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(54) Connector and connector arrangement for connecting at least two conductors

(57) The invention relates to a connector (2) for connecting at least one conductor to another conductor, with at least one fastening portion (21) for securing the connector (2) to a mating connector (3). The invention further relates to a connector (2) with at least one contact element (27), which is configured so as to be electrically connectable to the conductor and can be contacted in a contact direction (K), and at least one guide element (11) which defines a connecting direction (V). In order to provide a connector which can be repaired simply and economically in the event of damage caused by the action of external force, even when the contact elements (27) or mating contact elements (27') are soiled, the invention provides for the fastening portion (21) to have a weakened region (23) arranged in the flux of force between the connector (2) and mating connector (3), and for the connector (2) to be configured so as to be able to be transferred, on exceeding of a predetermined release force acting on the connector, to a release state in which a material failure is concentrated in the weakened region (23).

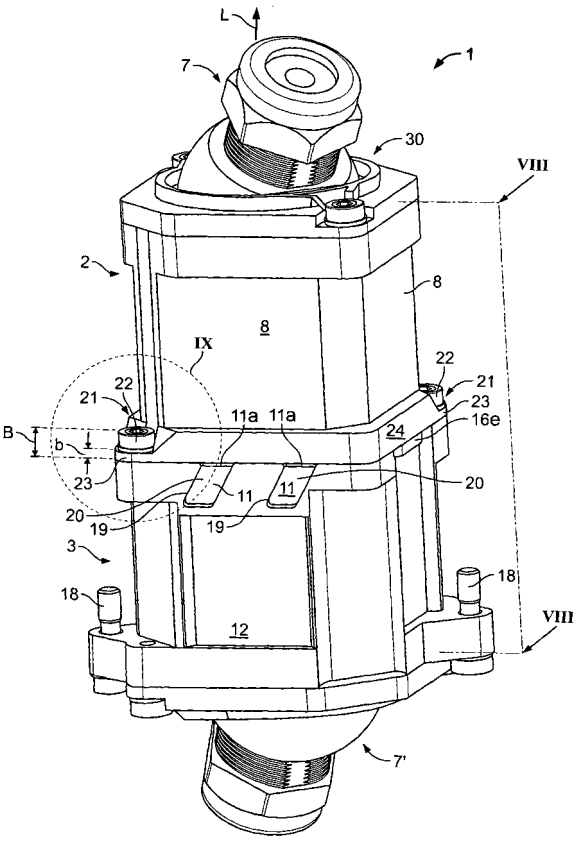


Fig. 4

EP 2 239 819 A1

Description

[0001] The invention relates to a connector for connecting at least one conductor to another conductor, with at least one fastening portion for securing the connector to a mating connector. The invention further relates to a connector for connecting at least one conductor to another conductor, with at least one contact element, which is configured to so as to be electrically connectable to the conductor and can be contacted in a contact direction, and at least one guide element which defines a connecting direction. Furthermore, the invention relates to a method for manufacturing a connector arrangement.

[0002] Connectors of the above-mentioned type are known. Connectors are used for example for electrically connecting two electrical conductors or for optically connecting two optical waveguides. Plug-in connections, which can be designed for example as pin and socket contacts, are inter alia conventional. In these connections, a pin or bolt-shaped portion of a connector dips into a socket-shaped portion of a mating connector. Furthermore, screwed or clamping connections are known in which the connector is connected to the mating connector via a screw fitting which can be arranged for example on a flange.

[0003] Connectors are used in electrically operated traffic systems, for example in street lamps, traffic routing system or traffic lights, to connect the traffic systems to a power supply cable running in the ground. For this purpose, a connection cable, which is connected to the power supply cable, is guided through a cable channel to the holding device of the traffic system and connected to the circuit of the traffic system in the region of the holding device which can be configured for example as a tubular mast.

[0004] Connectors are conventionally mounted in connector arrangements comprising connectors and mating connectors. The connector arrangements can become damaged under the action of external force. Even forces acting on just one connector can destroy a mating connector connected thereto. Incipient fractures or deformations can in this case form at any point of the connector arrangement and cause high repair costs.

[0005] A drawback of the conventionally used connectors is the fact that, in the event of damage to a connector arrangement consisting of the connector and mating connector under the action of external force, expensive components and/or components in inaccessible locations become damaged. Repairing such damage is for this reason often highly complex and very expensive. Furthermore, in connectors arranged outside buildings, in particular in connectors for electrically operated traffic systems, for example traffic lights or street lamps, the contact elements of the connectors become soiled in the event of damage. The contacts or contact elements of fixedly mounted mating connectors are, in particular, difficult to clean.

[0006] Accordingly, the invention is based on the object of providing a connector which can be repaired simply and economically in the event of damage caused by the action of external force.

[0007] According to the invention, for a connector of the type mentioned that the outset, this object is achieved in that the fastening portion has a weakened region arranged in the flux of force between the connector and mating connector, as a result of which the connector is configured so as to be able to be transferred, on exceeding of a predetermined release force acting on the connector, to a release state in which a material failure is concentrated in the weakened region.

[0008] The release force acting on the connector can result from any desired loading of the connector, for example a tensile force applied by a conductor or a transverse force acting on a connector housing.

[0009] An advantage of this solution according to the invention is the fact that, on exceeding of the predetermined release force, for example under the action of external force in the event of an accident, the material failure is limited to one or more predetermined components of the connector, so that just these predetermined components have to be exchanged in the event of damage to the connector. In addition, a connector arrangement made up of a connector and mating connector offers the advantage of allowing damage to the connector arrangement to be limited to the connector.

[0010] In order to concentrate the material failure in the weakened region, the strength of the fastening portion can be reduced therein, at least in relation to the environment of the weakened region. For example, different material properties can be provided in the weakened region to those in the adjacent regions of the connector. Preferably, the cross section of the fastening portion is reduced in the weakened region in relation to adjoining regions, so that a plastic deformation or a fracture takes place in the weakened region on exceeding of the predetermined release force. According to a preferred embodiment, the weakened region is configured in such a way that, on exceeding of the release force, a fracture occurs in the weakened region, as a result of which the connector is completely detached from the mating connector and set sufficiently far apart therefrom that electrical connections between the connector and mating connector are reliably broken and the risk of short circuits or electric shocks is avoided.

[0011] Furthermore, the weakened region can be provided with a notch in which the tensions caused by the release force are greatly increased. The notch can for example be formed by a locally delimited depression or a step in the fastening portion.

[0012] According to a further advantageous configuration of the connector according to the invention, the connector can have at least one conductor mount which is connected to the fastening portion in a force-conducting manner via a support structure, the elastic limit of the support structure being greater than the maximum tension which can be generated in the support structure by

the release force. In this way, forces acting on the connector via the conductor can be conducted into the fastening portion via the support structure without the support structure or other components of the connector becoming plastically deformed or damaged. The elastic limit is the magnitude of the mechanical tension on exceeding of which an irreversible elongation or compression or plastic deformation occurs.

[0013] In a further advantageous configuration of the connector, the connector can have a housing having the support structure and the fastening portion. In this embodiment, possible damage to the connector under the action of external force is limited to the housing, so that just the housing has to be exchanged when the connector arrangement is repaired. The housing can for example be arranged in a holding device for a traffic system so as to be easily accessible from the outside in order to ensure rapid and simple repair of the connector. In order to achieve a high strength of the housing, said housing can be formed from metal. In order to reduce the weight while at the same time maintaining good corrosion resistance, aluminium can be used as the housing material. For economical production, the housing can be manufactured by pressure diecasting.

[0014] In a further advantageous configuration, a joint, which allows a compensatory movement of the conductor in the event of displacement of the connector, can be arranged between the conductor mount and the fastening portion. The joint can advantageously be configured so as to be rotatable about at least two axes running substantially perpendicularly to one another in order to allow compensatory movements of the conductor in any desired directions. The risk of damage to the conductor caused by bending or buckling is in this way reduced.

[0015] In a further solution, which is also advantageous in isolation, the connector can have at least one contact element, which is configured so as to be electrically connectable to the conductor and can be contacted in a contact direction, and at least one guide element which defines a connecting direction, the connecting direction running at an inclination in relation to the contact direction. If the connector is connected to a mating connector, this produces a relative movement between the contact element of the connector and a mating contact element of the mating connector. This solution has the advantage that dirt on the contact faces of the contact element or the mating contact element arranged on the mating connector is automatically removed when the connector is mounted on the mating connector. An oxide layer, which may be present on the contact faces, is also broken open as a result of the relative movement, produced on account of the connecting direction, between the contact faces, so that expensive noble metal alloys for preventing oxidation may be dispensed with.

[0016] According to a further advantageous configuration of the connector, the guide element can have a weakened region which is configured so as to be plastically deformable or dividable on exceeding of the predetermined release force. In this way, the material failure, which is produced under the action of external force, in the connector is, if the release force runs substantially transversely to the connecting direction, concentrated on the weakened regions of the at least one fastening portion of the at least one guide element.

[0017] The contact elements of the connector can be associated with mating contact elements of the mating connector. In a further advantageous configuration of the connector or a connector arrangement comprising at least one connector and at least one mating connector, the contact elements and mating contact elements can be configured as butt contacts which rest on one another in a planar manner in a contact direction when the connector is mounted.

[0018] According to a further advantageous configuration of the connector, the contact element can be resiliently and displaceably mounted in the contact direction. In a preferred configuration of the connector, said contact element can be elastically deflectable counter to the contact direction. For example, elastically deformable spring elements, which exert on the contact element a contact force running in the contact direction, can be arranged in the connector. Preferably, the spring element is arranged between a contact portion of the contact element for contacting a mating contact element and a support face of the housing that points in the contact direction.

