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(54) **COUPLING ELEMENT TO ENSURE AND FIX A CORRECT POSITIONING BETWEEN A FIRST CONNECTOR ELEMENT AND A SECOND CONNECTOR ELEMENT**

(57) The present invention relates to a coupling element (300), an electrical connector device comprising such coupling element (300) and a connection and fixing method by means of a coupling element (300). The coupling element (300) is configured to ensure and fix the correct relative positioning between a first connector element (10) and a second connector element (20) which can be coupled to one another along a first direction (R1). The coupling element (300) is configured so as to fix the relative positioning between the first connector element (10) and the coupling element (300) along a second direction (R2) that is perpendicular to the first direction (R1).

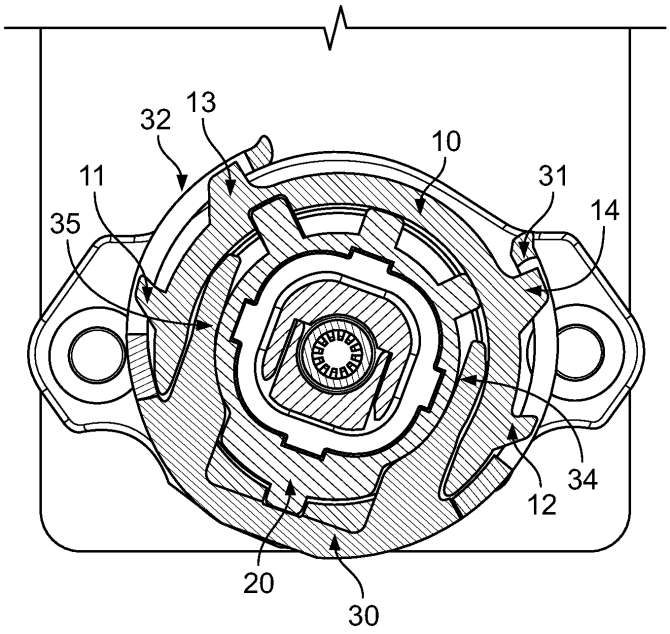

Fig. 20

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Description

TECHNICAL FIELD

[0001] The present invention relates to the field of electrical connectors and in particular relates to a coupling element that ensures and fixes the correct relative positioning between a first and a second connector element. Furthermore, the present invention relates to an electrical connector device comprising such coupling element and a method for ensuring and fixing a coupling between the first connector element and the second connector element.

BACKGROUND ART

[0002] An electrical connector device is known in the state of the art, described in Italian patent application 102017000057099 and represented in Figure 1.

[0003] The electrical connector device 400 comprises a first connector element 401 and a second connector element 402 that are configured so as to be coupled mechanically along a first direction, which corresponds to a vertical direction of Figure 1 of the present application.

[0004] After the first connector element 401 and the second connector element 402 have been coupled to one another, an elastic fastener 430 is positioned so as to fix the relative positioning between the connector element 401 and the second connector element 402. The first connector element 401 and the second connector element 402 are comprised of bodies made of plastic material that carry within them the electric terminals that can be coupled to one another following the mechanical connection between the first connector element 401 and the second connector element 402.

[0005] The elastic fastener 430 is mounted on the first connector element 401 at a grooved portion 405 positioned at a lower part of the connector element 401. The elastic fastener 430 comprises a pair of end portions 432 configured so as to be able to slide along a surface of the first connector element 401 and to divaricate with respect to one another so as to be able to be elastically connected to a locking element 420 positioned on the second connector element 402.

[0006] To prevent a possible uncoupling between the first connector element 401 and the second connector element 402, due for example to a pressure exerted on the central portion 433 of the elastic fastener 430, which would therefore compromise the relative displacement between the two end branches 432 and therefore the possibility of distancing the first connector element 401 from the second connector element 402, a safety locking member 440 is provided, positioned slidably along the first connector element 401.

[0007] The safety locking member 440 is configured so as to be able to slide along the lateral surface of the connector element 401 so as to be interposed between the lateral wall of the first connector element 401 and the central portion 433 of the elastic fastener 430.

[0008] Such configuration is particularly complicated both in economic terms, due to the presence of two additional elements, and from a practical point of view, as an operator must first work on the elastic fastener 430 and then on the safety locking member 440 thus increasing both the time necessary for making the connection and the difficulty of making such connection.

[0009] Therefore, the aim of the present invention is that of providing a single coupling element configured so as to guarantee a correct positioning of the first connector element and of the second connector element and to fix the first connector element to the second connector element without requiring the presence of a second external additional element that allows such aim to be performed, as instead happens in the state of the art.

[0010] A further connector of the state of the art is known from EP 2 876 745 A1.

SUMMARY

[0011] The present invention is based on the idea of providing a coupling element that makes it possible to both ensure and fix the correct relative positioning between a first connector element and a second connector element.

[0012] According to an embodiment of the present invention a coupling is provided which is configured to ensure and fix the correct relative positioning between a first connector element and a second connector element. The first connector element and the second connector element are configured so as to be able to be coupled to one another along the first direction. The coupling element comprises a first arched portion, having a first terminal portion and a second terminal portion, and a second arched portion, having a first terminal portion and a second terminal portion, wherein the first terminal portion of the first arched portion is connected to the first terminal portion of the second arched portion. The coupling element further comprises a first locking means comprising at least a first projecting element that extends from the first arched portion and is configured so as to be inserted within an opening of the first connector element and a groove of the second connector element for fixing the relative positioning of the first connector element with respect to the second connector element along the first direction. The coupling element further comprises a second locking means comprising a closing means positioned at the second terminal portion of the first arched portion and of the second terminal portion of the second arched portion; wherein the closing means is configured so as to fix the second terminal portion of the first arched portion to the second terminal portion of the second arched portion so as to fix the relative positioning between the first connector element and the coupling element along a second direction that is perpendicular to the first direction. This solution is particularly advantageous as it allows the first connector element to be "em-

braced" along the entire outer peripheral surface thereof by means of the connector element. In the present description, the term "arched" means any shape that allows an external body to be "embraced". For example, an arched portion may be a portion that joins two different points by means of two or more broken lines or by means of a continuous curved line. This solution is also advantageous as it makes it possible to have a single element, represented by the coupling element, able to ensure and fix the correct relative positioning between the first and the second connector element. This is guaranteed by the presence of the first locking means and the second locking means. In particular, the first locking means is able, thanks to the presence of at least one projecting element, to pass through an opening of the first connector element and a groove of the second connector element so as to be able to fix the relative positioning along a direction that is perpendicular to the insertion direction of the coupling element. Additionally, in the presence of the second locking means the fixing of the coupling element to the first connector element is guaranteed, so as to be able to guarantee the relative positioning between the first connector element and the second connector element. In fact, by locking the movement of the first connector element it will be possible to prevent the uncoupling of the coupling element from the two connector elements. In practice, such second locking means guarantees obtaining the same function as the safety locking member described in the electrical connector device known in the state of the art.

[0013] According to a further embodiment of the present invention, a coupling element is provided, in which the second locking means further comprises a fixing projection positioned at a terminal portion of the first projecting element of the first locking means and configured so as to lock the relative positioning between the projecting element of said first locking means and said second connector element. This solution is advantageous as it allows the relative positioning between the coupling element and the second connector element to be locked by means of a fixing projection positioned on the first projecting element so that the first projecting element acts both as the first locking means along the first direction and, by means of such fixing projection positioned at the end thereof, as the second locking means.

[0014] According to a further embodiment of the present invention, a coupling element is provided, in which the first locking means comprises a first projecting element and a second projecting element, wherein a terminal portion of each of the first projecting element and of the second projecting element comprises a fixing projection configured so as to lock a relative positioning between the projecting elements of the first locking means and the second connector element. This solution enables uniform locking to be obtained between the first connector element and the second connector element thanks to the fact that the locking along the first direction is provided by two different fixing projections positioned on two separate projecting elements.

[0015] According to a further embodiment of the present invention a coupling element is provided, wherein the first projecting element of the first locking means is configured so as to be elastically deformable along a perpendicular direction to the extension direction of the first projecting element. This solution is particularly advantageous as it allows the projecting element to be elastically deformed and therefore a fixing projection able to act as the second locking means to be able to be installed on the terminal portion of the projecting element. In fact, thanks to such elasticity, the projecting element, with the end on which the fixing projection is positioned, can be effectively inserted within a groove having a lower height with respect to the height of the projecting element in proximity to the fixing projection.

[0016] According to a further embodiment of the present invention a coupling element is provided, wherein the closing means of the second locking means comprises a hook closure wherein a male hook portion is positioned preferably at said second terminal portion of said first arched portion and a female hook portion is positioned preferably at said second terminal portion of said second arched portion. This solution is particularly advantageous as it allows a common hook closure to be used for connecting and fixing the second terminal portion of the first arched portion with the second terminal portion of the second arched portion. Furthermore, given the reversibility of the hook type opening, it will be possible to reuse such coupling element various times.

[0017] According to a further embodiment of the present invention a coupling element is provided, further comprising a third locking means configured so as to fix the positioning of said coupling element with respect to said first connector element along a circumferential direction of said first connector element, said third locking means comprising a locking protrusion that extends along an internal circumferential surface of said second arched portion. Thanks to the presence of the third locking means, it will be possible to prevent the opening of the coupling element due for example to high vibrations to which a coupling element can be subject.

[0018] According to a further embodiment of the present invention a coupling element is provided, wherein the first arched portion is provided integrally with the second arched portion, wherein a connection portion is configured so as to connect the first terminal portion of the first arched portion to the first terminal portion of the second arched portion. This solution is particularly advantageous as it allows a single and strong coupling to be provided thanks to the fact that the first arched portion is provided integrally with the second arched portion.

[0019] According to a further embodiment of the present invention a coupling element is provided, wherein each of the first arched portion and the second arched portion comprises a semicircular body. This solution is particularly advantageous as it allows two semicircular bodies to be obtained that are easily adapted to the outer

lateral surface of the first connector element in the case in which it has a cylindrical outer lateral surface. In fact, thanks to the curved surface, it will be possible to obtain a better support of the first arched portion and of the second arched portion on the outer lateral surface of the first connector element.

[0020] According to a further embodiment of the present invention, an electrical connector device is provided comprising a coupling element according to any one of the preceding embodiments and a first connector element and a second connector element. The first connector element and the second connector element bearing respective electrical terminals with respective bodies that can be coupled to one another being configured so as to be able to be coupled to one another along the first direction. The first connector element comprising a first lateral opening configured so as to be able to allow the passage of the first projecting element of the first locking means. The second connector element comprising a first lateral groove configured so as to house the first projecting element of the first locking means, the first lateral groove comprising a wall perpendicular to the first direction and positioned above the projecting element of said first locking means so as to fix the relative positioning of the first connector element with respect to the second connector element along the first direction; wherein the closing means of the second locking means is configured so as to rest the coupling element against an outer surface of the first connector element so as to fix the coupling element to the first connector element. This solution is particularly advantageous as it allows the connection to be made between the first connector element and the second connector element thanks to the presence of a single coupling element able to perform a double function: that of ensuring the relative positioning between the first connector element and the second connector element and that of fixing such connection so as to be able to prevent a possible uncoupling between the two elements. In particular, the first locking means is able to lock the relative movement along the first direction between the first and the second connector element, thanks to the insertion of projections along a perpendicular direction with respect to the first direction, so that an abutment surface positioned above the projecting element of the first locking means is able to prevent the coupling element from being translated along the first direction and therefore prevent a relative movement between the second connector element and the coupling element along the first direction. Furthermore, the locking of the relative movement along the second direction is guaranteed thanks to the fact that the closing means of the second locking means is configured so as to rest the outer surface of the first connector element, so as to be able to be engaged therewith.

[0021] According to a further embodiment of the present invention an electrical connector device is provided, wherein the first connector element comprises a support groove positioned along an outer lateral wall of the first connector element and extending along a perpendicular direction to the first direction, the support groove is configured so as to be coupled with a locking protrusion of the second arched portion so as to lock a circumferential positioning between the second arched portion of the coupling element and the first connector element. This solution is particularly advantageous as it allows uncoupling to be prevented which could happen because of the vibrations to which the electrical connector device is subject. In fact, it could happen that, because of vibrations, the closure hook of the second locking means opens. However, the presence of such support groove and of such locking protrusion allows the vibrations to which the second locking means is subjected to be dampened, thus reducing the probability of the second locking means being able to open.

[0022] According to a further embodiment of the present invention an electrical connector device is provided in which the first connector element further comprises a second lateral groove configured so as to house the first locking means, wherein the second groove comprises a wall perpendicular to the first direction and positioned above the first locking means so as to fix the relative positioning of the first connector element with respect to the second connector element along the first direction.

[0023] According to a further embodiment of the present invention an electrical connector device is provided, in which the first and the second lateral groove have an open terminal portion configured so as to allow fixing projections of the second locking means to be fixed to the first and to the second lateral groove. This solution is particularly advantageous as it allows the grooves of the second conductor element to be used both for the locking of the coupling element along the first direction and for the locking of the coupling element along the second direction.

[0024] According to a further embodiment of the present invention an electrical connector device is provided, wherein the first connector element and the second connector element have a substantially cylindrical shape. In the present description, the term cylindrical identifies any curve having a cylindrical surface (e.g. an elliptical cylinder or a parabolic cylinder).

[0025] According to a further embodiment of the present invention a method is provided for ensuring and fixing a coupling between a first connector element and a second connector element; said method comprising the following steps:

a. coupling the first connector element to the second connector element along a first direction;

b. inserting a coupling element in at least one opening of the first connector element and in a groove of the second connector element so as to fix the positioning of the first connector element with respect to the second connector element along the first direc-

tion;

c. fixing the coupling element to the first connector element so as to fix the relative positioning between the coupling element and the first connector element along a second direction that is perpendicular to the first direction.

[0026] According to a further embodiment, the method defined in the previous paragraph is realised with a coupling element according to any one of the embodiments defined in the previous paragraphs.

[0027] According to an embodiment of the present invention a coupling is provided which is configured to ensure and fix the correct relative positioning between a first connector element and a second connector element, the first connector element and the second connector element are configured so as to be able to be coupled to one another along a first direction. The coupling element comprises: a main body, a first locking means that comprises at least one projecting element that extends from the main body and is configured so as to be inserted within an opening of the first connector element and a groove of the second connector element to fix the relative positioning of the first connector element with respect to the second connector element along the first direction, a second locking means comprising a pair of projecting elements that are positioned on opposite sides in the width direction of the main body and that are configured to fix the relative positioning between the coupling element and the first connector element along a second direction that is perpendicular to the first direction. This solution is particularly advantageous as it makes it possible to have a single element, represented by the coupling element, able to ensure and fix the correct relative positioning between the first and the second connector element. This is guaranteed by the presence of the first locking means and the second locking means. In particular, the first locking means is able, thanks to the presence of at least one projecting element, to pass through an opening of the first connector element and a groove of the second connector element so as to be able to fix the relative positioning along a direction that is perpendicular to the insertion direction of the coupling element. Additionally, in the presence of the second locking means the fixing of the coupling element to the first connector element is guaranteed, so as to be able to guarantee the relative positioning between the first connector element and the second connector element. In fact, by locking the movement of the first connector element it will be possible to prevent the uncoupling of the coupling element from the two connector elements. In practice, such second locking means guarantees obtaining the same function as the safety locking member described in the electrical connector device known in the state of the art.

[0028] According to a further embodiment of the present invention a coupling element is provided, wherein the pair of projecting elements of the second locking means is represented by a pair of elastically deformable elements and configured so as to be able to press on the outer surface of the first connector element. This solution is particularly advantageous as it allows the coupling element to be elastically coupled to the first connector element therefore having a stable and at the same time reversible coupling as, once the coupling element has ensured and fixed the correct positioning between the two elements, the same coupling element may be dismounted and reused at another time.

[0029] According to a further embodiment of the present invention a coupling element is provided in which each of the projecting elements of the second locking elements has an opening positioned at a distal portion of the projecting elements, wherein the opening extends along a longitudinal direction of the projecting elements. Thanks to this configuration it is effectively possible to use the projecting elements of the second locking means to mechanically couple the coupling element to the outer surface of the first connector element. In fact, thanks to the presence of the opening positioned at a distal portion, such distal portion can be coupled for example to the projections positioned on the outer lateral surface of the first connector element so as to fix the opening of the projecting elements to such lateral projections. Furthermore, the longitudinal extension of the opening of the projecting elements of the second locking means allows such opening to be used also as a positioning groove able to guide the coupling element in a precise position with respect to the lateral surface of the first connector element.

[0030] According to a further embodiment of the present invention a coupling element is provided wherein the first locking means comprises at least three projecting elements positioned along a width direction of the main body and that extend from the main body. Thanks to this solution, it is possible to have at least three different positions at which the coupling element fixes the relative positioning of the first connector element with respect to the second connector element along the first direction. This means that the fixing is more stable fixing as it is more uniform and distributed across various points.

[0031] According to a further embodiment of the present invention a coupling element is provided wherein the first projecting element is positioned at a central position of the main body and a second and third projecting element are positioned symmetrically opposite with respect to the first projecting element along a width direction of the coupling element. This solution is particularly advantageous as it allows stable fixing to be obtained between the first connector element and the second connector element which is symmetrical.

