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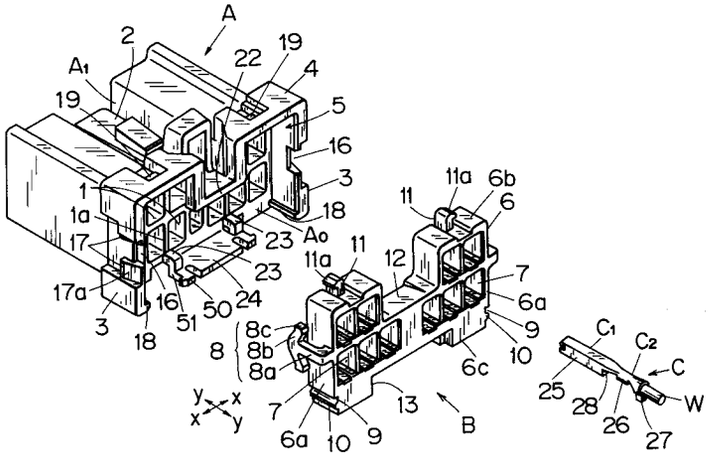
(54) An electrical connector.

(57) The electric connector consists of a connector housing having terminal accommodating chambers; terminals inserted into the terminal accommodating chambers; and a terminal locking device. The terminal locking device has a preliminary connection means and a full connection means that allow the terminal locking device to be mounted to the rear part of the connector housing in two steps - first in a preliminary-connected condition and then in a full-connected condition. The connector housing has at its rear portion a member that prevents the terminal locking device from returning from the full connection condition to the preliminary connection condition even when the latter is subjected to external forces. The terminal locking device provides double locking for the terminals inserted in the connector housing. The terminal locking device can also be locked to the housing even when the terminal is slightly longer than the specified length.

F I G. 1



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BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an electric connector and more particularly to improvements of an electric connector equipped with a terminal locking device that prevents terminals inserted into the terminal accommodating chambers in the connector housing from coming off from the rear.

Description of the Prior Art

Normally, between the terminal and the terminal accommodating chamber there is provided a locking means called a terminal lance or a case lance to prevent the terminal from coming off from the rear of the terminal accommodating chamber. The terminal lance is raised from the terminal and engaged with an engagement groove formed in the inner wall of the terminal accommodating chamber. The case lance is a resilient engagement arm projecting from the inner wall of the terminal accommodating chamber and engaged with a shoulder or engagement hole of the terminal.

As the connector pin number increases and the size of the terminal becomes smaller, the raised lances and the flexible engagement arms also decrease in size, making it difficult to secure sufficient strength and holding power of these lances. In recent years, a method has come into use which employs a rear holder, separate from the connector housing, together with the above-mentioned locking means to reinforce the connector's ability to retain terminals, thus improving reliability of the electric connection. Figure 9a and 9b show one example of a conventional electric connector having a rear holder (Japanese Patent Publication No. Heisei 1-43986), with the rear holder ***b*** in Figure 9a preliminarily connected to the housing ***a*** and with the rear holder in Figure 9b fully connected.

With the rear holder ***b*** preliminarily mounted to the connector housing ***a*** as shown in Figure 9a, the terminal ***c*** is inserted into a terminal accommodating chamber a_1 to cause its engagement piece c_1 to engage with a terminal locking step a_2. The terminal is now in a preliminary engaged state. The rear holder ***b*** is then moved to be fully connected to the connector housing so as to lock the terminal ***c*** by an edge portion b_1 of the holder.

In the electric connector of prior art, to prevent the rear holder ***b*** from inadvertently coming into a full engagement during the preliminary mounting process, a step b_2 is provided in the interior of the rear holder ***b***. Fully engaging the rear holder ***b*** requires a two-step assembly process, i.e. shifting the holder ***b*** in the direction of arrow ***p*** and then pushing it forward in the direction of arrow ***q***. This increases the number of assembling steps.

Further, when in Figure 9b a pulling force is applied to the wire ***w*** in a direction ***r*** reverse to the arrows ***p***, ***q***, the rear holder ***b*** returns from the fully engagement condition to the preliminary engagement condition, releasing the terminals ***c*** from the double lock.

SUMMARY OF THE INVENTION

This invention has been accomplished to overcome the above-mentioned problems experienced with the conventional techniques and its objective is to provide an electric connector, which allows the terminal locking device to be shifted from the preliminary engagement condition to the full engagement condition in one step and which prevents the terminal locking device from inadvertently returning from the full engagement state to the preliminary engagement state when subjected to external forces.

To achieve this objective, the electric connector of this invention comprises: a connector housing having terminal accommodating chambers; terminals inserted into the terminal accommodating chambers; a terminal locking device having a preliminary connection means and a full connection means that allow the terminal locking device to be mounted to the rear part of the connector housing in two steps - first in a preliminary-connected condition and then in a full-connected condition; and a member provided to the rear part of the connector housing to prevent the terminal locking device from returning from the full connection condition to the preliminary connection condition.

