(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 742 457 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
13.05.2026 Bulletin 2026/20

(21) Application number: **25210902.0**

(22) Date of filing: **23.10.2025**

(51) International Patent Classification (IPC):
H01R 4/48 *(2006.01)* ***H01R 11/28*** *(2006.01)*
H01R 13/187 *(2006.01)* ***H01R 13/631*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
H01R 4/48; H01R 11/288; H01R 13/187; H01R 13/6315

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
GE KH LA MA MD TN

(30) Priority: **06.11.2024 IT 202400024993**

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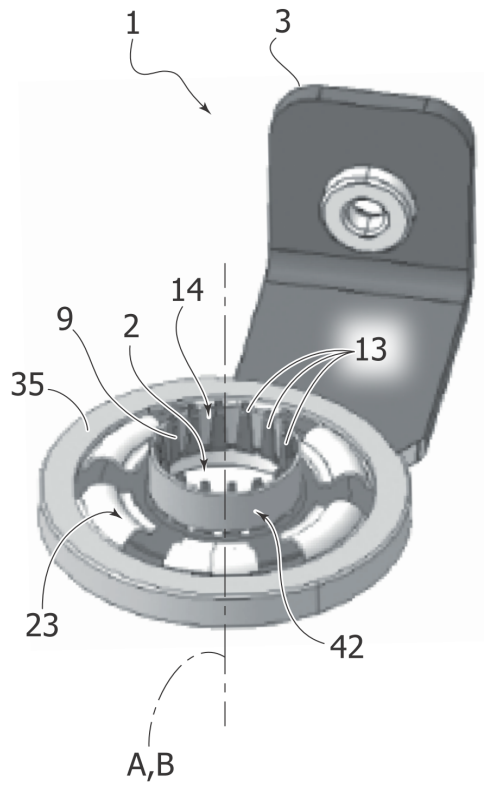
(54) FEMALE ELECTRICAL CONNECTOR FOR A BUSBAR WITH GEOMETRIC TOLERANCE COMPENSATION

(57) A female electrical connector (1) for a bus bar, couplable to a corresponding male electrical connector, comprising:
- a base body (3) including a connecting portion (5) defining a through opening (7) configured to be freely crossed by a terminal (100) of said male electrical connector,
- a contact element (9) slidably arranged on said base body (3), and including a flange portion (11) and a plurality of contactor elements (13) arranged angularly spaced from each other around a first axis (B), and protruding with respect to said flange portion (11) along said first axis (B),
said contactor elements (13) being configured to abut an external surface (101) of the terminal (100) of said male electrical connector thereby forming an electrical connection therewith,
- a first elastic spring element (23) configured to push said flange portion (11) of the contact element (9) against said base body (3),
- a second elastic spring element (42) arranged surrounding said contactor elements (13) of the contact element (9) and configured to apply a preload radial with respect to said first axis (B).

FIG. 1



EP 4 742 457 A1

Description

Field of the invention

[0001] The present invention relates to an electrical connector usable on electrical energy conductive bars, commonly referred to by the expression busbar, suitable for electrically connecting different components of a related system to each other. In particular, the present invention relates to a female type electrical connector couplable to a corresponding male type electrical connector for the conduction of electrical energy, for example in applications characterized by high current.

Prior art

[0002] In the field of electrical energy conduction, particularly for establishing an electrical connection between a first component, for example a busbar, and a second component, it is widely known to use pairs of electrical connectors carried respectively by the first component and the second component and configured to mutually engage in order to establish an electrical connection. Generally, such pairs of electrical connectors comprise a first electrical connector commonly referred to as "female type" and a second electrical connector commonly referred to as "male type", wherein the female electrical connector defines a seat suitable for receiving an electrical terminal, for example a pin, of the male connector.

[0003] More in detail, female electrical connectors generally comprise one or more contact elements defining contact surfaces intended to abut against the electrical terminal of the male connector, thereby establishing the electrical connection between the two connectors.

[0004] A limitation of known electrical connectors is represented by the fact that the mutual engagement between the male connector and the female connector requires high precision in the positioning of the contact elements, which can be compromised by the chain of geometric tolerances introduced during the design phase of the connectors, as well as by incorrect alignment of the components to be electrically connected.

[0005] Therefore, there is a particularly felt need to produce electrical connectors capable of guaranteeing an electrical connection between two components even in the case of misalignments, for example parallel or angular, between the electrical terminal of the male type electrical connector and the corresponding seat of the female type electrical connector.

[0006] For this purpose, document US 11,855,388 B2 describes a female type electrical connector couplable to a pin of a corresponding male type electrical connector, comprising an elastic contact element configured to be mounted on a contact circuit and an external housing arranged to protect the contact element. In particular, the elastic contact element comprises a plurality of shaped laminations connected to each other by a connecting element and having respective contact portions and respective.

[0007] More in detail, the contact portions are shaped so as to define respective shaped contact areas suitable for abutting against the pin of the male connector, establishing the electrical connection between the pin and the contact element. The curved elastic portions are, instead, received within a compartment defined by the external housing and are made in such a way that when the pin is inserted inside the connector with misalignment, they elastically deform by abutting against an external surface of the housing and causing the housing to translate, aligning it with the pin.

[0008] This solution is not, however, free from drawbacks. In fact, a female type electrical connector of this type proves complex in design and realization.

[0009] Furthermore, the shaped geometry of the contact portions does not guarantee an electrical contact in case of deformation

Object of the invention

[0010] It is therefore an object of the invention to produce an electrical connector of the type indicated above which is free from the drawbacks discussed above.

[0011] In particular, an object of the invention is to produce a female type electrical connector that allows receiving an electrical terminal of a corresponding male connector even in the case of misalignments, for example parallel or angular misalignment, between the terminal and the respective seat of the two connectors.

[0012] A further object of the present invention is to produce an electrical connector of the type indicated above which is simple and economical to produce.

Summary of the invention

[0013] With a view to achieving the aforementioned object, the invention has for its object a female type electrical connector for a busbar, couplable to a corresponding male type connector, comprising:

- a base body including a connection portion defining a through opening configured to be freely traversed by a terminal of the male connector,
- a contact element slidably mounted on the base body, and including a flanged portion and a plurality of contact elements angularly spaced apart from each other around a first axis and protruding relative to said flanged portion along said first axis,

the contact elements being configured to abut with an external surface of the terminal of the male type electrical connector establishing an electrical connection therewith,

- a first elastic spring element configured to press the flanged portion of the contact element against the base body,

- a second elastic spring element arranged to surround the contact elements of the contact element and configured to apply on each contact element a radial preload in the direction of the first axis.

[0014] The present invention also has for its object a method for assembling the female type electrical connector, according to the characteristics indicated in claim 8.

Brief description of the figures

[0015] Further characteristics and advantages of the invention will become apparent from the following description with reference to the accompanying drawings, provided by way of non-limiting example, in which:

- figure 1 is a perspective view of an electrical connector according to the present invention,
- figure 2 is an exploded perspective view of the electrical connector of figure 1,
- figure 3 is a perspective view of an electrical connector according to the present invention in a configuration coupled with an electrical terminal of a second electrical connector,
- figure 4 is a perspective view of an alternative embodiment of the electrical connector according to the present invention,
- figures 5A and 5B are perspective views of a component of the electrical connector according to the present invention,
- figures 6A and 6B are perspective views of a component of the electrical connector according to the present invention,
- figure 7 is a perspective view of a component of the electrical connector according to the present invention,
- figure 8 is a perspective view of the connector according to the present invention in an alternative assembly configuration,
- figure 9 is a sectional view of a coupling configuration of the electrical connector according to the present invention,
- figures 10A - 10C are sectional views of a coupling sequence of the electrical connector according to the present invention according to an alternative coupling configuration,
- figures 11A - 11C are plan views of the coupling sequence of figures 10A - 10C
- figure 12 is a sectional view of an alternative coupling configuration of the electrical connector according to the present invention
- figure 13 is a perspective view illustrating some steps of the assembly method of the electrical connector according to the present invention.

Detailed description of several embodiments

[0016] In the following description, various specific details are illustrated aimed at an in-depth understanding of examples of one or more embodiments. The embodiments can be realized without one or more of the specific details, or with other methods, components, materials, etc. In other cases, known structures, materials or operations are not shown or described in detail to avoid obscuring various aspects of the embodiments. Reference to "an embodiment" within this description is intended to indicate that a particular configuration, structure or characteristic described in relation to the embodiment is included in at least one embodiment. Therefore, phrases such as "in one embodiment", possibly present in different places in this description, are not necessarily referring to the same embodiment. Furthermore, particular conformations, structures or characteristics can be suitably combined in one or more embodiments and/or associated with the embodiments in a different way than illustrated here, so that for example a characteristic exemplified here in relation to one figure can be applied to one or more embodiments exemplified in a different figure. The references illustrated here are only for convenience and therefore do not limit the scope of protection or the scope of the embodiments.

