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(54) **ELECTRICAL CONNECTOR ASSEMBLY**

ELEKTRISCHE VERBINDERBAUGRUPPE

ENSEMBLE CONNECTEUR ÉLECTRIQUE

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EP 2 340 588 B1

## Description

**[0001]** The present invention relates to the electrical connector field. For instance, the invention relates to connectors for motorized vehicles applications.

**[0002]** Electrical connectors are intended to connect electrical cables, wires or cable harnesses to each other or to electrical or electronic devices. Connectors usually comprise an insulating housing and conductive terminals.

**[0003]** For certain applications and in particular applications in motorized vehicles, it is of importance to ensure that the connectors are properly mated and that they will not unplug when exposed to vibrations. Consequently, electrical connector assemblies may comprise two electrical connectors intended to mate with each other, and a locking system for locking the two mated connectors.

**[0004]** Typically, the locking system comprises a first stop carried by one connector, and a locking pawl with a second stop, carried by the other connector. The second stop of the locking pawl engages the first stop when the connectors are mated in order to lock the mate connectors.

**[0005]** In addition, it is know, for example from EP 1 763 114, to use a connection position assurance (CPA) element, which is able to move from an initial position to a final position only when the connectors are properly mated.

**[0006]** The invention aims at providing an electrical connector assembly with strengthened locking means.

**[0007]** Accordingly, the invention provides an electrical connector assembly according to claim 1.

**[0008]** Other features of the invention are presented in the dependant claims 2 to 5.

**[0009]** Features and advantages of the invention will become apparent upon reading the following description of a preferred embodiment of the invention, which is given purely by way of example. The description refers to the accompanying drawings, in which:

- figure 1 is a three dimensional exploded view of an electrical connector assembly according to a first embodiment of the invention;
- figure 2 is a three dimensional cross section view of the electrical connector assembly of figure 1 in a mated position, with a CPA element in an initial position;
- figure 3 is a three dimensional view of a CPA element of the electrical connector assembly of figure 1;
- figure 4 is a three dimensional cross section view of the electrical connector assembly of figure 1 in the mated position, with the CPA element in a final position;
- figure 5 is a three dimensional exploded view of a locking system according to a second embodiment which is not part of the claimed invention;
- figure 6 is a three dimensional cross section view of the locking system of figure 5, with a CPA element in initial position; and
- figure 7 is a cross section view of the locking system of figure 6, with the CPA element in final position.

**[0010]** Referring to figure 1, an electrical connector assembly 100 comprises a female electrical connector 102 and a male electrical connector 104, which are intended to mate with each other along a mating direction XX'.

**[0011]** In the following description, orientation terms such as "longitudinal" or "lateral" will refer to the mating axis XX'. Furthermore, term relating to heights such as "top" or "bottom" are to be understood relative to a axis perpendicular to the mating XX', which is not necessarily the vertical axis.

**[0012]** The female connector 102 comprises a housing 105 and a terminal position assurance (TPA) element 116.

**[0013]** The housing 105 comprises a housing body 106, which is essentially cylindrical around the mating axis XX' and is provided with a top side 108. The housing 105 further comprises a terminal housing 110 located at least in part into the housing body 106, and defining terminal accommodating chambers 112. The housing 105 further comprises a housing cover 114 covering the top side 108.

**[0014]** The terminal position assurance (TPA) element 116 is intended to be mounted on the terminal housing 110 only if the terminals are properly accommodated in the accommodating chambers 112.

**[0015]** The male connector 104 comprises a housing 120, of which only a housing body 122 of is illustrated. The housing body 122 is essentially cylindrical around the mating axis XX' and provided with a top side 124. The housing 120 typically further comprises a terminal housing (not shown) extending in the housing body 122.

**[0016]** A locking system 130 of the connector assembly 100 will now be described.

**[0017]** The male connector 104 comprises a first locking stop 132 protruding from the top side 124.

**[0018]** The female connector 102 further comprises a primary locking pawl 134 fixed to the top side 108, and comprising a locking front end 136 (i.e. oriented towards the male connector 104) and an operable rear end 138 (i.e. extending away from the male connector 104).

**[0019]** Referring to figure 2, the locking front end 136 comprises a longitudinal slit 140 ending frontward with a second locking stop 142. When the connectors 102, 104 are mated, the first locking stop 132 is located in the slit 140 and is engaged by the second locking stop 142 so as to lock the connectors 102, 104 together and to avoid their unintended unmating and unplugging. The primary locking pawl 134 comprises a pivot point 144 located between the locking front end 136 and the operable rear end 138, so that the operable rear end 138 can be pushed in order to lift up the locking front end 136, leading to the disengagement of the locking stops 132, 142, which allows the unmating of the connectors 102, 104. The locking pawl 134 is elastically movable about the pivot point 144 so as to allow the second locking stop 142 to slide

above the first locking stop 132 and to be biased behind the first locking stop 132 when the first and second connectors are mated.