The electric connector of this invention allows the terminal locking device to be moved from the preliminary engagement condition to the full engagement condition in a single step by sliding the terminal locking device in one direction with respect to the rear part of the connector housing, improving the efficiency of the assembly work. Furthermore, since the connector housing has at its rear part a member that prevents the terminal locking device from shifting from the fully engagement state to the preliminary engagement condition, there is no chance of the locking device returning to the preliminary engagement condition inadvertently by external force, thereby assuring double lock of the terminals.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of one embodiment of the electric connector according to this invention showing the rear holder or terminal locking device separated from the connector housing;

Figure 2 is a side view of the male connector housing and the terminal locking device of Figure 1;

Figure 3 is a rear view of the male connector housing of Figure 1;

Figure 4a is a perspective view of the terminal locking device of Figure 1 as seen from the front; 4b a rear view; and 4c a right-side view;

Figure 5a and 5b are rear views of the male connector housing showing the terminal locking device in a temporarily connected state and in a fully connected state, respectively;

Figure 6a and 6b are cross sections of the electric connector showing the terminal locking device in the preliminarily connected state and in the fully connected state as in Figure 5;

Figure 7a and 7b are left-side views of a locking arm of Figure 6;

Figure 8 is a partially enlarged view showing an engagement rod of Figure 5 in the preliminary-connected state; and

Figure 9a and 9b are cross sections of the conventional electric connector in the preliminary-connected state and in the full-connected state, respectively.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

In Figure 1 through Figure 5, reference symbol ***A*** represents a male connector housing made of synthetic resin (hereinafter simply referred to as a housing); ***B*** a terminal locking device made of synthetic resin; and ***C*** a female terminal secured to the end of a wire ***W***. Inside the housing ***A*** there are a number of compartmented terminal accommodating chambers ***1*** (in this embodiment a total of 10 chambers arranged in the upper and lower tiers) to receive female terminals ***C***. On the upper part of the outer circumferential wall is formed a center recess A_1, in which a simple beam type lock arm ***2*** is formed to lock the mating female connector housing (not shown). On the rear part of the housing ***A*** is formed a locking device accommodating chamber ***5*** defined by side walls ***3***, ***3*** and an upper wall ***4*** to receive the terminal locking device ***B***.

The terminal locking device consists of a main frame ***6*** having a plurality of openings ***7*** that correspond to the terminal accommodating chambers ***1*** in the housing ***A***. The size of the openings ***7*** is such that the female terminal ***C*** can be inserted therethrough when the terminal locking device ***B*** is in the preliminary-connected condition. The opening ***7*** may be formed smaller in the cross-sectional area than the terminal accommodating chamber ***1***. At one inner edge portion of each opening ***7*** on the front side is formed a tapered thrust engagement surface ***7a*** for the female terminal ***C*** (see Figure 4).

The main frame ***6*** consists of side frames ***6a***, an upper frame ***6b***, and a lower frame ***6c***. The side frames ***6a*** each have a lock arm ***8***, an engagement groove ***9*** and an engagement projected strip ***10*** formed on the outer surface thereof. The upper frame ***6b*** has a pair of engagement rods ***11***, ***11*** and a recess ***12***. The lock arm ***8*** is shaped like a letter T, consisting of a horizontal resilient arm ***8a*** that extends forwardly from the rear of the side frame ***6a*** and longitudinally flexible arms ***8b*** that extend up and down from the front end of the horizontal resilient arm ***8a***. The longitudinally flexible arms ***8b*** deflect backward and act as lock springs as will be described later. The longitudinally flexible arms ***8b*** each have an engagement projection ***8c*** at its free end. The horizontal resilient arm ***8a*** can be elastically deflected in the direction of arrow ***x*** and the longitudinally flexible arms ***8b*** in the direction of arrow ***y***. The engagement rod ***11*** is shaped like a hook and has an engagement claw ***11a*** at the top end protruding outwardly. The lower frame ***6c*** has a recess ***13*** at the center of its underside. On the front side, the lower frame ***6c*** has a pair of notched recesses ***14***, ***14*** at each side of the recess ***13*** and a pair of rotation prevention pieces ***15***, ***15*** that extend forwardly from inner walls of the recess ***13***. The rotation prevention piece ***15*** consists of an L-shaped arm ***15a*** and an engagement projection ***15b*** provided on the inner side of the front end of the arm ***15a*** (see Figure 4).

On the rear side of the housing ***A***, i.e. on the locking device accommodating chamber ***5*** side, the side wall ***3*** has a passage ***16*** for the horizontal resilient arm ***8a*** of the lock arm ***8*** at the middle part of the outer surface. On the upper and lower side of the passage ***16***, engagement portions ***17***, ***17*** for the engagement projections ***8c*** are formed on the outer surface of the side wall ***3***. A projected strip ***18*** that fits into the engagement groove ***9*** is formed on the inner side of the side wall ***3*** at the lower end. The upper wall ***4*** is formed with two engagement chambers ***19*** for the engagement rods ***11***. Each engagement chamber ***19*** is provided with an engagement hole ***20*** and a full-engagement projection ***21*** (see Figure 8). Between the engagement chambers ***19***, ***19*** is formed an engagement portion ***22*** that engages with the recess ***12*** of the terminal locking device ***B***. Further, on the rear side of the housing ***A***, positioning projections ***23***, ***23*** are formed at the lower part to engage with the pair of the notched recesses ***14***, ***14***. The positioning projections ***23*** are situated at the end surfaces of the partition walls ***1a*** of the terminal accommodating chambers ***1*** and have a guide tongue, L-shaped in cross section, that connects the lower ends of the positioning projections ***23***, ***23***.

The female terminal ***C*** is made of a conductive metal plate and consists of an electric contact

portion C_1 at the front and a wire connecting portion C_2 at the rear. The electric contact portion C_1 has a receptor cylinder ***25*** that receives a mating tab, and an elastic contact piece (not shown) provided in the receptor cylinder. The wire connecting portion C_2 has a pair of conductor clamping pieces ***26*** and a pair of insulator clamping pieces ***27***. The female terminal ***C*** may be provided with a stabilizer (not shown) after the insulator clamping pieces ***27***.

The guide tongue ***24*** of the housing ***A*** is formed at both sides with projections ***50*** through hinges ***51*** to prevent unlocking of the terminal locking device ***B***. At locations corresponding to the projections ***50***, the lower frame ***6c*** of the terminal locking device ***B*** is formed with projection holding portions ***52*** that have receptor grooves ***53*** (see Figure 6). The projection holding portions ***52*** are situated inside the pair of rotation prevention pieces ***15*** at the underside of the lower frame ***6c***.