[0017] With reference to the figures, reference numeral 1 indicates as a whole a female type electrical connector usable for the electrical connection of two components of a system (not visible in the figures), for example in applications in the field of batteries for electric vehicles, in the railway sector, or more generally in electrical applications characterized by high current.

[0018] In particular, the electrical connection between the two components is realized by means of a coupling between the female type electrical connector 1 carried by the first component, for example an electrical energy conduction bar, commonly referred to by the expression busbar, and a corresponding male type electrical connector carried by the second component.

[0019] An known per se, the coupling between the electrical connector 1 and the corresponding male type electrical connector occurs by means of a mutual engagement between an engagement element, hereinafter referred to as terminal and indicated by reference numeral 100 in the figures, of the male type connector and a respective seat 2 defined by the female type connector 1.

[0020] In the embodiment illustrated in figures 1 to 3, the electrical connector 1 comprises a base body 3 including a connection portion 5 defining a through opening 7, and a contact element 9 associated with the base body 3 and comprising a flanged portion 11 and a plurality of contactor elements 13 configured to contact the terminal 100 during a coupling phase of the connector 1 with the corresponding male connector.

[0021] In a preferred embodiment, which will be referred to in the following of the present description, the connector 1 and the corresponding male connector are of

the "cylindrical" type.

[0022] In other words, the terminal 100 of the male connector has a substantially cylindrical geometry having a circular cross-section. Accordingly, the seat 2 defined by the connector 1 has a geometry such as to come into contact in a substantially axisymmetric manner, as will become clearer in the following of the present description.

[0023] In this example, the through opening 7 of the connection portion 5 has a substantially circular geometry which identifies a first axis of symmetry A.

[0024] Naturally, embodiments are not excluded wherein the terminal 100 and the seat 2 have any cross-sections.

[0025] Figure 4 illustrates an alternative embodiment of the present invention, in which the electrical connector 1 comprises two distinct contact sites, or in other words, comprises two female connector portions, indicated by reference numeral 1', arranged at respective connection portions 5 provided on two opposite ends of the base body 3, and defining respective seats 2 for coupling with respective terminals 100 of a corresponding male electrical connector.

[0026] The two female connector portions 1' are entirely analogous in construction and operation to the electrical connector 1 which is the subject of figures 1 to 3; therefore, the considerations made in the following of the present description with reference to the connector according to the embodiment of figures 1 to 3 remain valid for the embodiment illustrated in figure 4.

[0027] With reference to figures 5A and 5B, the flanged portion 11 of the contact element has a substantially annular geometry and extends around a second axis B, defining a passage 14 freely traversable by the terminal 100 and developing along the second axis B.

[0028] The contactor elements 13 are arranged angularly spaced apart from each other around the second axis B and extend protruding relative to the flanged portion 11 parallel to the second axis B.

[0029] As illustrated in the figures, in an assembled configuration of the electrical connector 1, the contact element 9 is slidably mounted on the base body 3.

[0030] More in detail, the contact element 9 is mounted such that an external surface, for example a lower surface 12 (figure 5B) of the flanged portion 11 is arranged overlapping and abutting against a face 15, for example an upper face 15, of the connection portion 5 of the base body.

[0031] In the illustrated embodiment, in an assembled configuration of the electrical connector 1 the base body 3 and the contact element 9 are arranged such that the through opening 7 of the connection portion 5 and the passage 14 defined by the contact element 9 are arranged coaxially to define said seat 2 or, in other terms, such that the first and second axes A, B are coincident.

[0032] Still with reference to figures 5A and 5B, each contactor element 13 of the contact element comprises a base portion 17 rigidly connected to the flanged portion 11, and a free end portion 19 arranged at an end opposite the base portion 17.

[0033] In particular, each end portion 19 defines a contact surface 21 configured to abut against an external surface 101 of the terminal 100 of the male type electrical connector 100, establishing an electrical connection with it.

[0034] With reference to figure 3 and from the preceding description, it is therefore evident that the electrical coupling between the electrical connector 1 and the terminal 100 of the male electrical connector is realized by bringing the terminal 100 and the seat 2 into mutual engagement, in particular by inserting the terminal 100 through the through opening 7 of the base body 3 and through the passage 14 of the contact element 9 and bringing the external surface 101 of the terminal 100 into abutment against the contact surfaces 21 of the contactor elements 13.

[0035] In a preferred embodiment, the contactor elements 13 of the contact element 9 extend along respective directions incident to the second axis B and converging with each other proceeding from their respective base portions 17 towards the end portions 19.

[0036] In other words, the contactor elements 13 define in the space between them a portion of the seat 2 having a substantially truncated conical geometry including a first larger base near the opening 7 of the connection portion 5 and a smaller base at the end portions 19. Advantageously, such a geometry of the contactor elements 13 to facilitates an insertion of the terminal 100 during a coupling phase of the electrical connector 1 with the respective male electrical connector.

[0037] In the considered embodiment, when the terminal 100 of the male type electrical connector is inserted into the seat 2 and brought into abutment with the contactor elements 13, it elastically deforms the contactor elements 13 radially outward relative to the second axis B. Consequently, the elastic spring reaction of the contactor elements 13 determines an increase in the contact pressure with the terminal 100, thereby reducing the risk of contact interruption or disengagement of the terminal 100, due for example to vibrations.

[0038] With particular reference to figures 1 to 3 and figures 6A and 6B, the electrical connector 1 according to the present invention further comprises a first elastic spring element 23 configured to press the contact element 9 against the connection portion 5 of the base body 3 so as to maintain a contact between the external surface of the flanged portion 11 and the face 15 of the connection portion 5.

[0039] In the illustrated embodiment, the first elastic spring element 23 is in the form of a cup spring comprising an annular body 25 disposed externally to the contact element 9 and so as to surround a lateral band of the flanged portion 11, and a plurality of retention clips 27 arranged angularly spaced apart from each other along a peripheral edge 29 of the annular body 25 and configured to exert a pressure on the flanged portion 11 of the contact

element 9.

[0040] In particular, each retention clip 27 comprises an elastic arm 31 extending from the annular body 25 and defining a respective contact area 33 suitable for abutting against a surface, for example an upper surface 34, of the flanged portion 11, meaning by the term "upper surface" the surface of the flanged portion 11 opposite the lower surface 12 abutting against the base body 3.

[0041] Naturally, the first elastic spring element 23 is described here by way of example only. Embodiments are not excluded comprising any type of retention element suitable for pressing the flanged portion 11 of the contact element 9 and the base body 3 together.

[0042] For example, in an alternative embodiment not illustrated in the figures, the retention clips 27 of the first elastic spring element 23 can comprise respective second arms extending from the edge 29 so as to externally surround the connection portion 5 and abut against a lower surface of the base body 3, meaning by the term "lower surface", the surface of the base body 3 opposite the face 15 in abutment with the contact element 9, thereby realizing an "anchoring" of the spring element 23 on the base body 3. In this configuration, the retention clips act like pliers to press the flanged portion 11 of the contact element 9 and the connection portion 5 of the base body 3 together in a stack.

[0043] With particular reference to figure 7, the electrical connector 1 according to the present invention may further comprise a retaining element 35 extending externally to the first elastic spring element 23 and configured to maintain the first elastic spring element 23 in position relative to the connection portion 5 of the base body 3.

[0044] In the embodiment illustrated in the figures, the retaining element 35 has an annular geometry having a substantially C-shaped cross-section.

[0045] More in detail, the retaining element 35 comprises a lateral band 37 arranged to surround at least a portion of a peripheral edge of the connection portion 5 and of the peripheral edge 29 of the annular body 25 of the first elastic spring element 23, and a pair of surfaces 39A, 39B spaced apart from each other and connected by the lateral band 37, configured to abut respectively against the upper face 15 of the base body 3 on one side and against a lower face 41, opposite the upper face 15, of the base body 3.

[0046] In other words, the pair of surfaces 39A and 39B acts like pliers, pressing the annular body 25 of the first elastic spring element 23 and the connection portion 5 of the base body 3 together in a stack.

[0047] As can be inferred from the preceding description, the provision of the retaining element 35 allows preventing a sliding of the contact element 9 relative to the base body 3 along the second axis B.

[0048] In fact, as will become clearer in the following of the present description, maintaining the first elastic spring element 23 in position allows applying an elastic spring reaction on the flanged portion 11 by means of the retention clips 27 in the presence of forces acting on the contact element 9 parallel to axis B or, in other terms, tending to separate the contact element 9 from the base body 3 interrupting the contact between them.

[0049] Naturally, the retaining element 35 is described here by way of example only. Embodiments are not excluded comprising any type of retaining element suitable for maintaining the first elastic spring element 23 in position relative to the base body 3.