**[0020]** Preferably, the first locking stop 132 comprises an angled top side 132A, angled so as to draw forward the primary locking pawl 134, in order to ensure that the connectors attain their fully, i.e. properly, mated position. This drawing effect usually requires a locking pawl or level 134 which is itself relatively rigid, as well as relatively rigidly articulated on the pivot point.

**[0021]** The female connector 102 further comprises a connection position assurance (CPA) element 146.

**[0022]** Referring to figure 3, the CPA element 146 comprises a mobile base 148 slidably mounted on the female housing 105, for instance on the housing cover 114, between an initial rear position (figure 2) of the CPA element 146 and a final front position (figure 4) of the CPA element 146.

**[0023]** The CPA element 146 further comprises a longitudinal CPA lever 150 fixed to the mobile base 148, and having a front free head 152.

**[0024]** In the initial position, and when the connectors are unmated, the free head 152 is located in the slit 140 and stopped by the second locking stop 142, so that the CPA element 146 cannot move towards its final position.

**[0025]** Referring to figure 2, when the connectors are mated, the first locking stop 132 in the slit 140 pushes and removes the free head 152 out of the slit 140 up to roughly the level of upper surface of the second locking stop 142, allowing the movement of the CPA element 146 towards its final position.

**[0026]** A movement of the CPA element 146 from the initial position to the final position is therefore possible only when the connectors 102, 104 are properly mated, i.e. when the first locking stop 132 is located in the slit 140.

**[0027]** Referring to figure 4, in the final position of the CPA element 146, the free head 152 engages the locking pawl 134, for instance covers its second locking stop 142.

**[0028]** However, the CPA lever 150 is preferably not made too rigid, for instance not more rigid than the primary locking pawl 134, so that mounting the CPA element 146, which usually requires bending the CPA lever 150, can be easily achieved by an operator. But the consequence may be that the deformation stress of the CPA lever 150 is not too important when the CPA element is in final position (figure 4). Then, the CPA element 146 further comprises a secondary locking member 154 extending above the free head 152 of the CPA lever 150, and comprising two lateral flanges 156, 158 projecting on either side from the CPA lever 150 (see Figure 3).

**[0029]** Referring to figure 4, the secondary locking member 154 is blocked, in the final position of the CPA element 146, by a wall 160 of the cover housing 114.

**[0030]** As shown on Figure 1, advantageously, the wall 160 comprises an aperture 162 located above the locking free end 136 of the primary locking pawl 134, so as to permit the molding of the slit 142 during the manufacturing process of the connector. Since the free head 152 of the CPA lever 150 is also in the slit 140 when it covers the locking stop 142 of the locking front end 136 of the primary locking pawl 134 (i. e. when the CPA element 146 is in the final position), the aperture 162 is also located above the free head 152 of the CPA lever 150 when the CPA element 146 is in the final position. In order to force the CPA lever 150 to block the locking stop, despite its flexibility, the flanges 156, 158 are blocked by the wall 160, respectively on each side of the aperture 162.

**[0031]** In this way, it is not possible to lift up the locking free end 136 of the primary locking pawl 134 by pressing the operable rear end 138. The CPA element 146 thus prevents the first and second locking stops 132, 142 to disengage, thereby ensuring that the connectors 102, 104 remain mated.

**[0032]** The CPA element 146 further comprises lateral pawls 170, 172 intended to engage corresponding aperture 174, 176 of the housing 105 in the final position, so as to prevent the CPA element 146 from going back unintentionally from the final position to the initial position.

**[0033]** As an alternative, the CPA lever 150 does not comprise the secondary locking member 154 and is more rigid than the primary locking pawl 134, so as to be able to block the primary locking pawl 134 by itself, without being blocked by the wall 160.

**[0034]** Referring to figure 5, a locking system 200 according to a second embodiment which is not part of the claimed invention is illustrated. The second embodiment essentially differs from the first embodiment by the arrangement of the primary locking pawl and the CPA element. In the following, the elements similar to the previous embodiment have the same reference signs.

**[0035]** Referring to figure 6, the primary locking pawl 200 comprises a locking lever 202 with, on both of its side, a rear end 204 (visible on figure 7) elastically hinged to the top side 108 of the housing 105, and a locking front end 206 comprising the slit 140 and the second locking stop 142.

**[0036]** In order to lift up the front locking end 206, the primary locking pawl 200 comprises a lifting lever 208 having a front end 210 fixed to the locking front end 206, and a operable rear free end 212. The lifting lever 208 comprises a pivot lug 214 intended to cooperate with the top side 124 of the male housing 122, when the connectors are mated. In this way, the locking end 206 can only be lifted up when the connectors are mated.