Now, we will explain how the terminal locking device ***B*** is used as well as its workings. First, the terminal locking device ***B*** is inserted onto the rear part of the housing ***A*** to preliminarily engage it on the housing. In this condition, the female terminal ***C*** is inserted into the terminal accommodating chamber ***1*** and locked there. Finally, the terminal locking device ***B*** is slid upwardly to fully engage it with the housing. This condition prevents the female terminal ***C*** from slipping off rearwardly and the terminal locking device ***B*** from returning to the preliminary-connected condition.

In Figure 2, the terminal locking device ***B*** is moved in the direction of arrow ***P*** and inserted into the locking device accommodating chamber ***5*** of the housing ***A***. With its engagement grooves ***9*** slid along the engagement projected strips ***18*** on the side walls ***3*** of the housing ***A***, the terminal locking device ***B*** is guided into the locking device accommodating chamber ***5***. At this time, the terminal locking device ***B*** is supported from below by the guide tongue ***24*** inserted into the recess ***13*** at the underside of the terminal locking device ***B***. Two engagement rods ***11*** are advanced into the engagement chambers ***19*** and the positioning projections ***23*** fit into the notched recesses ***14*** at the front of the terminal locking device.

As the terminal locking device ***B*** is advanced, the upper and lower engagement projections ***8c*** of the lock arms ***8*** are slid along tapered surfaces ***17a*** of the engagement portions ***17*** on the outer surface of the side walls, causing the lock arms ***8*** to deflect outwardly. When the engagement projections ***8c*** ride over the tapered surfaces ***17a***, the lock arms ***8*** snap back to the original shape. At this time, the front surface B_0 of the terminal locking device ***B*** contacts the rear surface A_0 of the housing ***A***, and the rear ends of the engagement projections ***8c*** temporarily engage with the engagement portions ***17*** as shown in Figure 7a. As a result, the terminal locking device ***B*** can be prevented from coming off rearwardly. Further, longitudinally elastic arms ***8b***, ***8b*** formed as locking springs urge the terminal locking device ***B*** toward the housing ***A***.

In the above temporary-connected condition, the terminal locking device ***B*** is firmly held in the vertical direction by the engagement between the engagement grooves ***9*** and the engagement projected strips ***18*** and between the engagement claws ***11a*** of the engagement rods ***11*** and the full engagement projections ***21*** in the engagement chambers ***19*** as shown in Figure 5a and Figure 8, so that the axes of the openings ***7*** in the terminal locking device ***B*** and the terminal accommodating chambers ***1*** are correctly aligned. The provision of the guide tongue ***24*** prevents the terminal locking device ***B*** from returning to the preliminary connected condition.

In this preliminary-connected condition, the female terminal ***C*** connected with a wire ***W*** is inserted from the opening ***7*** into the terminal accommodating chamber ***1*** until the resilient engagement arm ***29*** in the chamber engages with the shoulder ***28*** of the electric contact portion C_1, to prevent backward dislocation of the terminal ***C***, as shown in Figure 6a. (This represents a primary locking of the terminal.) Next, the terminal locking device ***B*** is slid in the direction of arrow ***Q***. When the terminal locking device ***B***, which is in surface contact with the housing, is pushed up, the engagement groove ***9*** gets out of engagement with the projected strip ***18***, allowing the terminal locking device ***B*** to move upward. As a result, the engagement claw ***11a*** of the engagement rod ***11*** rides over the full engagement projection ***21*** in the engagement chamber ***19*** into the engagement hole ***20*** on the upper side of the projection ***21*** (see Figure 8). The projected strips ***10*** on both sides of the terminal locking device ***B*** are now supported by the projected strips ***18*** on the inner surfaces of the side walls, thereby fully locking the device ***B***.

Figure 5b and Figure 6b show the terminal locking device ***B*** in the fully connected state. The terminal locking device ***B*** is reliably prevented from coming off backwardly from the housing by the engagement between the engagement claw ***11a*** of the engagement rod ***11*** and the engagement hole ***20*** and between the projected strips ***18*** and ***10*** as well as by the engagement between the engagement projection ***15b*** of the rotation prevention piece ***15*** and the rear of the guide tongue ***24*** and between the engagement portion ***22*** of the upper wall ***4*** and the recess ***12***.

In the fully connected condition, when the female terminal ***C*** is pulled backwardly through the wire ***W***, the terminal locking device ***B*** acts as a stopper against the rear end of the female terminal

C (in the example shown, the insulator clamping pieces ***27***). Thus, the terminal locking device ***B*** combined with the primary locking of the terminal reliably prevents backward slip-off of the terminal. During the process of sliding the terminal locking device ***B*** from the preliminary-connected state to the full-connected state, if there is any female terminal ***C*** that was incompletely inserted, the tapered thrust engagement surface ***7a*** of the opening ***7***, as the device ***B*** is moved, engages with the insulator clamping pieces ***27*** to advance the female terminal ***C*** toward the front of the terminal accommodating chamber ***1***. Hence, any incomplete insertion of the terminal can be eliminated.

In Figure 6b, when the terminal locking device ***B*** is applied with a rotating force as shown by the arrow ***R*** through the wire ***W***, the rotation prevention piece ***15*** engages with the guide tongue ***24*** as mentioned earlier, so that there is no possibility of the terminal locking device ***B*** getting out of the fully connected condition.

Furthermore, with the female terminal ***C*** fully inserted, when the rear end ***27a*** of the insulator clamping piece ***27*** protrudes from the rear surface A_0 of the housing ***A*** by a small amount Δl as shown in Figure 6 and Figure 7b, the terminal locking device ***B*** is retracted backward against the elastic force of the longitudinally flexible arm ***8b***, while maintaining the fully connected condition.