[0050] According to a further characteristic of the present invention, the electrical connector 1 comprises a second elastic spring element 42, preferably in the form of a torsion spring 42, arranged to surround the contactor elements 13 of the contact element 9.

[0051] In particular, the second elastic spring element 42 is arranged fitted with interference on the contactor elements 13 so as to apply a radial preload on them in the direction of the second axis B. In this way, during the coupling phase of the contact element 9 with the terminal 100 of the male type electrical connector, it is possible to increase the contact pressure between the contactor elements 13 and the surface 101 of the terminal 100 further reducing the risk of disengagement of the terminal 100 and, therefore, the interruption of contact.

[0052] In one or more embodiments and with reference to figure 8, at least one of the contactor elements 13 comprises a free end 43 protruding relative to the second elastic spring element 42 along the second axis B and bent so as to extend radially outward relative to the second axis B.

[0053] In this configuration, the second elastic spring element 42 is limited along the second axis B by the flanged portion 11 on one side and by the bent free portions 43 of the contactor elements 13 on the other.

[0054] In this way, it is therefore possible to block a relative sliding of the second elastic spring element 42 relative to the contact element 9 along the second axis B, without however blocking a radial deformation of the elastic element 42, for example, in the case of a torsion spring 42, without preventing the coils of the spring from sliding relative to each other.

[0055] According to a particularly advantageous characteristic of the present invention, and with reference to figures 9 to 11, the electrical connector 1 is configured to receive the terminal 100 even in case of misalignment between the terminal 100 and the through opening 7 of the connection portion.

[0056] By the term misalignment between the terminal 100 and the contact element 9 is meant an offset between a direction C of extension of the terminal 100 and the first axis A defined by the through opening 7.

[0057] More in detail, such misalignment can be parallel, i.e., the first axis A and the direction C are parallel and spaced apart from each other by a distance D, or angular, i.e., the direction C is incident relative to the first axis A and defines an angle X with it, and can be due, for example, to a chain of geometric tolerances imposed during a design phase of the components to be electri-

cally connected and/or of the electrical connectors, or to an incorrect assembly of the components, or yet to plastic deformations of the components.

[0058] In the preceding description, the electrical connector 1 has been described in a nominal alignment configuration, in which the first axis A coincides with the second axis B and in which, during the coupling with the terminal 100, the direction C is aligned with the first and second axes A, B, as illustrated in figure 8.

[0059] Figures 10A to 10C and 11A to 11C illustrate a coupling sequence between the electrical connector 1 and the terminal 100 in a configuration in which the direction C of extension of the terminal 100 extends parallel and spaced relative to the first axis A by a distance D.

[0060] By way of example only, the coupling process between the electrical connector 1 and the terminal 100 will be described starting from a condition in which the contact element 9 has the second axis B arranged coincident with the first axis A.

[0061] With reference to figures 10A and 11A, in such a configuration, when the terminal 100 is inserted through the through opening 7 of the base body 3, the surface 101 of the terminal 100 abuts against a group of contactor elements 13 (in the illustrated example the contactor elements 13 on the left).

[0062] The force exerted by the terminal 100 on the contactor elements 13 imposes a displacement of the contact element 9 along a plane orthogonal to the second axis B.

[0063] In particular, as illustrated in figures 10B and 11B, the displacement of the contact element 9 comprises a sliding of the flanged portion 11 relative to the connection portion 5 of the base body 3 such that the contact element passes from a first position in which the second axis B is coincident with the first axis A, to a second position in which the second axis B results aligned with the direction C of the terminal 100.

[0064] Note that during the insertion of the terminal 100, the relative position along the plane orthogonal to the directions A, B, C between the terminal 100 and the base body 3 remains constant. In other words, the insertion of the terminal 100 comprises a displacement of the terminal 100 having a single longitudinal component parallel to the direction C of extension of the terminal 100. By way of example only, in the figures the terminal 100 moves only vertically.

[0065] Note how the application of the force exerted by the terminal 100 on the contactor elements 13 can in general be decomposed into two main components, respectively one parallel and one orthogonal to the second axis B.

[0066] More in detail, the component of said force parallel to the second axis B is counteracted by the spring back action of the first elastic spring element 23 which tends to keep the flanged portion 11 pressed against the base body 3. The component orthogonal to the second axis B, instead, is partly counteracted by the friction between the mutually contacting surfaces of the flanged portion 11 and the base body 3.

[0067] With reference to figures 10C and 11C, when the contact element 9 reaches a final position in which the second axis B is aligned with the direction C, a final phase of the process of coupling the terminal 100 to the electrical connector 1 comprises the application of a second force suitable for elastically deforming the contactor elements 13 and radially widening the second elastic spring element 42, establishing an electrical connection between the electrical connector 1 and the corresponding male electrical connector.

[0068] Figure 12 illustrates a further coupling configuration between the electrical connector 1 and the terminal 100 in which the direction C of extension of the terminal 100 extends incident relative to the first axis A, forming an angle X with it.

[0069] In particular, figure 12 illustrates possible arrangements and orientations of the terminal 100 (for clarity and simplicity of representation, only the possible orientations of the extension axis C of the terminal 100 are illustrated).

[0070] Also in this case, the coupling process between the electrical connector 1 and the terminal 100 will be described, by way of example only, starting from a condition in which the contact element 9 has the second axis B arranged coincident with the first axis A.

[0071] Analogously to the case of coupling with parallel misalignment discussed above, when the terminal 100 is inserted through the through opening 7 of the base body 3, the surface 101 abuts against a part of the contactor elements 13 (in the illustrated example the elements 13 on the right).

[0072] In this case, the force exerted by the terminal 100 on the contactor elements 13 imposes an uneven elastic deformation of the contactor elements 13 around the second axis B.

[0073] With reference to figure 13, the method for assembling the electrical connector 1 according to the present invention is described below.

[0074] In particular, the method comprises slidably mounting the contact element 9 on the connection portion 5 of the base body 3 such that an external surface of the flanged portion 11 results abutting against the face 15, preferably the upper face 15, of the base body.

[0075] The assembly method further comprises fitting, preferably with interference, the second elastic spring element 42 onto the contact element 9 so as to externally surround the contactor elements 13.

[0076] A further phase of the assembly method comprises associating the first elastic spring element 23 with the contact element 9 so as to engage the flanged portion 11 of the contact element 9 and the connection portion 5 of the base body 3.

[0077] More in detail, associating the first elastic spring element 23 with the contact element 9 comprises applying the retention clips 27 such that their respective elastic arms 31 result abutting against the face 34 of the flanged

portion 11.

[0078] The method may further comprise plastically deforming at least one of the contactor elements 13 by bending its respective free end portion 43 radially outward relative to the second axis B so as to block a sliding, and possible disengagement, of the second elastic spring element 42 relative to the contact element 9 along the second axis B.

[0079] With particular reference to figures 1 and 2, in one or more embodiments, the assembly method further comprises associating the retaining element 35 with the first elastic spring element 23.

[0080] More in detail, associating the retaining element 35 with the first elastic spring element 23 comprises arranging the lateral band 37 of the retaining element 35 to surround a peripheral edge of the flanged portion 11 and simultaneously bringing the surface 39B of the retaining element 35 into abutment against the second face 41 of the base body.

[0081] In this phase, the retaining element 35 has a substantially L-shaped cross-section, wherein the lateral band 37 and the surface 39A are substantially parallel to each other.

[0082] A further mounting phase of the retaining element 35 comprises bending the surface 39A along a bending line 51 so as to bring the surface 39A into abutment against the annular body 25 of the first elastic spring element 23.

[0083] From the preceding description, it is therefore evident that the female type electrical connector 1 according to the present invention is particularly advantageous in that it allows guaranteeing a correct electrical connection with the corresponding male type electrical connector, even under conditions of misalignment between the direction C of extension of the terminal 100 and the second axis B around which the contact element 9 extends.

[0084] In other words, the electrical connector is capable of recovering errors, radial and/or angular, due, for example, to chains of geometric tolerances introduced during the design phase of the connector.

[0085] A further advantage of the present solution concerns the fact of implementing this capability of recovering geometric tolerances by employing a reduced number of components, and requiring components that are simple to produce and assemble.

[0086] A further advantage of the present solution relates to the lower effort required from an operator to realize the coupling between the female electrical connector 1 and the terminal 100. In fact, particularly in case of misalignment between the terminal 100 and the contact element 9, the coupling phase of the two connectors involves the application of two distinct forces applied at different instants, in particular a first force suitable for moving the contact element aligning it to the terminal 100, and a second force suitable for elastically deforming the contactor elements 13 realizing the contact. The decoupling of the two forces allows, therefore, reducing the maximum force necessary to realize the electrical coupling.