**[0037]** The primary locking pawl 200 further comprises two lateral blocking flanges 216, (only one side is visible on the figures) each extending on a respective side, from the locking lever 202.

**[0038]** Referring to figure 5, the CPA element 220 only comprises the mobile base 148 and the CPA lever 150. However, the mobile base 148 further comprises two lateral guiding flanges 222, 224, on each side.

**[0039]** Referring to figure 7, each lateral guiding flange 222, 224 is slidably mounted in a respective lateral guiding groove 226 (only one side is visible on the figures) provided in the housing cover 114, so as to guide the

CPA element 220 form the initial position to the final position.

**[0040]** The lateral blocking flanges 216 are located in front of the lateral guiding grooves 226, 228, in their continuity, so that, when the CPA element 220 moves form the initial position (figure 6) to the final position (figure 7), the lateral guiding flanges 222 extend in part ahead from the lateral guiding grooves 226 and cover the lateral blocking flanges 216 of the primary locking pawl 200, ahead of the pivot point corresponding to the pivot lug 214. In the final position, the lateral guiding flanges 222, 224 of the CPA element 220 are blocked upwardly by the wall 160 of the housing 105. Consequently, the primary locking pawl 200 can no longer pivot if the operable rear free end 212 of the lifting lever 208 is actuated, thereby preventing the first and second locking stops 132, 142 to disengage which would result in an unintentional unmating of the connectors.

**[0041]** In the second embodiment, the CPA element 220 is prevented from going back unintentionally from the final position to the initial position, by the free end 152 of the CPA lever 150 being hook-shaped and stopped by the second locking stop 142.

**[0042]** In the above-described embodiments, the CPA element is manually movable from its initial position to its final position in the same direction as the mating direction, which is particularly suitable from the ergonomic standpoint.

## Claims

**1.** An electrical connector assembly comprising:

first and second connectors (102, 104) intended to mate with each other along a mating direction,
wherein one of the connectors (104) comprises a first locking stop (132) and the other of the connectors (102) comprises a primary locking pawl (134; 200) carrying a second locking stop (142) intended to engage the first locking stop (132) so as to lock the first and second connectors (102, 104) when they are mated,
wherein the first connector (102) comprises a CPA element (146) movable from an initial position to a final position,
wherein the CPA element (146) further comprises:

- a mobile base (148) mounted on a housing (105) of the first connector (102), and
- a CPA lever (150) fixed to the mobile base (148) and intended to allow a movement of the CPA element (146) from the initial position to the final position only when the first and second connectors (102, 104) are mated,

wherein the CPA lever (150) has a free head (152) which, in the final position of the CPA element (146), engages the primary locking pawl (134) so as to prevent the first and second locking stops (132, 134) to disengage, **characterized in that** the CPA element further comprises a secondary locking member (154) extending above the free head (152) of the CPA lever (150), and configured to be blocked, in the final position of the CPA element, by a wall of the first or the second connector, the secondary locking member (154) 25 comprising two lateral flanges (156, 158) projecting on either side from the CPA lever (150).

**2.** The electrical connector assembly of claim 1, wherein the CPA element is manually movable from its initial position to its final position in the same direction as the mating direction.

**3.** An electrical connector assembly according to claim 1 or 2, wherein the secondary locking member (154) is fixed to the free head (152) and is blocked, in the final position of the CPA element (146), so as to prevent the first and second locking stops (132, 142) to disengage.

**4.** An electrical connector assembly according to one of claims 1 to 3,
wherein the wall (160) comprises an aperture (162) located above the free head (152) of the CPA lever (150) when the CPA element (146) is in the final position, and
wherein each flange (156, 158) is blocked, when the CPA element (146) is in final position, on a respective side of the aperture (162).

**5.** An electrical connector assembly according to claim 1 or 2, wherein the CPA element is more rigid than the primary locking pawl, so as to be able to block the primary locking pawl by itself.

## Patentansprüche

**1.** Elektrische Verbinderanordnung, die aufweist:

erste und zweite Verbinder (102, 104), die zum Zusammenfügen entlang einer Zusammenfügen-Richtung vorgesehen sind,
wobei einer der Verbinder (104) einen ersten Verriegelungsanschlag (132) aufweist und der andere der Verbinder (102) eine primäre Sperrklinke (134; 200) aufweist, die einen zweiten Verriegelungsanschlag (142) trägt, der zum Kontaktieren des ersten Verriegelungsanschlags (132) vorgesehen ist, um die ersten und zweiten Verbinder (102, 104) zu verriegeln,

wenn sie zusammengefügt sind,
wobei der erste Verbinder (102) ein CPA-Element (146) aufweist, das von einer Ausgangsposition in eine Endposition bewegbar ist,
wobei das CPA-Element (146) weiter aufweist:

- eine mobile Basis (148), die an einem Gehäuse (105) des ersten Verbinders (102) angebracht ist, und
- einen CPA-Hebel (150), der an der mobilen Basis (148) befestigt ist und vorgesehen ist zum Ermöglichen einer Bewegung des CPA-Elements (146) von der Ausgangsposition in die Endposition nur dann, wenn die ersten und zweiten Verbinder (102, 104) zusammengefügt sind,

wobei der CPA-Hebel (150) einen freien Kopf (152) hat, der in der Endposition des CPA-Elements (146) die primäre Sperrklinke (134) derart kontaktiert, um zu verhindern, dass sich die ersten und zweiten Verriegelungsanschläge (132, 134) trennen, **dadurch gekennzeichnet, dass** das CPA-Element weiter ein sekundäres Verriegelungselement (154) aufweist, dass sich über dem freien Kopf (152) des CPA-Hebels (150) erstreckt und konfiguriert ist, in der Endposition des CPA-Elements durch eine Wand des ersten oder des zweiten Verbinders blockiert zu werden, wobei das sekundäre Verriegelungselement (154) zwei seitliche Flanschen (156, 158) aufweist, die an jeder Seite von dem CPA-Hebel (150) hervorragen.

**2.** Die elektrische Verbinderanordnung gemäß Anspruch 1, wobei das CPA-Element von seiner Ausgangsposition in seine Endposition in derselben Richtung wie die Zusammenfügen-Richtung manuell bewegbar ist.

**3.** Eine elektrische Verbinderanordnung gemäß Anspruch 1 oder 2, wobei das sekundäre Verriegelungselement (154) an dem freien Kopf (152) befestigt ist und in der Endposition des CPA-Elements (146) blockiert ist, um zu verhindern, dass sich die ersten und zweiten Verriegelungsanschläge (132, 142) trennen.

**4.** Eine elektrische Verbinderanordnung gemäß einem der Ansprüche 1 bis 3,
wobei die Wand (160) eine Öffnung (162) aufweist, die sich über dem freien Kopf (152) des CPA-Hebels (150) befindet, wenn das CPA-Element (146) in der Endposition ist, und
wobei jeder Flansch (156, 158) blockiert ist, wenn das CPA-Element (146) in der Endposition ist, auf einer jeweiligen Seite der Öffnung (162).

**5.** Eine elektrische Verbinderanordnung gemäß Anspruch 1 oder 2, wobei das CPA-Element steifer ist als die primäre Sperrklinke, um dadurch die primäre Sperrklinke selbst zu blockieren.

**Revendications**

**1.** Assemblage connecteur électrique comprenant
un premier et un second connecteur (102, 104) destinés à s'accoupler l'un avec l'autre le long d'une direction d'accouplement,
dans lequel l'un des connecteurs (104) comprend un premier arrêt de blocage (132) et l'autre des connecteurs (102) comprend un loquet de blocage primaire (134 ; 200) portant un second arrêt de blocage (142) destiné à engager le premier arrêt de blocage (132) de manière à bloquer le premier et le second connecteur (102, 104) quand ils sont accouplés,
dans lequel le premier connecteur (102) comprend un élément d'assurance de position couplée (APC) (146) déplaçable depuis une position initiale vers une position finale,
dans lequel l'élément APC (146) comprend en outre :

- une base mobile (148) montée sur un boîtier (105) du premier connecteur (102), et
- un levier APC (150) fixé sur la base mobile (148) et destiné à permettre un mouvement de l'élément APC (146) depuis la position initiale jusqu'à la position finale uniquement quand le premier et le second connecteur (102, 104) sont accouplés,

dans lequel le levier APC (150) comporte une tête libre (152) qui, dans la position finale de l'élément APC (146), engage le loquet de blocage primaire (134) de manière à empêcher que le premier et le second arrêt de blocage (132, 134) se désengagent, **caractérisé en ce que** l'élément APC comprend en outre un élément de blocage secondaire (154) s'étendant au-dessus de la tête libre (152) du levier APC (150) et configuré pour être bloqué, dans la position finale de l'élément APC, par une paroi du premier ou du second connecteur, l'élément de blocage secondaire (154) comprenant deux brides latérales (156, 158) qui se projettent de part et d'autre du levier APC (150).

**2.** Assemblage connecteur électrique selon la revendication 1, dans lequel l'élément APC est manuellement déplaçable depuis sa position initiale jusqu'à sa position finale dans la même direction que la direction d'accouplement.

**3.** Assemblage connecteur électrique selon la revendication 1 ou 2, dans lequel l'élément de blocage

secondaire (154) est fixé sur la tête libre (152) et est bloqué, dans la position finale de l'élément APC (156), de manière à empêcher que le premier et le second arrêt de blocage (132, 142) se désengagent.