[0019] In a preferred embodiment, the rest position of the contact element can be displaced in the contact direction when the connector is not mounted, so that the contact element is elastically deflected counter to the contact direction when the connector is connected. In particular in an embodiment of the connector according to the invention in which the connecting direction runs at an inclination in relation to the contact direction, this ensures that a mechanical contact between the connector and mating connector, and thus a friction, which breaks open oxide layers, between the contact faces, is produced as early as during the movement of the connector in the connecting direction.

[0020] The removal of oxide layers on the contact faces of the connector or the mating connector by a frictional movement of this type improves the electrical conductivity of the contact faces by reducing the transition resistance which is increased by the oxide layers. The use of noble metal alloys for the contact faces, for example gold-plated contacts, may for this reason be dispensed with, so that the costs of manufacturing the connector are reduced.

[0021] The connector according to the invention can be used in a holding device for electrically operated traffic systems with a base plate which is configured so as to be able to be fastened to a pedestal, and a holding mast which is fastened to the base plate and extends away from the base plate. Its position in direct proximity to the ground protects the base plate of a holding device of this type from damage in the event of action of external force,

caused for example by a vehicle striking the holding mast. The holding mast is, conversely, usually bent or buckled over above the base plate under the action of force. In a preferred configuration of a connector arrangement, the base plate can therefore serve to protectively receive the mating connector, wherein a connecting plane between the mating connector and connector can be arranged on or above the face of the base plate that points toward the holding mast. Thus, the at least one fastening portion of the connector is also arranged on the side of the base plate that faces the holding mast. In a release state of the connector arrangement, in which a material failure is concentrated in the weakened region of the fastening portion, the connector can accordingly be exchanged, together with the holding mast, in an easily accessible manner above the base plate.

[0022] The invention will be commented on hereinafter by way of example based on an exemplary embodiment with reference to the figures. In this case, the embodiment described is merely a possible configuration which can be modified for each application. Individual features, which are per se advantageous, can be added or omitted in accordance with the foregoing description of the advantageous configurations of the embodiment described.

[0023] In the drawings:

Fig. 1 is a perspective illustration of an exemplary embodiment of a connector arrangement according to the invention;

Fig. 2 is a schematic exploded view of an exemplary embodiment of a con- nector according to the invention;

Fig. 3 is a schematic exploded view of an exemplary embodiment of a mating connector according to the invention;

Fig. 4 is a schematic perspective view of a connector arrangement according to the invention with a connected connector and mating connector;

Fig. 5 is a schematic perspective view of the connector arrangement from Fig. 4 with the connector housing extracted;

Fig. 6 is a partial view of the connector arrangement from Fig. 4 with the con- nector housing extracted and the contact module housing extracted;

Fig. 7 is an enlarged perspective illustration of a partial view of the mating connector with contact elements of the connector;

Fig. 8 is a cut-away partial view of the connector arrangement from Fig. 4 along the sectional plane VIII; and

Fig. 9 is a perspective partial view of the detail IX from Fig. 4.

[0024] Firstly, the construction of a connector arrangement according to the invention will be described with reference to the exemplary embodiment from Fig. 1.

[0025] The connector arrangement 1 comprises a connector 2 and a mating connector 3. The interconnected connector 2 and mating connector 3 are inserted in a base plate 4 of a holding mast (not shown here), the mating connector 3 being positioned in the region of a tubular cable channel 5. For receiving connector arrangements 1, the base plate 4 is provided with a total of four receiving openings 6 into each of which a connector arrangement 1 can be inserted. In order to avoid rotation of a connector arrangement 1 in a receiving opening 6, the substantially rectangular inner contours of the receiving openings 6 are adapted to the substantially rectangular outer contours of the connector arrangement 1. The connector arrangement 1 is accordingly displaceable, during mounting of the connector arrangement 1 in the base plate 4, in or counter to the direction of the cable channel 5, but is protected from rotation or lateral displacement during and after mounting by the inner walls of the receiving openings 6.

[0026] The base plate 4 is further provided with openings 4a into which fastening elements, for example screws, can be inserted for fastening the base plate 4 to a foundation (not shown here). Furthermore, holes 4b are provided that serve to receive struts of a holding mast to be mounted on the base plate 4.

[0027] Fig. 2 is an exploded view of the connector 2 from Fig. 1. The connector 2 comprises a conductor mount 7 in which an electrical conductor or an optical waveguide, for example, can be received. The conductor mount 7 comprises a basic body 7a which is shaped in a substantially hemispherical manner. A spherical face 7b is arranged in a holding plate 7c when the connector 2 is mounted. The basic body 7a thus forms together with the holding plate 7c a joint 30 which is configured as a ball joint 30 and allows the basic body 7a to pivot and rotate in relation to the holding plate 7c.

[0028] For receiving a conductor, a receiving opening 7d, which is bounded by a sleeve-shaped threaded extension 7e, is arranged on the basic body 7a. For sealing the connector 2 from moisture and other atmospheric influences in a conductor received in the receiving opening 6, the conductor mount has a sealing body 7f provided with a central through-opening 7g for the conductor. A cap nut 7h, which can be screwed onto the threaded extension 7e, serves to fasten the sealing body 7f and the conductor when the conductor has been inserted. The cap nut, which has a through-opening, the internal diameter of which is smaller than the external diameter of the sealing body 7f, is provided for this purpose on its inner side with a funnel-shaped face tapering in a direction pointing away from the receiving opening 7d. Said funnel-shaped face presses, during screwing of the cap nut 7h

onto the threaded extension 7e, on the circumference of the sealing body 7f, so that said sealing body is on the one hand pressed onto the edge of the threaded extension 7e so as to produce a seal and on the other hand compressed in the region of the through-opening 7d. When the conductor has been inserted, this produces a sealed connection between the conductor and basic body 7a that causes strain relief of the conductor. As a result of the compressing of the sealing body 7f, the through-opening 7g is narrowed and pressure is thus exerted on a conductor (not shown) inserted into the through-opening 7g. This pressure produces a frictionally engaged connection or securing between the conductor and sealing body 7f and thus between the conductor and connector 2. This securing of the conductor to the connector 2 introduces forces acting on the conductor on the conductor mount 7 directly into the connector housing 8. The portions of the conductor that are arranged after the sealing body 7f in the contact direction K are thus not loaded by tensile or compressive forces acting externally on the conductor.

[0029] The conductor mount 7 is mounted on a connector housing 8 in which a contact module 9 is received. The connector housing 8 has a support structure 8b arranged between the conductor mount 7 and fastening portion 21. Fastening means 7i, which can be configured for example as screws 7i, are provided for fastening the conductor mount 7 to the connector housing 8. For fastening the conductor mount 7, the basic body 7a is first inserted into the holding plate 7c and the holding plate 7c is subsequently connected to the connector housing 8 by the fastening means 7i which are inserted into receiving openings of the holding plate 7c. A seal 7j, which is inserted between the holding plate 7c and the connector housing 8, serves to seal the connection between the holding plate 7c and the connector housing 8. In the exemplary embodiment shown, the seal 7j is configured as an O-ring 7j. Alternatively, a flat seal or a liquid-processable sealing compound can for example also be provided.

[0030] The contact module 9 to be inserted into the connector housing 8 is inserted into the connector housing 8 until a contact face 9a is aligned with a bearing face 8a of the connector housing 8. Fastening means 10, which can for example be configured as screws, are provided to fix the contact module 9 within the connector housing 8. In the embodiment shown, two screws 10 are screwed into appropriately configured tapped holes within the connector housing 8 once the contact module 9 has been inserted into the connector housing 8.

[0031] Guide elements 11, which are configured as guide extensions 11 and serve to guide the connector 2 during mounting on a mating connector 3, are arranged in the region of the bearing face 8a of the connector housing 8. The guide extensions 11 are provided along the edges of the bearing face 8a and on opposing sides of the connector housing 8. On account of the symmetrical arrangement of the guide extensions 11, the guide extensions 11 positioned on the opposing side of the connector housing are concealed by the extensions 11 positioned in the drawing plane of Fig. 2.

[0032] The guide extensions 11 are shaped substantially like a parallelogram with sides of different length. The longer sides of the parallelogram, and thus the guide extensions 11, form guide faces which rest against mating guide elements 19 shown in Fig. 3 and thus define a connecting direction V of the connector. Each short side of a guide extension adjoins the bearing face 8A of the connector housing 8. The short sides, adjoining the bearing face 8a, of the guide extensions 11 are each provided with a weakened region 11a which is configured as a depression or as a notch in the guide members 11. The strength of the guide members 11 is adapted at the locations of the weakened regions 11a to a predetermined release force which acts on the connector and on occurrence of which the guide members 11 are plastically stretched or separated from the connector housing 8 at the weakened regions 11a. The weakened regions 11a thus form rated breaking points allowing a controlled release of the connection between the connector 2 and mating connector 3 on occurrence of a predetermined release force acting on the connecting arrangement 1.

[0033] Fig. 3 is an exploded view of the mating connector 3.

[0034] Like the connector 2, the mating connector 3 is provided with a conductor mount 7' comprising a basic body 7a' provided with a spherical face 7b'. The basic body 7a' is connected to a mating connector housing 12 by a holding plate 7c'. As in the connector 2, the basic body 7a' and the holding plate 7c' together form a joint 30' via which the connected cable is articulated to the mating connector 3. A seal 7j', which is configured as a ring seal, is provided for sealing the connection between the holding plate 7c' and mating connector housing 12.