[0087] Furthermore, the provision of the elements 23, 42 is particularly advantageous in that it allows realizing a structure of the electrical connector 1 that is flexible and deformable so as to adapt to different misalignment configurations of the terminal 100, and at the same time rigid such that the elastic spring back reactions maintain a contact between the terminal 100 and the contact element 9, and between the contact element 9 and the connection portion 5, thereby guaranteeing the electrical connection between the terminal 100 and the base body 3.

[0088] Naturally, the principle of the invention remaining the same, the construction details and embodiments may vary widely with respect to what has been described and illustrated by way of example only, without thereby departing from the scope of the present invention as defined in the appended claims.

Claims

1. A female electrical connector (1) for a bus bar, couplable to a corresponding male electrical connector, comprising:

- a base body (3) including a connecting portion (5) defining a through opening (7) configured to be freely crossed by a terminal (100) of said male electrical connector,
- a contact element (9) slidably arranged on said base body (3), and including a flange portion (11) and a plurality of contactor elements (13) arranged angularly spaced from each other around a first axis (B), and protruding with respect to said flange portion (11) along said first axis (B),

said contactor elements (13) being configured to abut an external surface (101) of the terminal (100) of said male electrical connector thereby forming an electrical connection therewith,

- a first elastic spring element (23) configured to push said flange portion (11) of the contact element (9) against said base body (3),
- a second elastic spring element (42) arranged surrounding said contactor elements (13) of the contact element (9) and configured to apply a preload radial with respect to said first axis (B).

2. Electrical connector according to claim 1, wherein each of said contactor elements (13) comprises a base portion (17) rigidly connected to said flange portion (11) and a free end portion (19) defining a contact surface (21) for forming said electrical connection with the terminal (100) of said male electrical

connector.

3. Electrical connector according to claim 2, wherein said contactor elements (13) extend along respective directions incident to said first axis (B) and converging to each other proceeding from said base portions (17) to said free end portions (19).

4. Electrical connector according to any one of the preceding claims, wherein said second elastic spring element (42) is in the form of a torsion spring.

5. Electrical connector according to any one of the preceding claims, wherein said first elastic spring element (23) is in the form of a cup spring comprising an annular body (25) arranged so as to surround an external band of said flange portion (11) of the contact element (9) and a plurality of retaining clips (27) arranged angularly spaced from each other around said first axis (B) along a peripheral border (29) of said annular body (25),
each retaining clip (27) being configured to engage said contact element (9) so as to keep the flange portion (11) of the contact element (9) abutting against said connecting portion (5) of the base body (3).

6. Electrical connector according to any one of the preceding claims, comprising a retaining element (35) extending externally with respect to said first elastic spring elements (23) and configured to hold in position said first elastic spring element (23) with respect to said base body (3).

7. Electrical connector according to any one of the preceding claims, wherein at least one of said contactor elements (13) comprises a free end (43) protruding with respect to said second elastic spring element (42) along said first axis (B) and extending radially outward with respect to said first axis (B) so as to prevent an axial sliding of said second elastic spring element (42) with respect to said contact element (9) parallelly to said first axis (B).

8. A method for assembling a female electrical connector (1) for a bus bar, couplable to a corresponding male electrical connector,

wherein said female electrical connector (1) comprises:

- a base body (3) including a connecting portion (5) defining a through opening (7) configured to be freely crossed by a terminal (100) of said male electrical connector,
- a contact element (9) including a flange portion (11) and a plurality of contactor elements (13) arranged angularly spaced from each other around a first axis (B), and protruding with respect to said flange portion (11) along said first axis (B),
- a first elastic spring element (23) configured to push said flange portion (11) of the contact element (9) against said base body (3),
- a second elastic spring element (42) arranged surrounding said contactor elements (13) of the contact element (9) and configured to apply a preload radial with respect to said first axis (B),

the method comprising:

- slidably arranging said contact element (9) on said base body (3), wherein said step of arranging the contact element (9) comprises bringing into abutment an external surface (12) of said flange portion (11) against a face (15) of said connecting portion (5) of the base body (3),
- fitting with interference said second elastic spring element (42) on said contact element (9) so as to surround said contactor elements (13),
- associating said first elastic spring element (23) to said contact element (9) so that said first elastic spring element (23) engages said flange portion (11) of said contact element (9) and said connecting portion (5) of said base body (3).

9. The method according to claim 8, comprising plasticly deforming at least one connector element (13) so as to fold a respective free end portion (43) thereof radially outward with respect to said first axis (B) so as to prevent an axial sliding of said second elastic spring element (42) with respect to said contact element (9) along said first axis (B).

10. The method according to claim 8, wherein said female electrical connector (1) has one or more of the characteristics of claims 2 to 7.

