:

a receptacle (20; 123) into which a terminal-provided electrical/electronic part such as a relay (50; 110) is at least partly insertable through an insertion opening formed in the front surface of the receptacle (20; 123),

at least one resilient locking piece (27; 123D) formed between a pair of slits (26; 123E) formed in the receptacle (20; 123) and engageable with the electrical/electronic part (50; 110) to prevent the detachment of the electrical/

electronic part (50; 110), and at least one excessive deformation preventing portion (40; 41; 123H) provided at the receptacle (20; 123) for preventing the excessive resilient deformation of the resilient locking piece (27; 123D) by being brought substantially into abutment against the resilient locking piece (27; 123D) when the resilient locking piece (27; 123D) is resiliently deformed.

2. A connector according to claim 1, wherein the resilient locking piece (27; 123D) formed between a pair of slits (26) formed in the receptacle (20; 123) to extend substantially backward from the front end of the receptacle (20; 123).

3. A connector according to one or more of the preceding claims, wherein the excessive deformation preventing portion (40; 123H) is formed to bulge out so as to at least partly cover the outer side of one slit (26; 123E).

4. A connector according to one or more of the preceding claims, wherein the resilient locking piece (27; 123D) includes a main body (27F) provided with a locking claw (27A; 123F) for locking the electrical/electronic part (50) substantially at a proper connection position in the receptacle (20; 123), and an inner projection (27E) bulges out substantially in widthwise direction (WD) from the main body (27F), has an extended locking surface (27H) preferably substantially in flush with a locking surface of the locking claw (27; 123F) and can be brought substantially into abutment against the inner surface of the excessive deformation preventing portion (40; 123H) after passing one slit (26; 123E) when the resilient locking piece (27; 123D) is resiliently deformed outward (S).

5. A connector according to one or more of the preceding claims, wherein:

the resilient locking piece (27) includes a main body (27F) provided with a locking claw (27A) for locking the electrical/electronic part (50) substantially at a proper connection position in the receptacle (20), and an outer projection (27G) bulges out substantially in widthwise direction (WD) from the main body (27F), is formed to at least partly cover the outer side of one slit (26), preferably the other slit (27) as the one covered by the excessive deformation preventing portion (40), and can

be brought substantially into abutment against the outer surface of the receptacle (20) as the excessive deformation preventing portion (41) when the resilient locking piece (27) is resiliently deformed inward.

6. A connector, in particular according to one or more of the preceding claims, comprising a housing (121) including a terminal accommodating portion (122) accommodating one or more terminal fittings, and a receptacle (123) into which a terminal-provided electrical/electronic part (110) such as a relay (110) is at least partly insertable to electrically connect the one or more terminal fittings and respective terminals (111) of the electrical/electronic part (110),

wherein at least one hole (123K) through which the front surface and/or front edge of the electrical/electronic part (110) with respect to inserting direction (ID) can be seen is formed at a position of a surrounding wall (123C) of the receptacle (123) near the terminal accommodating portion (122).

7. A connector according to claim 6, wherein the electrical/electronic part (110) is inserted up to a position where the electrical/electronic part (110) can substantially abut against the front surface of the terminal accommodating portion (122), and at least one insertion opening (155) through which a detaching jig (170) is at least partly insertable to detach the electrical/electronic part (110) is so formed in the surrounding wall of the terminal accommodating portion (122) preferably as to be open in the front surface of the terminal accommodating portion (122) and substantially communicate with the hole (123K).

8. A connector according to one or more of the preceding claims, wherein the receptacle (20; 123) is formed at the front end of the terminal accommodating portion (12; 122) via a stepped portion (123J), the electrical/electronic part (50; 110) is inserted up to a position where the electrical/electronic part (50; 110) can substantially abut against the front surface of the terminal accommodating portion (12; 122).

9. A connector according to claim 8, wherein such a pedestal (123M) as to serve preferably as a supporting point of the detaching jig (170) operated to detach the electrical/electronic part (110) projects at a part of the stepped portion (123J) located in the hole (123K).

10. A connector according to one or more of the preceding claims 6 to 9, wherein at least one pedestal (123M) which bulges out on a portion of the terminal accommodation portion (122) near the hole (123K) can serve as a sup-

porting point of a detaching jig (170) operated to detach the electric/electronic part (110).