[0032] According to a further embodiment of the present invention a coupling element is provided wherein the second and the third projecting element of the first locking means have a distal surface turned towards the first projecting element that is at least partially curved. Thanks to this configuration it is possible to use the sec-

ond and the third projecting element for entering into lateral grooves, for example of a circular or oval element, without having the need to have to in some way perforate the oval or circular body as it will be sufficient to simply provide a groove placed on the lateral surface of the oval or circular body and such curved portion can "adapt" to the curved surface, thus "embracing" the curved portion of the groove.

[0033] According to a further embodiment of the present invention, an electrical connector device is provided comprising a coupling element according to any one of the preceding embodiment and a first connector element and a second connector element. The first connector element and the second connector element bear respective electrical terminals with respective bodies that can be coupled to one another and are configured so as to be able to be coupled to one another along the first direction. The first connector element comprises a first lateral opening configured so as to be able to allow the passage of the first projecting element of the first locking means. The second connector element comprises a first lateral groove configured so as to house the first projecting element of the first locking means in which the first lateral groove comprises a perpendicular wall to the first direction and positioned above the projecting element of the first locking means, so as to fix the relative positioning of the first connector element with respect to the second connector element along the first direction. Furthermore, according to the present embodiment, the pair of projecting elements of the second locking means is configured so as to press the coupling element against an outer surface of the first connector element so as to fix the coupling element to the first connector element. This solution is particularly advantageous as it allows the connection to be made between the first connector element and the second connector element thanks to the presence of a single coupling element able to perform a double function: that of ensuring the relative positioning between the first connector element and the second connector element and that of fixing such connection so as to be able to prevent a possible uncoupling between the two elements. In particular, the first locking means is able to lock the relative movement along the first direction between the first and the second connector element, thanks to the insertion of projections along a perpendicular direction with respect to the first direction, so that an abutment surface positioned above the projecting element of the first locking means is able to prevent the coupling element from being translated along the first direction and therefore prevent a relative movement between the second connector element and the coupling element. Furthermore, the locking of the relative movement along the second direction is guaranteed thanks to the fact that the projecting elements of the second locking means are configured so as to press the outer surface of the first connector element, so as to be able to be engaged therewith.

[0034] According to a further embodiment of the present invention an electrical connector device is provided in which the first connector element comprises a pair of first lateral projections positioned on opposite lateral portions of the first connector element and a pair of second lateral projections positioned on opposite lateral portions of the first connector element, wherein the pairs of first projections and of second projections are configured so as to be engaged with the pair of projecting elements of the second locking means. The pair of first projections is configured so as to guarantee a pre-mounting of the coupling element on the first connector element and the pair of second projections is configured so as to allow the fixing of the coupling element to the first connector element. Thanks to this particularly advantageous embodiment, it is possible to pre-mount the coupling element onto the first connector element so as to be able to simultaneously provide the first connector element with the coupling element integrated thereto. This means that a user will not be obliged to insert any external element to the electrical device. This therefore greatly simplifies the assembly method.

[0035] According to a further embodiment of the present invention, an electrical connector device is provided wherein the extension of the pair of first lateral projections along the first direction is shorter than the extension of the pair of second lateral projections along the first direction and wherein the longitudinal opening of each of the second locking means has a height along a perpendicular direction to the longitudinal direction of the opening that varies along the longitudinal direction of the opening; wherein the height at a terminal portion of the projecting elements is greater with respect to the height at a base portion of the projecting elements so as to be able to engage the longitudinal opening of each of the second locking means first with the pair of first lateral projections and then with the pair of second lateral projections. Preferably, the height along the perpendicular direction to the longitudinal direction of the opening has two different values along the longitudinal direction of the opening; a value that is constant along the longitudinal direction at a terminal portion of the projections and that is greater than a value that is constant along the longitudinal direction at a base portion of the projecting elements. This solution is advantageous as it allows the passing from a pre-coupling position to a coupling position by making the opening slide along the pair of first projections then inserting the opening into the pair of second projections. Furthermore, thanks to the fact that the height at the terminal portion is greater, it will be possible to effectively and precisely guide the coupling element with respect to the outer lateral surface of the first connector element as, preferably, the height at the base portion along the longitudinal direction of the projecting elements of the second locking means is preferably the same as the height of the pair of first projections so that the relative position between the coupling element and the first connector element is a predetermined position.

[0036] According to a further embodiment of the

present invention an electrical connector device is provided in which the first connector element further comprises a second lateral groove and a third lateral groove each configured so as to house the first locking means, wherein each of the second and third groove comprises a wall perpendicular to the first direction and positioned above the first locking means so as to fix the relative positioning of the first connector element with respect to the second connector element along the first direction. This solution is particularly advantageous as it allows the number of elements that provide the locking along the first direction between the first connector element and the second connector element to be increased. This will therefore provide more uniform and stable fixing.

[0037] According to a further embodiment of the present invention an electrical connector device is provided wherein the first connector element and the second connector element have a substantially circular outer side surface. This solution is particularly advantageous as it allows a particularly compact and simple body of the first connector element and of the second connector element and a symmetrical coupling element with respect to the central axis to be obtained.

[0038] According to a further embodiment of the present invention a method is provided for ensuring and fixing a coupling between a first connector element and a second connector element, wherein the method comprises the following steps:

a) coupling the first connector element to the second connector element along a first direction;

b) inserting a coupling element in an opening of the first connector element and of a groove of the second connector element so as to fix the positioning of the first connector element with respect to the second connector element along the first direction;

c) fixing the coupling element to the first connector element so as to fix the relative positioning between the coupling element and the first connector element along a second direction that is perpendicular to the first direction.

[0039] According to a further embodiment of the present invention, a method is provided in which the coupling element is pre-mounted onto the first connector element before the first connector element is coupled to the second connector element. This solution makes it possible to provide a first connector element on which a coupling element is pre-mounted, therefore making sure that an operator does not have to insert any additional element.

[0040] According to an embodiment of the present invention a method is provided wherein in the case in which the coupling element is inserted into the groove of the second connector element for more than a predetermined length, the coupling element is configured to prevent the coupling between the first connector element and the second connector element. This solution is particularly advantageous as it allows the coupling element to be used also to guarantee the correct positioning. In this particular case, if the coupling element is inserted too deeply within the first connector element, the one or more projections of the first locking means will prevent the first connector element and the second connector element from coupling with one another.

BRIEF DESCRIPTION OF THE DRAWINGS

[0041] The present invention is described with reference to the accompanying drawings in which the same reference numbers and/or marks indicate the same parts and/or similar parts and/or corresponding parts of the system.

Figure 1 schematically shows an electrical connector device known in the state of the art.

Figure 2 schematically shows a three-dimensional view of an electrical connector device according to a particular embodiment of the present invention in which the coupling element is in a pre-mounting state on the first connector element.

Figure 3 shows a three-dimensional view of the electrical connector device according to a particular embodiment of the present invention in a state in which the coupling element is in a fixing state.

Figure 4 shows a three-dimensional view of the coupling element according to a particular embodiment of the present invention.

Figure 5 shows a front three-dimensional view of the coupling element according to a particular embodiment of the present invention.

Figure 6 shows a three-dimensional view from above of the coupling element according to a particular embodiment of the present invention.

Figure 7 shows a particular opening of a projection of the second locking means according to a particular embodiment of the present invention.

Figure 8 shows a detailed view from above of the coupling element according to a particular embodiment of the present invention.

Figure 9 shows a lateral detailed view of the coupling element according to a particular embodiment of the present invention.

Figure 10 shows a front view of the coupling element according to a particular embodiment of the present

invention.

Figure 11 shows a first three-dimensional view of the second connector element.

Figure 12 shows a second three-dimensional view of the second connector element.

Figure 13 shows a three-dimensional view of the overturned second connector element.

Figure 14 shows a front view of the second connector element.

Figure 15 shows a view from above of the second connector element.

Figure 16 shows a three-dimensional view of the first connector element.

Figure 17 shows a view from above of the first connector element.

Figure 18 shows a lateral view of the first connector element.

Figures 19a to 19c show respectively a state in which the coupling element is completely uncoupled from the first and from the second connector element (Figure 19a); a state in which the coupling element is pre-mounted on the first connector element (Figure 19b) and a state in which the coupling element is fixed to the first connector element (Figure 19c).

Figure 20 shows a sectional view from above of a state in which the coupling element is fixed with the first connector element.

Figure 21a and 21b show a view from below of the first connector element and of the coupling element in a state in which the coupling element is pre-mounted in a correct position (Figure 21a) and in a state in which the coupling element is positioned in an incorrect position (Figure 21b).

Figure 22 shows a three-dimensional view of an electrical connector device according to a second embodiment (main embodiment) of the present invention in a pre-fixing state.

Figure 23 shows a three-dimensional view of the electrical connector device according to the second embodiment of the present invention in a fixing state.

Figure 24 shows a three-dimensional view of the coupling element in an open state according to the second embodiment of the present invention.

Figure 25 shows a three-dimensional view of the coupling element in a closed state according to the second embodiment of the present invention.

Figure 26 shows a view from above of the coupling element according to the second embodiment of the present invention.

Figure 27 shows a lateral view of the coupling element according to the second embodiment of the present invention.

Figure 28 shows a detail of the coupling element seen from above in an open state.

Figure 29 shows a detail of the coupling element seen from above in a closed state.

Figure 30 shows a detail of the coupling of the coupling element with the second connector element wherein the presence of the first connector element has been omitted.

Figure 31 shows a three-dimensional view of a first step of the coupling of the coupling element with the first conductor element and the second conductor element.

Figure 32 shows a second step of the coupling between the coupling element and the first and second connector element.

Figure 33 shows a final state in which the coupling element is fixed to the first conductor element and to the second conductor element.

DETAILED DESCRIPTION

[0042] The present invention is described in the following by making reference to particular embodiments as shown in the accompanying figures. However, the present invention is not limited to the particular embodiments described in the following detailed description and depicted in the figures, rather the embodiments described simply exemplify the various aspects of the present invention, the scope of which is defined by the claims. Further modifications in relation to the present invention will be apparent to those skilled in art.

[0043] Figures 2 and 3 show two three-dimensional views of a coupling between a first connector element 10 and a second connector element 20, with a coupling element 30 configured so as to fix the mechanical coupling between the first conductor element 10 and the second connector element 20 according to a first embodiment of the present invention.

[0044] As can be seen in the figure, the first connector element 10 and the second connector element 20 are elements intended to be electrically connected to one

another through mechanical type operations actuated by a user.

[0045] According to the prior art, the connector elements 10 and 20 are formed by respective bodies of preferably elastic material that supports and houses respective electrical terminals that can be coupled to one another following the mechanical connection, and therefore the coupling, between the two elements 10 and 20.

[0046] With particular reference to Figure 2, the coupling between the first connector element 10 and the second connector element 20 is performed by means of a pressure exerted on the first connector element 10 above the second connector element 20 along the direction R1 shown in the figure (hereinafter referred to as "first direction R1").

[0047] The construction details related to the electrical terminals of the two elements 10 and 20 are not presented as such details may be performed in any way known in the state of the art. Furthermore, the removal of these details from the drawings makes the latter clearer and easier to understand.

[0048] The first connector element 10 can be a plug connector whereas the second connector element 20 can be an external header connector. However, it is clear that the present invention can also operate in the event in which the first connector element is made of an external header connector and the second connector element is made of a plug connector.

[0049] The first connector element 10 like the second connector element 20 is made, as mentioned, of plastic material, for example PA46-GF30 plastic.

[0050] Such features of the first connector element 10 and of the second connector element 20 are valid both for the first and for the second embodiment.

[0051] As shown in Figure 14, the second connector element has a height D12 that can preferably be equal to 12.5 mm. Furthermore, as shown in the view from above of Figure 15, the width D13 of the second connector element 20 is preferably equal to 31 mm whereas the depth D14 thereof is preferably equal to 20.3 mm.

[0052] However, it is clear that such measurements can vary according to requirements in the event in which a second connector element 20 is to be created having different features.

[0053] In the same way, as shown in Figures 17 and 18 the depth D15 of the first connector element is preferably equal to 19 mm whereas the length D16 and the height D17 are preferably 49 mm and 24 mm respectively.

[0054] Returning to the coupling between the first connector element 10 and the second connector element 20, as shown in Figures 2 and 3, the mechanical connection is made by means of a coupling element 30 that is inserted through the first connector element 10 and the second connector element 20 along a direction R2 (hereinafter called "second direction R2") which is perpendicular to the first direction R1.

[0055] The coupling element 30 is preferably made of plastic material, e.g. PA46-GF30 plastic.

[0056] Below, with reference to Figures 4 to 18, the features of the first connector element 10 and of the second connector element 20 and of the coupling element 30 will be presented in detail. Following such detailed description, with reference to Figures 19 and 20, the coupling mode will be described between the three elements together.

[0057] As described in Figure 4, the coupling element 30 comprises a main body 33 from which a series of projecting elements extend.

[0058] In the first place, a pair of projecting elements 31 and 32 extends from lateral portions of the main body 33 and is configured so that the projecting elements 31 and 32 are elastically deformable along a parallel plane to the plane on which the coupling element 30 lies so that the two projections 31 and 32 can be moved towards and away from one another by exercising pressure thereon. On such projecting elements 31 and 32 two openings 37 and 38 are made, which extend along a longitudinal direction of the projecting elements 31 and 32. As will become clearer from the following description, the pair of projecting elements 31 and 32 form, together with the openings 37 and 38, a "second locking means".

[0059] Furthermore, as clearly shown in Figure 5, the coupling element 30 comprises three projecting elements 34, 35 and 36 which substantially extend perpendicularly from the main body 33. As can be seen in the figure, the projecting elements 31 and 32 were omitted from such figure so as to be able to show the arrangement of the projections 34 and 35 more clearly.

[0060] The three projecting elements 34, 35, 36 form a first locking means.

[0061] For simplicity purposes, in the following description the projecting element 36 will simply be called the first projection of the first locking means whereas the projecting elements 34 and 35 will be respectively referred to as second and third projection of the first locking means. Preferably, the three projections 34, 35, 36 of the first locking means are fixed stably to the main body therefore preferably having high rigidity in spite of the elasticity of the pair of projecting elements 31 and 32 and of the second locking means.

[0062] The first projection 36 is positioned centrally in a lower portion of the main body 33 whereas the second and third projection 34 and 35 are always positioned in a lower portion of the main body but symmetrically opposite with respect to the first projection 36. The longitudinal extension of the second and third projection is, as will be described below, much higher with respect to the longitudinal extension of the first projection 36 so that the second and the third projection 34 and 35 can reach further portions of external elements. Furthermore, as shown in the figure, the second and third projection 34 and 35, have a curved inner surface. In the present description, inner surface of the second and third projection 34 and 35 means a surface facing towards the first projection 36.

[0063] This curved conformation allows, as will become clearer from the following description, an external body to be able to be "embraced" so as to position such external body between the second projection 34 and the third projection 35.

[0064] Figure 6 shows a detail of a view from above of the coupling element 30 in which all the projections 31, 32, 34, 35, 36 of the first and second locking means can be seen.

[0065] As can be appreciated from the view from above of Figure 6, the coupling element 30 is perfectly symmetrical with respect to a central axis, at which the first projection 36 of the first mounting means is placed.

[0066] Figure 7 shows a detail of the openings 37 and 38 of the pair of projecting elements 31 and 32.

[0067] Even if, for simplicity purposes, the drawing only shows the opening 37, it is clear that also the opening 38, as shown in Figure 4, preferably has the same conformation as the opening 37. As can be seen in the detail, the height of the opening 37 along a longitudinal length of the projecting element 32 varies: a first portion 37a has a height along a perpendicular direction to the longitudinal direction of the projecting element 32 that is shorter with respect to the height of the second portion 37b positioned closer to the distal portion of the projecting element 32.

[0068] Between the first portion 37a and the second portion 37b there is preferably a step 37c perpendicular to the longitudinal direction of the projecting element 32, which allows the passage from the first portion 37a to the second portion 37b.

[0069] With reference to Figures 8 to 10 an idea of reference values that the coupling element 30 can assume will be provided.

[0070] As can be seen, and as also shown in Figure 8, the shape of the coupling element 30 seen in plan view is of a substantially circular element wherein a portion of the circle is removed to allow the coupling element 30 to be coupled with an external body.

[0071] Therefore, it is possible to talk about the diameter of the coupling element D1 that will preferably be equal to 20.6 mm. The distance D2 between an outer portion of the second projection 34 and an outer portion of the third projection 35 of the first locking means is preferably equal to 14.7 mm. In the same way the first projection 36 has a substantially quadratic shape and has a length D3 preferably equal to 2 mm and a width D4 preferably equal to 2.1 mm.

[0072] Instead, with regard to the second locking means, the pair of projecting elements 31 and 32 has a height D5 preferably equal to 4.8 mm. The distal portion 37b (second portion) of the opening 37 has a height D6 preferably equal to 2.1 mm whereas the first portion 37a of the opening 37 preferably has a height D9 equal to 1.7 mm.

[0073] Therefore, the step 37c between the first portion 37a and the second portion 37b, which is preferably equal in a lower portion and an upper portion of the opening 37, will preferably be equal to 0.2 mm. The length D7 of the second and of the third projection 34 and 35 of the first locking means is preferably equal to 13 mm whereas the total extension D8 of the pair of projecting elements 31 and 32 of the second locking means is preferably equal to 19 mm. The total height D10 of the coupling element 30 is preferably equal to 5.8 mm. Furthermore, as shown in Figure 10, the first projection 34 of the first locking means which, as previously mentioned, is substantially quadratic shaped, has a height D11 preferably of 2.2 mm.