FIG. 3

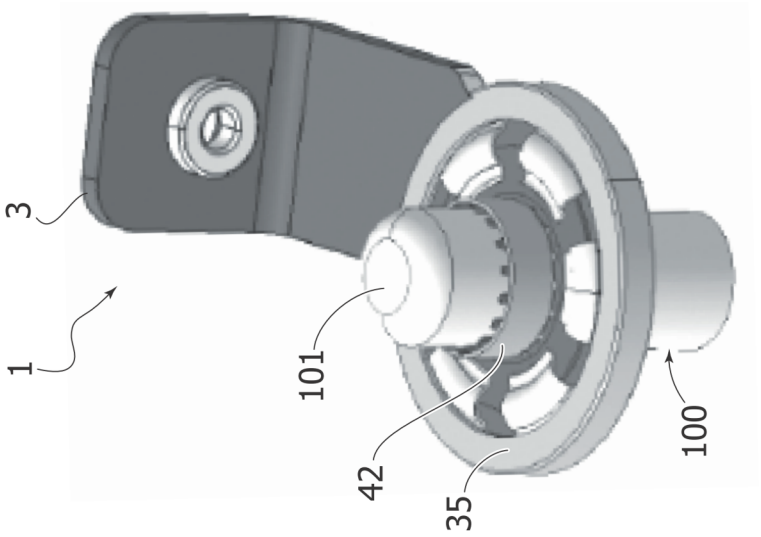


FIG. 2

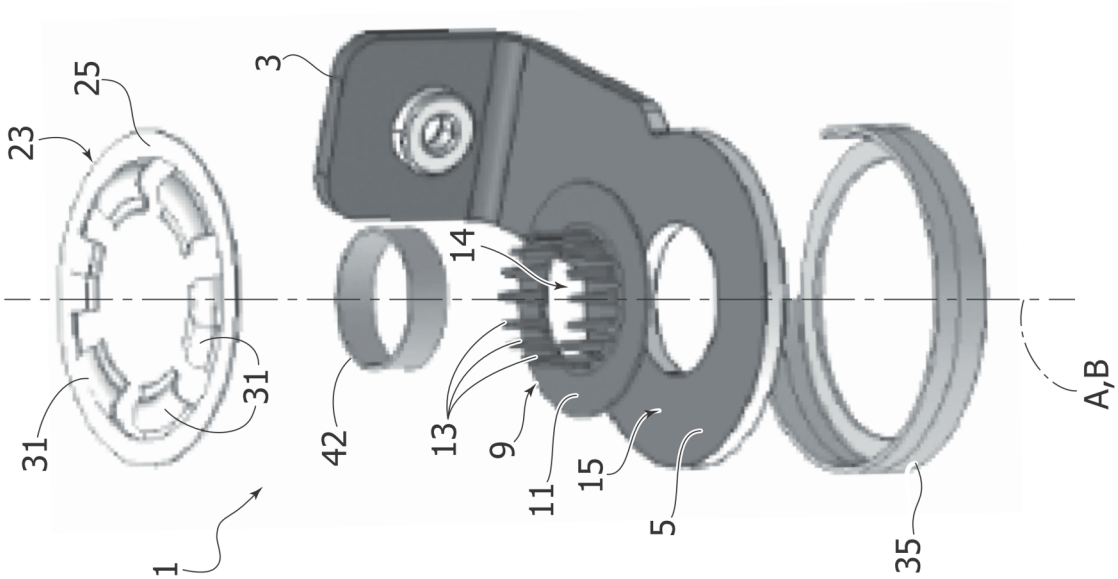


FIG. 1

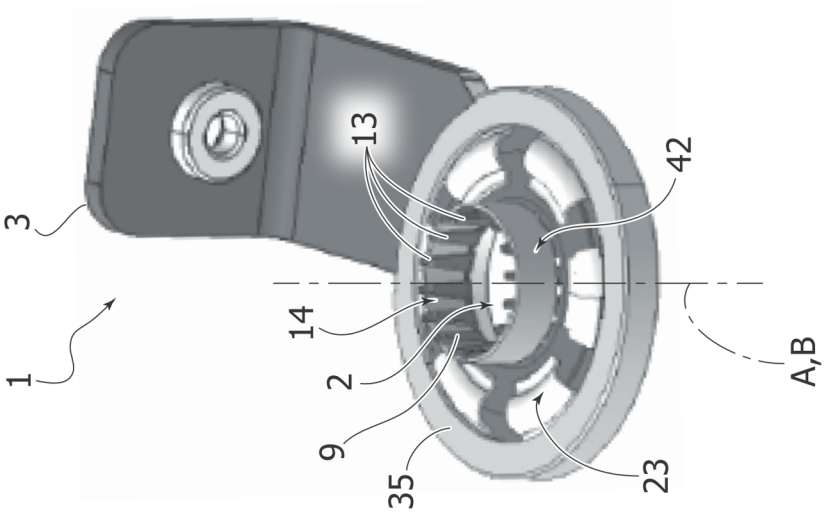


FIG. 4

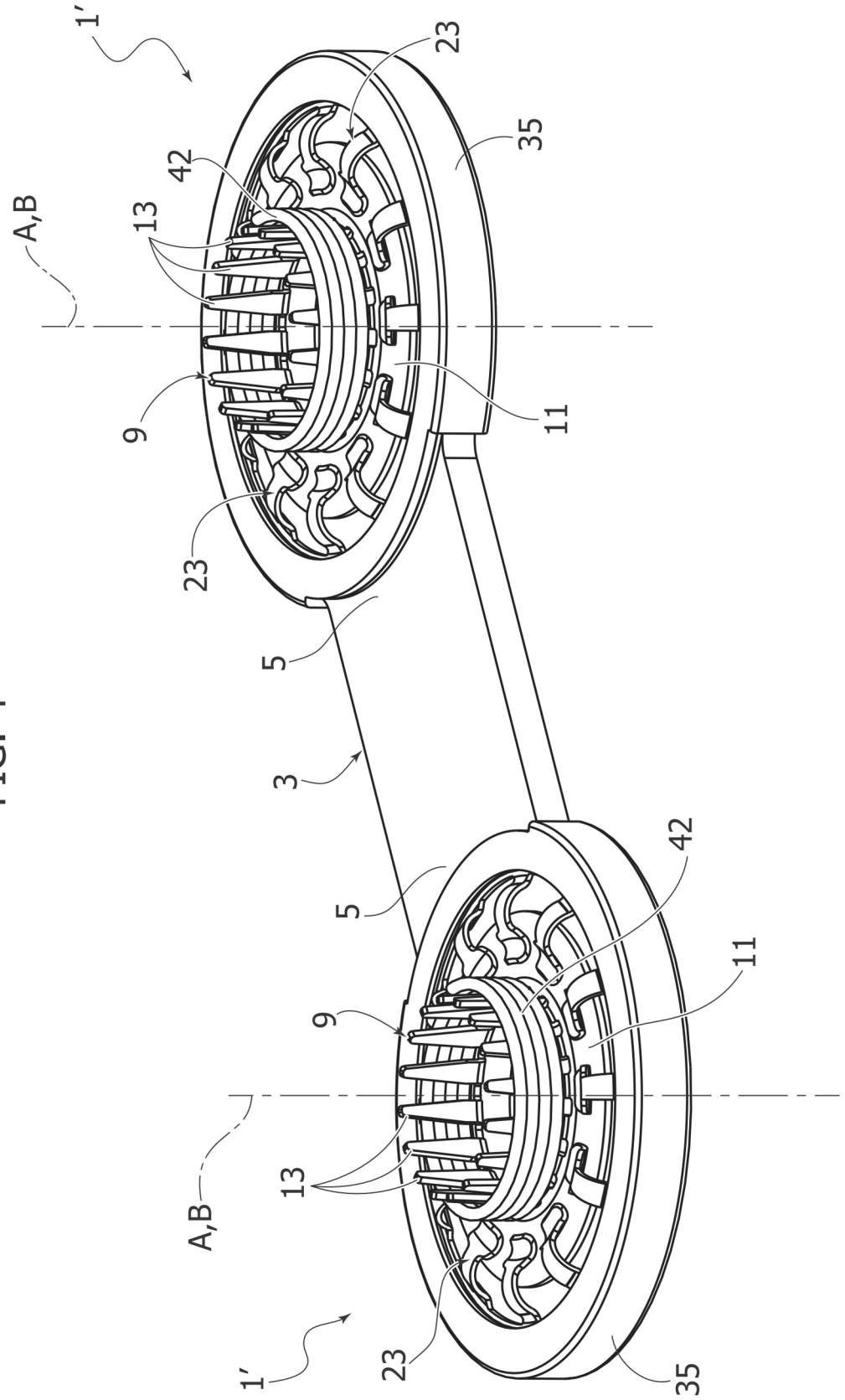


FIG. 5A