[0035] A receiving opening 7d', which is surrounded by a threaded extension 7e', is arranged on the basic body 7a' for receiving a conductor. As in the connector 2, a sealing body 7f' and a cap nut 7h', which is screwed onto the threaded extension 7e', serve for fastening the conductor and for sealing the receiving opening 7d' in order to hold the sealing body 7f' in the receiving opening 7d' and to fix a conductor inserted into the through-opening 7g' of the sealing body. As in the connector 2, a funnel-shaped face 13, which, when the mating connector 3 is mounted, presses on the substantially cylindrical sealing body 7f' and presses together, as a result of the bearing forces acting in the circumferential direction of the sealing body 7f, the through-opening 7g' in the sealing body 7f, is provided in the cap nut 7h'. In this way, an inserted conductor is held with frictional engagement by the sealing body 7f' and sealed at its lateral face in relation to the environment.

[0036] A mating contact module 14, which is fixed in the mating connector housing 12 via fastening means 15, is inserted into the mating connector housing. When the connector arrangement is mounted, a sealing means

16, which rests on a bearing face 12a of the mating connector 12 and also the bearing face 8a of the connector housing 8 and as a result seals and protects the interface between the connector 2 and mating connector 3 from environmental influences, for example moisture, is inserted between the connector and mating connector. By virtue of the fact that the sealing means 16 covers almost the entire bearing face 12a of the mating connector 12, it outwardly seals the mating connector 3 even when the connector 2 is demounted. By preventing moisture from infiltrating the mating connector 3, the sealing means 16 thus allows the connector arrangement 1 to be opened even in rainy weather.

[0037] The sealing means 16 is preferably made from plastics material, in particular from a thermoplastic polymer which is resistant to atmospheric influences and easy to process. Alternatively, the sealing means 16 can be made from an elastomeric plastics material. Positioning extensions 16a on the sealing means 16 are inserted into depressions of the mating contact module 14 to simplify mounting of the sealing means 16 in a predetermined position. The positioning extensions 16a can be somewhat larger than the recesses, provided for receiving the positioning extensions 16a, in the mating contact module 14, so that a frictionally engaged connection is produced when the positioning extensions 16a are pressed into the recesses.

[0038] The sealing means 16 is provided at its circumference with an elastically deformable sealing bead 16c and on its face pointing counter to the contact direction K with an elastically deformable sealing bead 16d. When the connector arrangement 1 is mounted, the sealing bead 16c compensates for deviations in size or unevenness on the adjoining sealing face, shown in Fig. 7, of the mating connector housing 12 and the sealing bead 16d compensates for deviations in size or unevenness of the bearing faces 8a and 12a by elastic deformation.

[0039] At a narrow side, the sealing means 16 is provided with a holding tongue 16e. The holding tongue 16e is provided in the contact direction K with an anchor-shaped profile and reaches, through an opening 12f, shown in Fig. 7, in the mating connector housing 12, behind the outer wall of the mating connector housing 12, as shown in Fig. 5, in a form-fitting manner.

[0040] The mating connector housing has fastening extensions 17, which are provided with openings for receiving connecting means 18, for fastening the connector arrangement 1 to the base plate 4 shown in Fig. 1. The connecting means 18, which are configured as screws 18, are inserted into the openings of the fastening extensions 17 and screwed into tapped holes on the underside of the holding plate 4.

[0041] Mating guide elements 19, which are configured as guide grooves 19 and the contour of which, like that of the guide extensions 11, is shaped, in a direction of projection running transversely to the contact direction K, like a parallelogram, are arranged on opposing sides of the mating connector housing 12. When the connector arrangement 1 is mounted, a respective guide extension 11 is arranged in a guide groove 19. A guide groove 19 forms, together with an associated guide extension 11, a respective guide member 20. The connector arrangement made up of the connector 2 and mating connector 3 thus comprises a total of four guide members 20.

[0042] In order to simplify, during mounting of the connector arrangement 1, insertion of the guide extensions 11 shown in Fig. 2 into the guide grooves 19, the guide grooves 19 are provided at their openings pointing counter to the contact direction K with radii 19a and 19b which form a funnel-shaped widening of the opening, pointing counter to the contact direction K, of the guide grooves 19 and thus facilitate insertion of the guide extensions 11.

[0043] Fig. 4 shows a connector arrangement 11 with a connector 2 and mating connector 3. In the connector arrangement shown, the bearing face 8a of the connector 2 rests at its edge on the bearing face 12a of the mating connector 3. In the mounting position shown of the connector arrangement 1, the guide elements 11, which form guide members 20 together with the mating guide elements 19, are completely inserted into the guide grooves 19. The connector 2 is provided with fastening portions 21 for fastening the connector 2 to the mating connector 3. The fastening portions 21 comprise an eye (not shown here) into which a respective fastening means 22 in the form of a screw 22 is inserted. A tapped hole (not shown here) is arranged in the portion of the mating connector housing 12 that opposes the fastening portion 21 for receiving and for fixing the screw 22.

[0044] The connector 2 is provided with two diagonally opposing fastening portions 21. Together with the guide extensions 11 arranged in guide grooves 19 of the mating connector 3, a sufficiently secure and offset-free connection between the connector 2 and mating connector 3 is produced. If a predetermined release force is exceeded, for example, as shown in Fig. 1, in a connector arrangement 1 built into a holding mast, by a vehicle colliding with the holding mast, the connector 2 is separated from the mating connector 3 by material fractures on the fastening portions 21 and the weakened regions 11a of the guide extensions 11. For this purpose, the fastening portions 21 have weakened regions 23 formed substantially by a reduced cross section of a connection flange 24 surrounding the connector housing 8.

[0045] The connector housing 8 of the connector 2 has a support structure 8b which is arranged between the conductor mount 7 and fastening portion 21 and connects said conductor mount and fastening portion in a force-transmitting manner. This support structure 8b has a much greater strength than the sum of the weakened regions 23 and 11a. Thus, it is ensured, even under the action of a release force L, applied for example via a conductor, on the conductor mount 7, that the material failure remains concentrated on the weakened regions 23 and 11a.

[0046] The housing 12 of the mating connector 3 is also provided with a support structure 12b which, when

the mating connector 3 is mounted, conducts release forces acting on the connector 2 to the fastening extensions 18. The high strength of the housing 12 in relation to the weakened regions 23 and 11a rules out the risk of damage to the housing 12 caused by a release force acting on the connector 2.

[0047] Fig. 5 shows the connector arrangement from Fig. 4, the connector housing 8 of the connector 2 being extracted. The contact module 9 rests directly on the plate-shaped sealing means 16. A total of 8 contact elements, which are displaceable in or counter to the contact direction K, are arranged in a contact module housing 9b. Sleeves 25, which are preferably made from plastics material and surround the contact elements, (not shown here), serve as support elements and also for insulating the contact elements. A cover 9c, which closes the contact module housing 9b, serves as a support structure for the spring elements arranged in the contact module housing 9b, so that the elastic spring elements can press the contact elements arranged in the sleeves 25 together with the sleeves 25 in the contact direction K.

[0048] The holding tongue 16e of the sealing means 16 protrudes from the mating connector housing 12 through an opening 12f. While the holding tongue 16e has in the region of the opening 12f transversely to the contact direction K a width corresponding roughly to the width of the opening 12f, the holding tongue 16e has, outside and within the mating connector housing 12, a greater width. This produces a form-fitting connection which prevents displacement of the sealing means 16 during mounting, in particular as a result of the relative movement, running during mounting of a connector arrangement 1 substantially obliquely to the contact direction K, of the connector 2 and mating connector 3. The holding tongue 16e also serves as an easily accessible handle which simplifies demounting of the sealing means 16. In addition, the holding tongue 16e is visible from the outside even when the connector arrangement is mounted, and is thus an indicator as to whether the sealing means 16 is mounted as intended.

[0049] Fig. 6 is a partial view of the upper portion of the connector arrangement from Fig. 5, the contact module housing 9b with the cover 9c and five of the sleeves 25 being extracted.

[0050] The sleeves 25 are surrounded by spring elements 26 which are supported, when the connector 2 is mounted, on the inner side of the cover 9c shown in Fig. 5 and each exert via a shoulder 25a of the sleeves 25 a contact force, acting in the contact direction K, on the sleeves 25. In this way, contact elements 27, which are arranged non-displaceably in the sleeves 25, are pressed with the sleeves 25 in the contact direction K. Through recesses 16b in the sealing means 16, the contact elements 27 abut contact elements of the mating connector and 3 that are arranged opposing them.

[0051] An earthing contact 28, which is configured so as to be able to be inserted into the contact module 9, is arranged on a contact element 27 intended for earthing. The earthing contact 28, which is formed from a metal sheet, preferably from stainless steel, has an arcuate, elastically deformable portion which, when the connector arrangement 1 is mounted, rests on the inner side of the connector housing 8 shown in Fig. 4 and ensures an electrical contact between the earthing contact 28 and connector housing 8 by spring pressure. For this purpose, the earthing contact 28 is configured in a resiliently elastic manner and elastically deformed in the mounted state by the adjoining connector housing 8. The connector housing 8 and/or the mating connector housing 12 can in this way be connected to an earthing conductor which is connected in an electrically conductive manner to the contact element 27 or mating contact element 27' adjoining the earthing contact 28.