As can be seen from the above description, the lock arm ***8*** and the engagement portions ***17***, ***17*** on the outer surfaces of the side walls ***3*** combine to form the preliminary connection means and full connection means between the terminal locking device ***B*** and the housing ***A***. In the preliminary-connected condition, the engagement groove ***9*** and the engagement projected strip ***18***, or the recess ***13*** and the guide tongue ***24*** engage with each other to support the terminal locking device ***B*** and thereby prevent it from coming off the housing ***A***. Similarly, the engagement claw ***11a*** of the engagement rod ***11*** and the full engagement projection ***21*** in the engagement chamber ***19***, or the engagement projected strips ***10*** and ***18*** engage with each other to prevent the terminal locking device ***B*** from getting out of the fully connected condition. Further, the recess ***12*** and the engagement portion ***22***, or the rotation prevention piece ***15*** and the guide tongue ***24*** effectively increase reliability level in keeping the terminal locking device in the fully connected condition.

With the terminal locking device ***B*** in the preliminary-connected state, the unlocking prevention projection ***50*** of the housing ***A*** is received in the receptor groove ***53*** in the projection holding portion ***52***, as shown in Figure 6a. As the terminal locking device ***B*** is moved into the fully connected condition, the projection ***50*** is bent upward by the bottom surface ***53a*** of the receptor groove ***53***. When the device ***B*** has come into the fully connected condition, the bottom surface of the device ***B*** (***6c***) and the rear end surface ***50a*** of the projection ***50*** interfere with each other, so that application of tension in the direction of arrow ***R'*** to the wire ***W*** cannot cause the terminal locking device ***B*** to return to the preliminary-connected condition. In this way, the female terminal ***C*** is double-locked.

While the above description takes an example of the terminal accommodating chambers ***1*** arranged in the upper and lower tiers in the housing ***A***, this invention can also be applied to connectors with a single row of terminal accommodating chambers. Since the terminal locking device ***B*** is independent of the locking means between the female terminal ***C*** and the terminal accommodating chamber ***1***, i.e. the resilient engagement arm ***29*** of the conventional case lance type, the invention can also be applied to the terminal lance type. The invention is also applicable to a female connector housing that contains male terminals.

With this invention, the transfer of the terminal locking device from the preliminary connection state to the full connection state with respect to the housing can be done smoothly in one step by sliding the terminal locking device in one direction relative to the rear part of the housing, improving the efficiency of operating work. This invention eliminates the possibility of the terminal locking device returning to the preliminary connection state inadvertently by external force. The invention provides a double locking for the terminals in the connector housing.

Claims

1. An electric connector comprising:

a connector housing having terminal accommodating chambers;

terminals inserted into the terminal accommodating chambers;

a terminal locking device having a preliminary connection means and a full connection means that allow the locking device to be mounted to a rear part of the connector housing in two steps -- first in a preliminary-connected condition and then in a full-connected condition; and

a prevention means provided at the rear part of the connector housing to prevent the locking device from returning from the full-connected condition to the preliminary-connected condition.

2. An electric connector as claimed in claim 1, wherein the prevention means is provided adjacent a lower end portion of the rear part of

the connector housing and includes a first prevention means engageable, in the full-connected condition, with a mating means adjacent a lower end portion of the locking device such that the lower end portion of the locking device is prevented from being rearwardly and upwardly displaced.

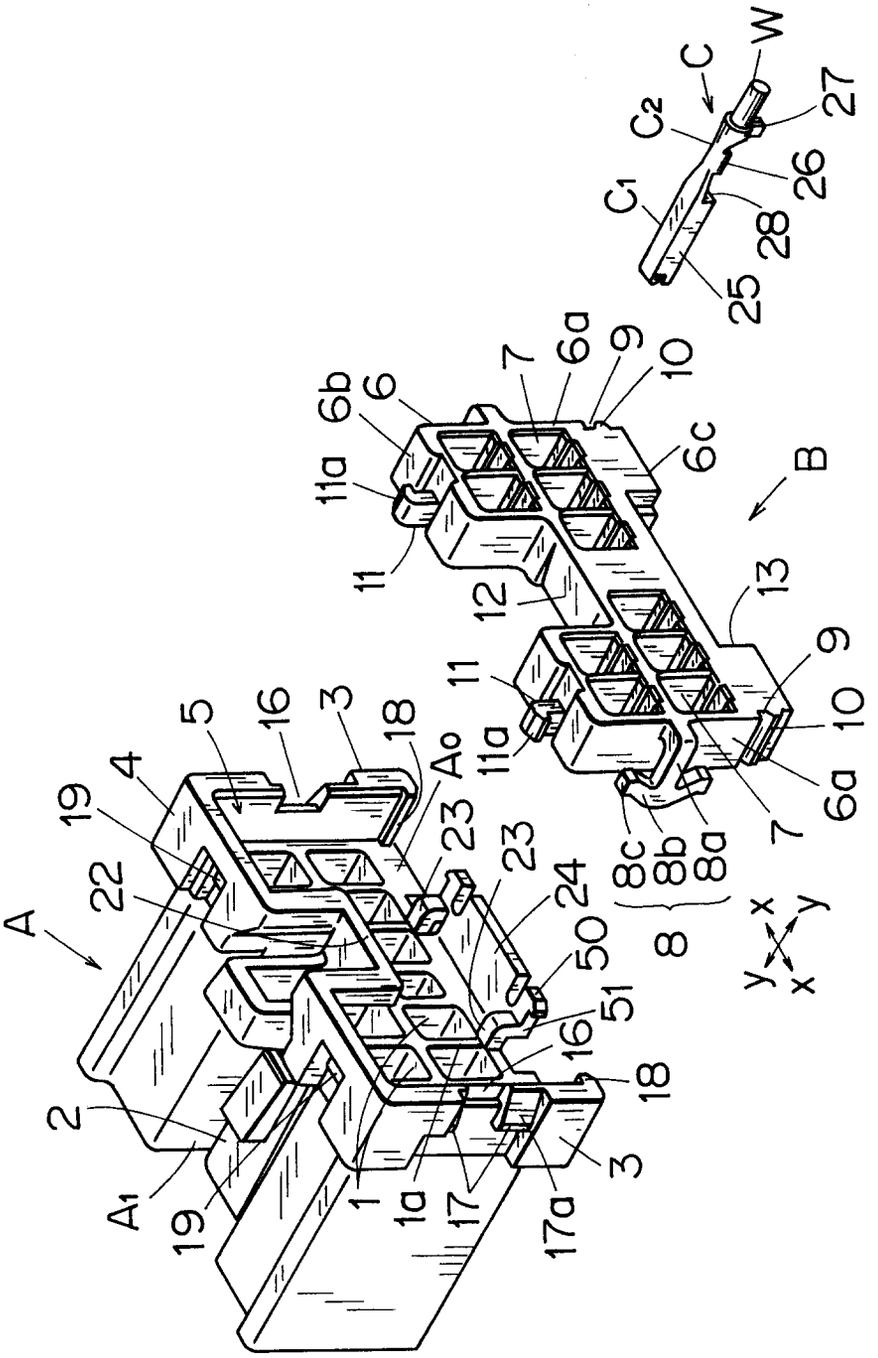
3. An electric connector as claimed in claim 2, wherein the first prevention means comprises shoulder portions downwardly opened and facing toward the side opposite the locking device and the mating means comprises a pair of arms provided extending in a fitting direction with the connector housing and with inwardly directed projections at the front end thereof that engage with the shoulder portions from the side opposite the locking device.