**4.** Assemblage connecteur électrique selon l'une des revendications 1 à 3,
dans lequel la paroi (160) comprend une ouverture (162) située au-dessus de la tête libre (152) du levier APC (150) quand l'élément APC (146) est dans la position finale, et
dans lequel chaque bride (156, 158) est bloquée, quand l'élément APC (146) est en position finale, sur un côté respectif de l'ouverture (162).

**5.** Assemblage connecteur électrique selon la revendication 1 ou 2, dans lequel l'élément APC est plus rigide que le loquet de blocage primaire, de manière à être capable de bloquer le loquet de blocage primaire par lui-même.

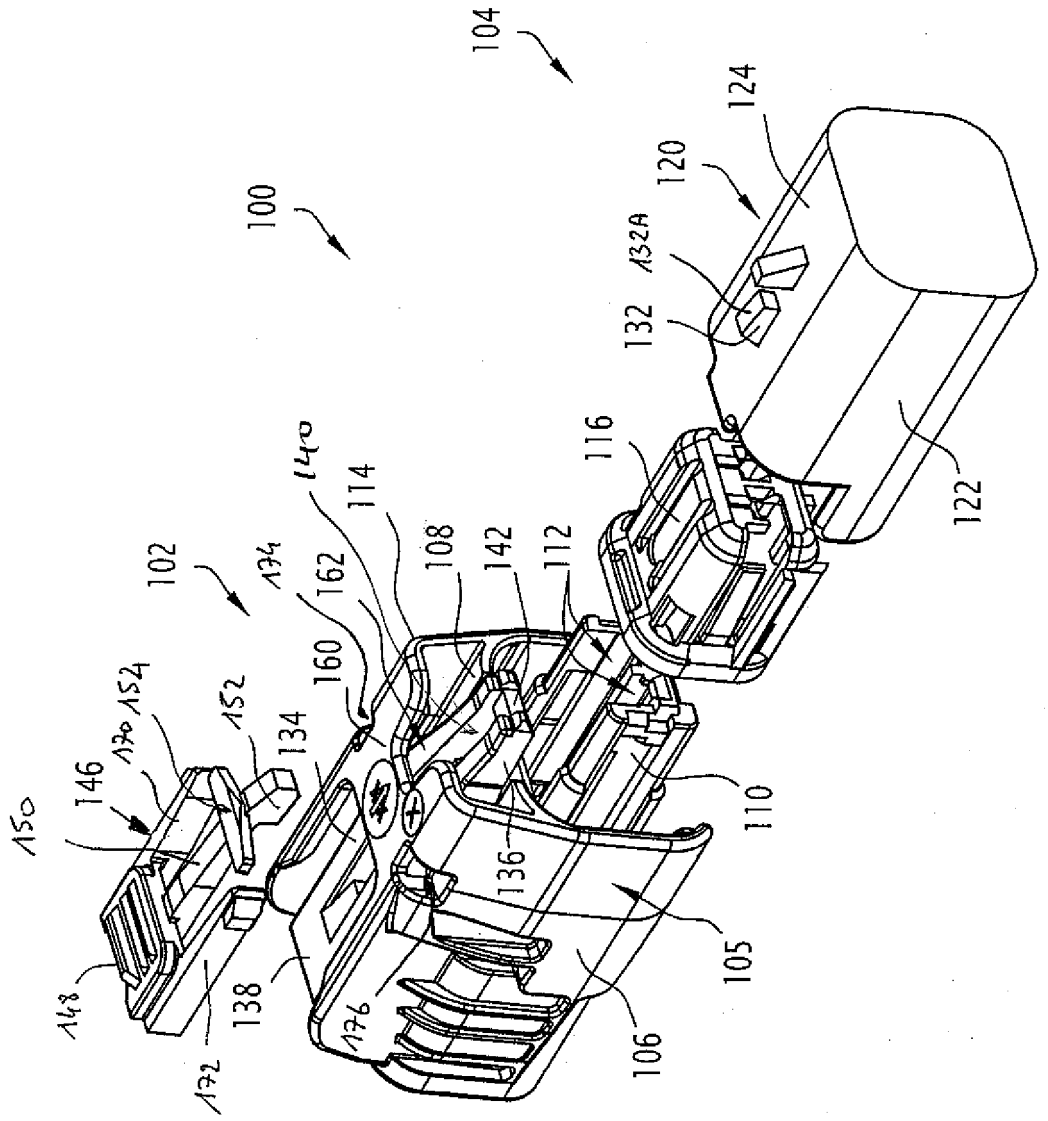

104
100
124
120
132A
132
116
122
102
134
162
160
114
108
142
112
140
150
146
130
154
152
134
110
136
105
148
138
172
176
106