[0052] Fig. 7 is an enlarged perspective view of the contact elements 27 and the opposingly arranged mating connector 3. In addition, in contrast to Fig. 6, Fig. 7 does not show any sealing means 16.

[0053] A depression 12c in the mating connector housing 12 forms a receptacle 12c for the sealing means 16. When the sealing means 16 is inserted, the sealing bead 16c shown in Fig. 3 rests against a sealing face 12d bounding the receptacle 12c.

[0054] The contact elements 27 abut mating contact elements 27' in the contact direction K. The contact elements 27 are provided with a conductor receptacle 27a into which a conductor can be inserted and fixed, for example by crimping. For this purpose, the contact element 27 is configured in a hollow, substantially tubular manner in a region 27b. An opening 27c, arranged at the end of this tubular portion 27b, simplifies, for improving the conductivity of the tubular portion 27b, the silver-plating of the inner walls of the portion 27b by serving as an inflow or outflow of air or silver.

[0055] The contact elements 27 are each fastened in a form-fitting manner in sleeves 25. For establishing a form-fitting connection, the contact elements 27 are provided with a spring ring 27d which is made from metal, preferably from stainless steel, and is arranged in a peripheral groove 27e of the contact element 27. The spring ring 27d delimits with a support shoulder 27f a holding region 27g which is designed as a peripheral depression and comes to lie, after a contact element 27 has been inserted into a sleeve 25 in the contact direction K, on a taper of the sleeve 25 having an internal diameter corresponding roughly to the external diameter of the holding region 27g.

[0056] The earthing contact 28 is provided with an arcuate contact portion 28a which connects, when the connector arrangement is mounted, the contact element 27 adjoining in the contact direction K and the mating contact element 27' adjoining counter to the contact direction K to the connector housing 8 in an electrically conductive manner. The earthing contact 28 can be configured so as to be able to be inserted into the contact module 9 substantially transversely to the contact direction K. Thus, the mounting of the earthing contact 28 is greatly

simplified in relation to conventional screwed earthing contacts. When the connector 2 is mounted, the contact portion 28a rests resiliently and in an electrically conductive manner against the inner wall of the connector housing 8 shown in Fig. 4, which is made from an electrically conductive material, preferably aluminium. A connecting portion 28b adjoining the contact portion 28a is provided at opposing sides in each case with a saw tooth profile 28c which, after the earthing contact 28 has been inserted, rests against the inner walls of a slot, configured for receiving the earthing contact 28, of the contact module and prevents, by a frictional and/or form-fitting engagement with the inner walls, the earthing contact 28 from slipping out of the contact module K. A spring contact 28d, which is formed by a tongue punched from the earthing contact, presses, when the earthing contact 28 has been inserted, elastically on the mating contact element 27' adjoining the tongue 28. This ensures that even the mating contact element 27', which, in contrast to the contact element 27, is arranged in the mating connector not in an elastically deflectable manner, but rather non-displaceably, is electrically connected to the earthing contact 28.

[0057] Fig. 8 is a sectional view along the plane VIII from Fig. 4. The connector 2 and mating connector 3 are connected to each other at mutually opposing end sides 2a, 3a. The plate-shaped sealing means 16, which protects the contact elements 27 and mating contact elements 27' arranged in the connector 2 and mating connector 3 from atmospheric influences, is inserted between the connector 2 and mating connector 3. Together with the sealing means 16, the connector housing 8 and mating connector housing 12 thus form for the contact elements 27 and mating contact elements 27' a space which is closed off in a water and air-tight manner and in which the oxidation or corrosion of the contact elements 27 and mating contact elements 27' is prevented or at least slowed down.

[0058] The sleeve 25 is provided with a cylindrical receiving opening 25a for receiving the contact element 27, which receiving opening has a support shoulder 25b for fixing the contact element 27. For mounting, the contact element 27 is slid in the contact direction K into the receiving opening 25a until the spring ring 27d has overcome the support shoulder 25b. The spring ring 27d is extended after the support shoulder 25b on account of the larger internal diameter of the receiving opening 25a. If a force is applied to the contact element 27, for example a contact force operating counter to the contact direction K, the spring ring 27d is supported against the support shoulder 25b, thus preventing displacement of the contact element 27 counter to the contact direction K. The support shoulder 27f of the contact element 27, the spring ring 27d and the support shoulder 25b of the sleeve 25 thus together form a form-fitting connection between the contact element 27 and sleeve 25.

[0059] The sleeve is mounted in the contact module housing 9b so as to be displaceable in and counter to the contact direction K and is pressed by the spring element 26 in the contact direction K. The spring element 26, which is configured as a spiral spring 26, is centred by the interior sleeve 25 and arranged between the cover 9c of the contact module 9 and a rest 25c, configured as a shoulder 25c, of the sleeve 25.

[0060] The mounting, which is displaceable in the contact direction K, of the contact element 27 in the connector 2 and the contact force C, which is transmitted by the spring element 26 to the contact element 27 in the contact direction K, ensure the electrical contact between the contact element 27 and mating contact element 27'.

[0061] If the connector 2 is fastened to the mating connector 3, the connector 2 and mating connector would be moved by the guide elements 11 shown in Fig. 2, which are configured as a guide extension 11, and the guide elements 19 shown in Fig. 3, which are configured as a guide groove 19, in a connecting direction V running obliquely to the contact direction K. In this way, the oxide layers formed on the contact portion 29, configured as a butt contact 29, of the contact element 27 or on the contact portion 29', configured as a butt contact 29', of the mating contact element 27' are broken open. In addition, this breaking-open of the oxide layers is assisted by the contact force C which is generated by the spring element 26 and presses the contact portion 29 onto the contact portion 29' even during the relative movement of the contact elements 27 and 27' in the connecting direction V.

[0062] Fig. 9 is an enlarged perspective illustration of the detail IX of the connector arrangement according to the invention shown in Fig. 4. The fastening portion 21 is shown without fastening means 22. The fastening portion 21 is provided with a weakened region 23 arranged in the flux of force between the connector 2 and mating connector 3. The weakened region 23 is weakened in relation to adjacent regions of the connection flange 24 or a mating connection flange 24' of the mating connector 3 in order to concentrate a material failure in the weakened region 23 on occurrence of a predetermined release force. For this purpose, the weakened region 23 has a reduced cross section. For this purpose, the width b of the weakened region 23 in the contact direction K is greatly reduced in relation to the width B of the adjacent regions of the connection flange 24 in the contact direction K.

[0063] The fastening portion 21 is provided with an eye 21a in which the fastening means 22 can be received. For an alternative or additional configuration of the weakened region 23, it is possible to provide between the eye 21a and adjacent regions of the connection flange 24 or the connector housing 8 a notch in which the tension generated by forces acting on the connector is locally increased, so that a material failure concentrated on the weakened region takes place at the location of the notch on occurrence of the predetermined release force. Instead of a notch, it is alternatively also possible to provide in the connector housing 8, which is preferably made from plastics material, regions which are embrittled in a locally delimited manner or separating joints which are

connected to one another by adhesive. In addition, the weakened region can also be arranged in the fastening means 22 and be formed, for example, by a taper or notch in the fastening means.

Claims

1. Connector (2) for connecting at least one conductor to another conductor, with at least one fastening portion (21) for securing the connector (2) to a mating connector (3), **characterised in that** the fastening portion (21) has a weakened region (23) arranged in the flux of force between the connector (2) and mating connector (3), and in this way the connector (2) is configured so as to be able to be transferred, on exceeding of a predetermined release force acting on the connector, to a controlled damaged state in which a material failure is concentrated in the weakened region (23).

2. Connector (2) according to claim 1, **characterised in that**, in the weakened region (23), the strength of the fastening portion (21) is reduced, at least in relation to the environment of the weakened region (23).

3. Connector (2) according to one of claims 1 or 2, **characterised in that** the connector (2) has at least one contact element (27), which is configured so as to be electrically connectable to the conductor and can be contacted in a contact direction (K), and at least one guide element (11) which defines a connecting direction (V), the connecting direction (V) running at an inclination in relation to the contact direction (K).

4. Connector (2) for connecting at least one conductor to another conductor, with at least one contact element (27), which is configured so as to be electrically connectable to the conductor and can be contacted in a contact direction (K), and at least one guide element (11) which defines a connecting direction (V), **characterised in that** the connecting direction (V) runs at an inclination in relation to the contact direction (K).

5. Connector (2) according to claim 3 or 4, **characterised in that** the contact element (27) is resiliently and displaceably mounted in the contact direction (K).

6. Connector (2) according to claim 4 or 5, **characterised in that** the connector (2) comprises at least one fastening portion (21) for securing the connector (2) to a mating connector (3), which fastening portion has a weakened region (23) arranged in the flux of force between the connector (2) and mating connector (3), the connector (2) being configured so as to be able to be transferred, on exceeding of a predetermined release force acting on the connector (2), to a release state in which a material failure is concentrated in the weakened region (23).

7. Connector (2) according to one of claims 4 to 6, **characterised in that** the guide element (11) has at least one weakened region (23) which is configured so as to be plastically deformable or dividable on exceeding of the predetermined release force (L).

8. Connector (2) according to one of claims 1 to 7, **characterised in that** the connector (2) has at least one conductor mount (7) which is connected to the fastening portion (21) in a force-conducting manner via a support structure (8b), the elastic limit of the support structure (8b) being greater than the maximum tension which can be generated in the support structure (8b) by the release force (L).

9. Connector (2) according to claim 8, **characterised in that** the connector (2) has a connector housing (8) having the support structure (8b) and the fastening portion (21).