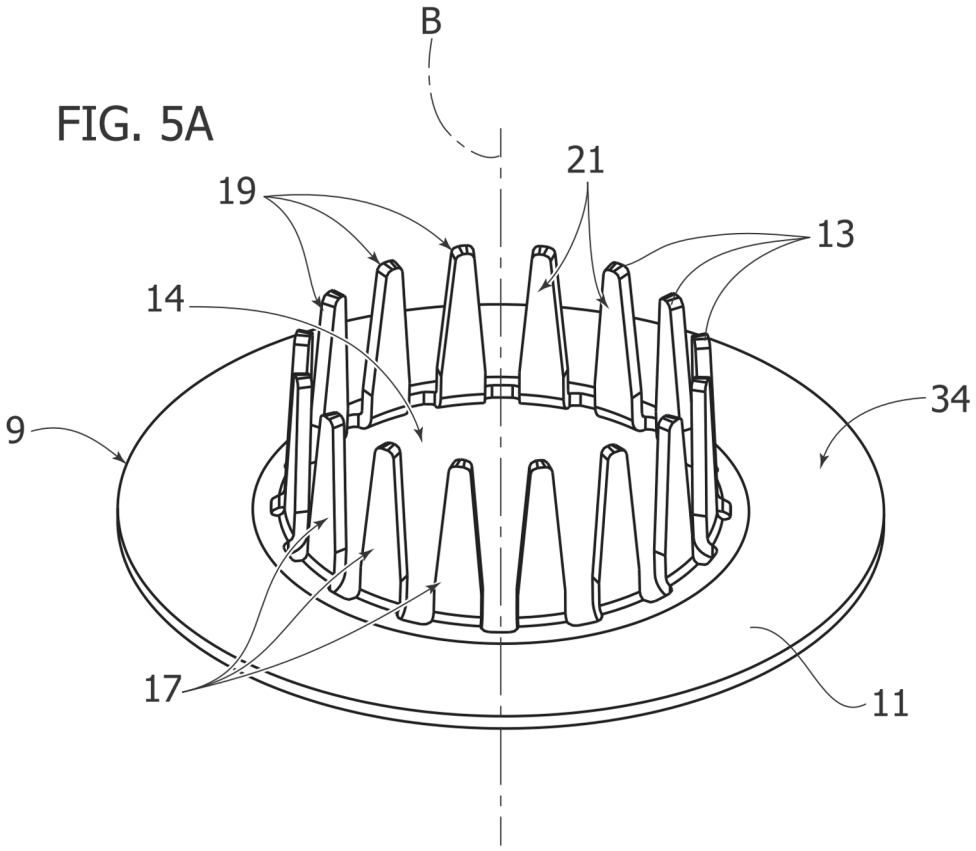


FIG. 5B

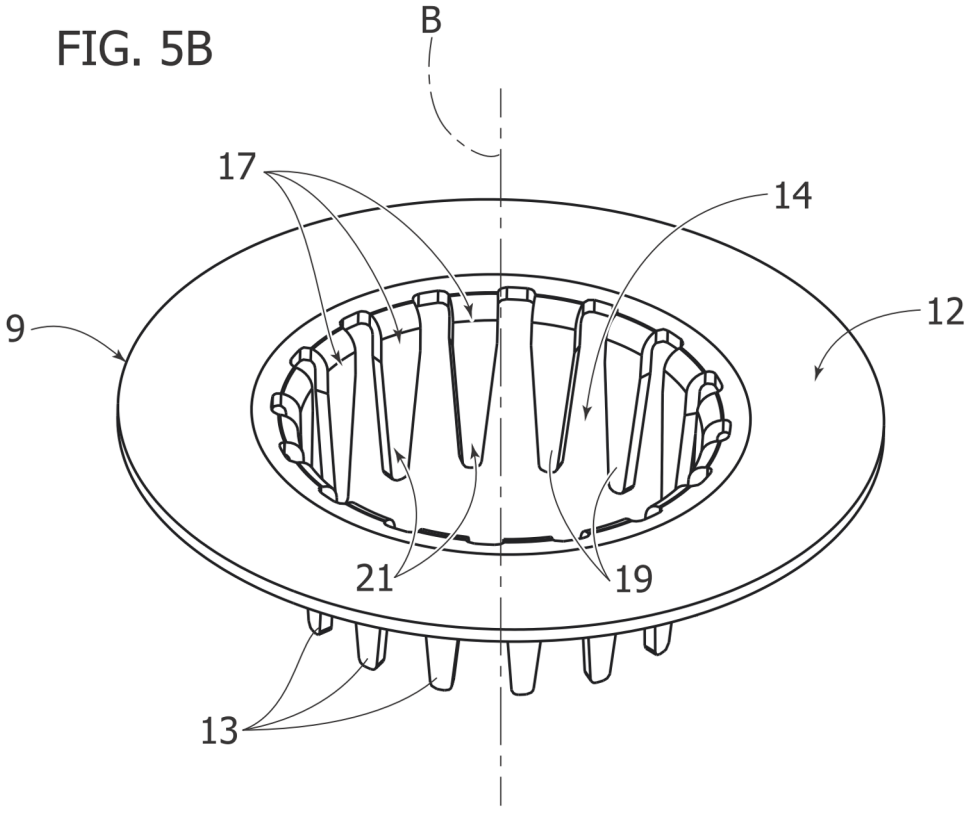


FIG. 6A

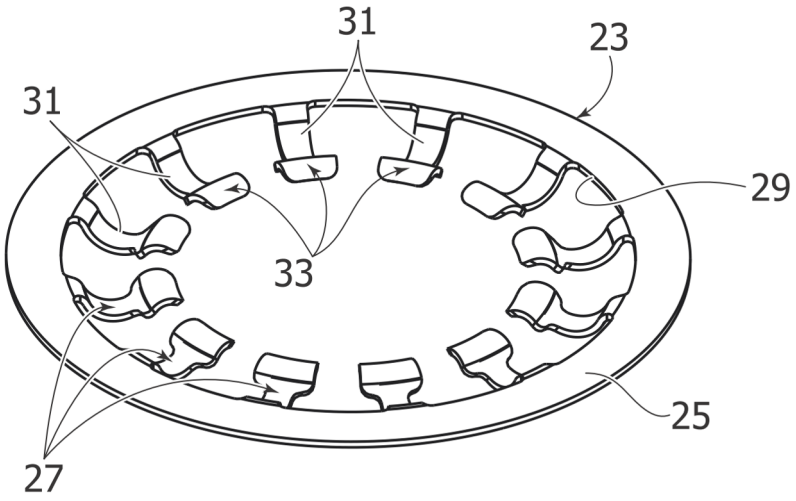


FIG. 6B

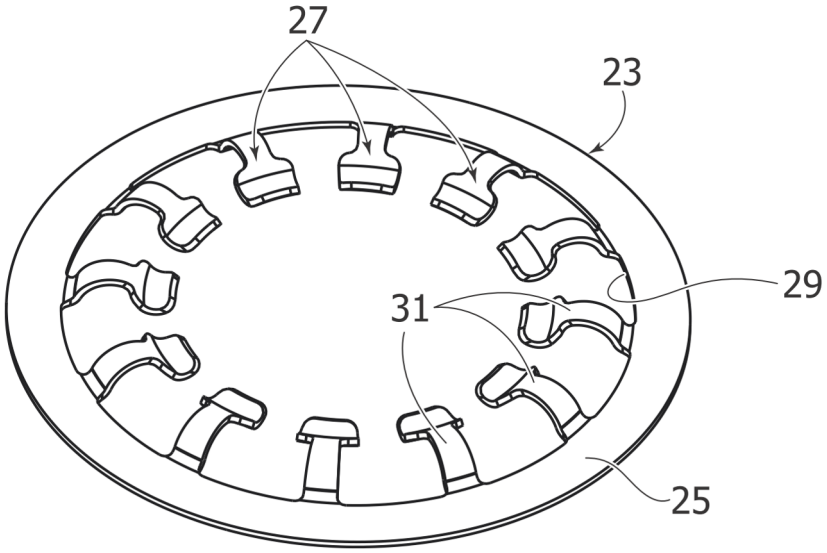
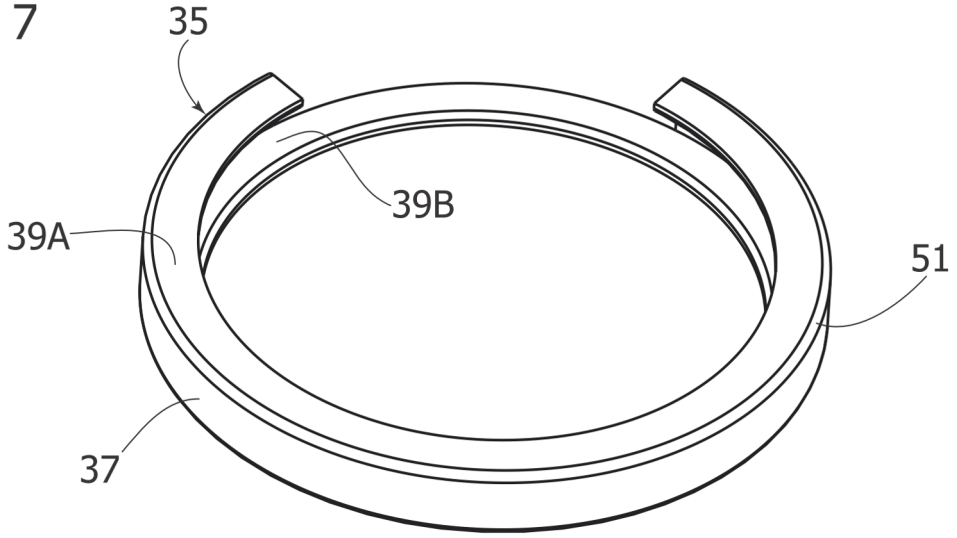