5

10

15

20

25

30

35

40

45

50

55

FIG. 1

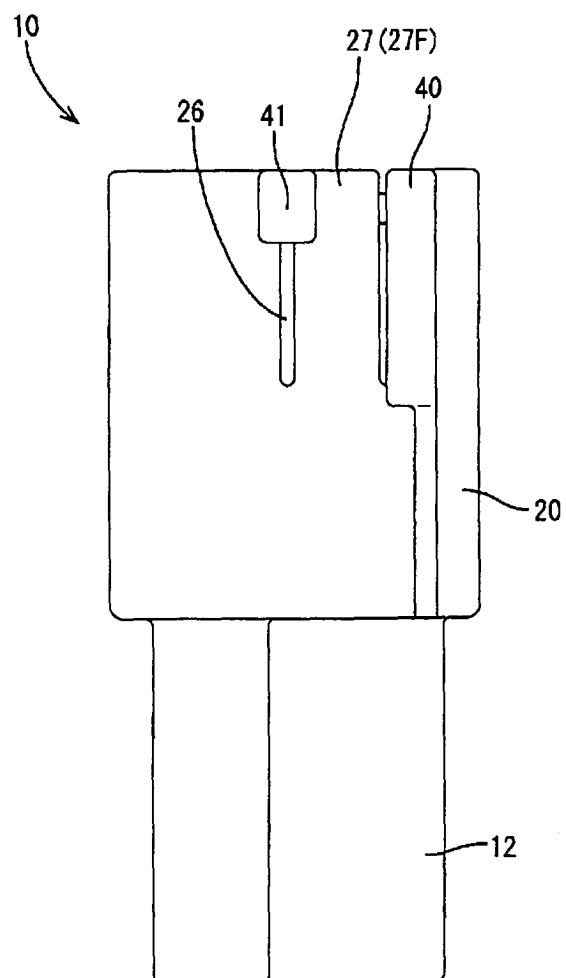


FIG. 2

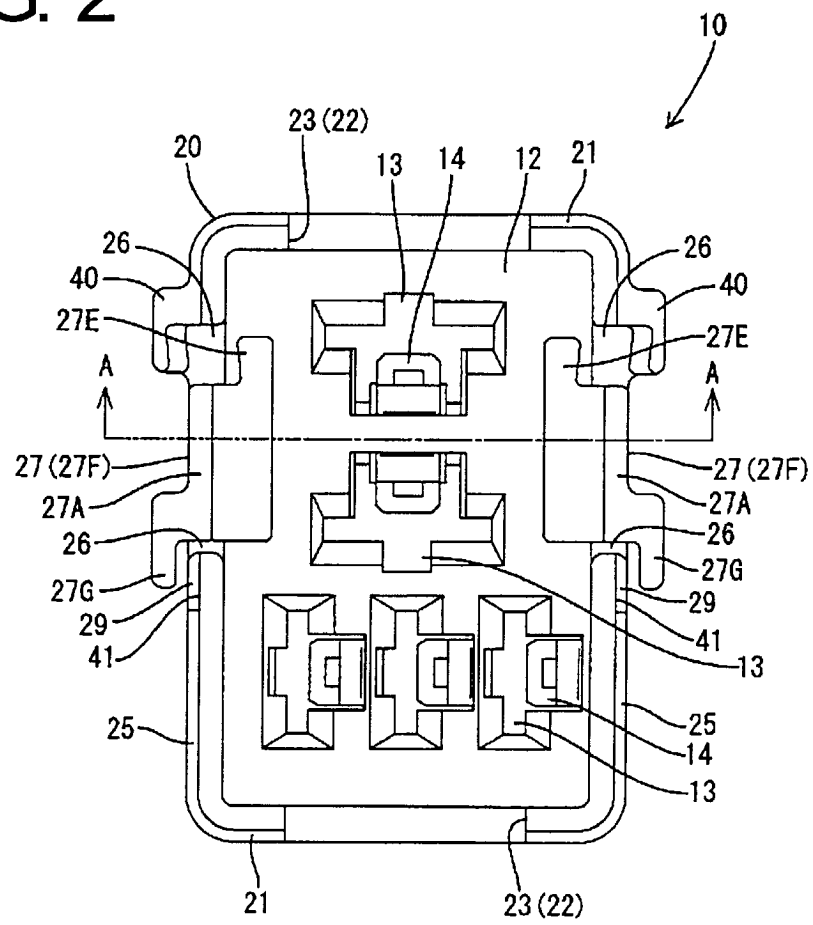


FIG. 3

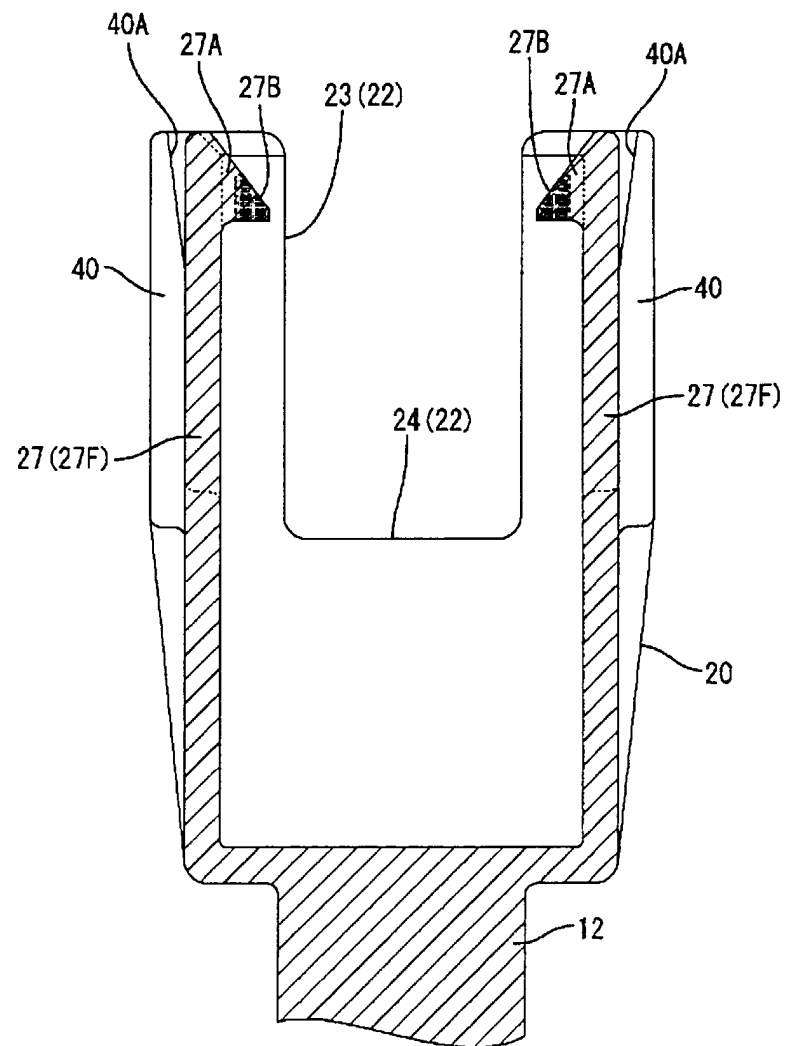