FIG.1

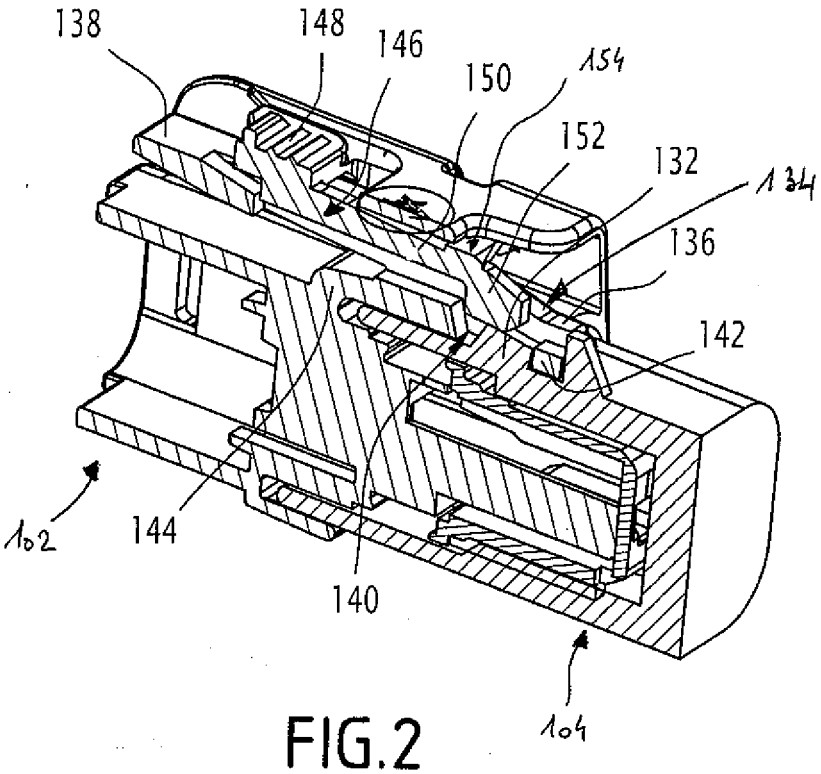

138
148
146
150
154
152
132
134
136
142
102
144
140
104

FIG.2

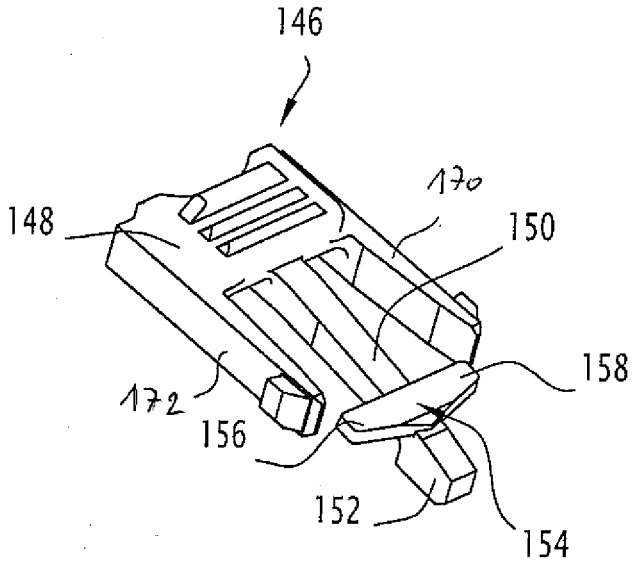

146
170
148
150
158
172
156
152
154