FIG. 7



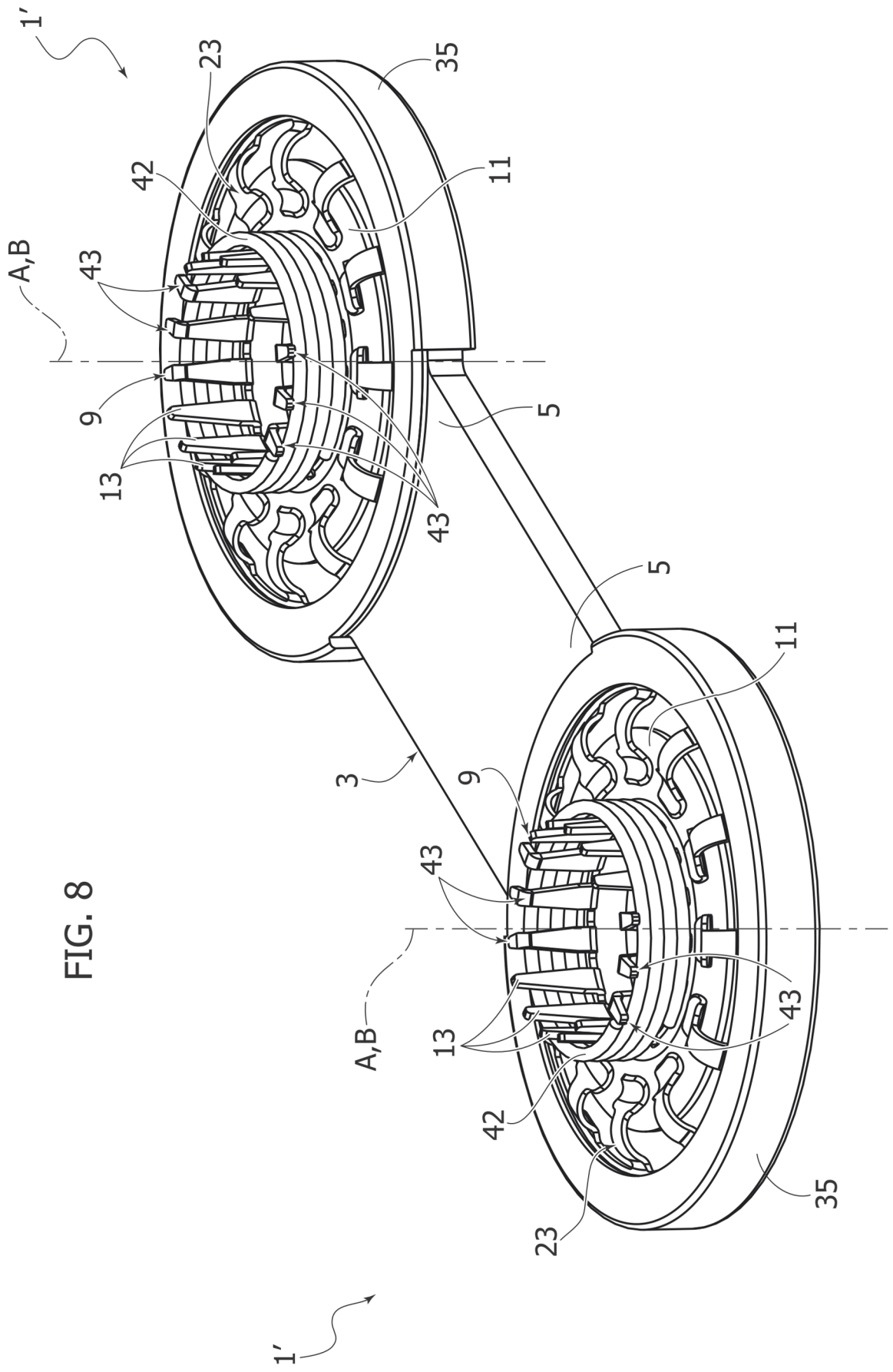

1'
23
35
42
11
A,B
43
9
13
5
3
FIG. 8

FIG. 9

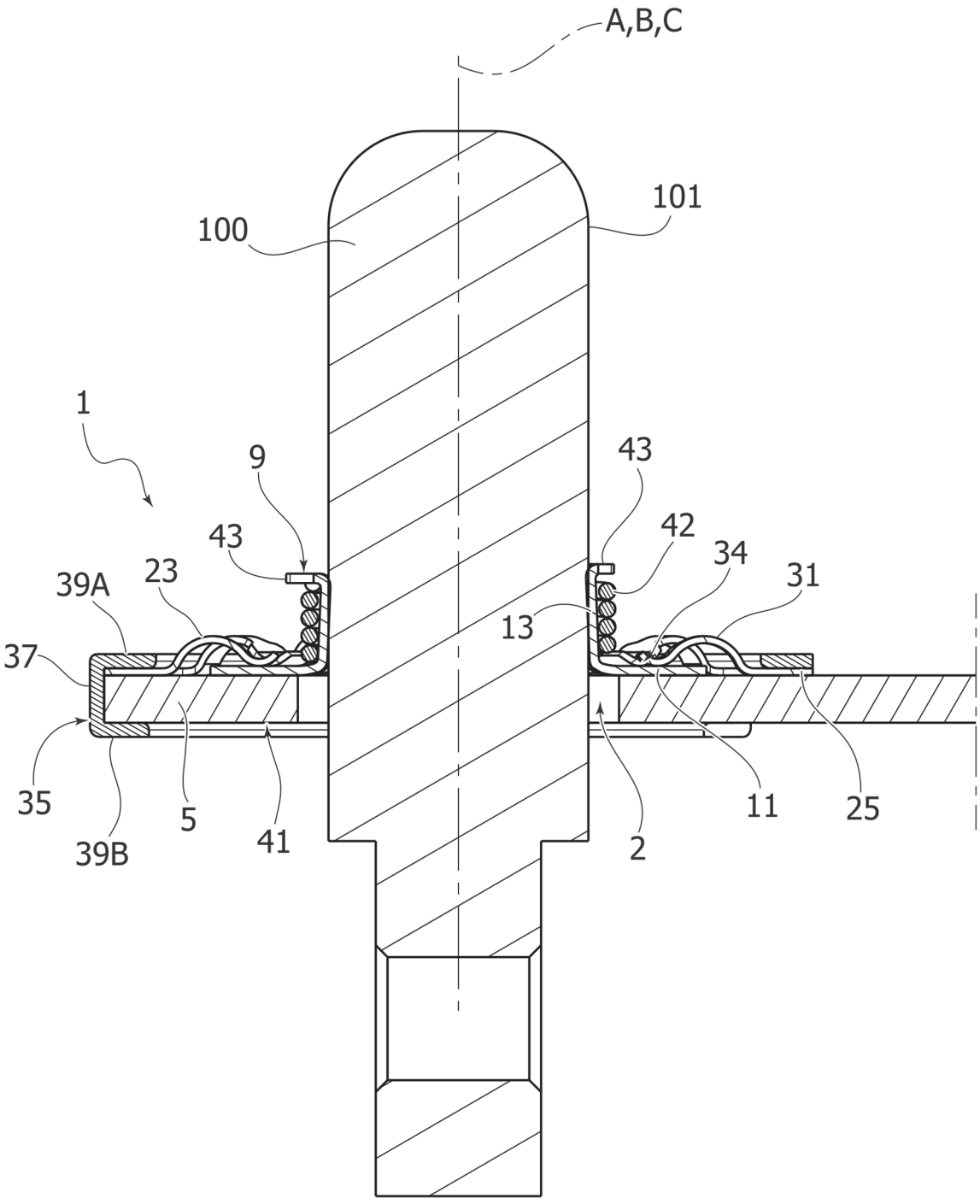


FIG. 10C

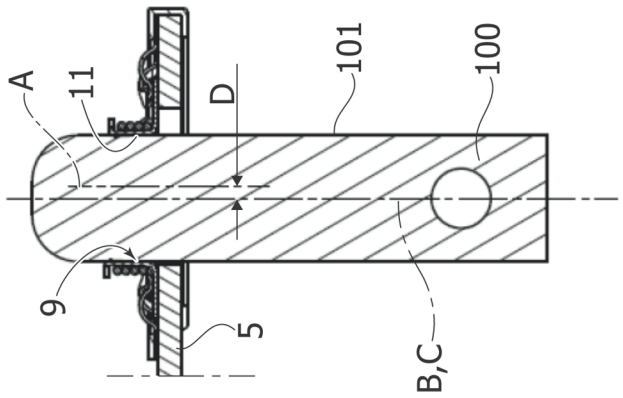


FIG. 10B

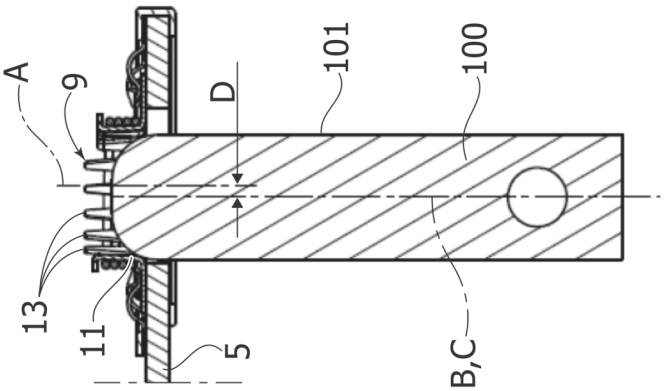


FIG. 10A

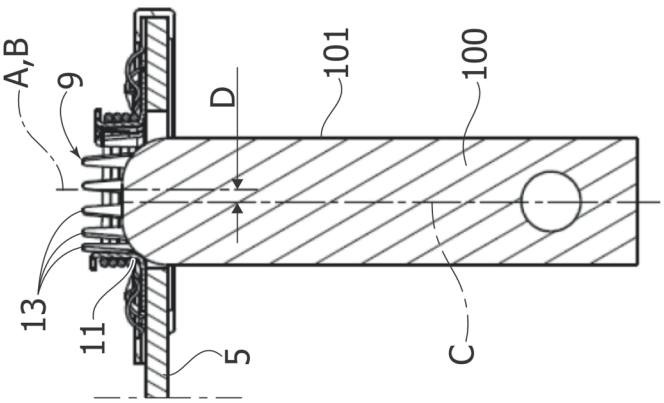


FIG. 11C

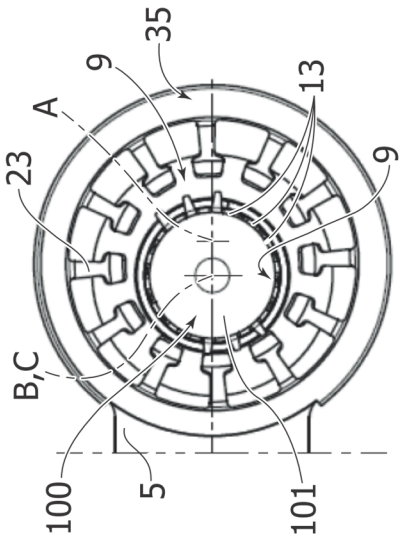


FIG. 11B

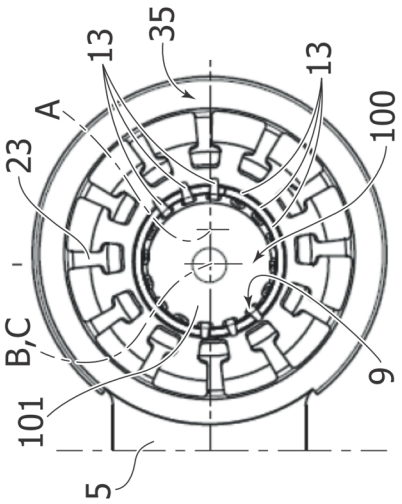