FIG. 4

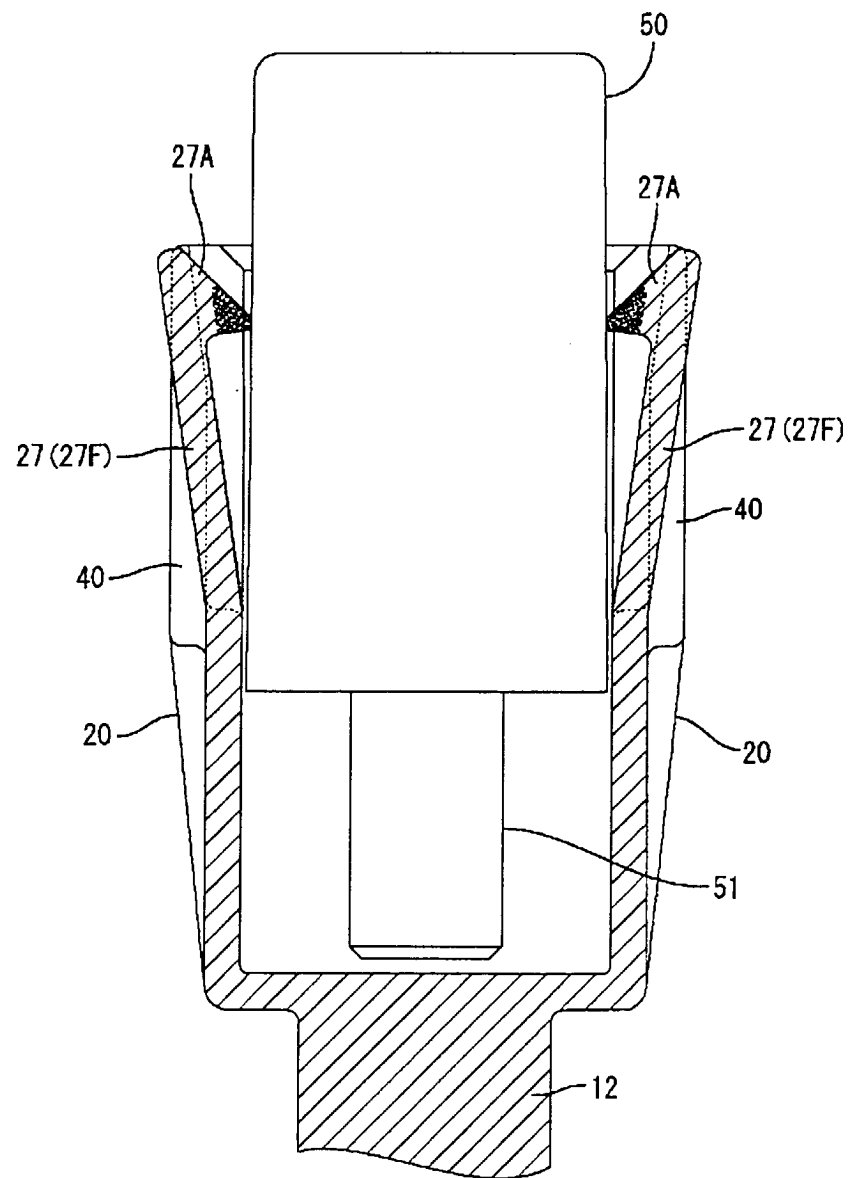


FIG. 5

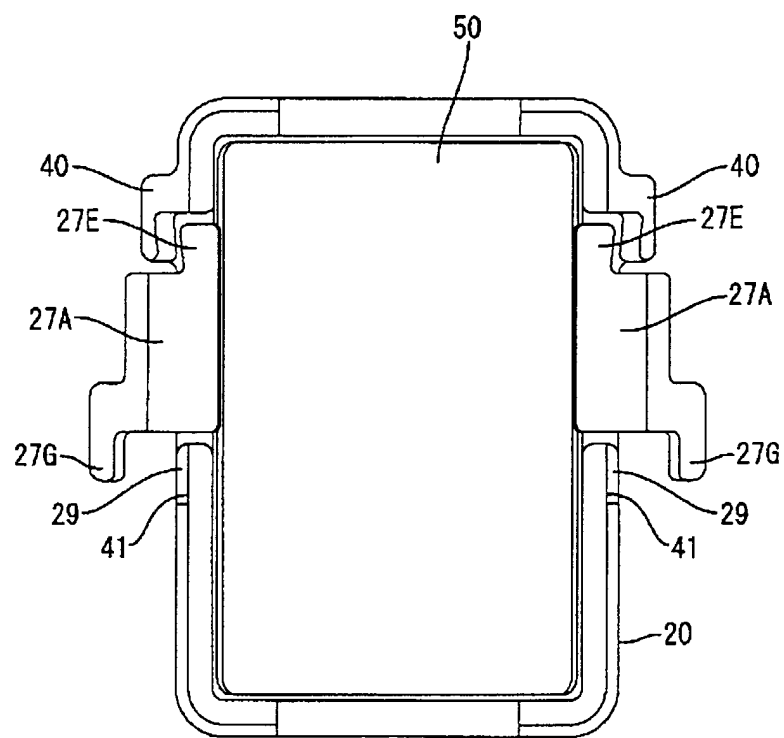


FIG. 6

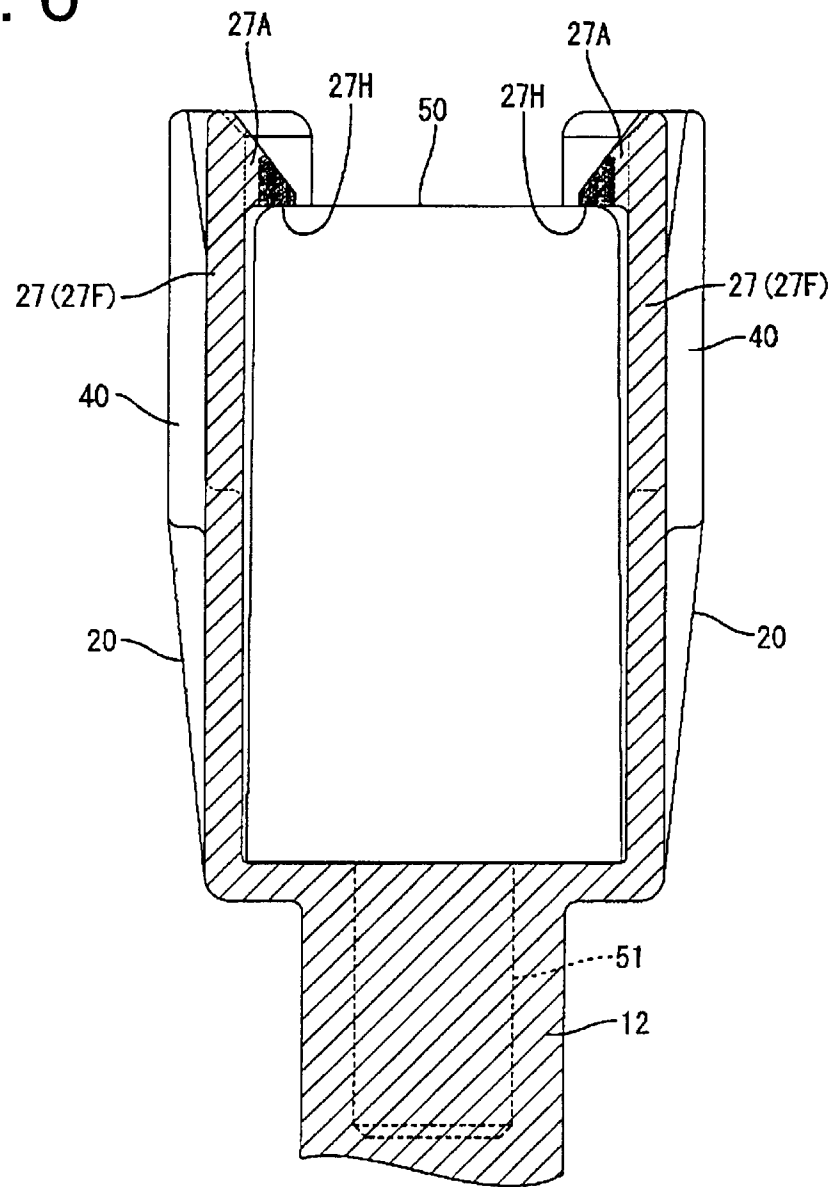


FIG. 7

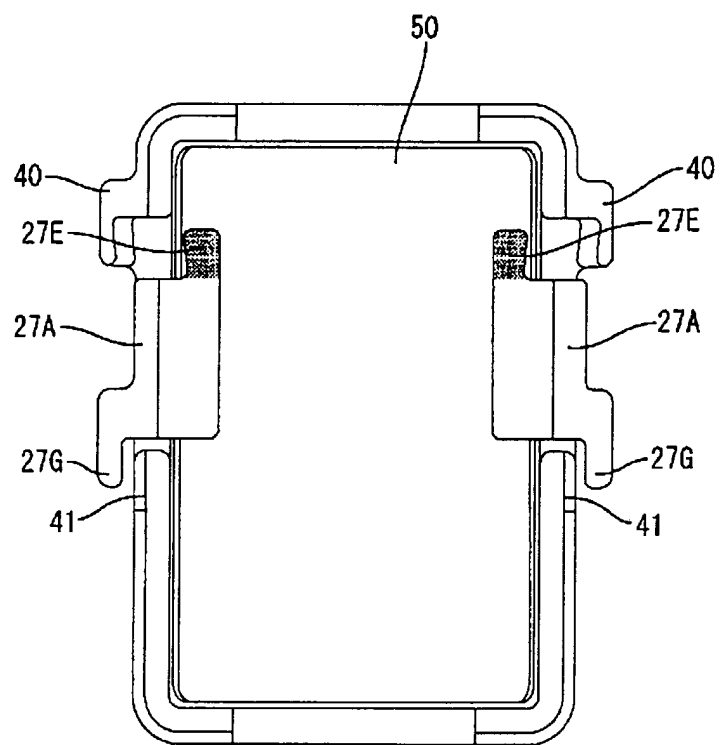