FIG.3

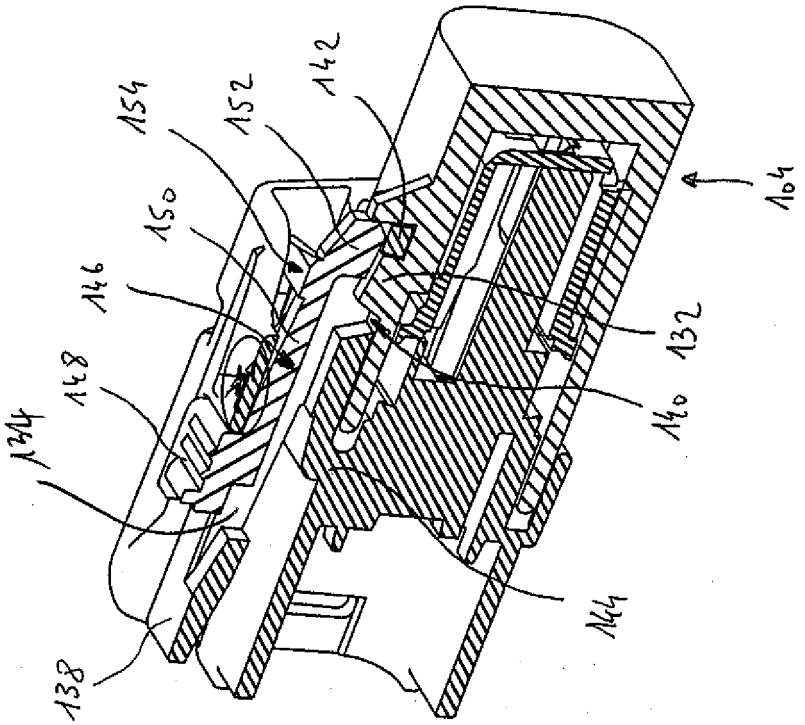



FIG.4

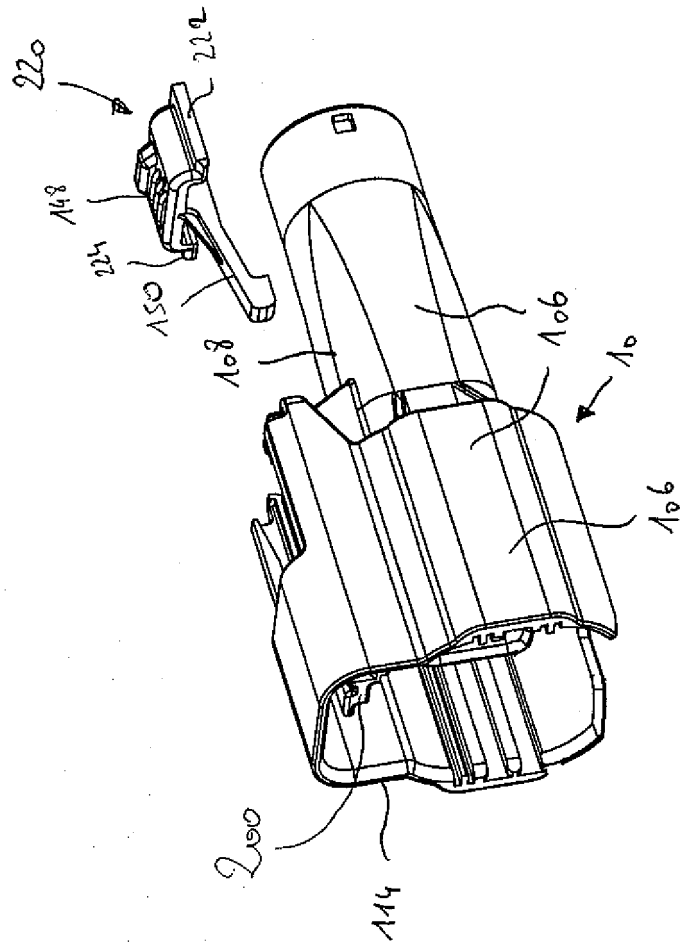



FIG.5

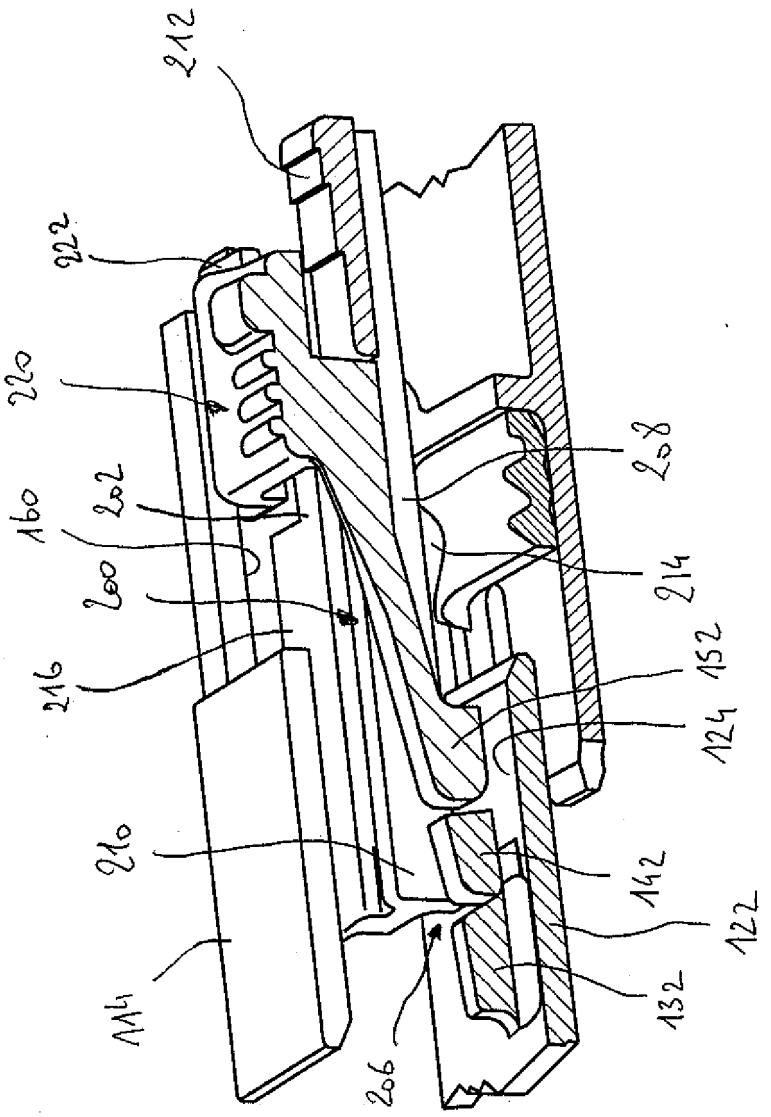

212
222
220
160
202
200
216
208
214
152
124