4. An electric connector as claimed in claim 2, wherein the prevention means further includes a second prevention means engageable, in the full-connected condition, with the locking device such that the locking device is prevented from being displaced to the preliminary connected condition.

5. An electric connector as claimed in claim 4, wherein the second prevention means comprises hinged projections extending in a fitting direction with the locking device, which are in the full-connected condition bent upwardly such that the rear end surfaces thereof interfere with a bottom surface of the locking device.

6. An electric connector as claimed in claim 1, wherein the preliminary connection means and the full connection means include in common a lock arm, the lock arm comprising a resilient arm provided on a side surface of the locking device to extend in a fitting direction with the connector housing and longitudinally flexible arms extending up and down from a front end of the resilient arm, the longitudinally flexible arms being slid, when the locking device is fitted to the connector housing, along tapered surfaces formed on engagement portions on a corresponding side surface of the connector housing while being outwardly deflected until the arms ride over the tapered surfaces, at which the longitudinally flexible arms snap into engagement with step portions formed on the side of the engagement portions opposite the locking device.

FIG. 1


W
C
C2
C1
27
26
28
25
6a
9
10
6b
6
7
6c
11a
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B
12
13
9
10
11
11a
6a
7
8c
8b
8a
8
x
y
y
x
A
22
19
4
5
16
3
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17
17a