[0074] Now with reference to Figures 11 to 13, the features of the second connector element 20 will be shown in detail.

[0075] In the present description, only the necessary features of the second connector element for the realisation of the present invention will be underlined.

[0076] However, it is clear that the second connector element 20 can have numerous variations with respect to what has been described up to now, as the present invention is not limited to this particular embodiment of the second connector element 20 rather, as will become clearer from the following description, it relates to a coupling element that guarantees the coupling and fixing between the first connector element and the second connector element.

[0077] As can be seen in Figures 11 and 12, which show two three-dimensional views of the second connector element 20, in this embodiment the second connector element 20 comprises a base 29 on which a substantially cylindrical body is placed having a plurality of protrusions on the outer surface thereof. It is clear that, for example, the base 29 can have any other shape able to allow the coupling of the second connector element 20 to an external element.

[0078] As will be explained below, the presence of the protrusions guarantees for the coupling element 30 to fix a positioning along the first direction R1 between the first connector element 10 and the second connector element 20.

[0079] On the cylindrical lateral surface 23 there are two symmetrically opposite protrusions 24 and 25 positioned at about half the height of the cylindrical lateral surface 23. Protrusions 21 and 22 are arranged below such protrusions. The second and third projection 34 and 35 of the first locking means are configured so as to be interposed between the protrusions 21, 24 and 22, 25, respectively. In this way the curved portion of the second and third projection 34 and 35 will contact the outer surface 23 of the second connector element positioned between the protrusions 24 and 25 and the protrusions 21 and 22.

[0080] Furthermore, an upper surface of the second and third projection 34 and 35 (which preferably have a flat shape) will abut with a lower surface of the protrusions 24 and 25, so that the coupling element 30 cannot move along the first direction R1 with respect to the second connector element 20. Furthermore, as shown in Figures

11 and 12, on the lateral surface 23 of the second connector element 20 there is a further protrusion 266 placed substantially at the same height as the protrusions 24 and 25 and configured so as to be able to house the first projection 36 of the first locking means.

[0081] As clarified from the present description, the protrusions 21 and 24 form a first groove 27 comprised between the upper wall of the protrusion 21, the lateral wall 23 and the lower wall of the protrusion 24. Furthermore, the protrusions 22 and 25 form a second groove 28 formed by the upper wall of the protrusion 22 of the lateral wall 23 and the lower wall of the protrusion 25. Additionally, the protrusion 26 forms a groove 266 below. Such groove will be formed by the lower wall of the protrusion 26 and the upper wall of the base 29.

[0082] As shown from the overturned view of the second conductor element 20 shown in Figure 13 on the lower surface of the base 29 of the second connector element 20 a sealing element 201 may be placed to allow the seal between the second connector element 20 and an element placed below. Such sealing element 201 is preferably made of rubber by means of a generic silicone.

[0083] Figure 16 shows a three-dimensional view of the first connector element 10.

[0084] Also the first connector element 10, like the second connector element 20, has an outer lateral surface 18 that is substantially cylindrical. A pair of first projections 11, 12 and a pair of second projections 12, 13 are placed on the outer surface, which project outside the lateral surface 18.

[0085] As can be seen in the drawing, and as becomes clear from the previous description of the openings 37 and 38 of the pair of projecting elements 31, 32 of the second locking means, the height of the projections 11, 12 of the first pair of projections along the first direction R1 is less than the height of the projections 13, 14 of the second pair of projections.

[0086] Furthermore, the lateral surface 18 of the first connector element 10 comprises three openings 15, 16, 17 configured so as to allow the projections 34, 35, 36 of the first locking means to pass through them. Therefore, such openings shall be found in positions corresponding to the three projections 34, 35, 36 of the first locking means.

[0087] It is clear that if the number of projections of the first locking means is different from three, the number of openings positioned on the outer lateral surface 18 will preferably be equal to the number of projections of the first locking means.

[0088] Therefore, in the particular embodiment of the present invention, the first opening 16 will be at a central position and the openings 15, 17 will be configured so as to house the second projection and the third projections 34 and 35 respectively and will therefore be placed symmetrically opposite with respect to the first opening 16.

[0089] Furthermore, as shown in the figures, above the first opening 16, a sealing element 19 is preferably placed, represented by a rubber projection (made of a generic silicone) able to isolate the area of the electrical connection from the outside. Such element can prevent dust, damp and water or other fluids from penetrating into the electrical connection, preventing compromising the electrical functionality of the connection.

[0090] With reference to Figures 2 and 3 and Figures 19 and 20, the coupling method of the first connector element 10 with the second connector element 20 by means of the coupling element 30 will be described herein.

[0091] As can be seen in Figure 2, the coupling element 30 is pre-mounted on the outer surface 18 of the first connector element 10 by means of the interaction between the openings 37 and 38 of the pair of projecting elements 31 and 32 and the pair of first projections 11 and 12 positioned on the outer surface 18 of the first connector element 10.

[0092] This solution allows the first connector element 10 to be provided with the coupling element 30 premounted thereon so as to proceed with the coupling of two different elements from one another: the pair formed by the connector element 10 and the coupling element 30 with the second connector element 20.

[0093] As previously mentioned, the pair formed by the first connector element 10 and by the coupling element 30 is moved with respect to the second connector element 20 along the first direction R1. The correct final positioning between the first connector element 10 and the second connector element 20 will be terminated precisely by the coupling element 30 which will be able to fix the relative positioning between the first connector element 10 and the second connector element 20 only in the event in which the relative position between the first connector element 10 and the second connector element 20 is a predetermined position.

[0094] In fact, in the event that it is not, the projections 34, 35, 36 of the first locking means will not be coupled correctly with the grooves 27, 28, 266 of the second connector element 20 and the operator will not then be able to fix the coupling element 30 to the first connector element 10. As shown in Figure 3, which shows a subsequent state to the one shown in Figure 2, the coupling element 30 is translated along the direction R2 which is perpendicular to the direction R1 so that the projections 34, 35, 36 of the first locking means enter into the grooves 27, 28, 266 of the second connector element 20.

[0095] Thanks to such translation of the first locking means, the coupling element 30 will be able to be translated from the pre-mounting position shown in Figure 2 to the final position shown in Figure 3 wherein the coupling element 30 is in a fixing position, wherein the openings 37 and 38 are fixed to the pair of second projections 13 and 14 positioned on the outer lateral surface 18 of the first connector element 10.

[0096] To explain in more detail the way in which the coupling element 30 is fixed to the first connector element 10, reference is made to Figure 19 in which the various

steps are shown schematically through a sectional view from above of the connector device 100.

[0097] As can be seen in such figures, the second connector element 20 has been omitted such as to be able to more clearly represent the coupling between the first connector element 10 and the coupling element 30.

[0098] Figure 19a shows a previous state to the coupling wherein the first connector element 10 and the coupling element 30 are completely uncoupled from one another.

[0099] Following a translation along the second direction R2 shown by the arrow in Figure 19b, the coupling element 30 reaches a pre-mounting position, in which it is pre-mounted on the first connector element 10 through a coupling of the pair of first projections 11 and 12 with the openings 37, 38 of the pair of projecting elements 31 and 32.

[0100] At this point, after such pre-mounting has been performed, the pair formed by the first connector element 10 and the coupling element 30 can be coupled to the second connector element 20.

[0101] Between the step shown in Figure 19a and the step shown in Figure 19b the projections 34 and 35 of the first locking means are inserted within the openings 15 and 17 positioned on the outer lateral surface 18 of the first connector element 10.

[0102] In any case, the present invention is not limited to this particular method. In fact, it is possible to proceed at a first time with the coupling between the first connector element 10 and the second connector element 20 and, in a second step, mount the coupling element 30 thus ensuring the coupling between the first and the second connector element 10 and 20 and fixing it.

[0103] However, according to a preferable embodiment, as mentioned, following a pre-coupling between the first connector element 10 and the coupling element 30, the mechanical coupling with the second connector element 20 takes place. In a third step, shown in Figure 19c, the coupling element 30 has been translated along the direction R2 so that the projections 34, 35, 36 of the first locking means have penetrated into the grooves 27, 28, 266 of the second connector element.

[0104] As it will have been possible to see, between the step shown in Figure 19b and the step shown in Figure 19c, the first projection 36 of the first locking means is inserted through the opening 16 positioned on the outer lateral surface 18 of the first connector element 10.

[0105] Therefore, in the step shown in Figure 19c, the openings 37, 38 of the pair of projecting elements 31 and 32 are coupled in a fixed way to the pair of second projections 13 and 14.

[0106] It is clear that, thanks to the elasticity of the pair of projecting elements 31 and 32 of the coupling element 30, between the step shown in Figure 19b and the step shown in Figure 19c the projecting elements 31 and 32 are moved away from one another so as to overtake the step formed by the pair of second projections 13a, 14a and, after reaching the top of the step 13a, 14a, thanks to a further translation along the second direction R2, the projecting elements 31 and 32 move towards one another and remain "wedged" to the pair of second projections 13, 14 along the edge 13b, 14b of the second projections.

[0107] Figure 20 shows a sectional view of the state in which the coupling element 30 is fixed to the first connector element 10 (state shown in Figure 19c), so as to lock the relative positioning between the first connector element 10 and the second connector element 20.

[0108] As can be seen, the projections 34, 35, 36 of the first locking elements are inserted into the grooves 7, 28, 266 of the second connector element 20 and the pair of projecting elements 31, 32 of the second locking means is fixed to the pair of second projections 13, 14 of the first connector element 10.

[0109] In this state, the horizontal displacement between the coupling element 30 and the pair formed by the first connector element 10 and the second connector element 20 is locked by the interaction between the openings 37, 38 of the pair of projecting elements 31, 32 of the second locking means and the pair of second projections 13, 14.

[0110] In this way, the relative displacement along the first direction R1 perpendicular to the sectional plane shown in Figure 20 is locked thanks to an interaction of the first locking means and the lower wall of the protrusions 24, 25, 26 positioned on the outer lateral surface 23 of the second connector element 20.

[0111] Figure 21 shows a particular feature of the present embodiment.

[0112] In the case in which, as previously mentioned, the coupling element 30 is pre-mounted on the first connector element 10 before the coupling takes place with the second connector element 20, it is possible to use the relative positioning between the coupling element 30 and the first connector element 10 to make sure that the coupling with the second connector element 20 only takes place in the particular case in which the positioning of the second and third projecting element 34, 35 of the first locking means into the openings 15 and 17 of the first connector element 10 is a correct positioning, in which the coupling element 30 is inserted within the openings 15, 17 of the first connector element 10 for a length less than or equal to a predetermined length.

[0113] For example, as shown in Figure 21b, in the case in which the first and the second projections 34, 35 of the first locking means are inserted too deep, they prevent the second connector element 20 from being mechanically connected to the pair formed by the first connector element 10 and the coupling element 30.

[0114] On this point, Figure 21a shows instead a state in which the coupling element 30 and the first connector element 10 are positioned correctly in which the connection can take place with the second connector element 20.

[0115] With reference to Figures 22 to 33, a second embodiment of the present invention will be presented herein, which is the main embodiment of the present in-

vention.

[0116] Common elements to the first embodiment shall be identified with the same reference numbers.

[0117] In particular, also in the second embodiment the coupling takes place between a first connector element 10 and a second connector element 20 having analogous features to those of the first embodiment. The substantial difference between the first and the second embodiment is the particular shape of the coupling element 300 which, in this case, has slightly different features, which will be explained in detail in the following description.

[0118] As shown in Figure 22, the electrical connector device 101 comprises: a first connector element 10, a second connector element 20 and a coupling element 300 configured so as to ensure and fix the coupling between the first connector element 10 and the second connector element 20.

[0119] The coupling element 300 is preferably made of plastic material, e.g. PA46-GF30 plastic.

[0120] With respect to the connector element 10, shown for the first embodiment, in the present embodiment it is preferable for the first connector element 10 to have a longitudinal support groove 2 positioned along a circumferential surface of the outer lateral surface 18 of the first connector element 10 and a lateral opening 16 (shown in Figure 31). As can be seen in Figure 22, the coupling element 300 is configured so as to "embrace" the outer lateral surface 18 of the first conductor element 10.

[0121] The features of the coupling element 300 will be explained in detail below and, following such description, the particular operation of such coupling element 300 will be described.

[0122] As shown in Figure 24, the coupling element 300 comprises a first arched portion 301 and a second arched portion 302, connected to one another by a connection portion 303 configured so as to allow a first terminal portion of the first arched portion 301 to be connected to a first terminal portion of the second arched portion 302.

[0123] In the other two second terminal portions of the first arched portion 301 and of the second arched portion 302 a hooking system is placed. In particular, according to the particular embodiment described in the figure, the first arched portion 301 comprises a male hook portion 316 and the second arched portion 302 has a female hook portion 323 configured so as to be coupled mechanically to the male hook portion 316.

[0124] In this way, as shown in Figure 25, when the male hook portion 316 is coupled to the female hook portion 323, the first arched portion 301 and the second arched portion 302 close the circle in which a first terminal part of the two arched portions 301, 302 is connected by means of the connection portion 303, and the other second terminal portion is connected by means of the hook formed by the male hook portion 316 and the female hook portion 323.

[0125] As can be noted, between Figure 24 and Figure 25, the connection portion 303 has two different shapes. Figure 24 shows a connection portion 303 formed integrally with the first arched portion 301 and the second arched portion 302, so that the coupling element 300 forms an integral element. Instead, Figure 25 shows an additional connection portion 303 that connects the first arched portion 301 with the second arched portion 302 so as to connect them to one another.

[0126] Therefore, in the present invention, the coupling element 300 can be formed integrally or formed by two distinct and separate bodies which are coupled to one another by means of the connection portion 303.

[0127] The connection portion 303 is configured so as to allow the relative displacement between the first arched portion 301 and the second arched portion 302. Preferably, the first arched portion 301 forms a first semicircle and the arched portion 302 forms a second semicircle. However, it will also be possible that the first arched portion 301 forms a larger portion of a semi-circle (an arc of a circle or ellipse), and the second arched portion 302 forms a smaller portion of a semi-circle (an arc of a circle or ellipse) or vice versa.

[0128] As shown in the figure, the first arched portion 301 comprises a first semi-circular body 317 on which a base portion 311 is installed on which a first positioning projection 312 and a second positioning projection 313 are installed which extend from it along an at least partially perpendicular direction from such base portion 311. The positioning projections 312, 313 are projections that allow, as will be illustrated below, the correct positioning to be obtained between the first connector element 10 and the second connector element 20.

[0129] The first positioning projection 312 and the second positioning projection 313 have an at least partially arched inner surface, so as to be able to "embrace" an external body, for example elliptical or cylindrical. Preferably, also the outer surface will have an arched surface. In the present description, inner surface means a surface turned towards the first positioning projection 312 or towards the second positioning projection 313 and outer surface means a surface opposite it.

[0130] The upper terminal portion of the first positioning projection and of the second positioning projection 312, 313 each comprise a fixing projection 314, 315 which, as will become clearer in the continuation of the description, allows the coupling of the coupling element 300 with the connector element 20. As shown in the figure, such fixing projection is positioned at an upper terminal portion of the positioning projections.

[0131] Furthermore, the second arched portion 302 also comprises a second semicircular body 321 on which a locking protrusion 322 is placed, configured so as to extend along the circumference of the second semicircular body 321. Such locking protrusion 322 is preferably in a central portion along the first direction R1 of the second semicircular body 321.

[0132] Now with reference to Figures 26 to 29, the pref-

erable features of the lengths of the coupling element 300 will be presented in detail.

[0133] As shown in Figure 26, which shows a view from above of the coupling element 300, the outer diameter D19 of the first semicircular body 317 is preferably equal to 20 mm whereas the outer diameter D18 of the first and of the second positioning projection 313, 314 is preferably equal to 14.9 mm. The height D20 of the locking protrusion 322 is preferably equal to 1.5 mm. Height in this case means the extension length of the protrusion 322 along a perpendicular direction to the surface on which the protrusion 322 is located.

[0134] The height D22 of the first and the second positioning projection 312, 313 is preferably equal to 2.5 mm, whereas the height D23 of the first positioning projection and of the second positioning projection 314, 315 at the fixing projections is preferably equal to 3 mm. Furthermore, the height D24 of the first arched portion and of the second arched portion 301 and 302 is preferably equal to 4 mm.

[0135] As shown in Figure 28, the inner diameter D25 placed at the locking protrusion 322 is preferably equal to 15.6 mm whereas, as shown in Figure 29, the outer diameter D27 of the first arched portion and of the second arched portion 301, 302 in a state in which the first arched portion 301 is fixed to the second arched portion 302 by means of the hook, is preferably equal to 20 mm. In the same way, the outer diameter obtained, in the same state, of the outer hook, is preferably equal to 24.8 mm.

[0136] With reference to Figure 30, the fixing mode of the coupling element 300 to the second connector element 20 will be shown. To show such coupling more clearly, in such figure the first connector element 10 has been omitted.

[0137] As can be seen in the figure, the first positioning projection and the second positioning projection 312 and 313 are configured so as to be channelled into the lateral groove 27, 28 of the second connector element 20, as happened in the first embodiment of the present invention.