10. Connector (2) according to claim 8 or 9, **characterised in that** a joint (30) is arranged between the conductor mount (7) and the fastening portion (21).

11. Connector (2) according to claim 10, **characterised in that** the joint (30) is configured so as to be rotatable about at least two axes running transversely to one another.

12. Connector arrangement (1) for connecting at least two electrical conductors, with at least one mating connector (3) having at least one mating contact element (27'), which is configured so as to be electrically connectable to another conductor, and a mating guide element (19) which is configured so as to be complementary to the guide element (11), the contact element (27) and mating contact element (27') being contactable in a contact direction (K), **characterised by** a connector (2) according to one of claims 4 to 11.

13. Connector arrangement (1) according to claim 12, **characterised in that** the mating connector (3) is substantially undeformed in the release state of the connector (2).

14. Holding device for electrically operated traffic systems, with a base plate (4) which is configured so as to be able to be fastened to a pedestal, and a holding mast which is fastened to the base plate (4) and extends away from the base plate (4), **characterised by** a connector arrangement (1) according to claim 12 or 13, the mating connector (3) being secured in

or on the base plate (4) and the connector (2) extending away from the base plate (4) in the direction of the holding mast.

15. Method for manufacturing a connector arrangement (1) according to one of claims 13 or 14, **characterised in that** contact elements (27) of the connector (2) are placed onto mating contact elements (27') of the mating connector (3), pressed onto one another with a contact force (C) acting in the contact direction (K) and at the same time moved substantially transversely to the contact direction (K).

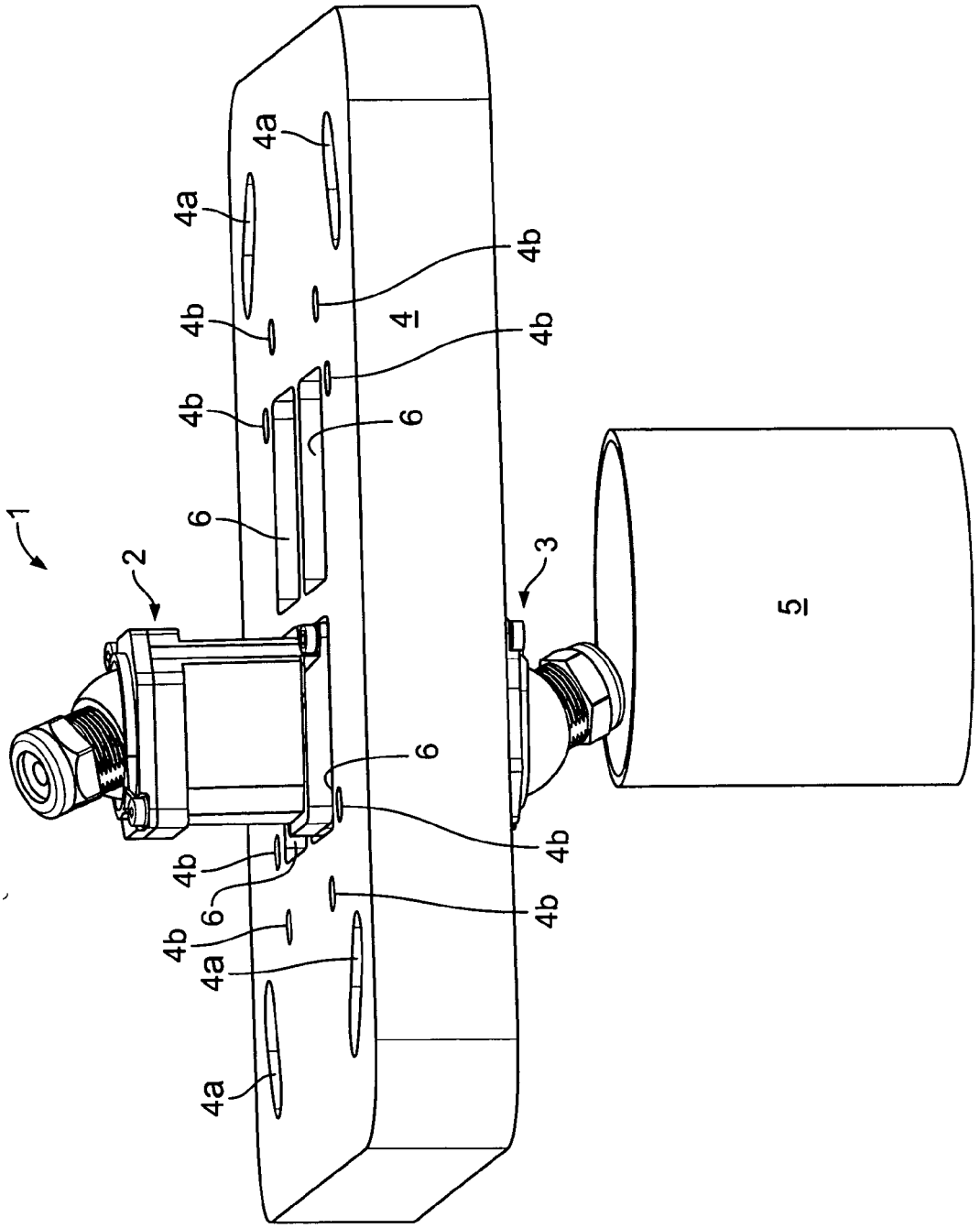


Fig. 1

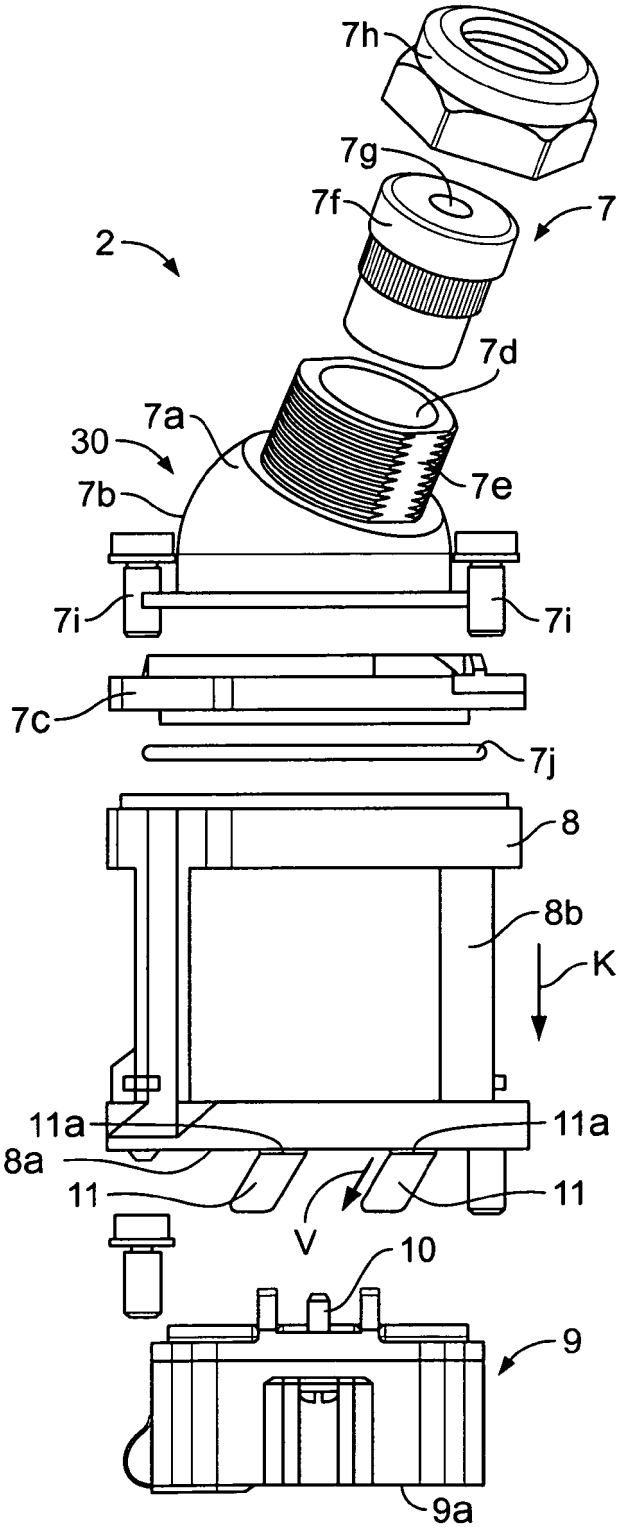
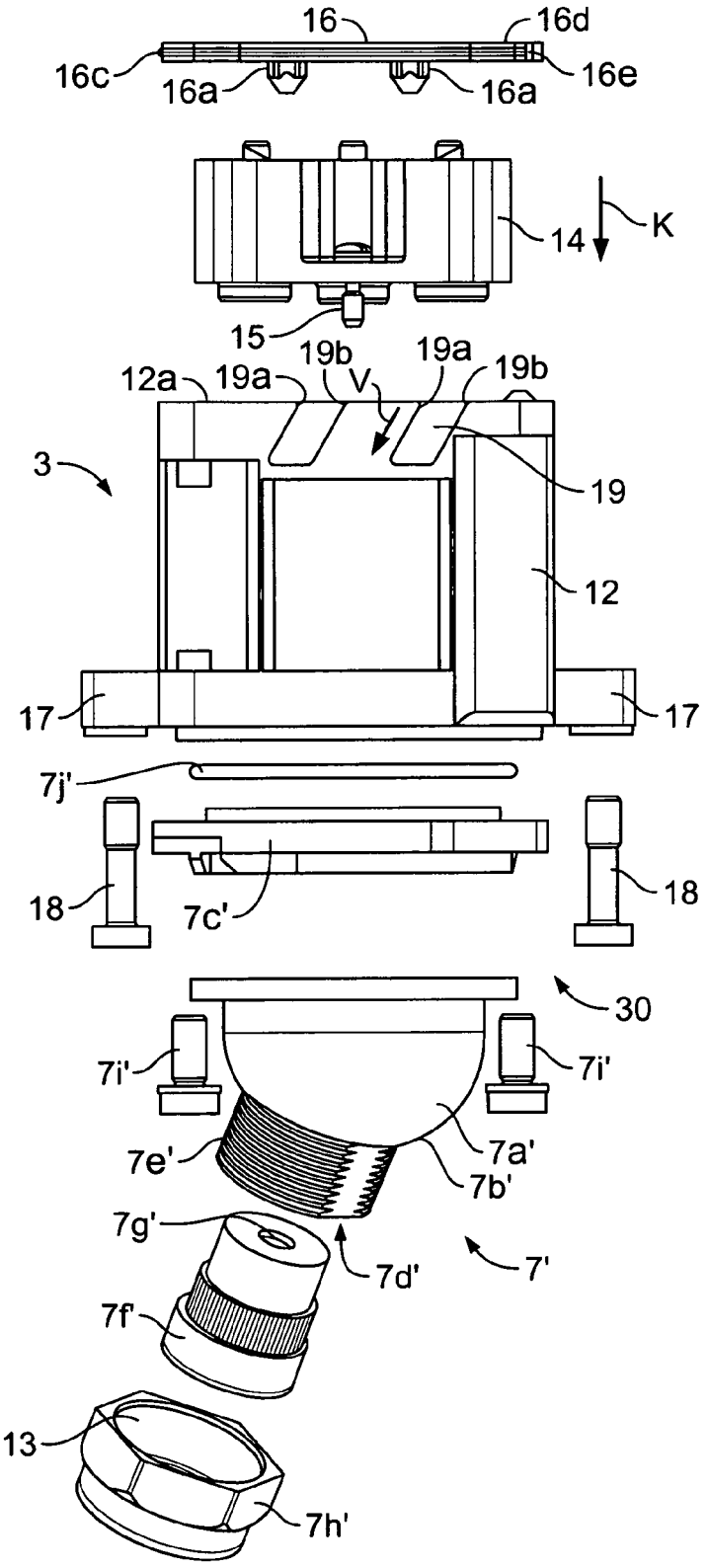