FIG. 8

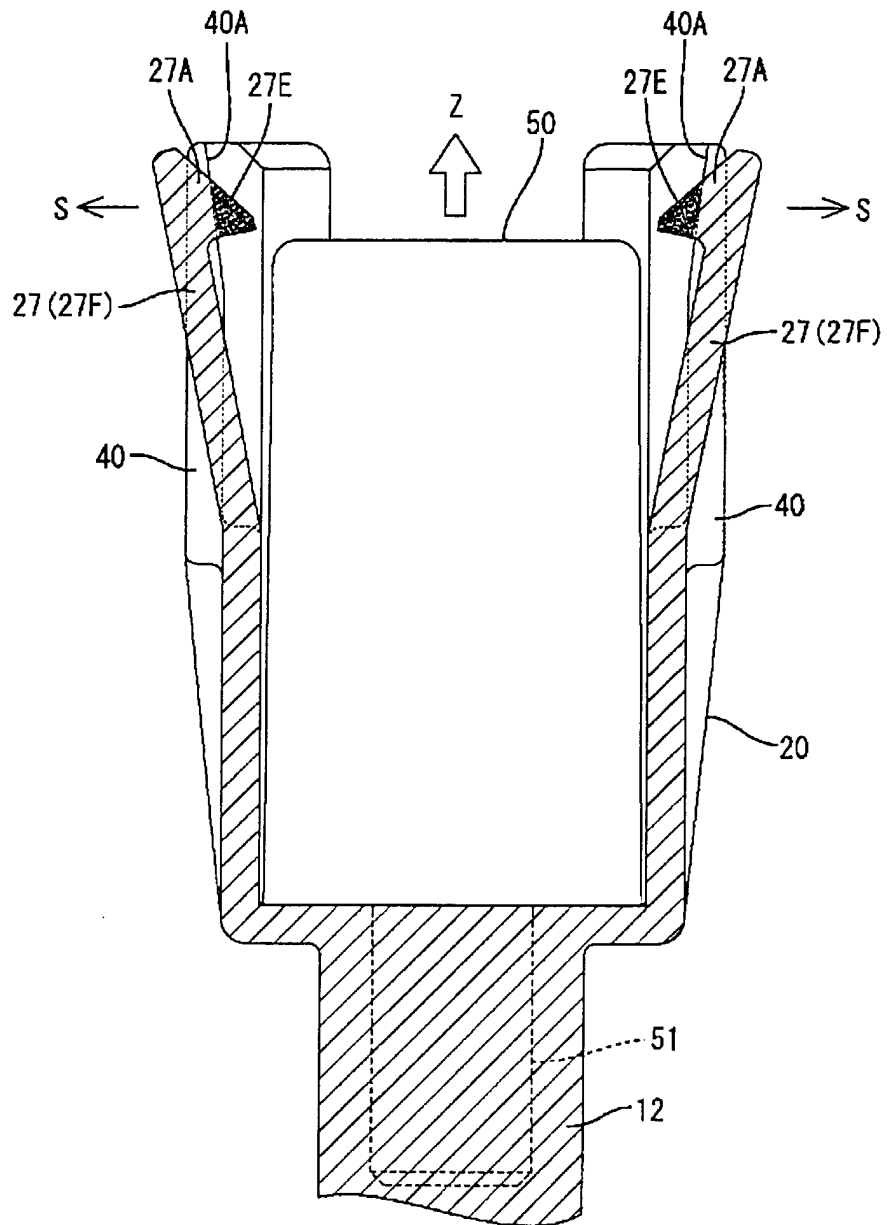


FIG. 9

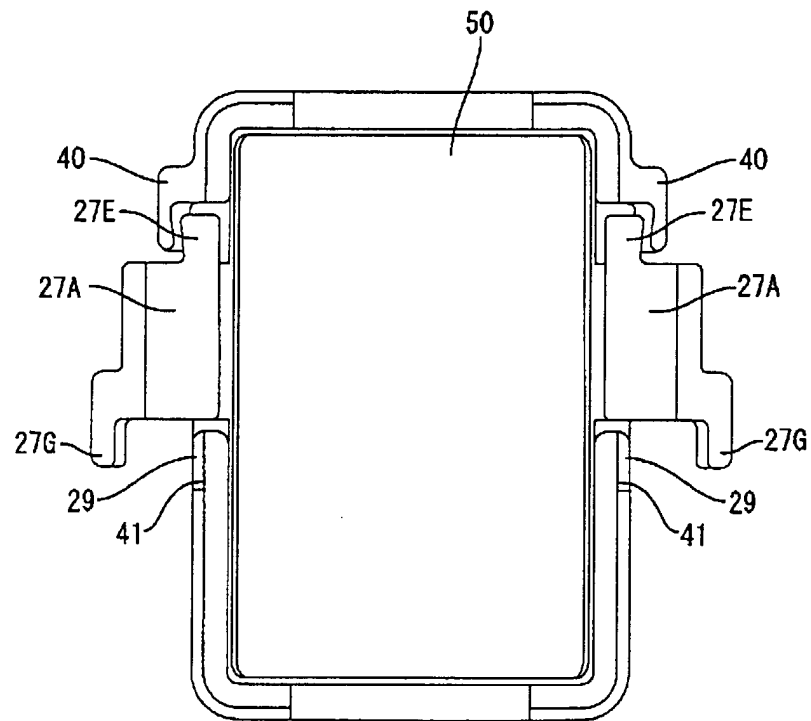


FIG. 10

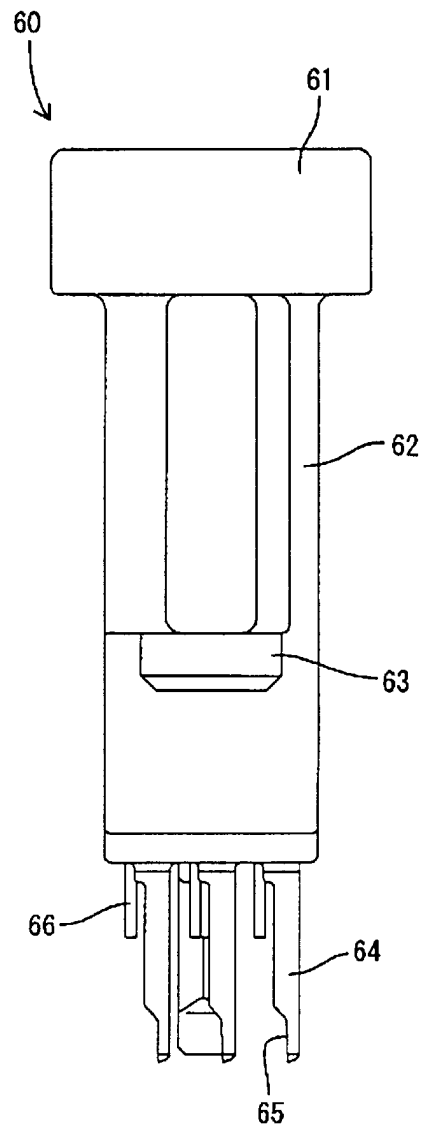


FIG. 11

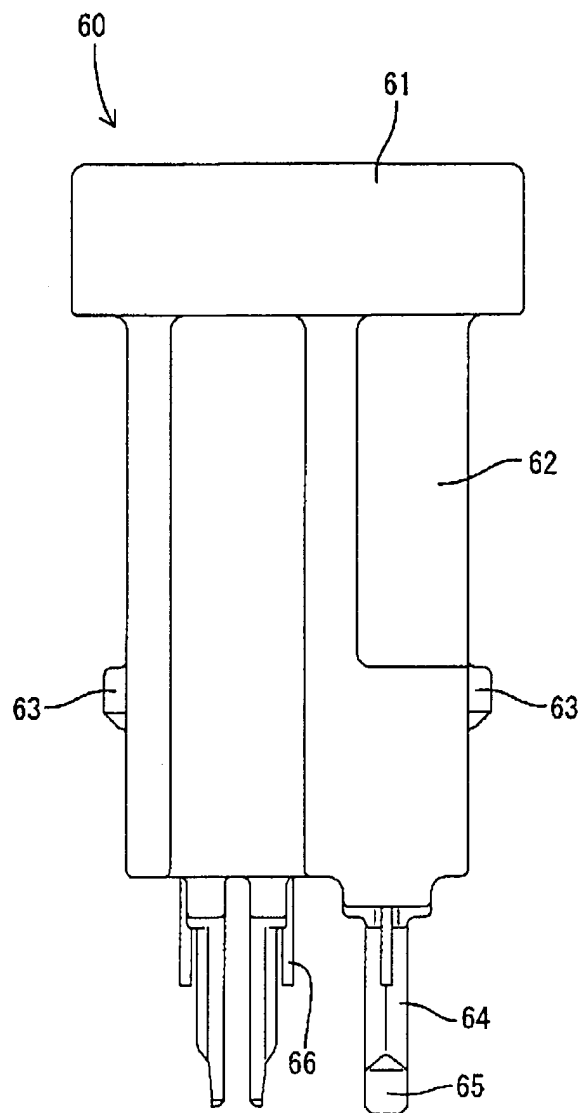