[0138] This "channelling" is precisely what allows the first connector element 10 to be positioned in a correct position with respect to the second connector element 20, from which the name "positioning projection" derives. However, as will be described below, the positioning projections 312, 313 also act as locking means as they allow a fixing between the first connector element 10 and the second connector element 20 along the first direction R1.

[0139] However, unlike the first embodiment, the terminal portion of the first and of the second positioning projection 312, 313, as previously described, have fixing projections 314, 315, which are also able to allow the locking of the coupling element 300 to the second connector element 20 along the second direction R2.

[0140] In fact, when the first and the second projection 312, 313 are inserted along the lateral grooves 27, 28, such positioning projections 312, 313 are configured so as to be slightly flexible along the second direction (perpendicular to the extension direction of the positioning projections 312, 313), so that the fixing projections 314, 315 can also be inserted into the lateral grooves 27, 28.

[0141] In the terminal portion of the lateral grooves 27, 28, thanks to the elasticity of the positioning projections 312, 313, such projections are configured so as to return into the initial position making sure that the fixing projections 314, 315 remain wedged with a terminal wall of the protrusions 24, 25 of the second connector element 20.

[0142] In this way, it will be possible to lock the movement of the coupling element 300 along the second direction R2. Such a configuration of the first positioning projection 312 and of the second positioning projection 313 comprising the fixing projections 314, 315 as described in the figure, can also be applied to the first embodiment and in particular in the terminal portions of the second and of the third projecting element of the first mounting means 34, 35.

[0143] When the first and the second positioning projection 312, 313 are inserted into the lateral grooves 27, 28, as previously mentioned, the relative movement between the coupling element 300 and the second connector element 20 is locked both along the first direction R1 and along the second direction R2, thanks to the first and the second positioning projection 312, 313 and the presence of the fixing projections 314, 315, respectively.

[0144] Below, with reference to Figures 31 and 32, the two steps that allow the coupling of the coupling element 300 to the first and the second connector element 10, 20 will be explained.

[0145] Unlike the first embodiment, in the second embodiment, the coupling element 300 is preferably coupled to the first and to the second connector element 10, 20 after the first conductor element 10 has been coupled to the second conductor element 20 along the first direction R1.

[0146] In fact, as shown in Figure 31, after the first conductor element 10 has been positioned at the second conductor element 20, the first and the second positioning projection 312, 313 of the coupling element 300 are inserted into the lateral opening 16 of the first connector element 10. In this way, such positioning projections 312, 313 will then enter the grooves 27, 28 of the second conductor element 20 so as to realise the fixing that was previously described in relation to Figure 30.

[0147] In the subsequent state, which is shown in Figure 32, the first positioning projection and the second positioning projection 312, 313 are inserted until the fixing projections 314, 315 fix the positioning of the coupling element 300 with respect to the second connector element 20 along the second direction R2.

[0148] Subsequently, the operator will exert a pressure along the second semicircular body 321 so that the second arched portion 302 closes the circle and the female hook portion 323 of the second arched portion 302 is placed at the male hook portion 316 of the first arched portion 301.

[0149] It is clear that in an alternative embodiment the

male hook portion can be positioned on the second arched portion 302 and the female hook portion 323 can be positioned on the first arched portion 301.

[0150] As shown in figure 33, in a final state, the female hook portion 323 is fixed to the male hook portion 316 and the locking protrusion 322 is inserted into the circumferential support groove 2 of the first conductor element 10 so that the locking protrusion 322 locks a possible relative movement along the circumferential direction of the first connector element 10 with respect to the coupling element 300.

[0151] The presence of the locking protrusion 322 is a preferable but not necessary feature as, thanks to the presence of the hook and the fixing projections 314, 315, in theory the locking is already guaranteed. However, the inventor has discovered that, due to the numerous vibrations that can take place on the body on which such electrical connector device is positioned 101, it is preferable to have such locking protrusion 322, so as to prevent any uncoupling caused by external vibrations.

[0152] Although the present invention was described with reference to the embodiments described above, it is apparent to an expert in the field that it is possible to make several modifications, variants and improvements to the present invention in light of the above teaching and within the scope of the appended claims, without departing from the object and the scope of protection of the invention.

[0153] For example, even if it has always been shown that the fixing projections 314, 315 are positioned in an upper portion of the first and of the second projecting element 312, 313 it is possible to position such fixing projections 314, 315 also in a lower position.

[0154] Furthermore, even if this is not shown in the figures, the first connector element 10 can have an outer lateral surface having a different shape from the cylindrical one. In the case, for example, in which the outer lateral surface of the first connector element 10 has a parallelepiped surface, the first arched portion 301 and the second arched portion 302 will have an arched portion configured so as to "embrace" the lateral surface of the parallelepiped portion. For example, if the parallelepiped has a hexagonal shape, each arched portion will preferably have three broken portions rather than having a curvilinear portion such as the one shown in the figure.

[0155] Finally, those fields known by experts in the field were not described to avoid excessively and uselessly overshadowing the invention described. Accordingly, the invention is not limited to the embodiments described above, but is only limited by the scope of protection of the appended claims.

LIST OF REFERENCE SIGNS

[0156]

100, 101: Electrical connector device;
R1: First direction;
R2: second direction;
10: First conductor element;
11, 12: Pair of first projections;
13, 14: Pair of second projections;
15, 16, 17: Lateral openings;
2: Longitudinal support groove;
18: Outer lateral surface;
19: Sealing element;
20: Second connector element;
21, 22, 24, 25, 26: Protrusions;
23: Lateral surface;
27, 28, 266: Grooves;
29: Base;
30, 300: Coupling element;
31, 32: Pair of projecting elements;
33: Main body;
34, 35, 36: projecting elements;
37, 38: Openings;
301: First arched portion;
302: Second arched portion;
303: Connection portion;
311: Base portion;
312: First positioning projection;
313: Second positioning projection;
314, 315: Fixing projections;
316: Male hook portion;
317: First semicircular body;
321: Second semicircular body;
322: Locking protrusion;
323: Female hook portion.

Claims

1. A coupling element (300) configured to ensure and fix the correct relative positioning between a first connector element (10) and a second connector element (20), said first connector element (10) and said second connector element (20) being configured so as to be able to be coupled to one another along a first direction (R1); said coupling element (30) comprising:

   a first arched portion (301), having a first terminal portion and a second terminal portion, and a second arched portion (302), having a first terminal portion and a second terminal portion, wherein said first terminal portion of said first arched portion (301) is connected to said first terminal portion of said second arched portion (302);

   a first locking means (312, 313) comprising at least a first projecting element (312, 313) that extends from said first arched portion (301) and is configured so as to be inserted into an opening (16) of said first connector element (10) and into a groove (27, 28) of said second connector element (20) for fixing the relative positioning of

said first connector element (10) with respect to said second connector element (20) along said first direction (R1);
a second locking means (314, 315, 316, 323) comprising a closing means (316, 323) positioned at said second terminal portion of said first arched portion (301) and of said second terminal portion of said second arched portion (302); wherein said closing means (316, 323) is configured so as to fix said second terminal portion of said first arched portion (301) to said second terminal portion of said second arched portion (302) so as to fix a relative positioning between said first connector element (10) and said coupling element (300) along a second direction (R2) that is perpendicular to said first direction (R2).

2. The coupling element (300) according to claim 1, wherein said second locking means (314, 315, 316, 323) further comprises a fixing projection (314, 315) positioned at a terminal portion of said first projecting element (312, 313) of said first locking means (312, 313) and configured so as to lock the relative positioning between said projecting element (312, 313) of said first locking means (312, 313) and said second connector element (20).

3. The coupling element (300) according to claim 1 or 2, wherein said first locking means (312, 313) further comprises said first projecting element (312) and a second projecting element (313), wherein a terminal portion of each of said first projecting element (312) and of said second projecting element (313) comprises a fixing projection (314, 315) configured so as to lock the relative positioning between said projecting elements (312, 313) of said first locking means (312, 313) and said second connector element (20).

4. The coupling element (300) according to any one of claims 1 to 3, wherein said first projecting element (312, 313) of said first locking means is configured so as to be elastically deformable along a perpendicular direction to the extension direction of said first projecting element (312, 313).

5. The coupling element (300) according to any one of claims 1 to 4, wherein said closing means (316, 323) of said second locking means (314, 315, 316, 323) comprises a hook closure wherein a male hook portion (316) is positioned preferably at said second terminal portion of said first arched portion (301) and a female hook portion (323) is positioned preferably at said second terminal portion of said second arched portion (302).

6. The coupling element (300) according to any one of claims 1 to 5, further comprising a third locking means (322) configured so as to fix the positioning of said coupling element (300) with respect to said first connector element (10) along a tangential direction of said first connector element (10), said third locking means comprising a locking protrusion (322) that extends along an internal circumferential surface of said second arched portion (302).

7. The coupling element (300) according to any one of claims 1 to 6, wherein said first arched portion (301) is provided integrally with said second arched portion (302), wherein a connection portion (303) is configured so as to connect said first terminal portion of said first arched portion (301) to said first terminal portion of said second arched portion (302).

8. The coupling element (300) according to any one of claims 1 to 7, wherein each of said first arched portion (301) of said second arched portion (302) comprises a semicircular body (317, 321).

9. An electrical connector device (101) comprising a coupling element (300) according to any of claims 1 to 8, a first connector element (10) and a second connector element (20), said first connector element (10) and said second connector element (20) bearing respective electrical terminals with respective bodies that can be coupled to one another and being configured so as to be able to be coupled to one another along said first direction (R1);
said first connector element (10) comprising a first lateral opening (16) configured so as to allow the passage of said first projecting element (312, 313) of said first locking means (312, 313);
said second connector element (20) comprising a first lateral groove (27, 28) configured so as to house said first projecting element (312, 313) of said first locking means (312, 313), said first lateral groove (27, 28) comprising a perpendicular wall to said first direction (R1) and positioned above said projecting element (312, 313) of said first locking means (312, 313), so as to fix the relative positioning of said first connector element (10) with respect to said second connector element (20) along said first direction (R1);
wherein said closing means (316, 323) of said second locking means (314, 315, 316, 323) is configured so as to rest said coupling element (30) against an outer lateral surface (18) of said first connector element (10) so as to fix said coupling element (30) to said first connector element (10).

10. The electrical connector device (101) according to claim 9, wherein said first connector element (10) comprises a support groove (2) positioned along an outer lateral wall (18) of said first connector element (10) and extending along a perpendicular direction to said first direction (R1), said support groove (2)

configured so as to be able to be coupled with a locking protrusion (322) of said second arched portion (302) so as to lock a tangential positioning between said second arched portion (302) of said coupling element (300) and said first connector element (10).

11. The electrical connector device (101) according to any one of claims 9 or 10, wherein said first connector element (10) further comprises a second lateral groove (27, 28) configured so as to house said first locking means (312, 313), wherein said second groove (27, 28) comprises a wall perpendicular to said first direction (R1) and positioned above said first locking means (312, 313) so as to fix the relative positioning of said first connector element (10) with respect to said second connector element (20) along said first direction (R1).

12. The electrical connector element (101) according to claim 11, wherein said first and said second lateral groove (27, 28) have an open terminal portion configured so as to allow fixing projections (314, 315) of said second locking means (314, 315, 316, 323) to be fixed to said first and said second lateral groove (27, 28).

13. The electrical connector device (101) according to any one of claims 9 to 12, wherein said first connector element (10) and said second connector element (20) have a substantially cylindrical outer lateral surface (18, 23).

14. A method for ensuring and fixing a coupling between a first connector element (10) and a second connector element (20); said method comprising the following steps:

a. coupling said first connector element (10) to said second connector element (20) along a first direction (R1);
b. inserting a coupling element (300) in at least one opening (16) of said first connector element (10) and in a groove (27, 28) of said second connector element (20) so as to fix the positioning of said first connector element (10) with respect to said second connector element (20) along said first direction (R1);
c. fixing said coupling element (300) to said first connector element (10) so as to fix the relative positioning between said coupling element (300) and said first connector element (10) along a second direction (R2) that is perpendicular to said first direction (R1).

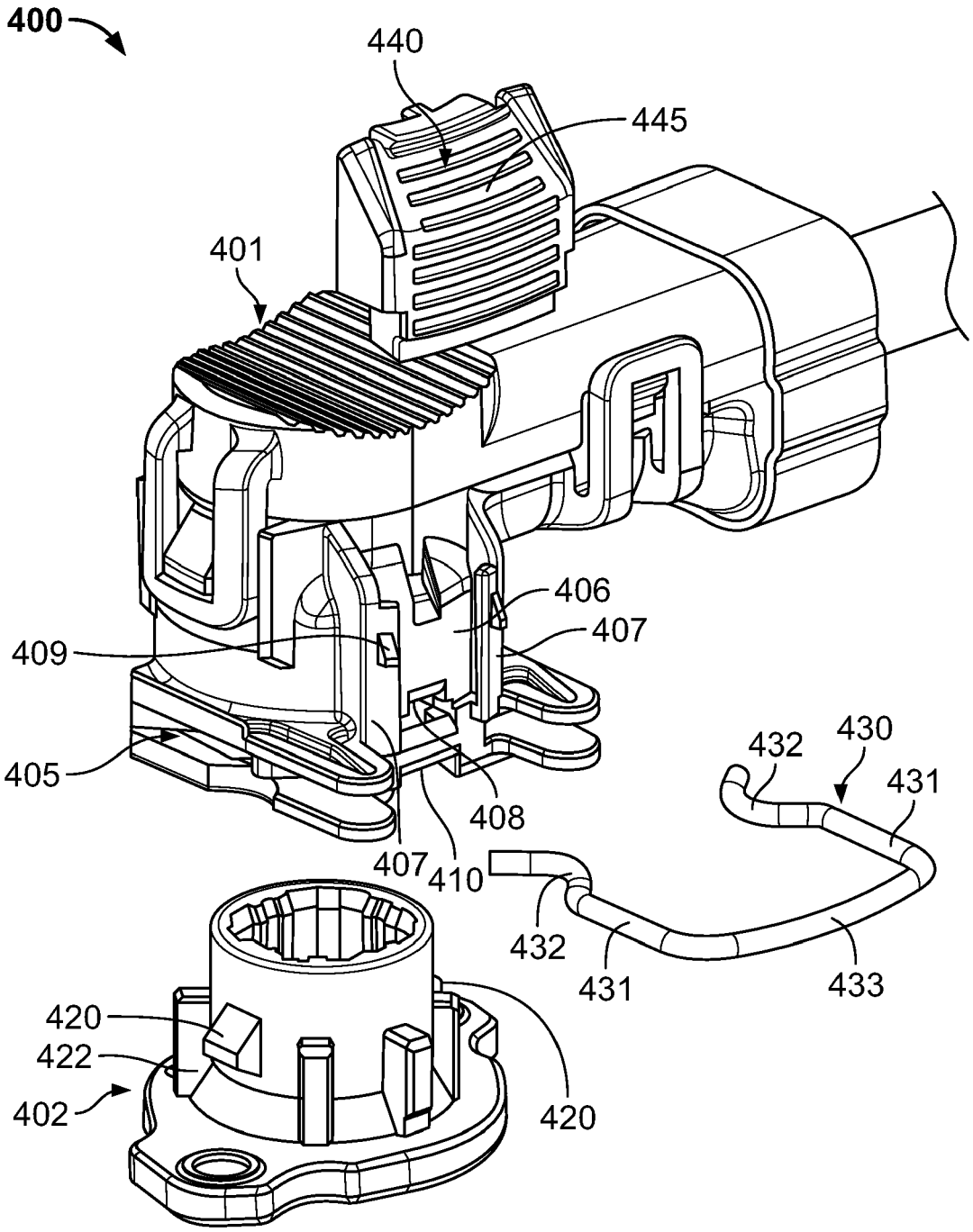
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Fig. 1