Fig. 2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16a
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16e
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K
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3
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17
17
7j'
18
7c'
18
30
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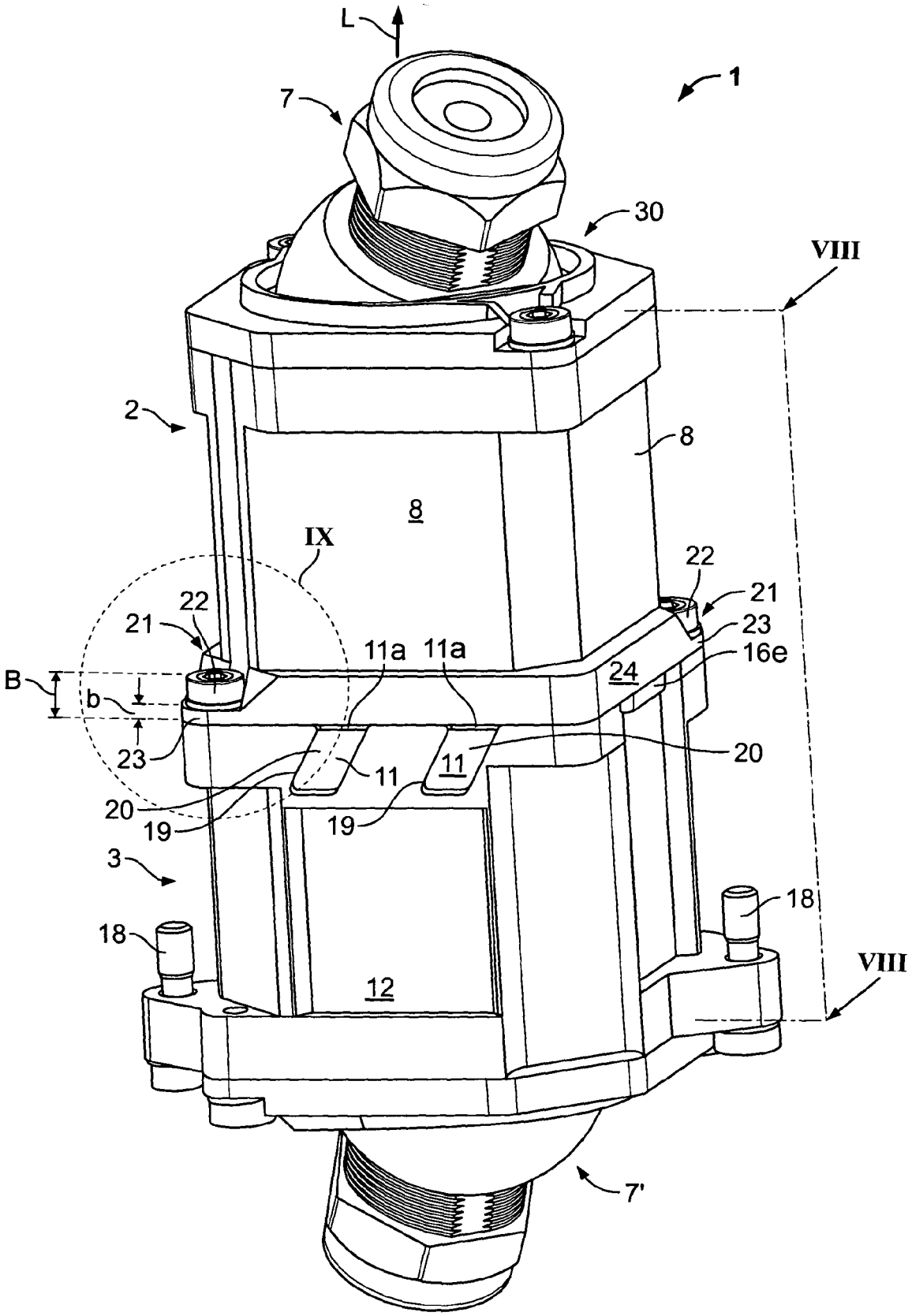
7d'
7'
7f'
13
7h'

Fig. 3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11
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20
19
19
3
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18
VIII
12
7'