FIG. 12

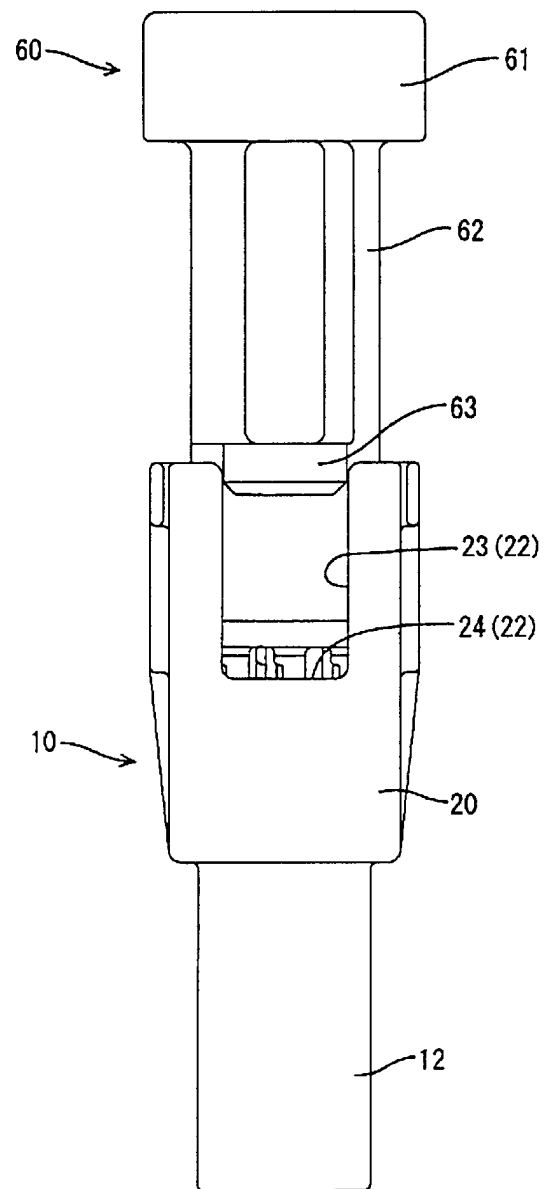


FIG. 13

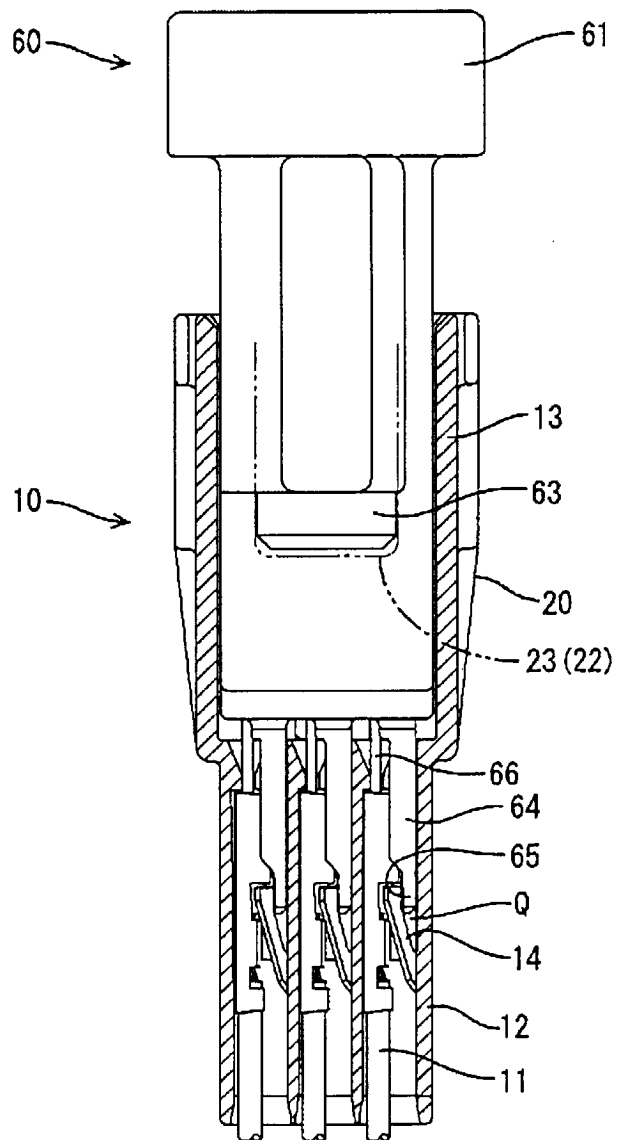


FIG. 14
PRIOR ART

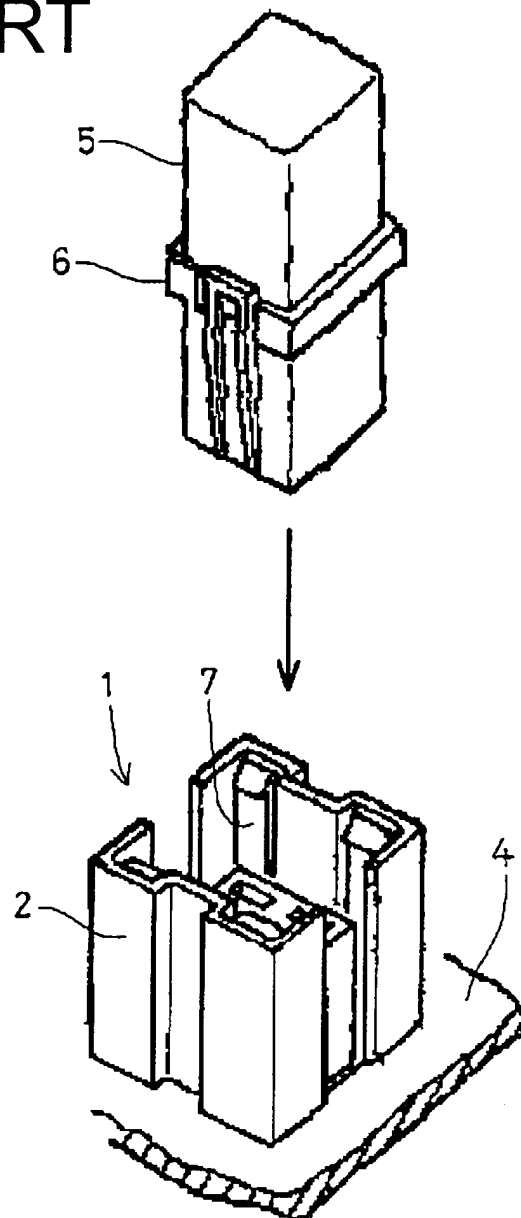


FIG. 15