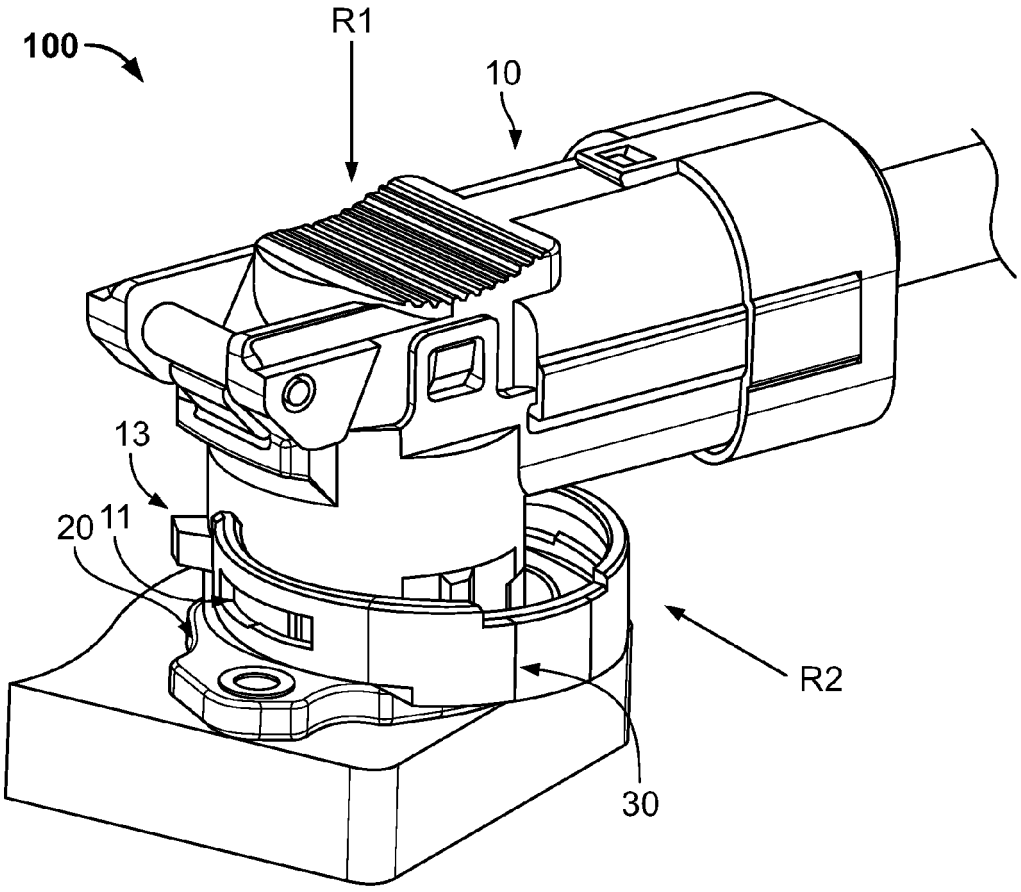


FIG. 2

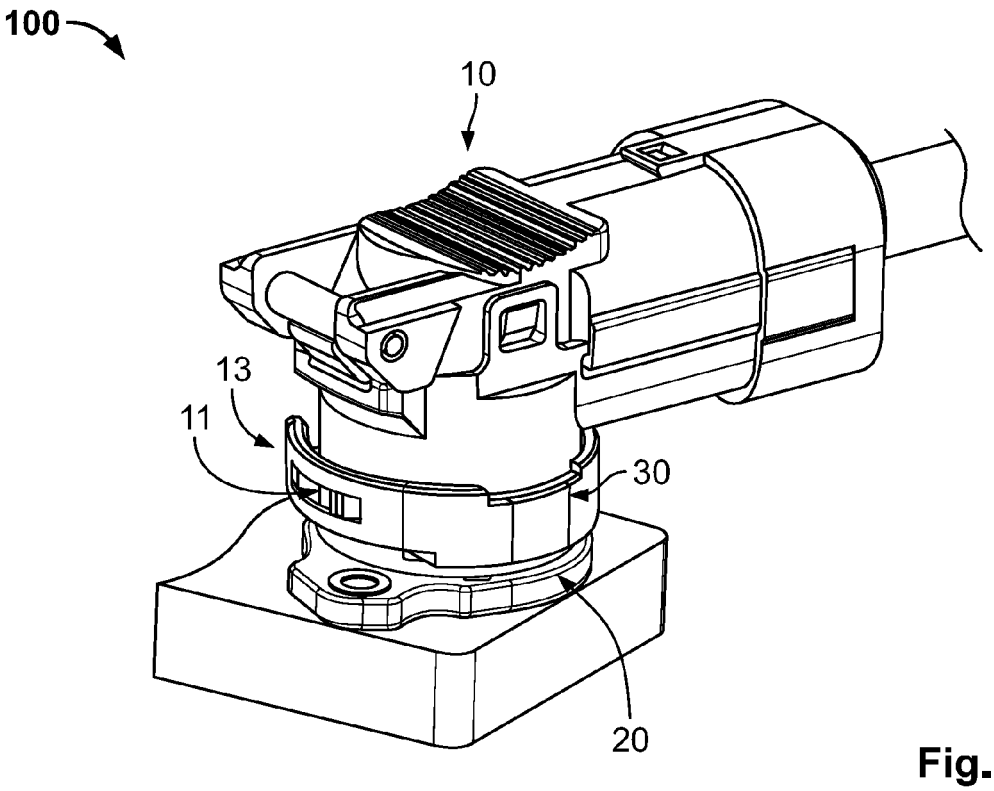


Fig. 3

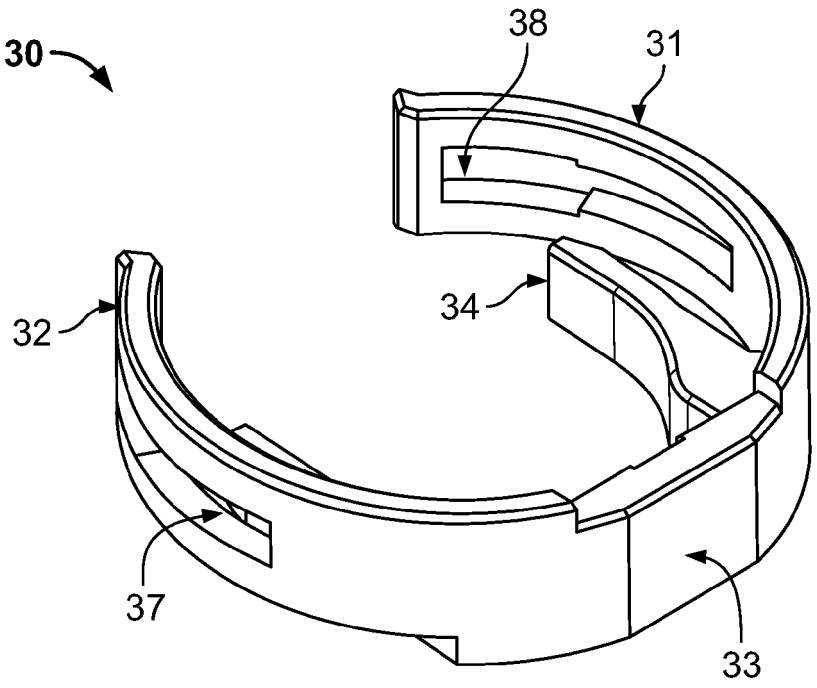


FIG. 4

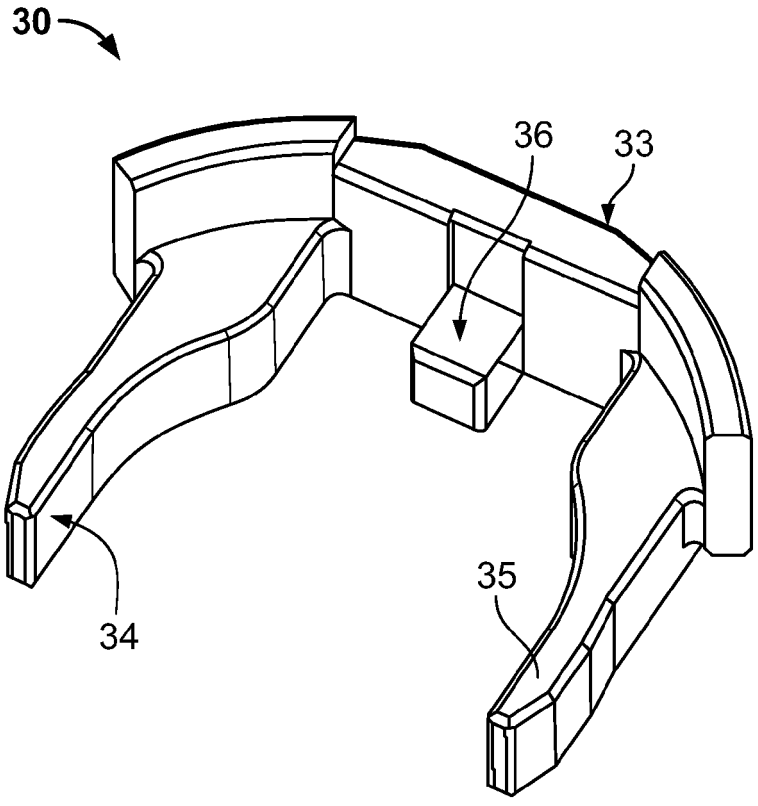


FIG. 5

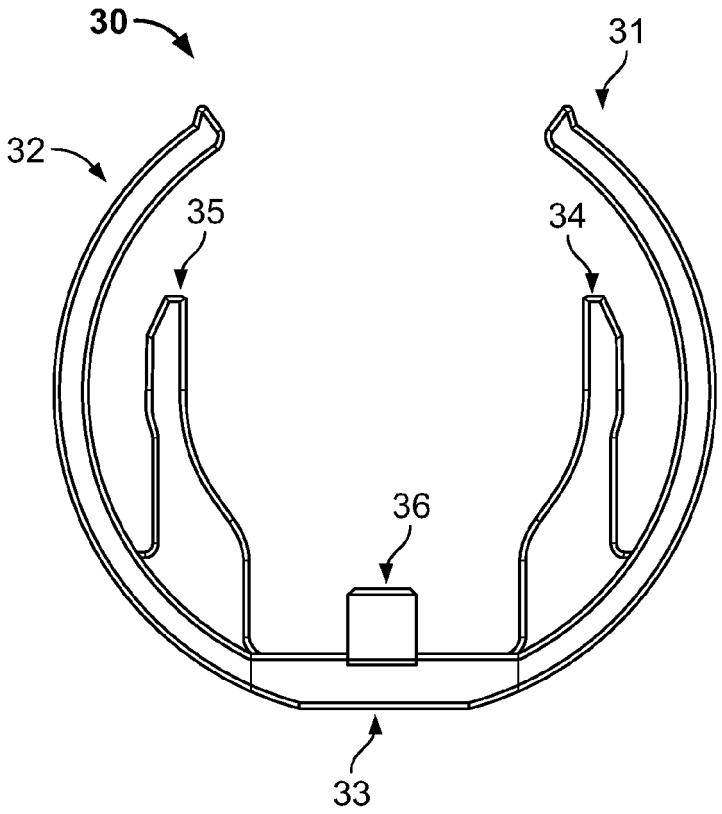


FIG. 6

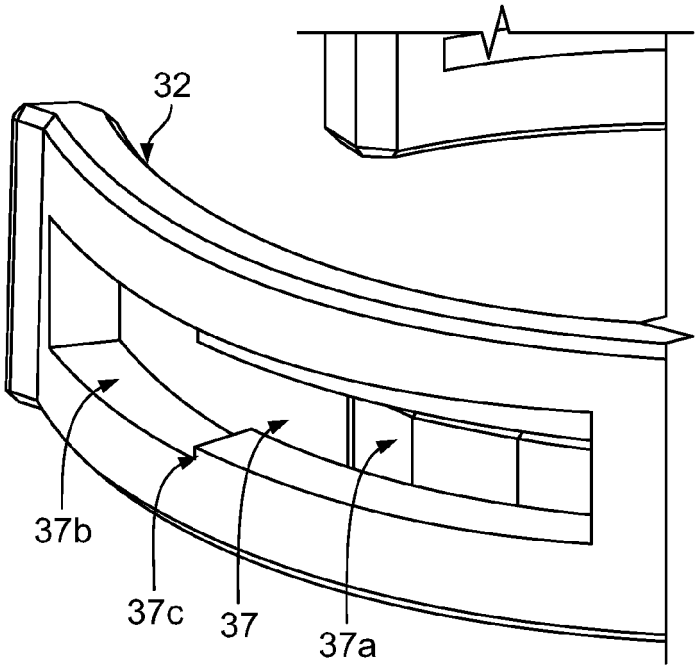


FIG. 7

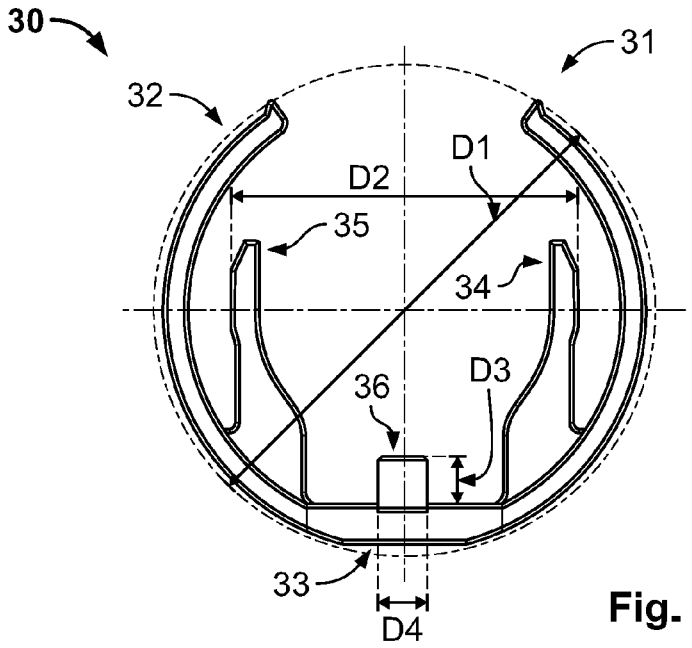


Fig. 8

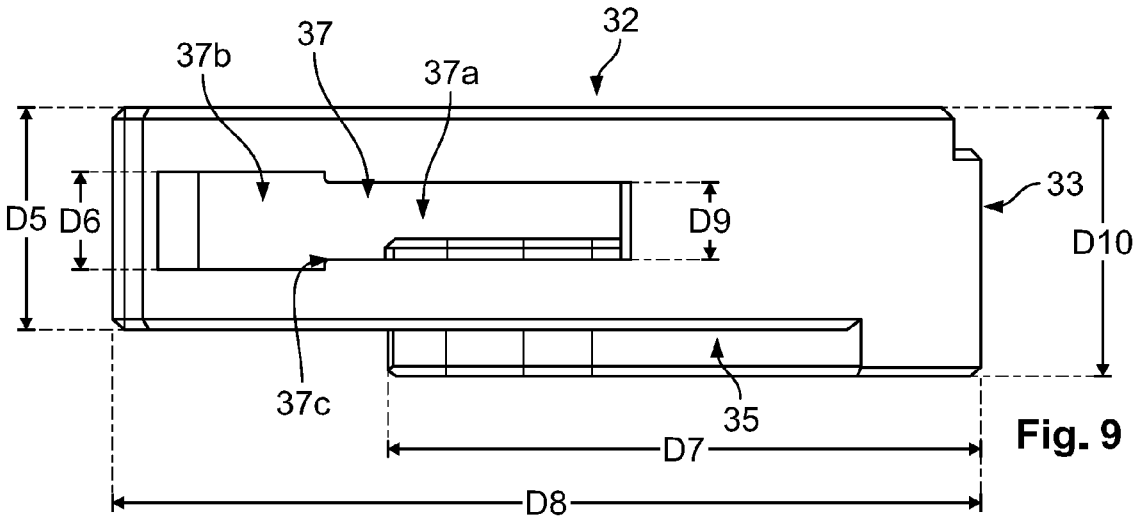
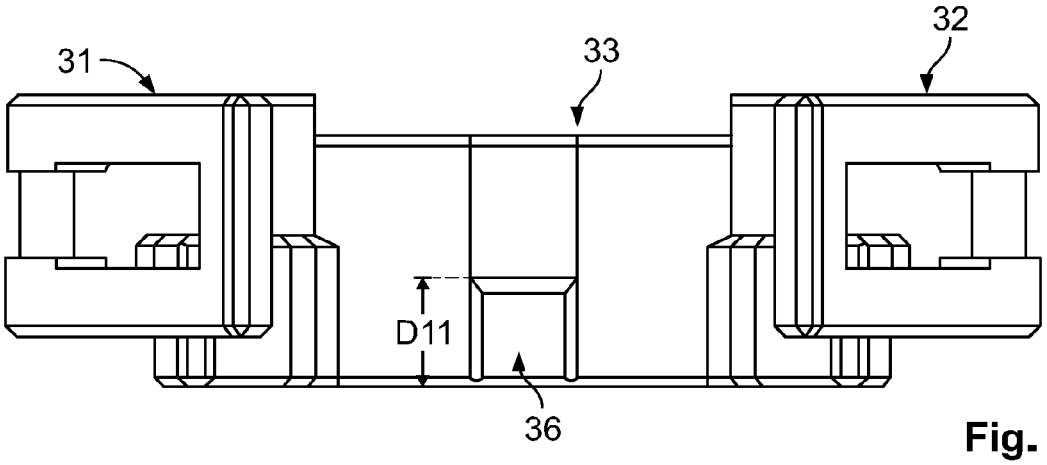


Fig. 9



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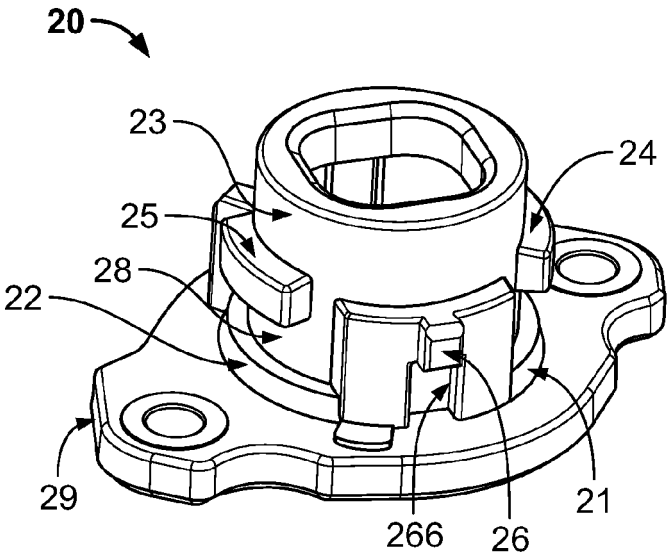