210
142
122
114
132
206

FIG.6

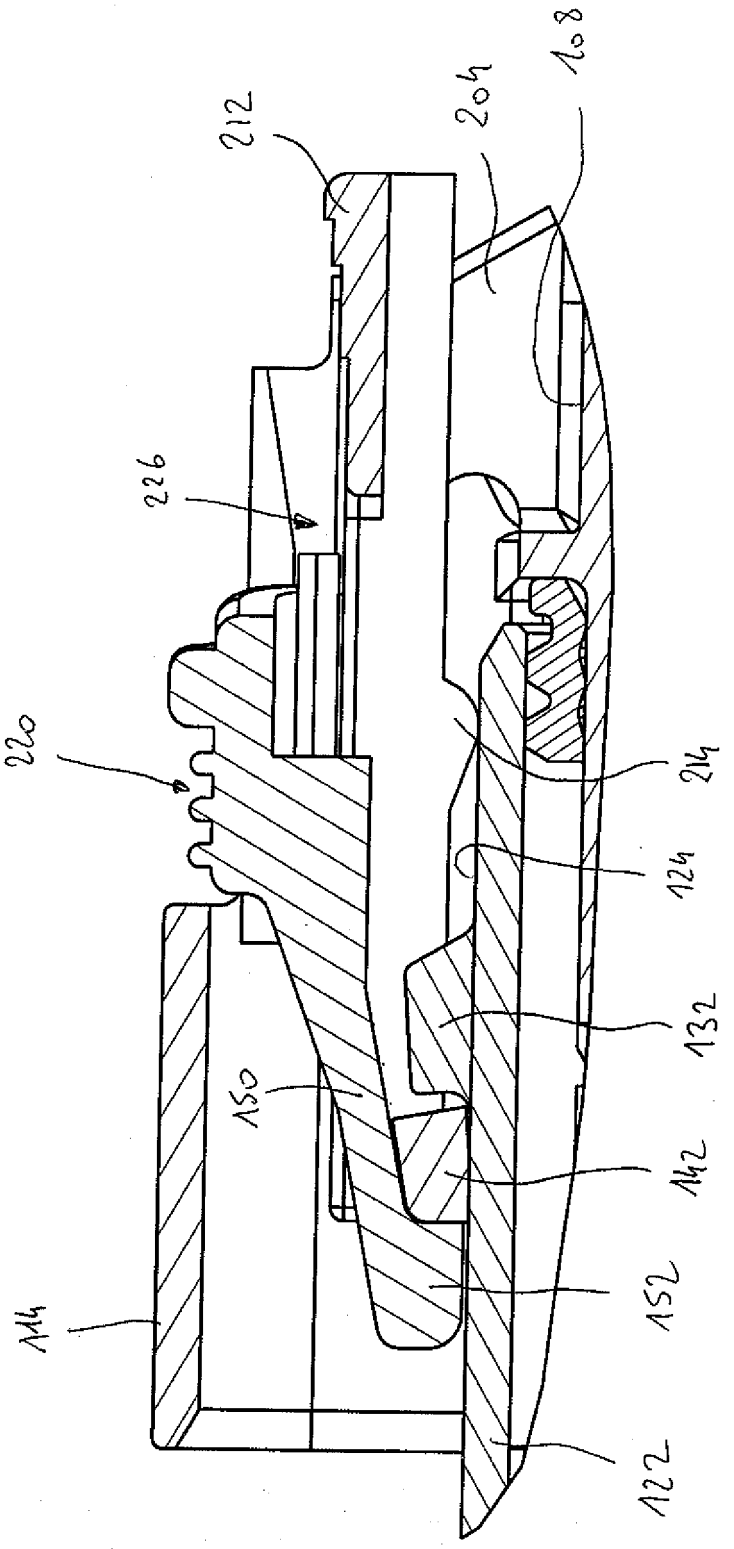



FIG.7

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


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