PRIOR ART

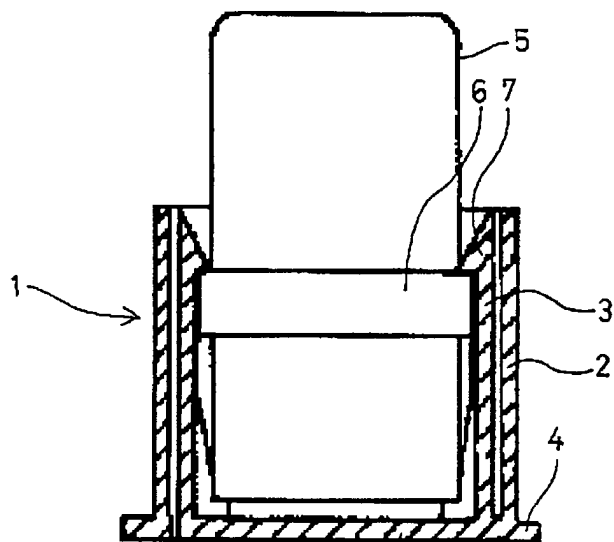


FIG. 16

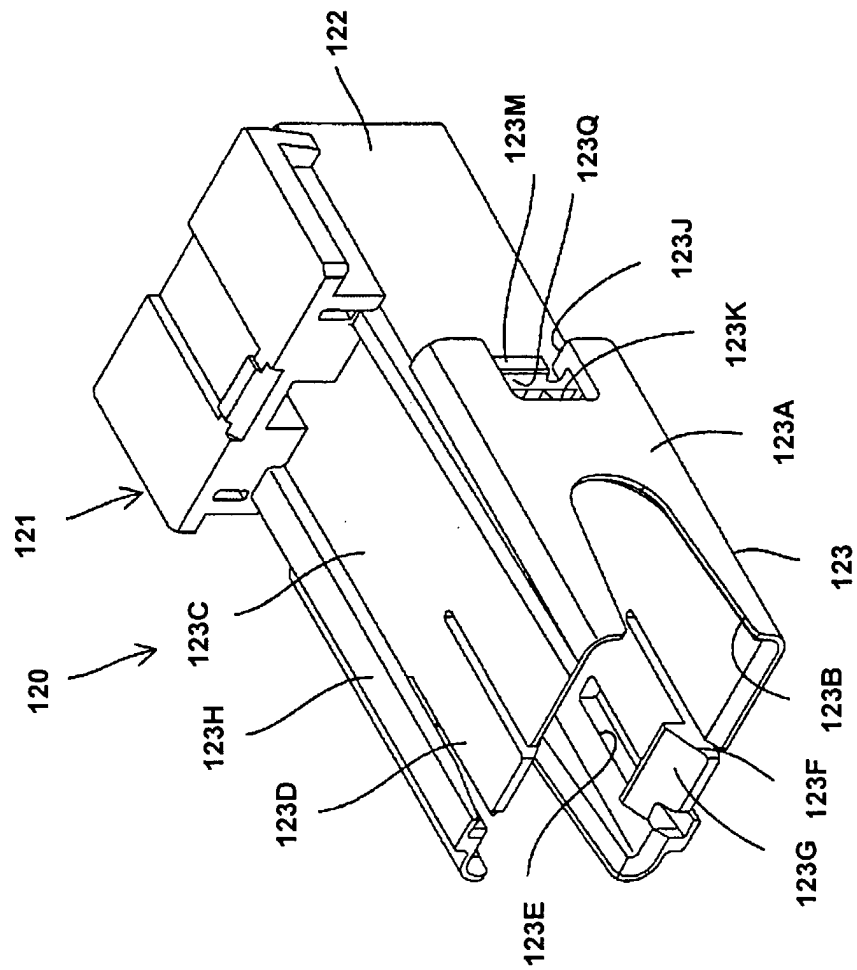


FIG. 17

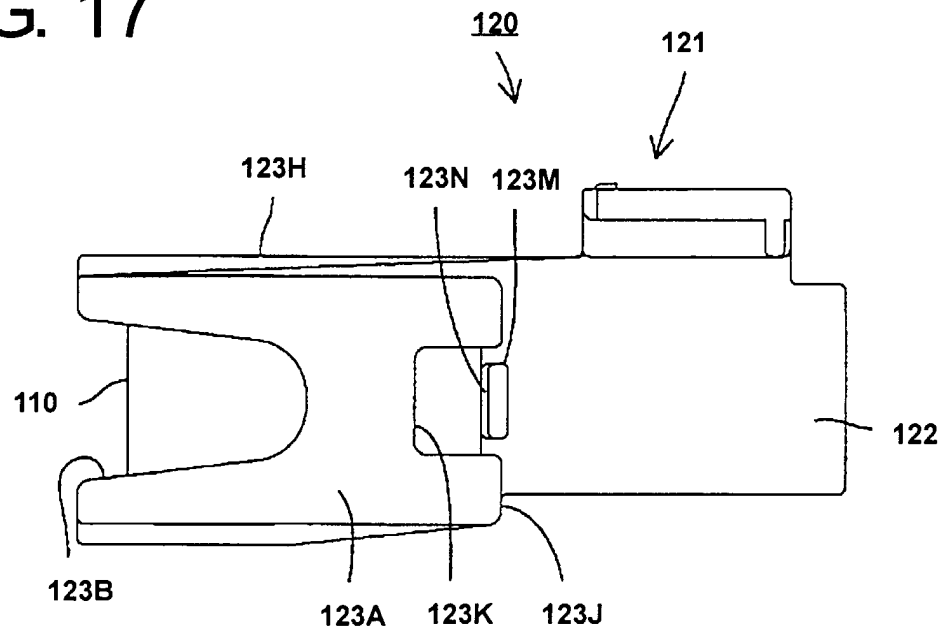


FIG. 18

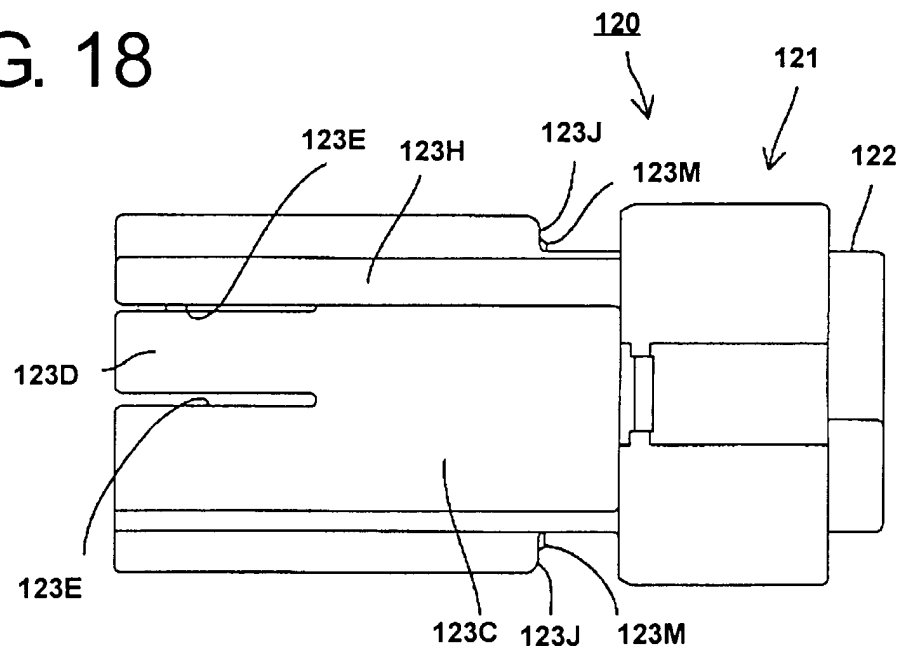