Fig. 11

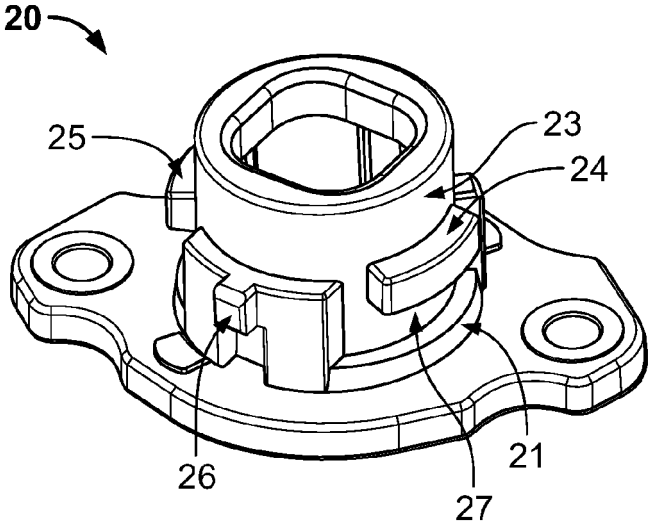


Fig. 12

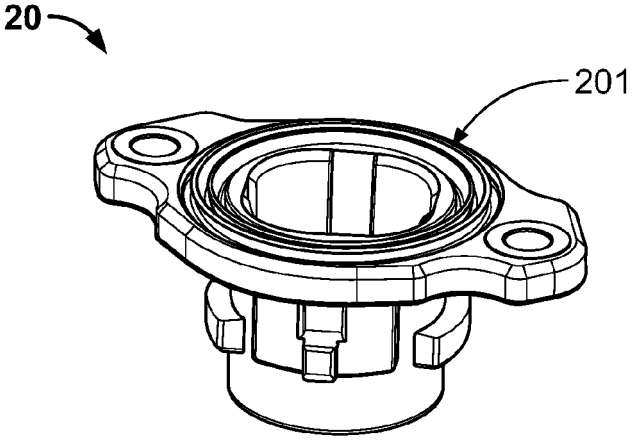


Fig. 13

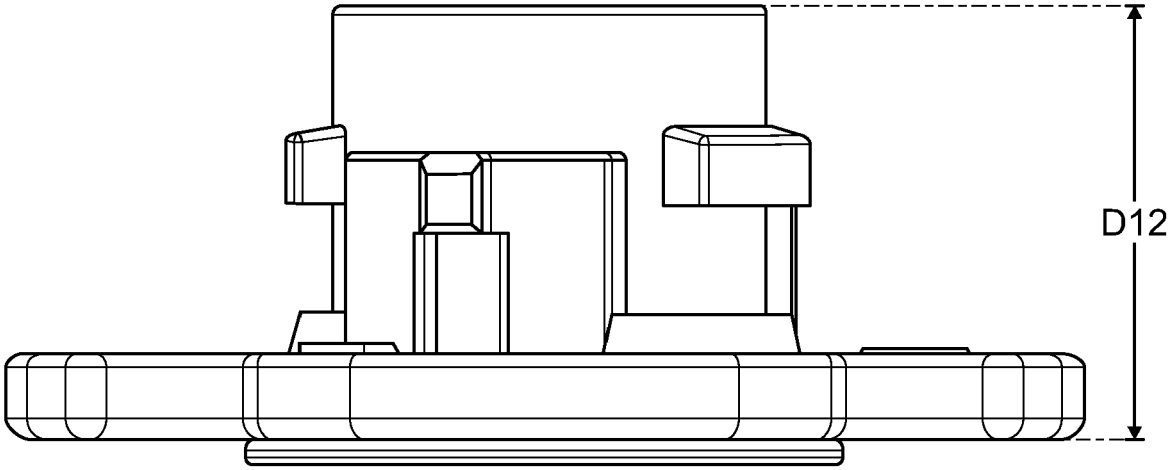


FIG. 14

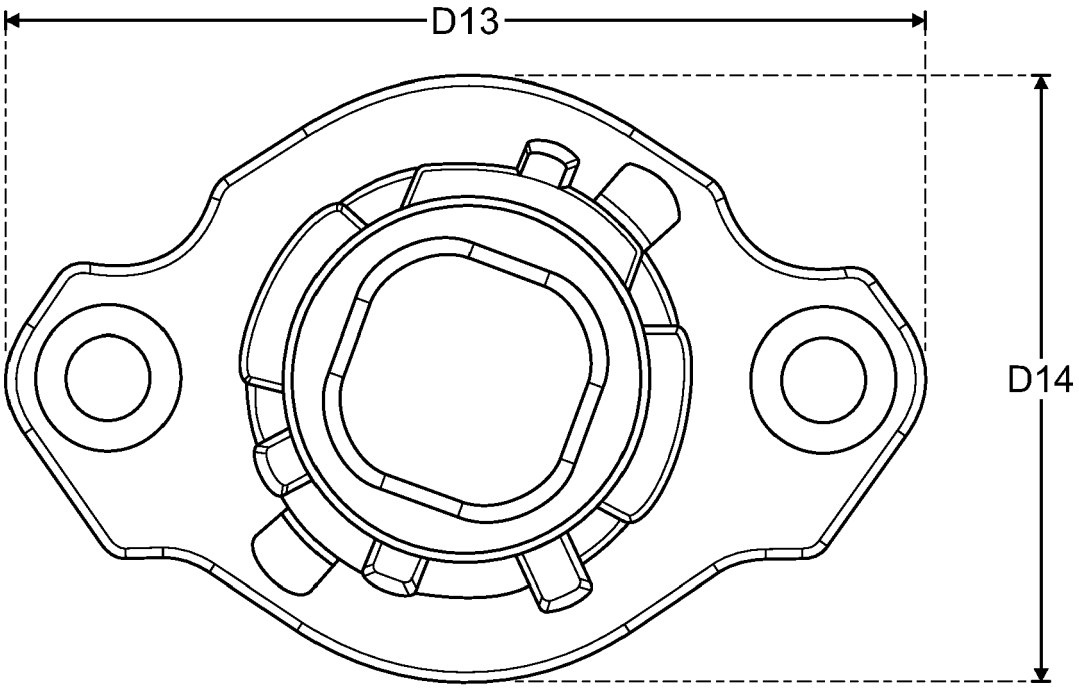


FIG. 15

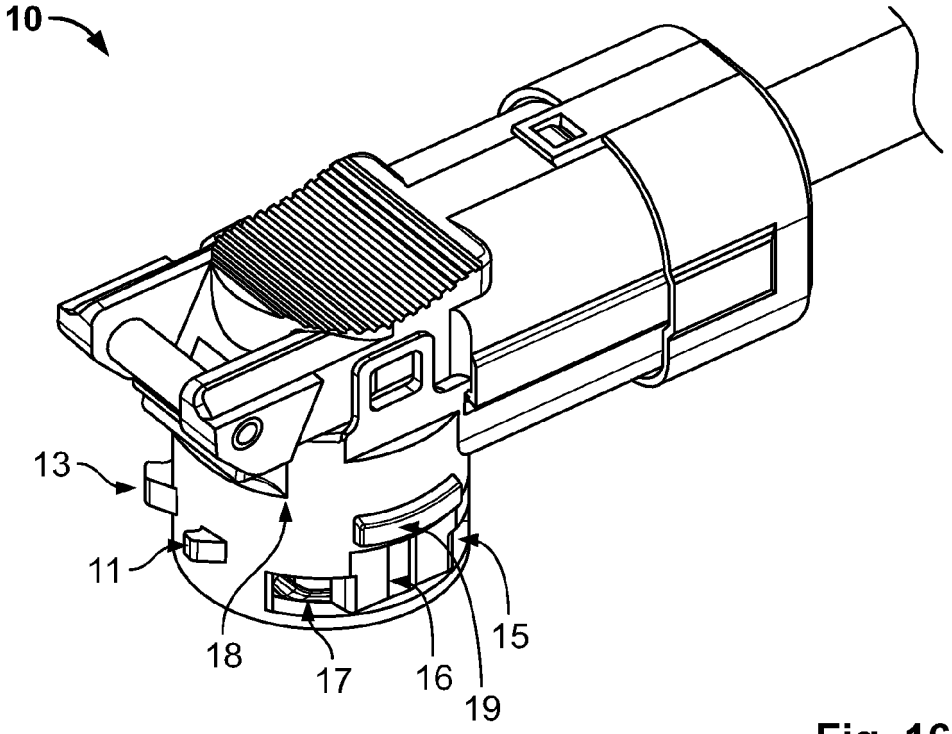


Fig. 16

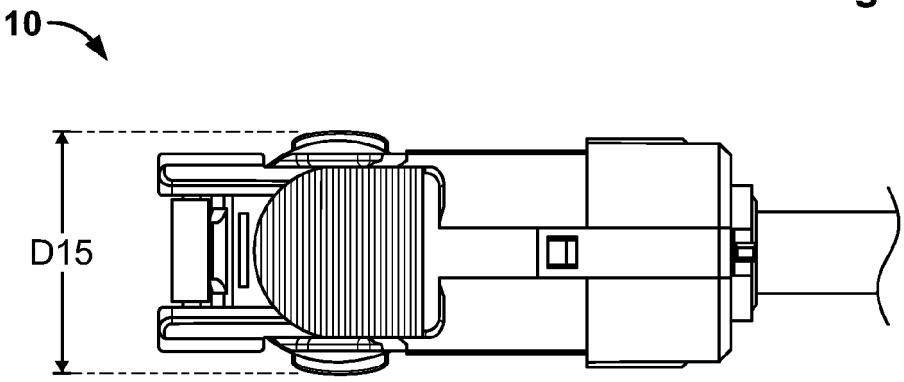
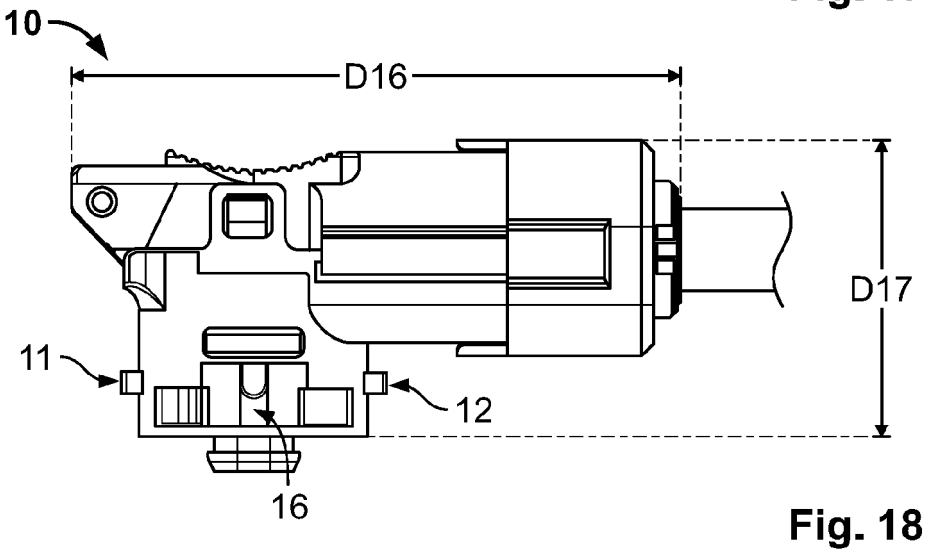


Fig. 17



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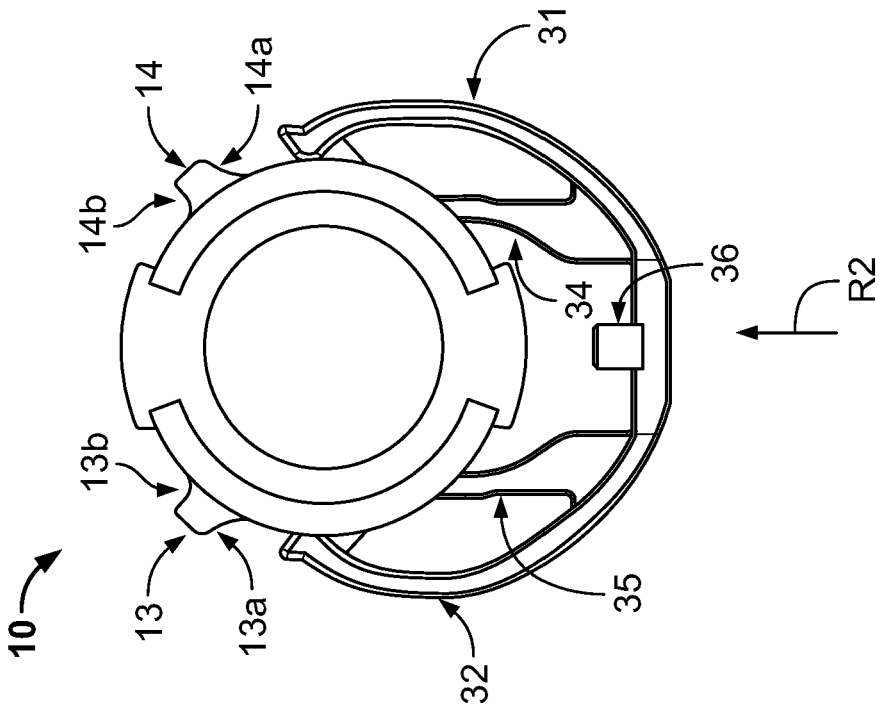