Fig. 4

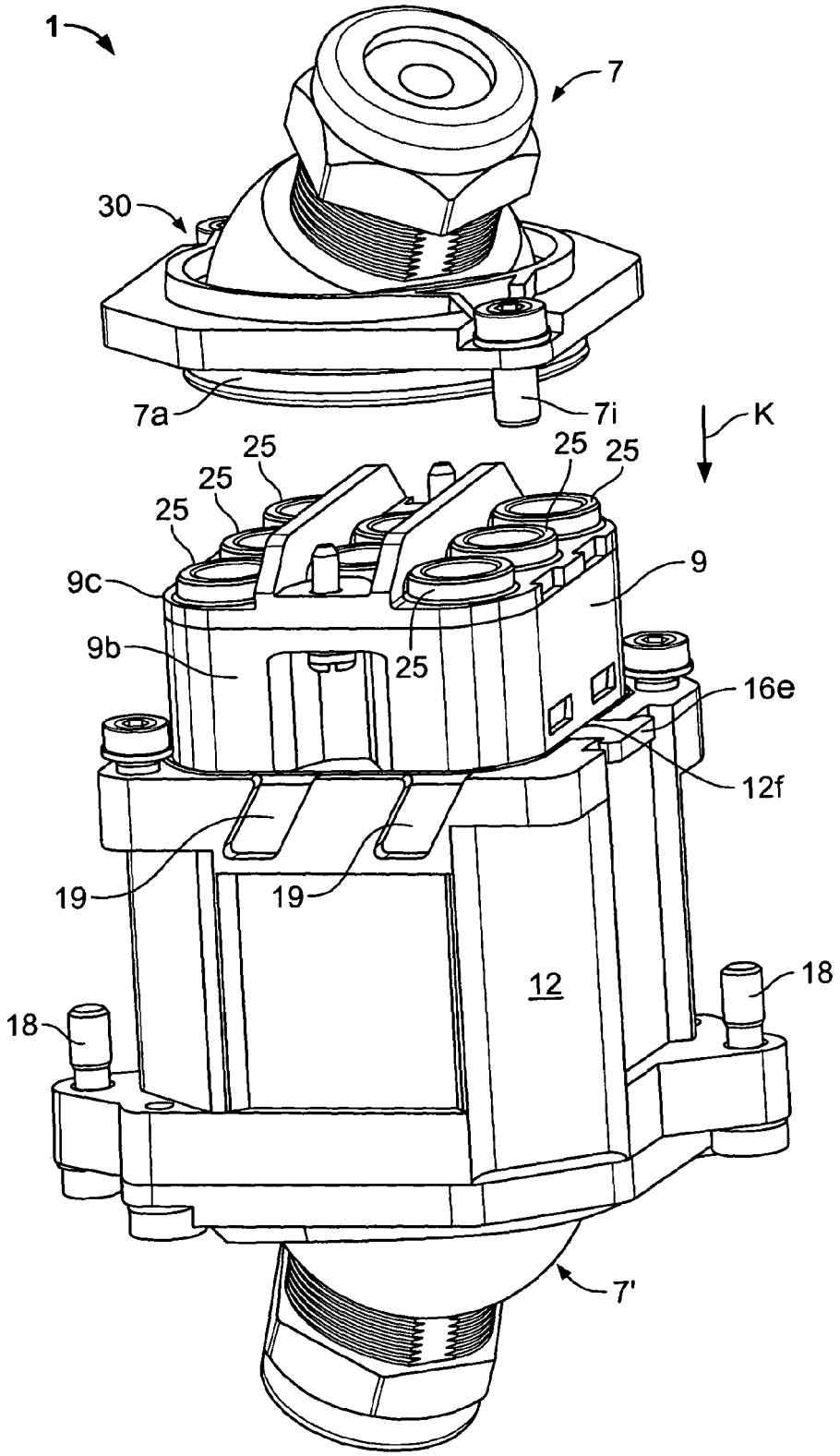
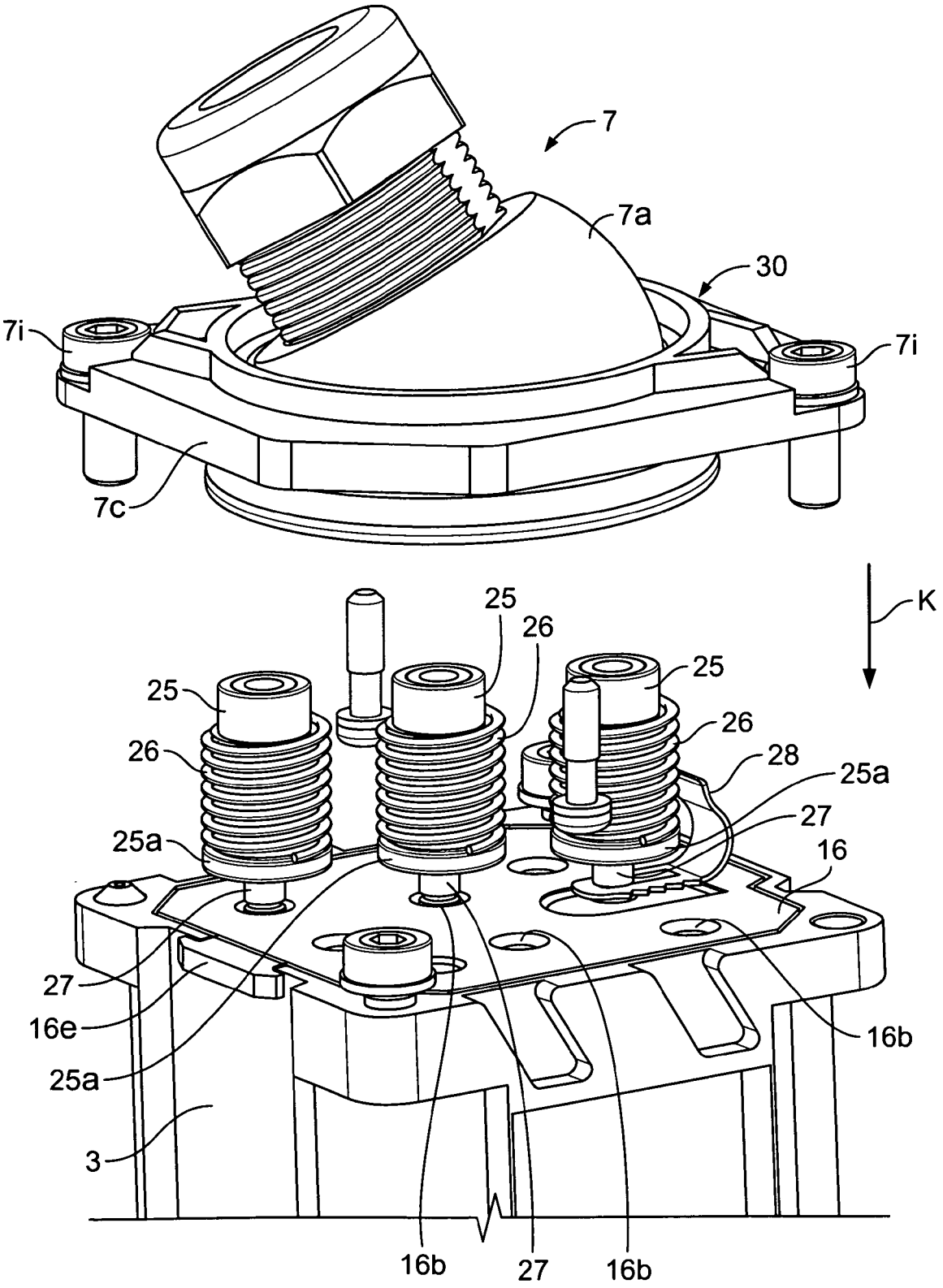


Fig. 5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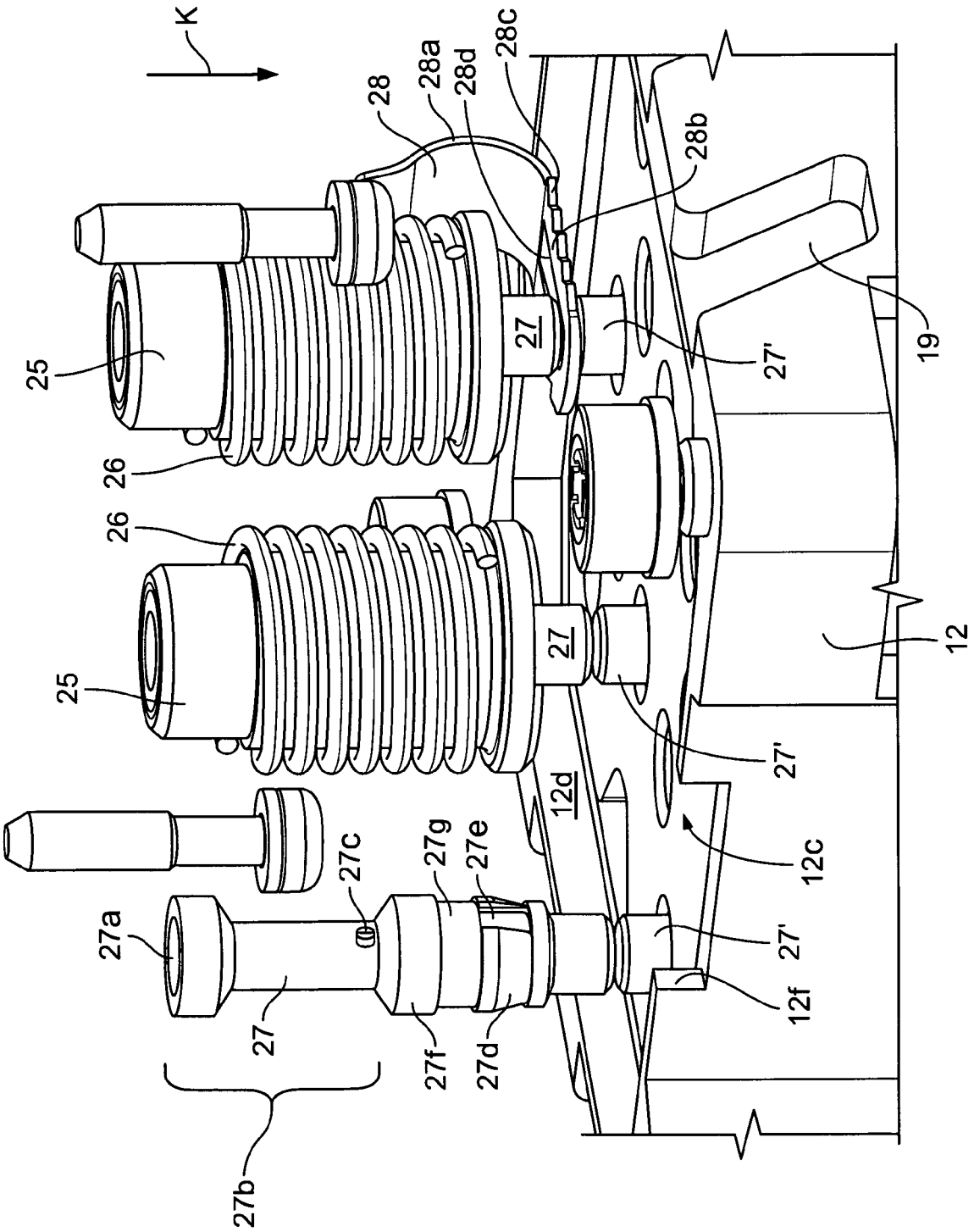
16b