FIG. 19

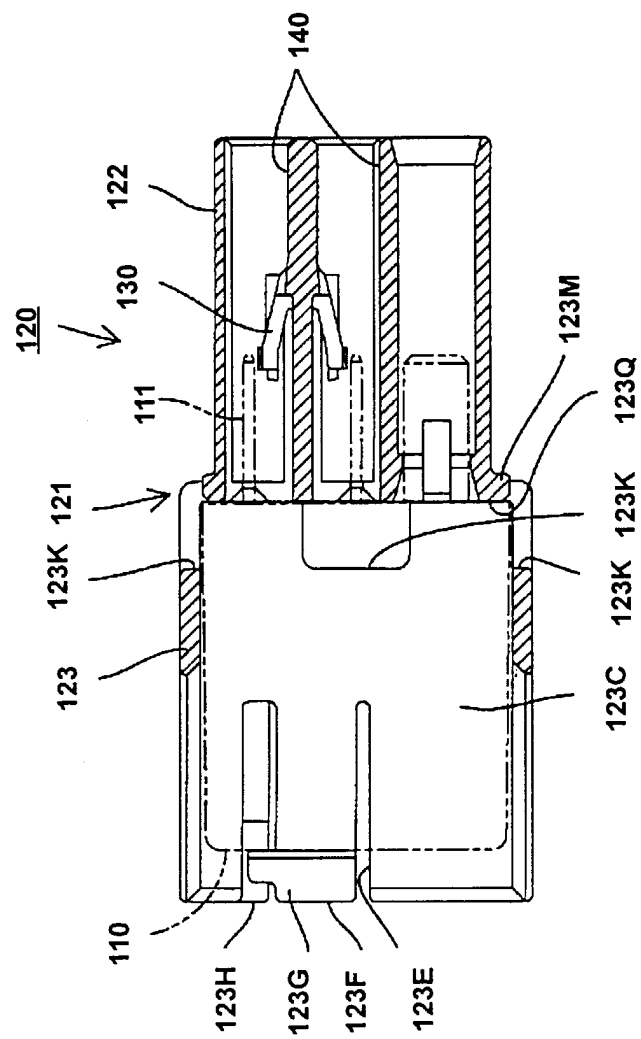


FIG. 20

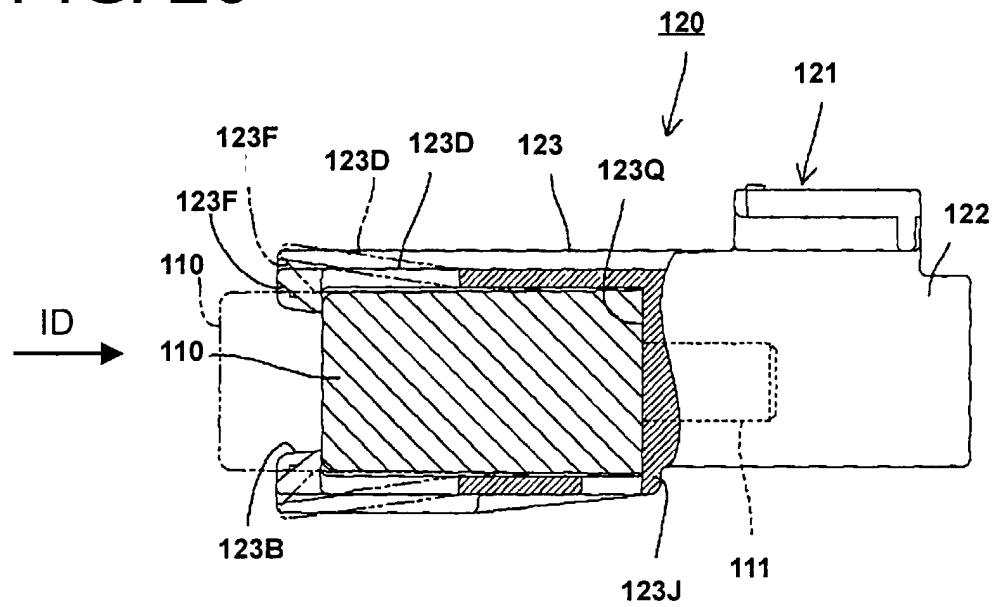
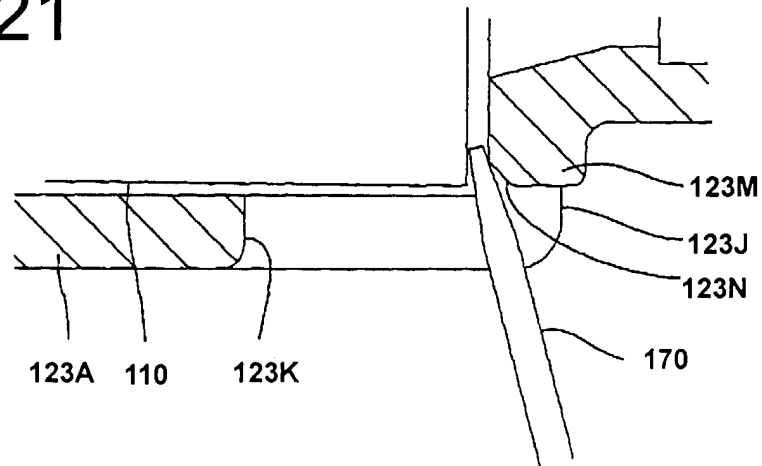
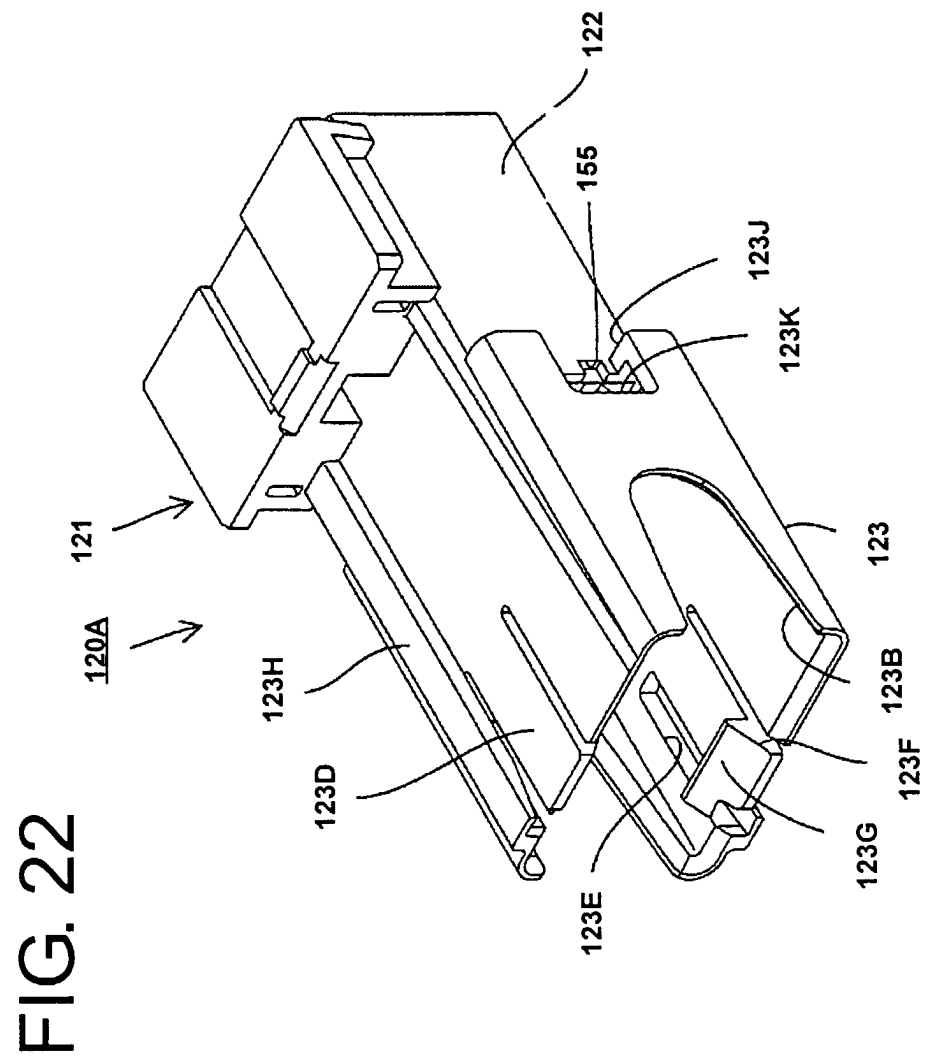