FIG. 19B

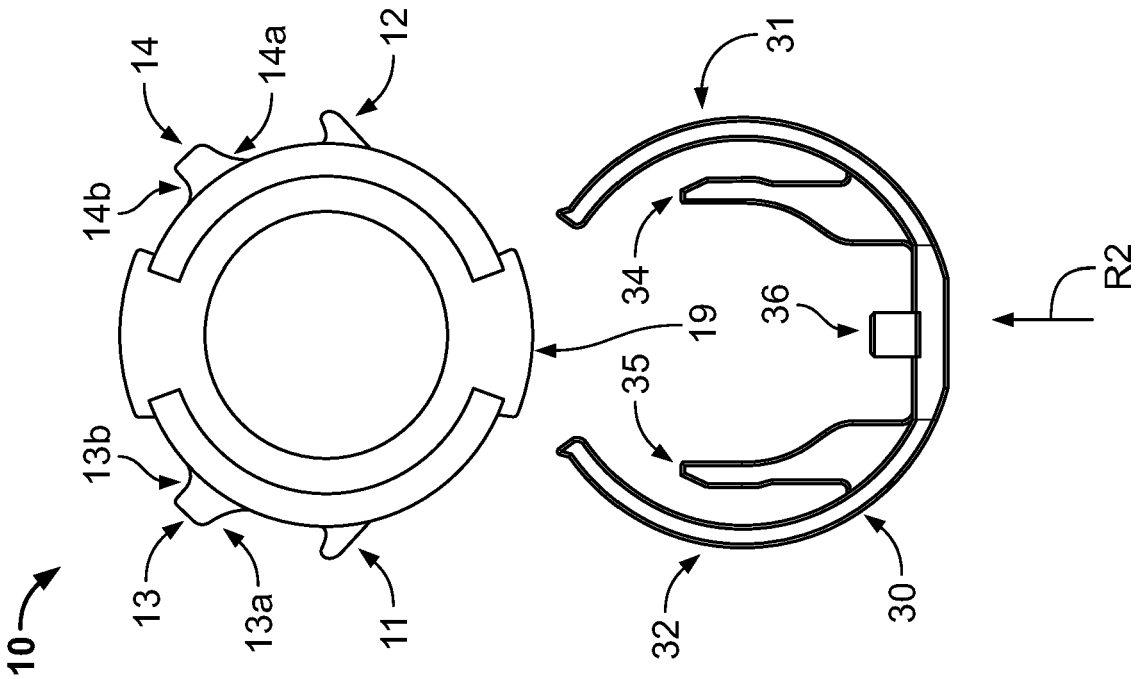

FIG. 19A

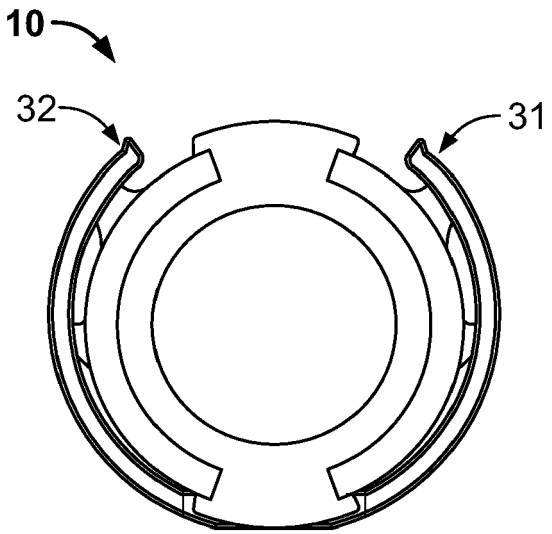

FIG. 19C

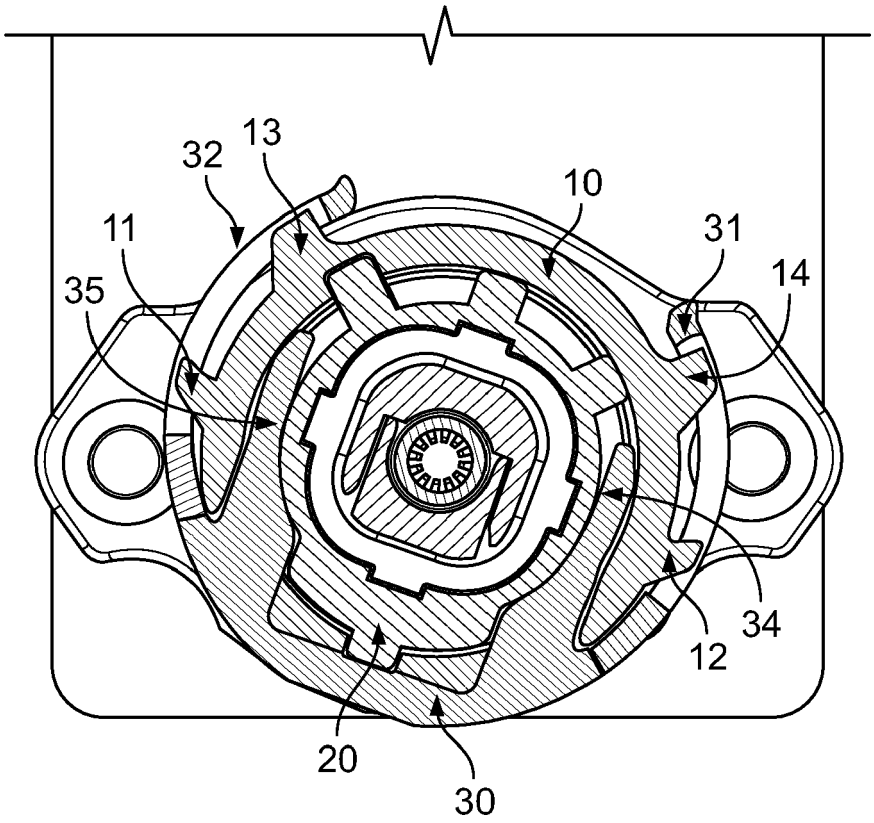

Fig. 20

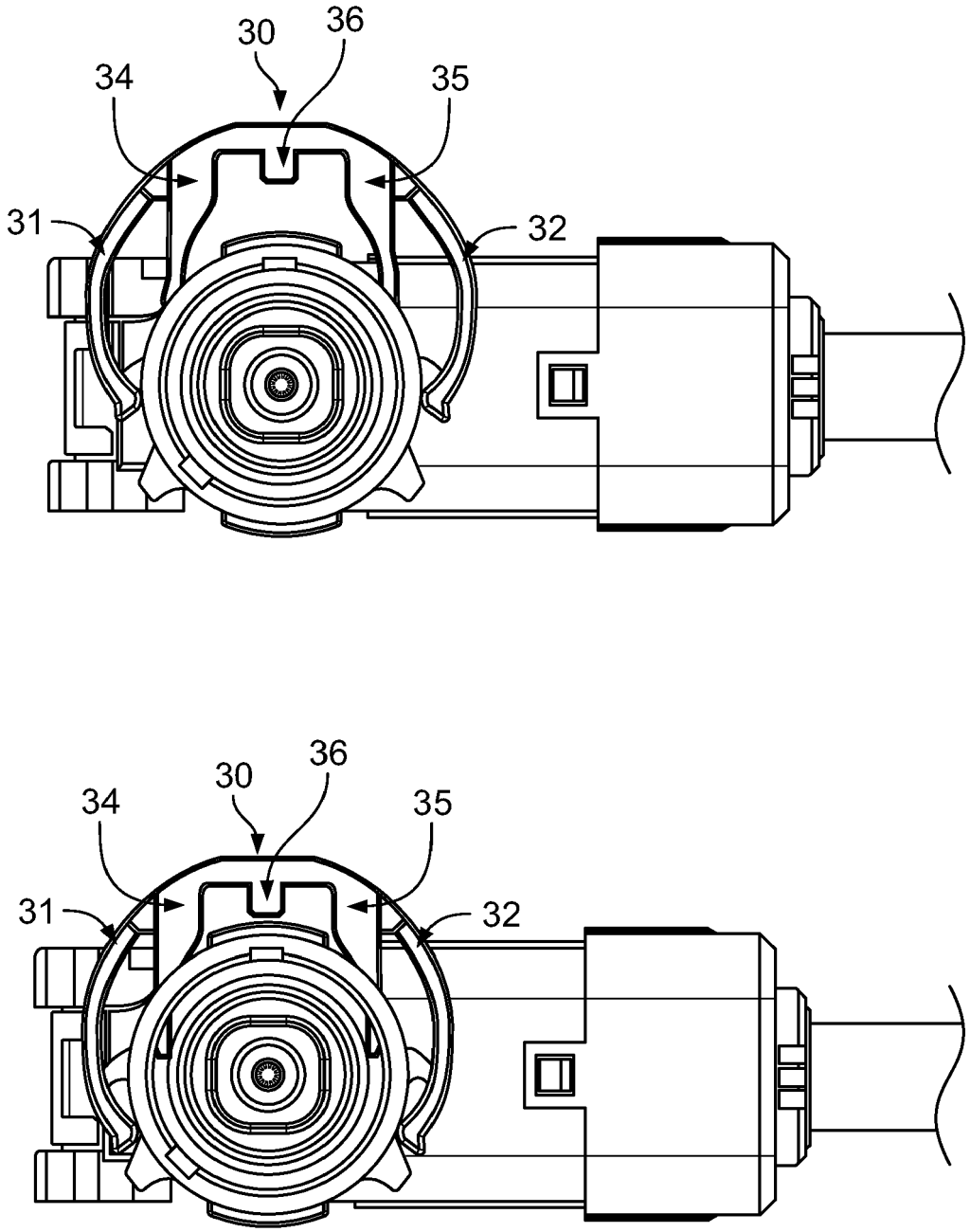

FIG. 21

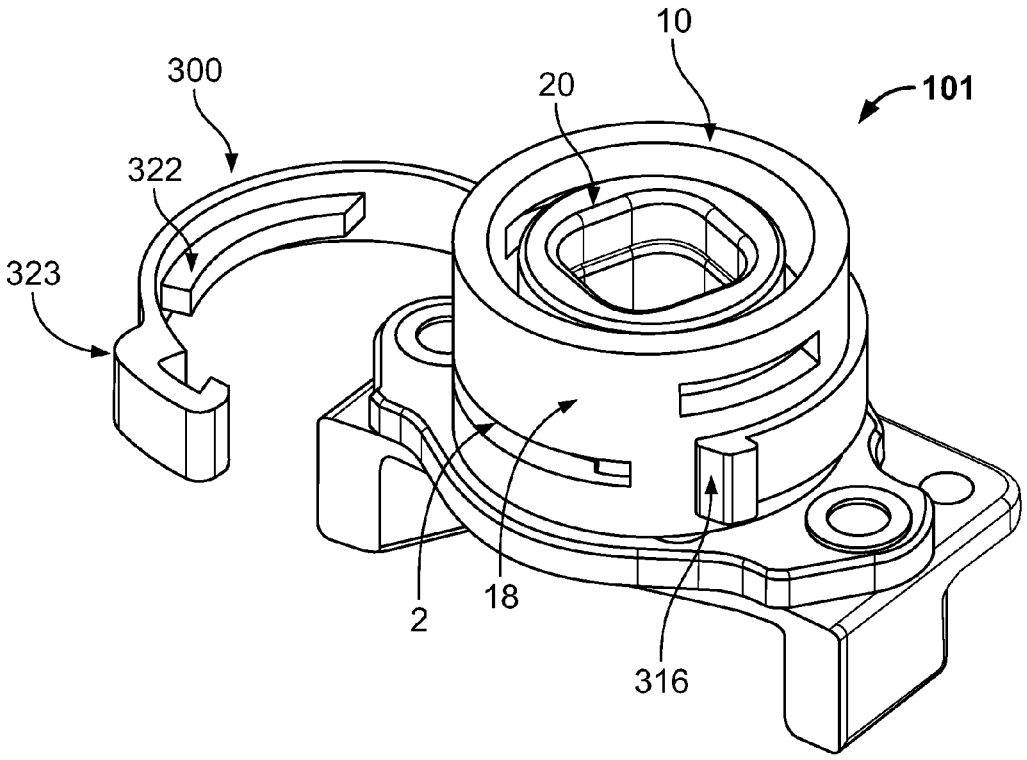

FIG. 22

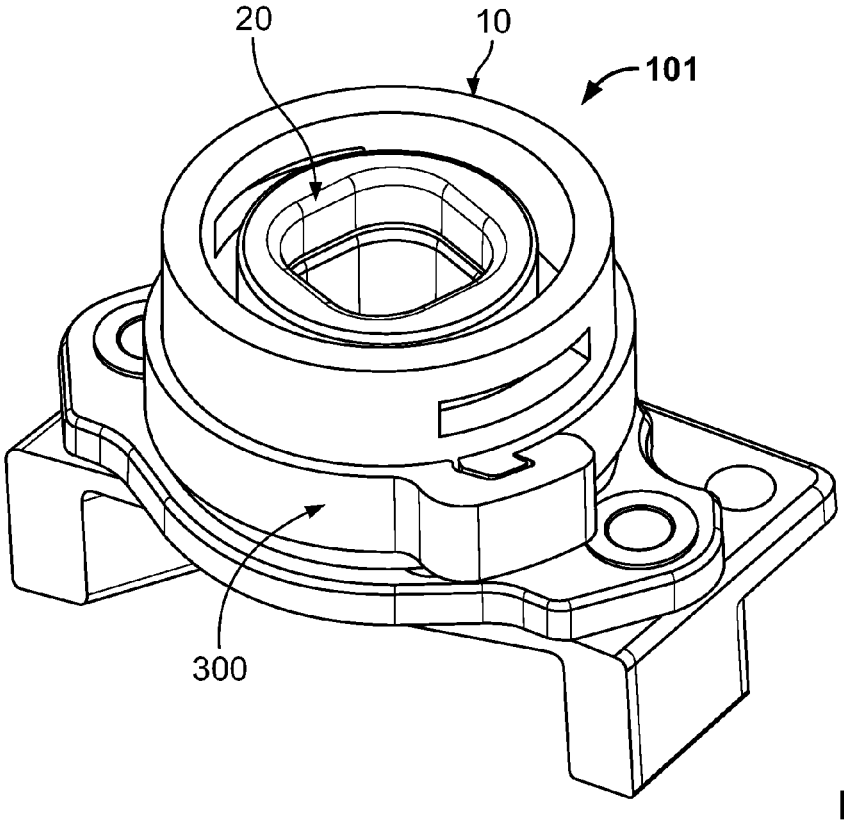

Fig. 23

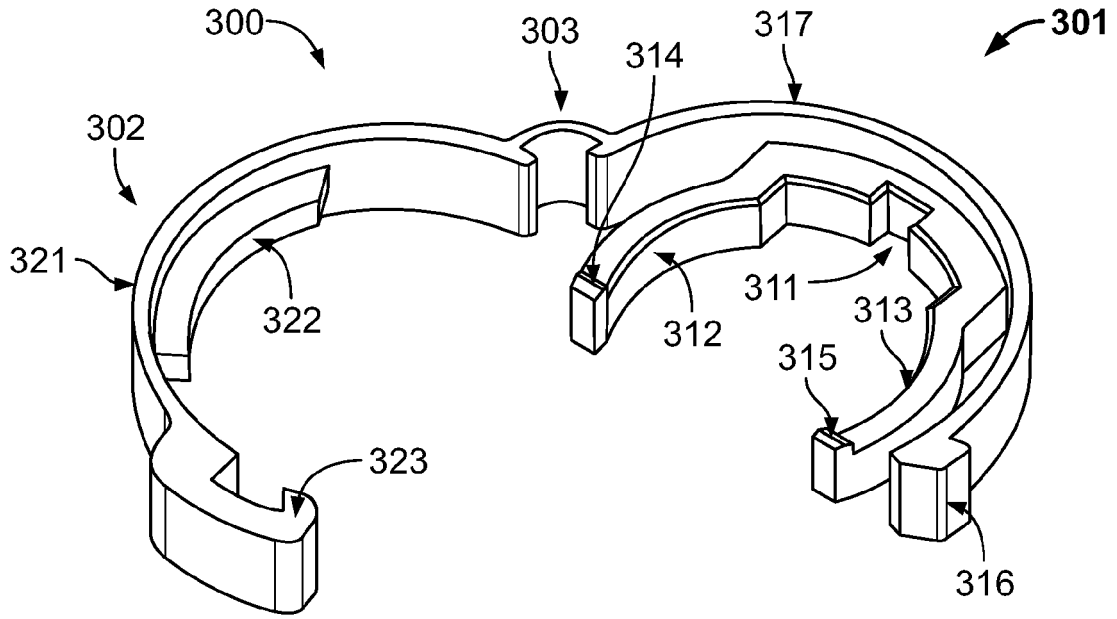
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FIG. 24

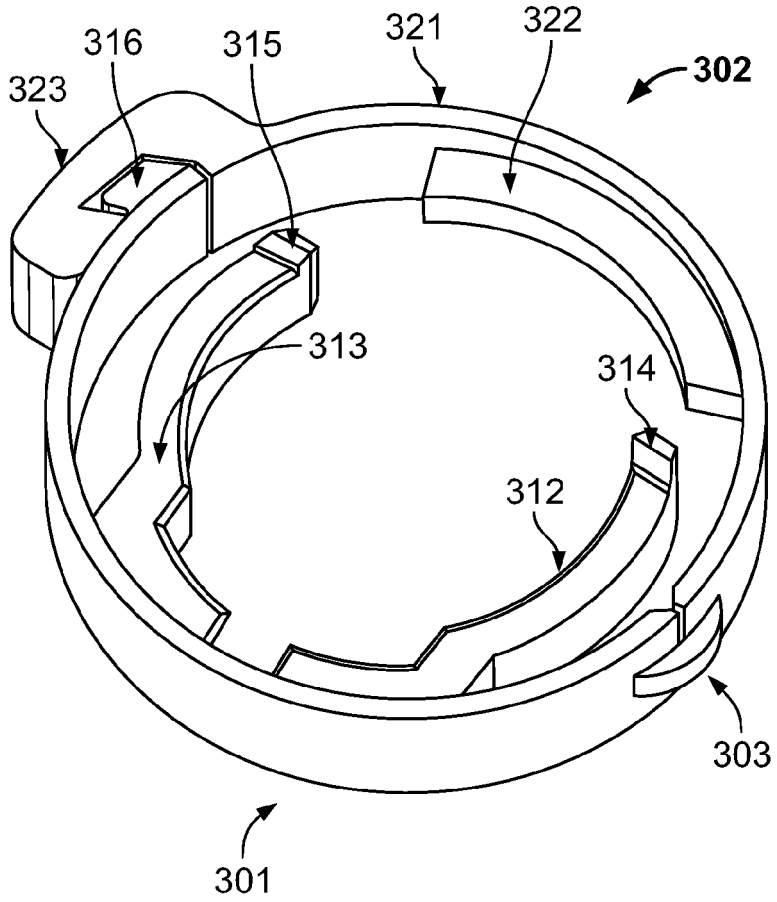
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FIG. 25

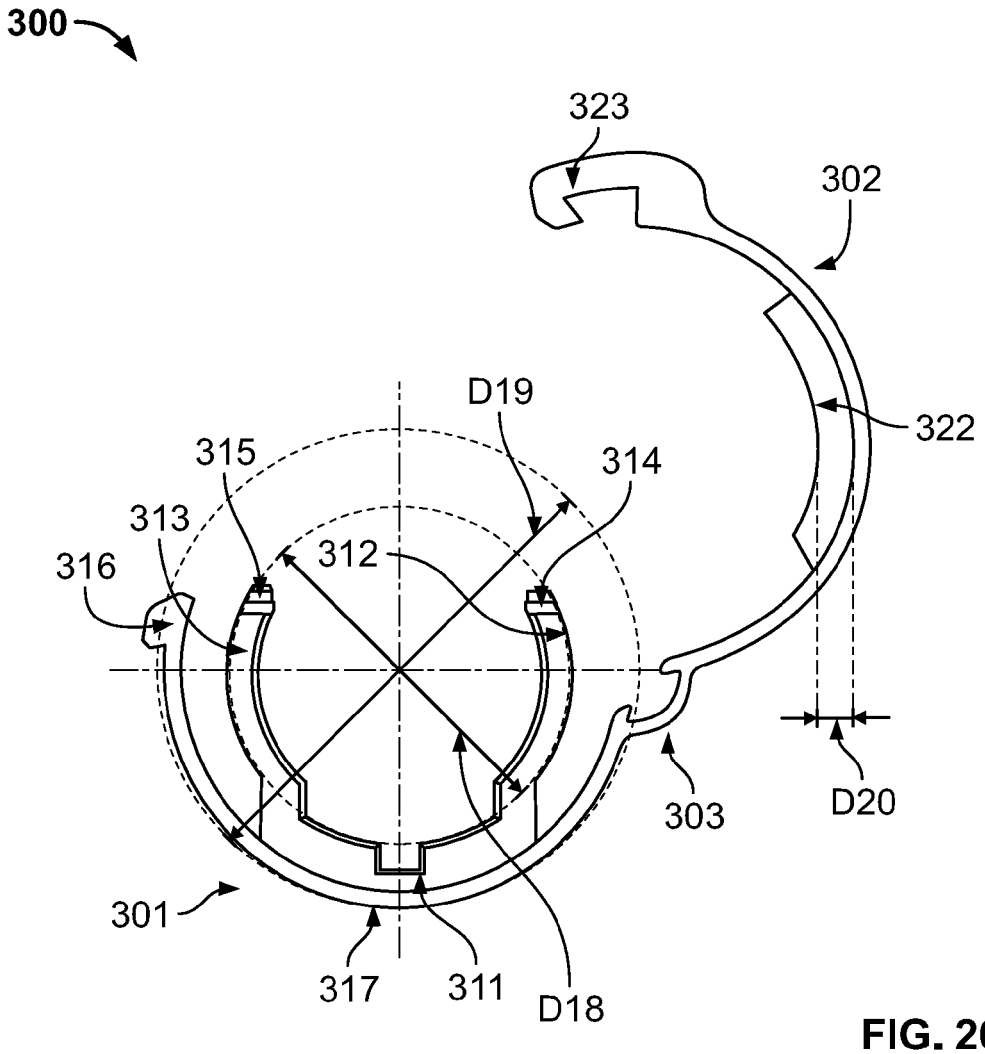
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FIG. 26