FIG. 2

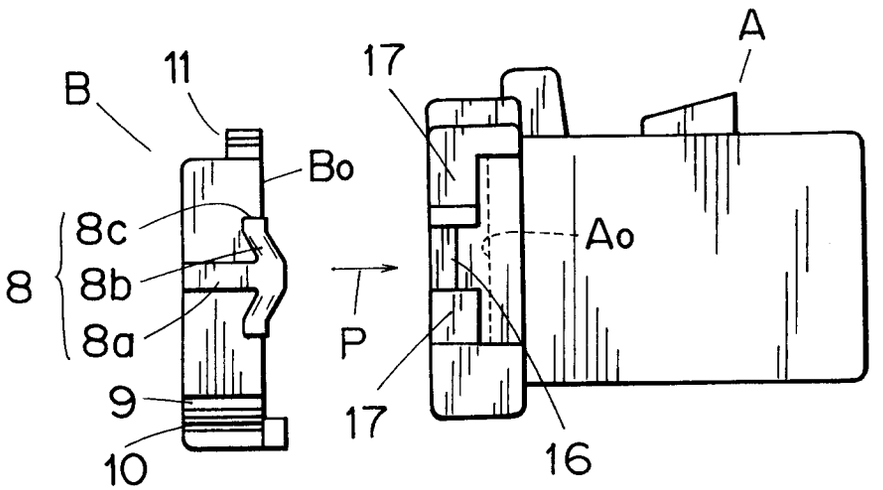


FIG. 3

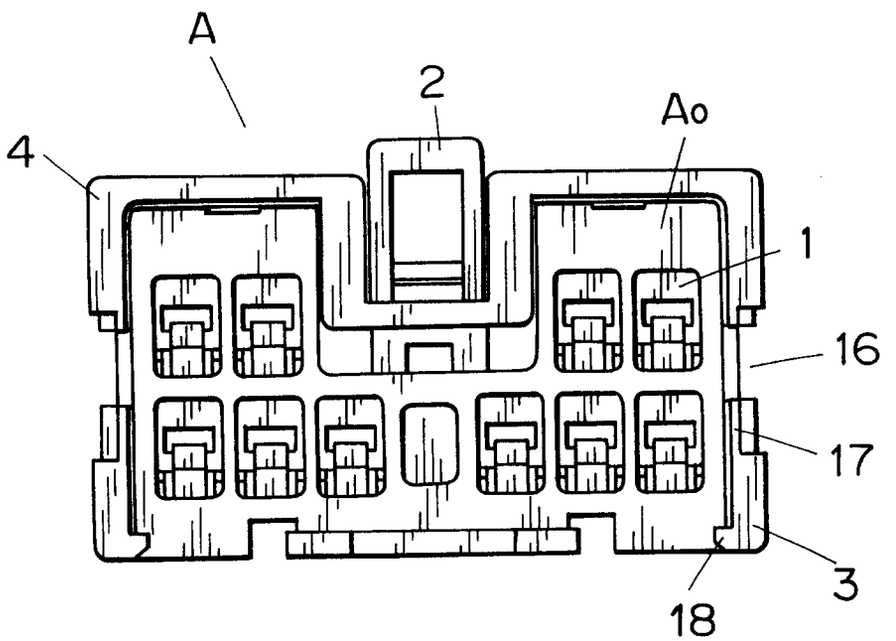


FIG. 4a

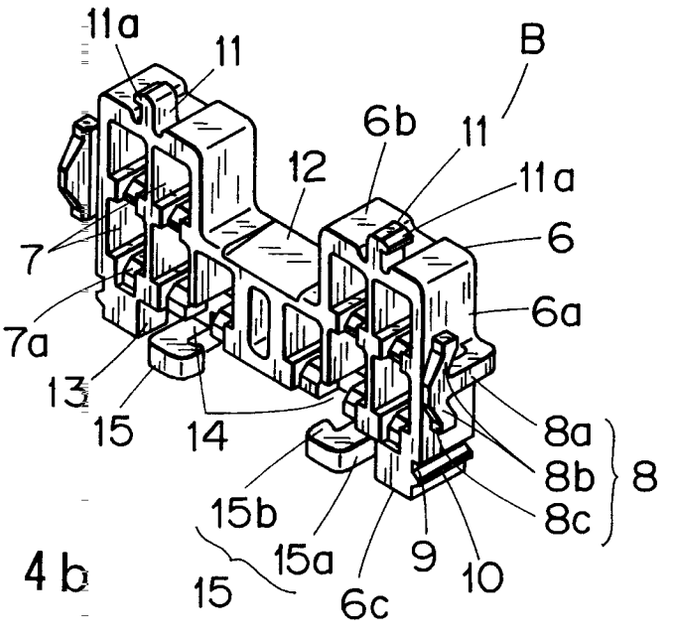


FIG. 4b

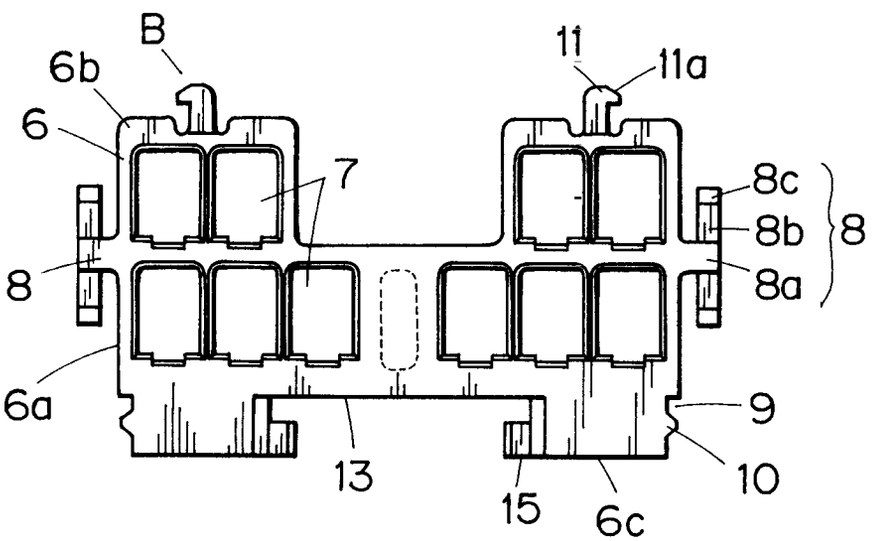


FIG. 4c

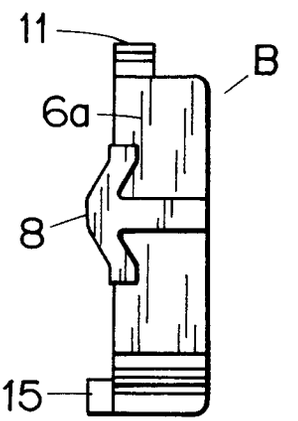


FIG. 5a

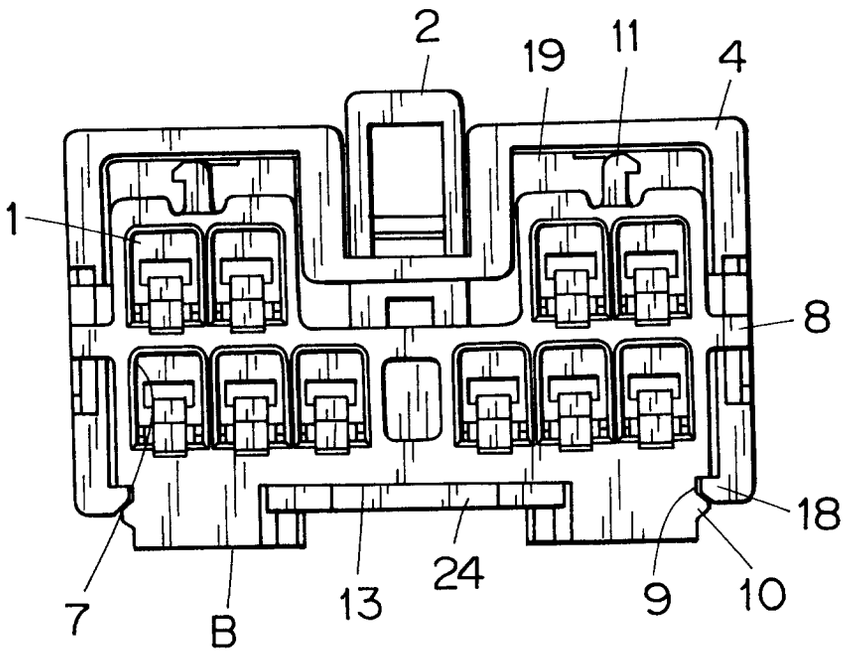


FIG. 5b

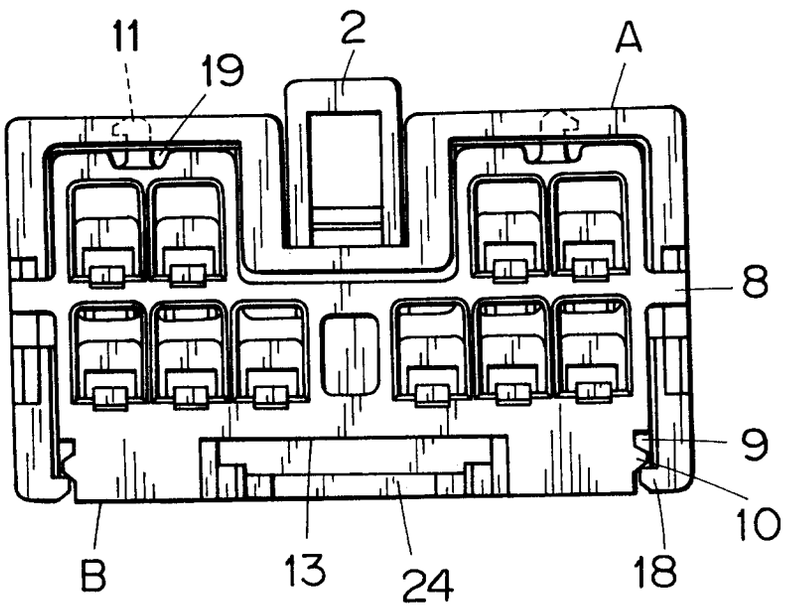