FIG. 11A

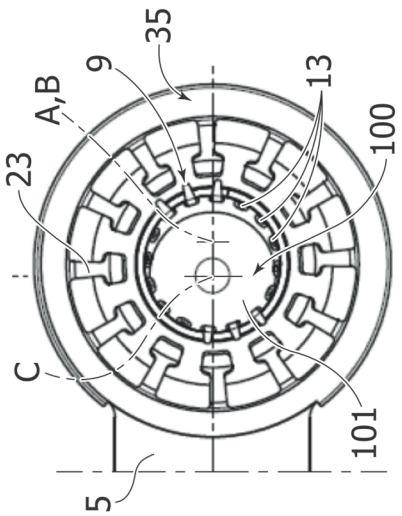


FIG. 12

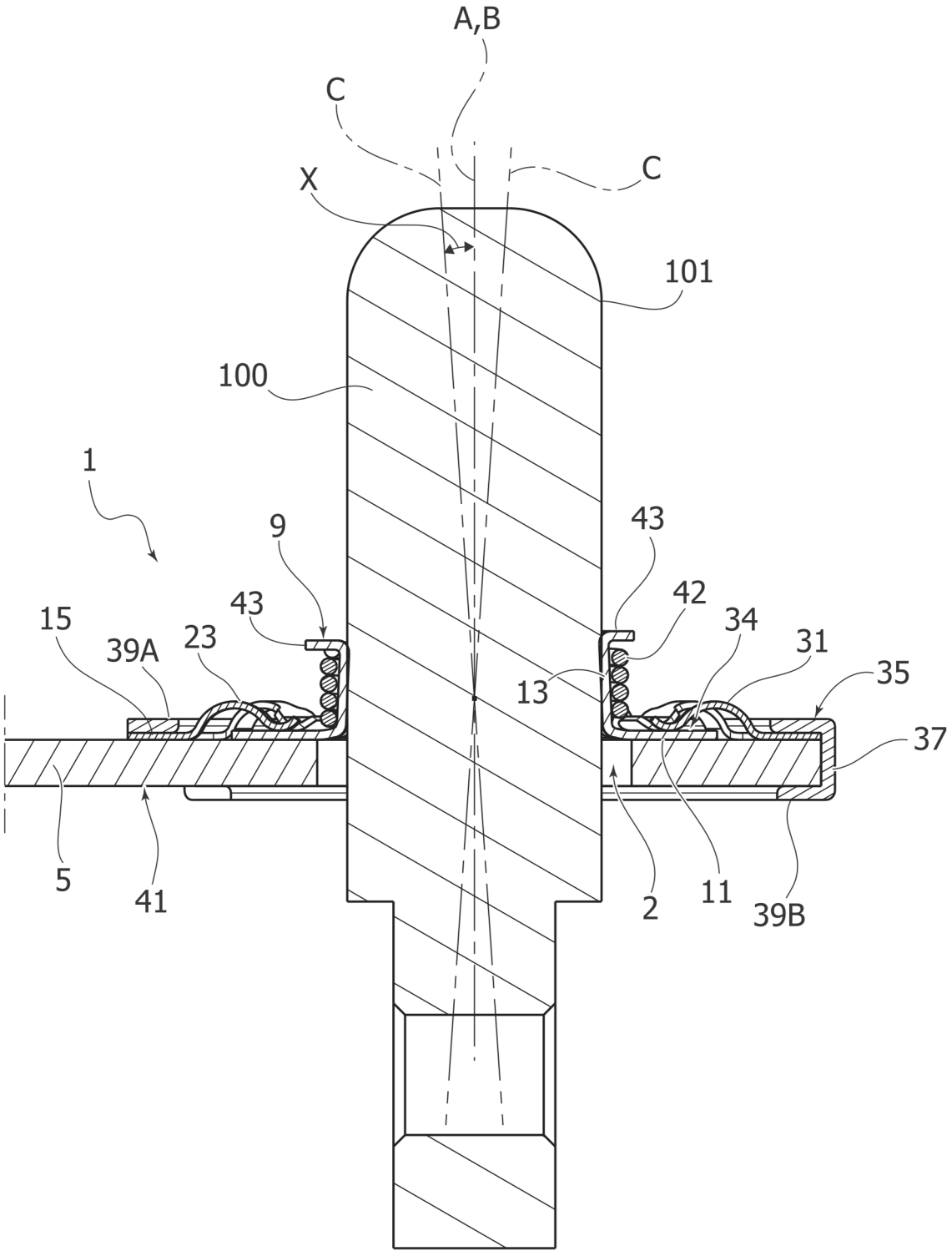
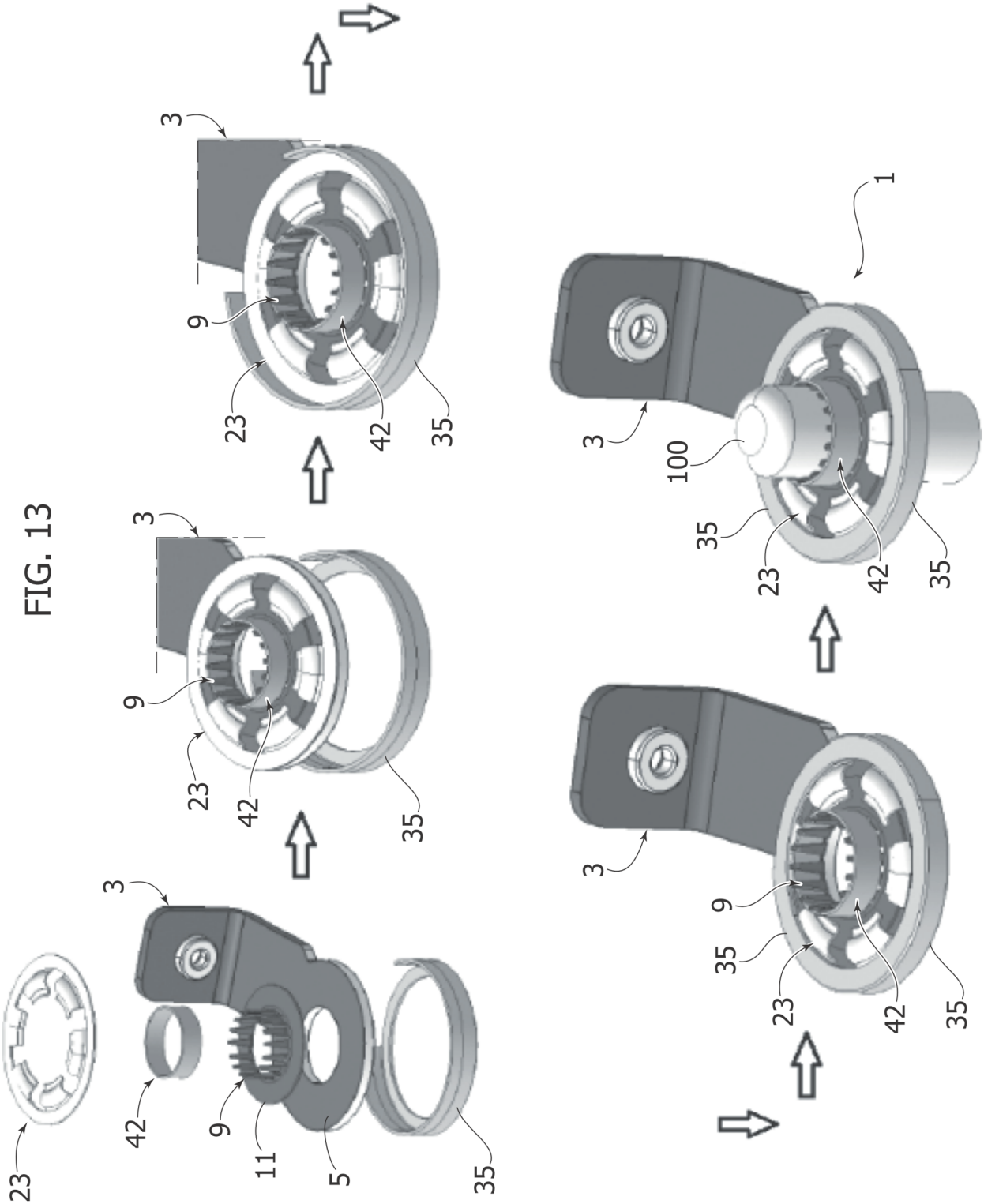


FIG. 13



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EUROPEAN SEARCH REPORT

Application Number
EP 25 21 0902

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	26 February 2026	López García, Raquel

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