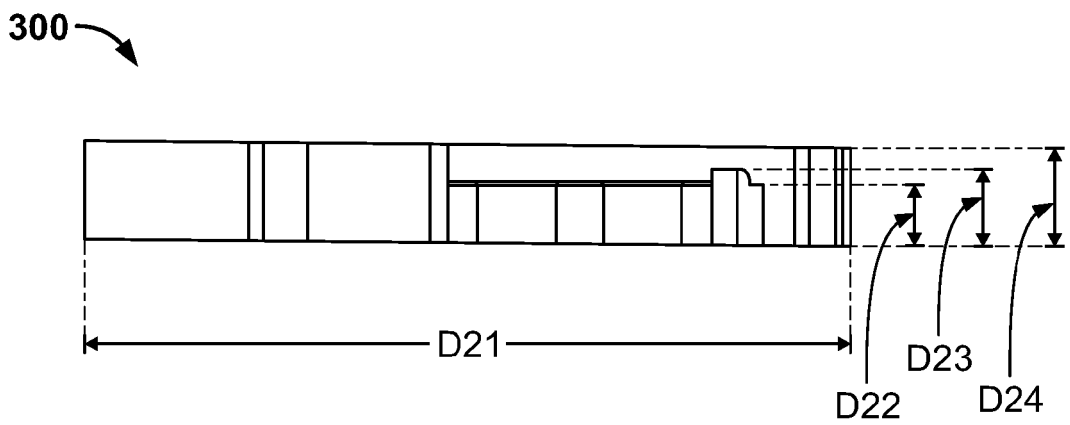
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FIG. 27

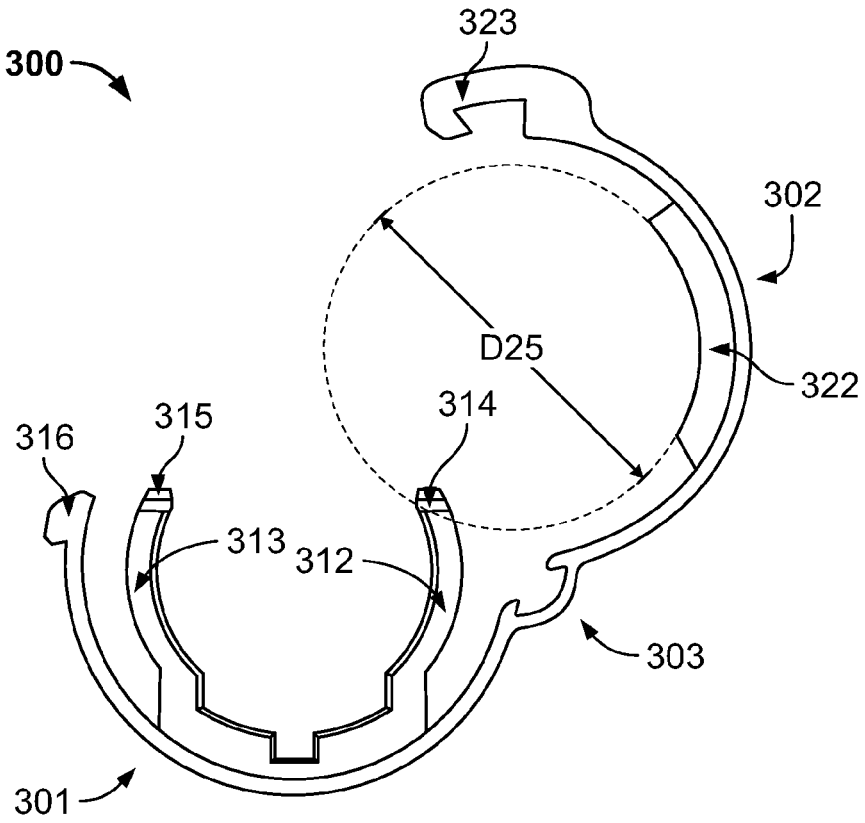
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Fig. 28

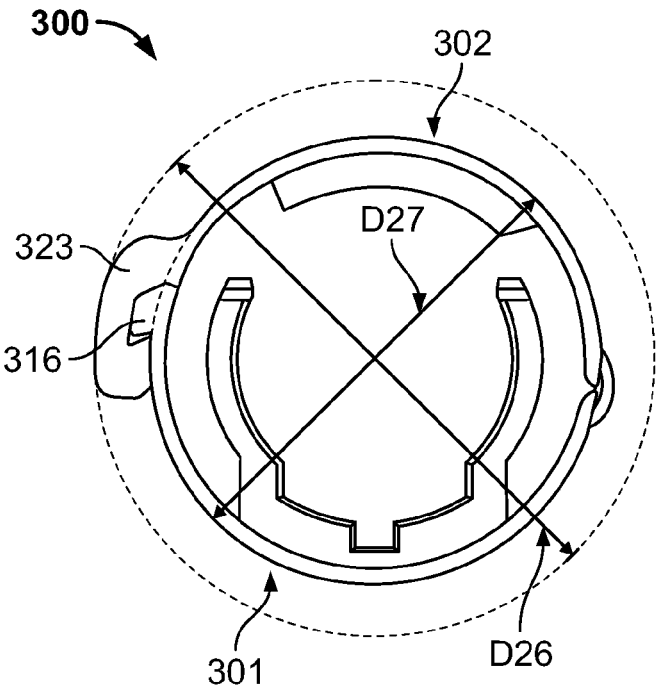
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Fig. 29

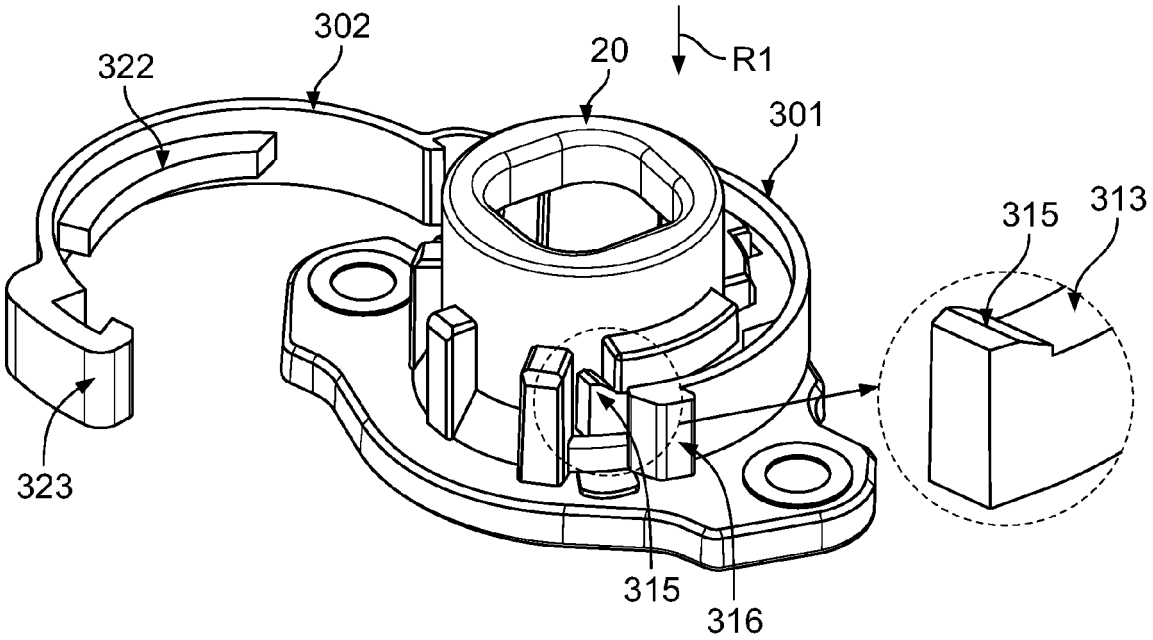

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Fig. 30

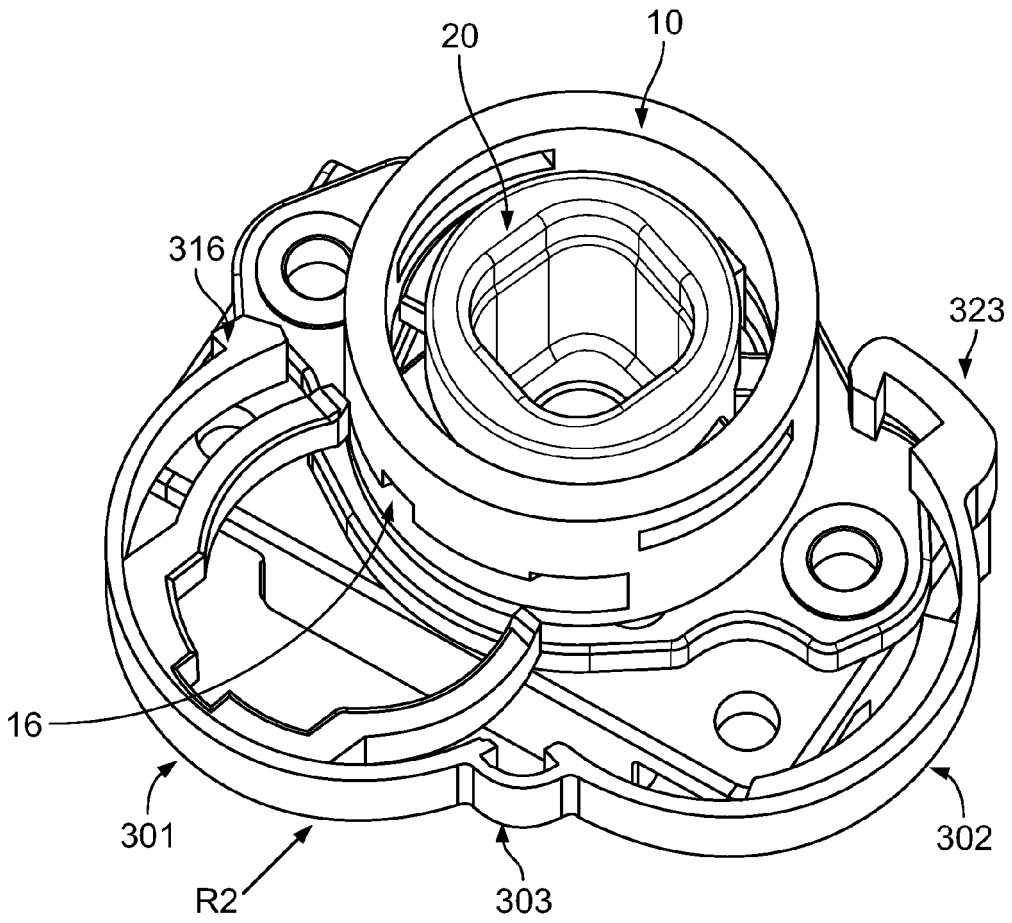

Fig. 31

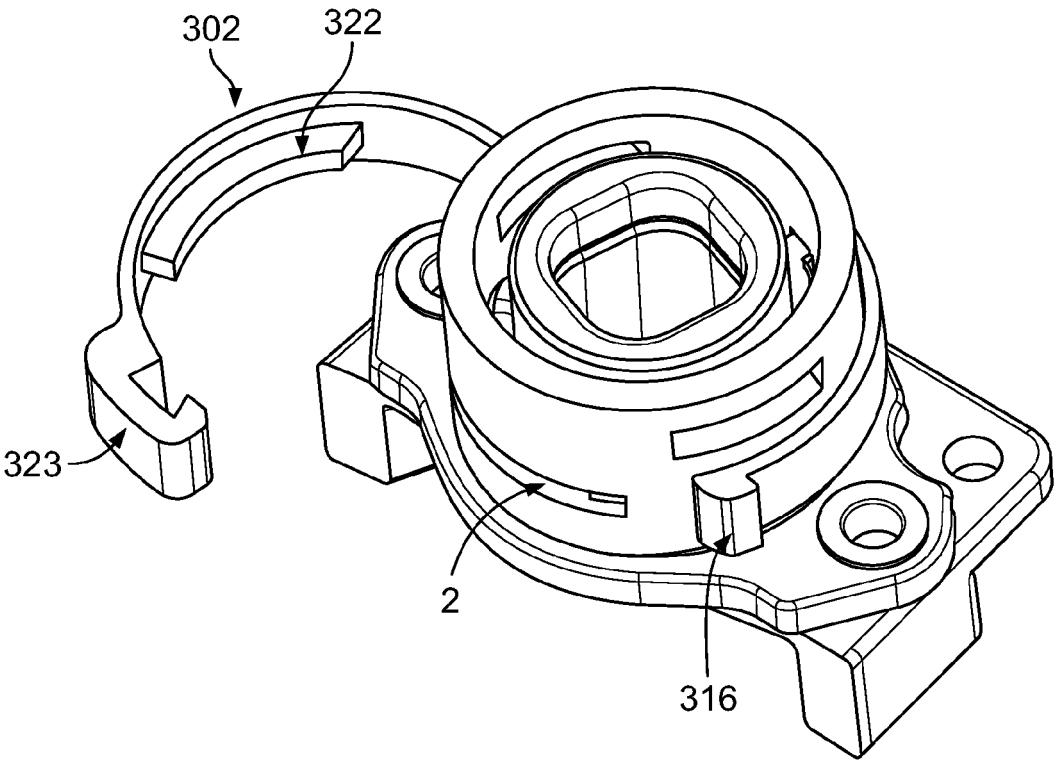

FIG. 32

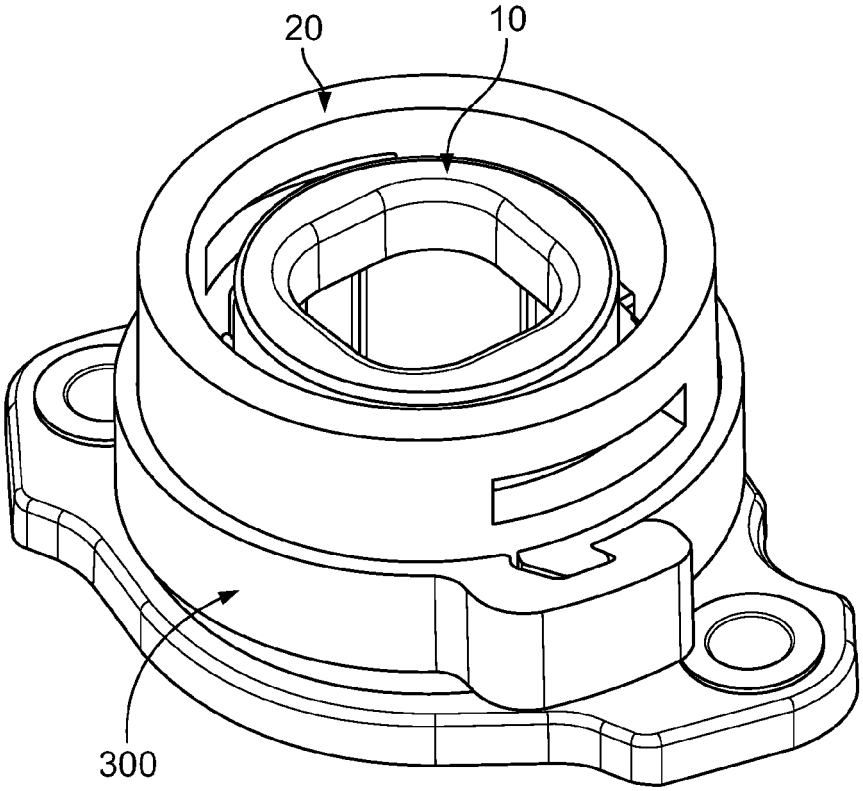

FIG. 33

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EUROPEAN SEARCH REPORT

Application Number
EP 19 21 7174

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 876 745 A1 (TYCO ELECTRONICS FRANCE SAS [FR]) 27 May 2015 (2015-05-27)	14	INV. H01R13/627 H01R13/639 H01R13/641
A	* paragraph [0042] - paragraph [0057] * * figures 3-7D *	1-13	

TECHNICAL FIELDS SEARCHED (IPC)

H01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	24 April 2020	Henrich, Jean-Pascal

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
O : non-written disclosure
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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EPO FORM 1503 03.82 (P04C01)

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24-04-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2876745 A1	27-05-2015	EP 2876745 A1	27-05-2015
		ES 2645139 T3	04-12-2017

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- IT 102017000057099 **[0002]**
- EP 2876745 A1 **[0010]**