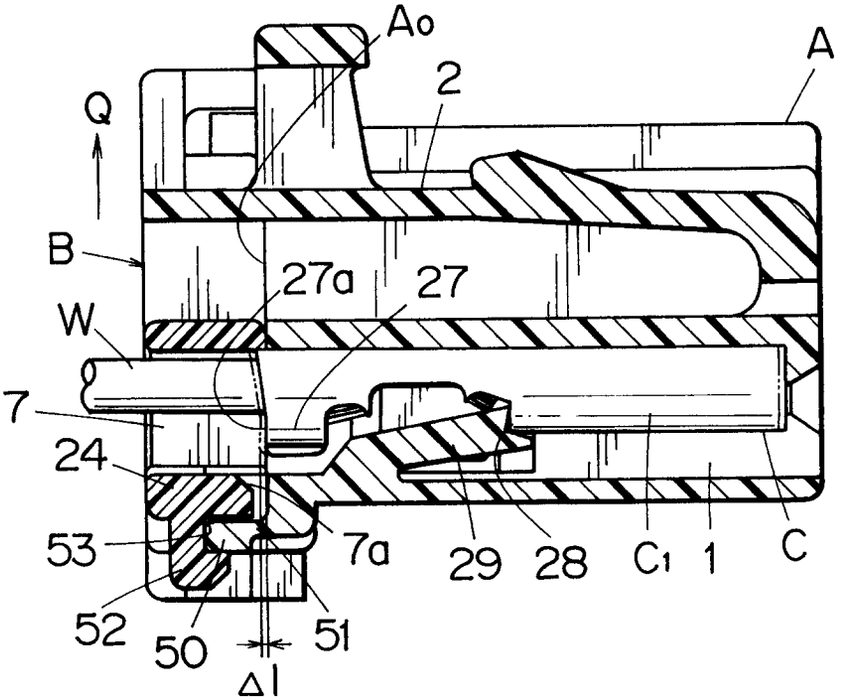


FIG. 6a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A
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Q
B
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27
W
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24
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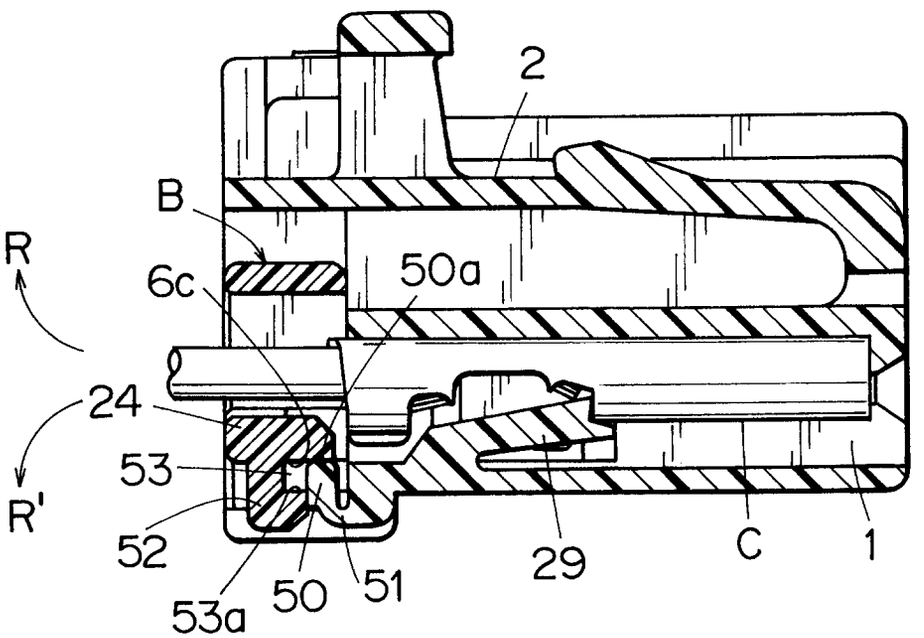
7a
29
28
C1
1
C
52
50
51
Δl