FIG. 21





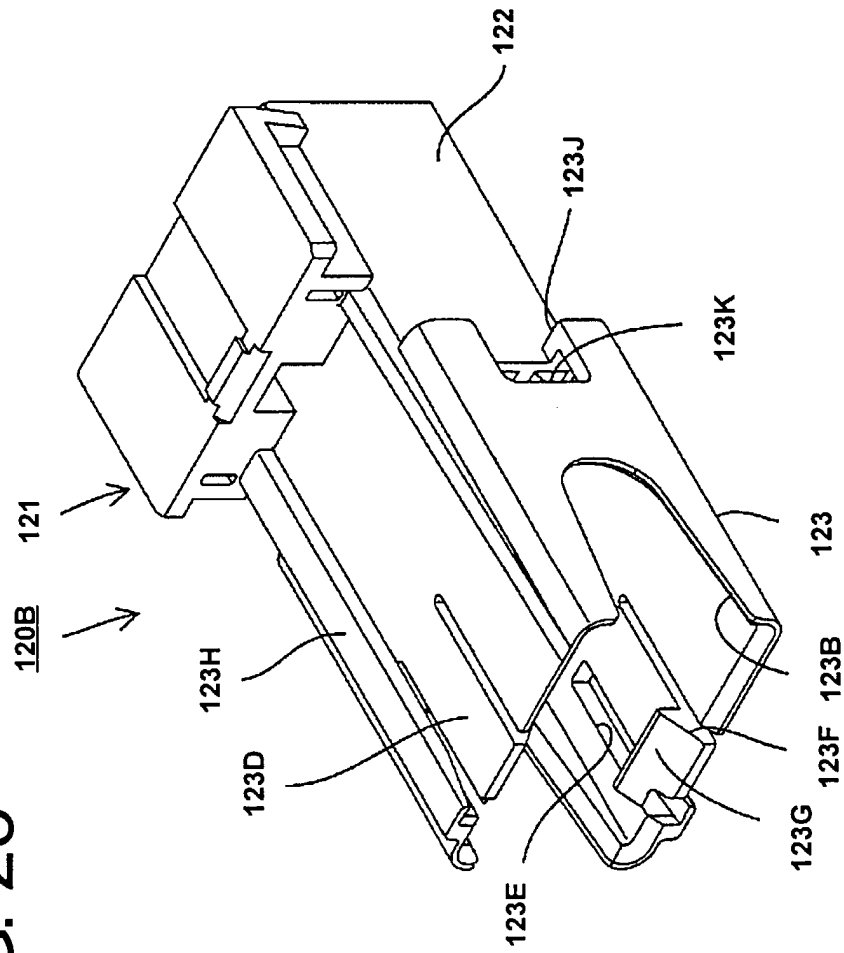
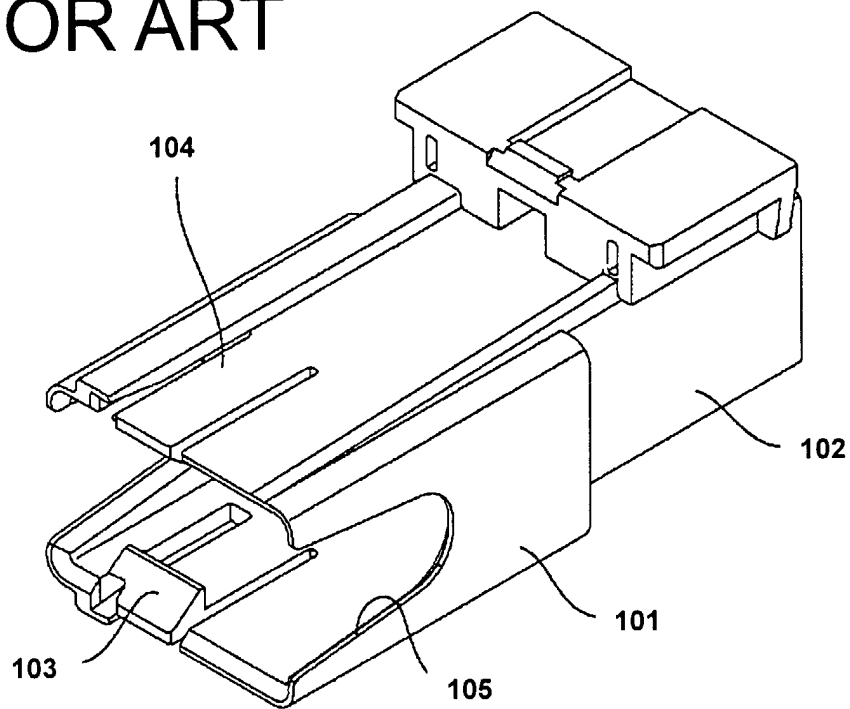


FIG. 23

FIG. 24
PRIOR ART





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 01 1076

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	US 6 126 474 A (DOYE DENNIS LEE ET AL) 3 October 2000 (2000-10-03)	1-3	H01R13/627
Y	* column 5, line 35 - column 7, line 19; figures 4,5,7 *	6-8	
X	US 5 980 297 A (SUGIE NAOTO) 9 November 1999 (1999-11-09) * column 3, line 17 - line 54; figure 2 *	1	
Y	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 06, 30 April 1998 (1998-04-30) & JP 10 050404 A (DAI ICHI DENSHI KOGYO KK), 20 February 1998 (1998-02-20) * abstract *	6-8	
A,D	PATENT ABSTRACTS OF JAPAN vol. 1997, no. 06, 30 June 1997 (1997-06-30) & JP 09 035605 A (YAZAKI CORP), 7 February 1997 (1997-02-07) * abstract *	1	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			H01R
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 11 August 2003	Examiner Stirn, J-P
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 03 01 1076

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

11-08-2003

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 6126474	A	03-10-2000	NONE	
US 5980297	A	09-11-1999	JP 3400679 B2	28-04-2003
			JP 11031554 A	02-02-1999
JP 10050404	A	20-02-1998	NONE	
JP 09035605	A	07-02-1997	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82