Fig. 6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27e
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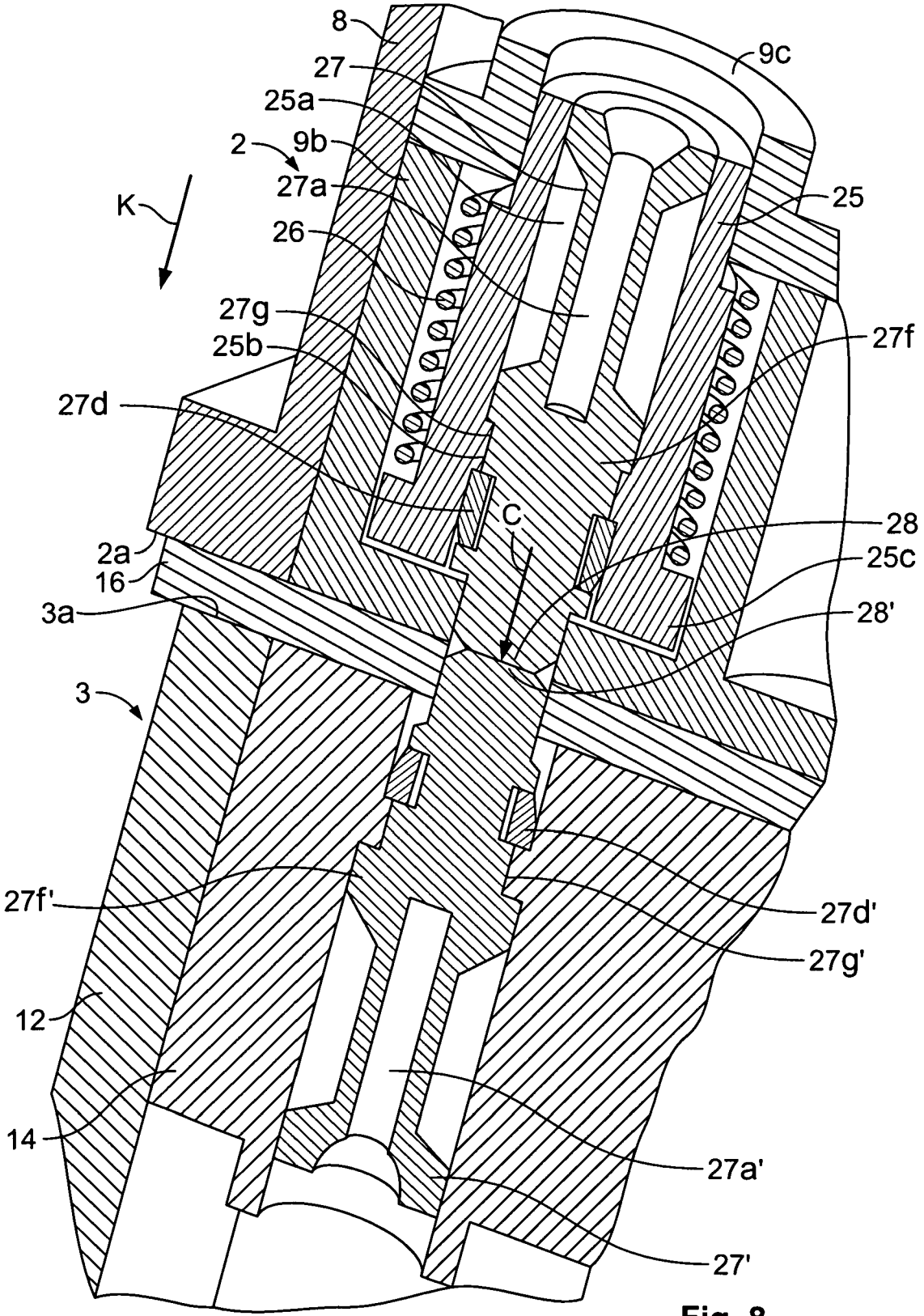
27f
27d
27b

Fig. 7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27g'
27a'
27'

Fig. 8

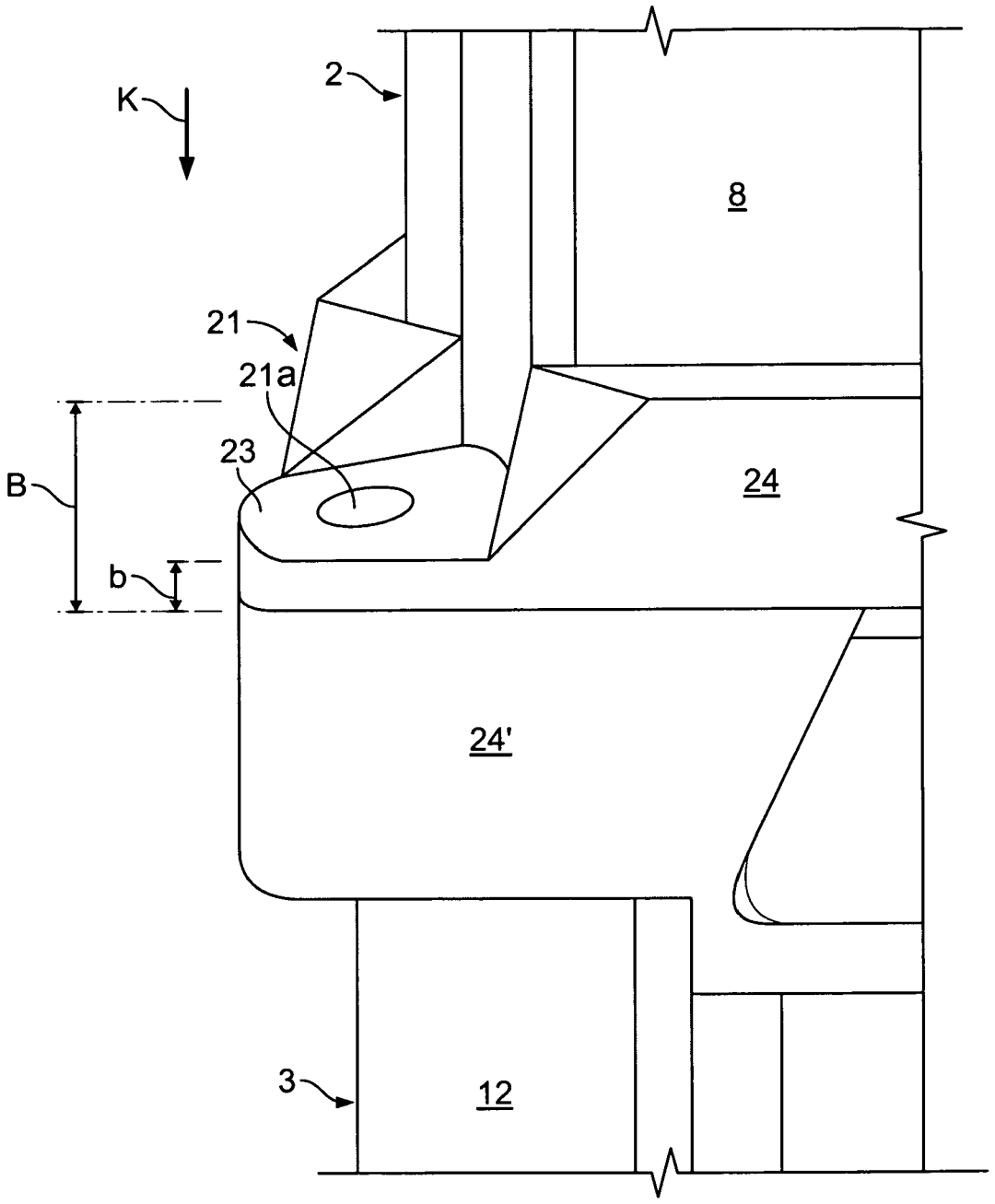

Fig. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 10 00 3641

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 Y	GB 1 311 905 A (CLANG LTD; AUSTEN H E) 28 March 1973 (1973-03-28) * the whole document * -----	1-3,8,9 6,10,11	INV. H01R13/56 H01R13/621 H01R13/629
X	GB 2 291 156 A (SUMITOMO WALL SYSTEMS LTD [JP] SUMITOMO WIRING SYSTEMS [JP]) 17 January 1996 (1996-01-17) * the whole document * -----	1,2	H01R13/24
X Y	US 2008/003894 A1 (HALL DAVID R [US] ET AL) 3 January 2008 (2008-01-03) * figure 2 * -----	4,5,12,13,15 6,14	
X	US 5 456 621 A (GAN GINN Y [US]) 10 October 1995 (1995-10-10) * the whole document * -----	4,5,12,13,15	
X	US 4 602 317 A (ROVNYAK RICHARD M [US] ET AL) 22 July 1986 (1986-07-22) * figure 3 * -----	4,5,12,13,15	
Y	GB 2 085 242 A (BICC LTD) 21 April 1982 (1982-04-21) * figure 1 * -----	10,11	TECHNICAL FIELDS SEARCHED (IPC) H01R F21S
Y	US 6 984 053 B1 (BIEBERDORF ROGER [US] ET AL) 10 January 2006 (2006-01-10) * figure 6 * -----	14	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	12 August 2010	Salojärvi, Kristiina

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons
.....
& : member of the same patent family, corresponding document

8

EPO FORM 1503 03.82 (P04C01)

Europäisches Patentamt
European Patent Office
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Application Number
EP 10 00 3641

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 10 00 3641

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-3, 8-11

   Connector having a fastening portion which has a weakened region. When an excessive external force hits the connector, the material damage is concentrated in the weakened region.

   ---

2. claims: 4-7, 12-15

   Connector having contact elements. The contact elements are contacted in a contact direction and a guide element defines a connecting direction which runs at an inclination in relation to the contact direction. Method for manufacturing a connector arrangement.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 00 3641

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

12-08-2010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 1311905 A	28-03-1973	NONE	
GB 2291156 A	17-01-1996	JP 8021425 A	23-01-1996
US 2008003894 A1	03-01-2008	US 2008220664 A1 US 2008223569 A1	11-09-2008 18-09-2008
US 5456621 A	10-10-1995	NONE	
US 4602317 A	22-07-1986	NONE	
GB 2085242 A	21-04-1982	NONE	
US 6984053 B1	10-01-2006	NONE	

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