FIG. 6b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R'
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C
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FIG. 7a

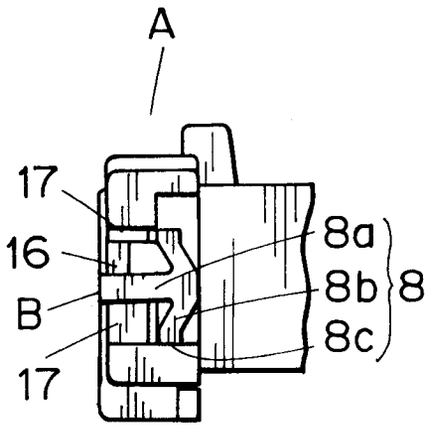


FIG. 7b

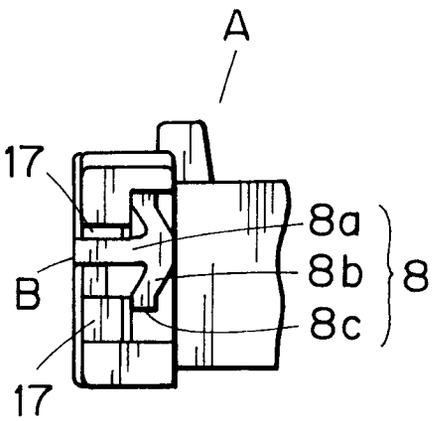


FIG. 8

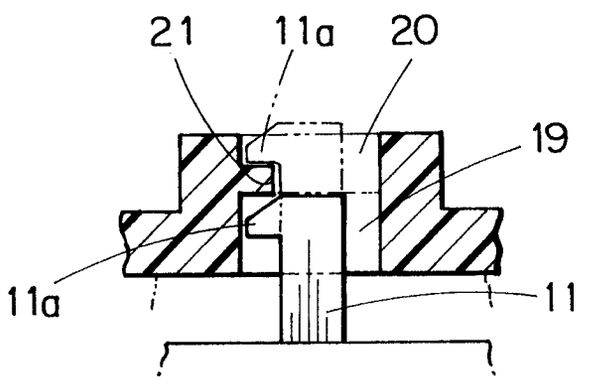


FIG. 9a

PRIOR ART

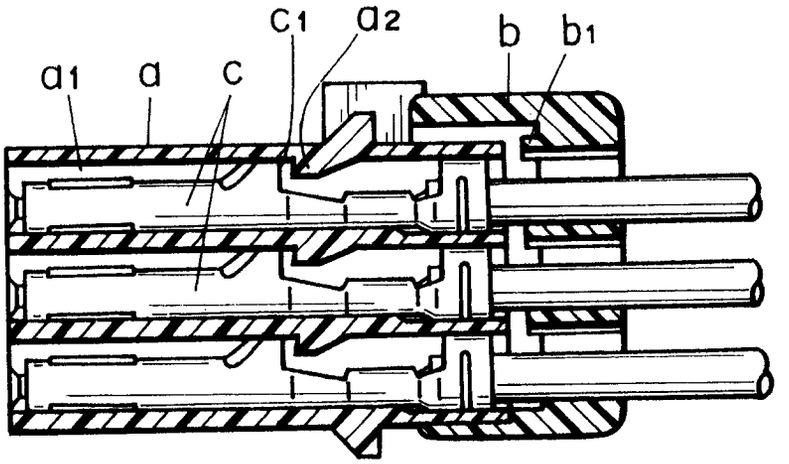
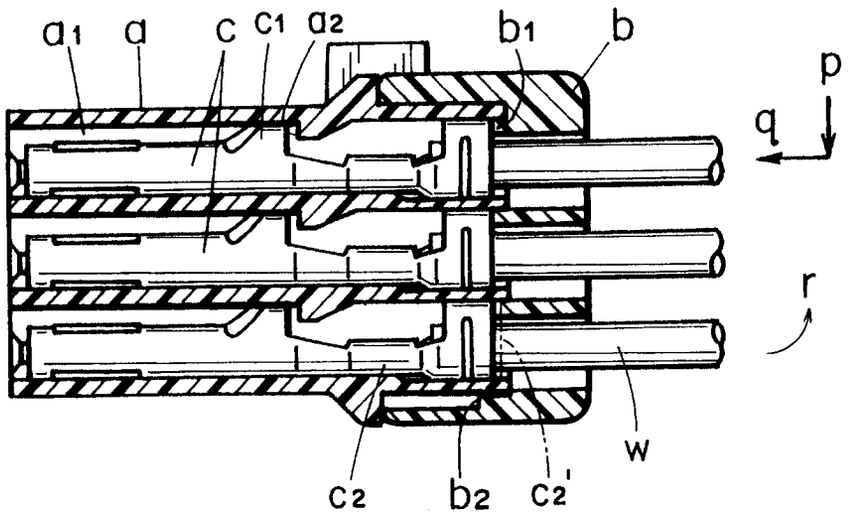


FIG. 9b

PRIOR ART



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 10 5162

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.5)
X	GB-A-2 245 777 (AMP) * page 4, line 5 - page 7; figures 1-4 *	1	H01R13/436
X	DE-C-4 010 440 (LEOPOLD KOSTAL GMBH & CO KG) * column 2, line 14 - column 4, line 14; figure 1 *	1	
X	US-A-4 946 398 (TAKENOUCHI ET AL.) * column 3, line 7 - column 4, line 22; figures 1-8 *	1	
A	GB-A-2 237 457 (YAZAKI CORPORATION) * page 4, line 13 - page 7; figures 1-5 *	1	
A	US-A-4 758 182 (ANBO ET AL.) * column 2, line 57 - column 7, line 5; figures 1-17 *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	05 JULY 1993	TAPPEINER R.

CATEGORY OF CITED DOCUMENTS

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