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(54) **Housing for a connector, housing for a counter connector, set of housings, connector and counter connector**

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Description

[0001] The invention relates to a housing for a connector that can be plugged into a counter connector along a connection direction. The invention further relates to a housing for a counter connector into which such a connector can be plugged along a connection direction. Furthermore, the invention relates to a set comprising a housing for a connector and a housing for a counter connector. Moreover, the invention relates to a connector or a counter connector with a housing.

[0002] When a first plurality of cables has to be connected to a second plurality of cables, several solutions exist in the prior art. For example, the ends of the first plurality and the ends of the second plurality could be connected by a terminal strip. Another solution is that the ends of the first plurality and the second plurality of cables are terminated by terminals which are then inserted into a connector and a counter connector which in turn are then connected to each other. However, these connection methods are cumbersome and require a lot of time and space to establish the contact. Further, the resulting connection arrangement takes up a lot of space. Moreover, as pluralities of cables are usually grouped in a circular arrangement, in particular the solution with the terminal strip requires a rearrangement of the cables and increases the required space significantly, in particular laterally, i.e. in directions perpendicular to the connection direction. However, space for assembly and installation and space for the resulting electrical arrangement is often very limited, for example in aircrafts.

[0003] In order to provide a solution that allows a simple and fast installation within a limited space, wherein the resulting electrical connection arrangement is flexible and compact, a housing for a connector is provided, wherein the housing has a first pair of outer faces, the outer faces of the first pair being complementary to each other and lying opposite each other in a first stacking direction that is perpendicular to the connection direction, and wherein the housing has a second pair of outer faces, the outer faces of the second pair being complementary to each other and lying opposite each other in a second stacking direction that is perpendicular to the connection direction, wherein the first stacking direction differs from the second stacking direction. Similarly, this objective is achieved by a similarly embodied housing for a counter connector. The set comprises at least one such housing for a connector or a counter connector. A connector or a counter connector comprises such a housing and a terminal for connection to a cable and to the housing.

[0004] The first pair of outer faces allows a compact stacking of several housings in the first stacking direction, where no space is wasted between the neighbouring housing and where a movement of the housings relative to each other is limited. The housings support each other. Thus, the resulting connection arrangement is compact and stable. The second pair of outer faces allows a compact and stable stacking in the second stacking direction.

The fact that the second stacking direction is different from the first stacking direction allows a flexible arrangement in two dimensions. Thus, the resulting plurality of cables can be arranged in a compact fashion perpendicular to the connection direction. The solution allows a simpler and less space and time consuming installation as the cables can be attached to different housings which is simpler than connecting all cables to one housing. Subsequently, the housings can be positioned next to each other in a flexible and space saving way.

[0005] From US 2011/0287655 A1, a combination of an electrical connector and a counter connector is known, each comprising an inner part and an outer part.

[0006] US 7 244 131 B1 shows a frame for housings that has an inclined face on a side.

[0007] It is an object of the invention to improve the electrical connection between the connector and the counter connector.

[0008] This object is achieved when the housing has a first pressing face that is accessible from outside and a second pressing face that is accessible from outside, wherein the second pressing face is adapted for cooperating with the first pressing face of a neighboring, identically embodied housing in the assembled state and at least one of the first pressing face and the second pressing face has a surface normal (that is inclined to the connection direction).

[0009] This solution allows the housings of a connector or a counter connector to be pressed or pushed towards and/or against each other, in particular in an automated manner resulting in an improved electrical contact.

[0010] The inventive solution can further be improved by the following developments and embodiments, the improvements being independent of each other and advantageous by themselves so that they can be combined arbitrarily as desired. The further improvements can also be independent of the inventive solution as described above and represent an inventive aspect by themselves.

[0011] The housing can be adapted to receive a cable or a cable with a terminal on its end along an insertion direction. The connection direction can be parallel to the insertion direction. The connection direction can also be parallel to a cable direction along which the inserted cable runs within the housing. These solutions allow an easy installation. In particular, the housing can be adapted to receive only a single cable. Thus, each end of a cable can be attached to only one housing. This makes the installation process simpler.

[0012] The housing can be adapted to receive an electric cable or for receiving an optical cable. However, the housing can also be adapted for use with another type of cable, for example hydraulic or pneumatic cables.

[0013] In the assembled state, the cable can be located between the two outer faces of a pair of outer faces. Such a housing can be more compact.

[0014] The outer faces can be planar or substantially planar. This allows an easy manufacturing of the housing. The outer faces can be parallel to the connection direc-

tion, resulting in an easy assembly of the housing and an easy mounting of the housing to the other housings. The housing can have a prismatic outer shape with the outer faces being the side faces of a prism. Such a design has the advantage of an easy handling.

[0015] The housing can have a third pair of outer faces, the outer faces of the third pair being complementary to each other and lying opposite each other in a third stacking direction that is perpendicular to the connection direction, wherein the third stacking direction differs from the first stacking direction and the second stacking direction.

[0016] In an advantageous embodiment, all outer faces of the housing are complementary to their opposing outer faces. At least all lateral outer faces should be complementary to their opposing outer face. This allows a very compact design where no space is wasted between neighbouring houses. Of course, this applies only to all outer faces that lie on the outside when the connector is plugged into the counter connector. The housing can have the shape of a unit cell for stacking in two directions, in particular for space filling stacking. Hence, the cross-section of the housing in a plane perpendicular to the connection direction can have a shape of a two dimensional unit cell. Such a unit cell does not leave any gaps when it is attached to identical unit cells which have been translated in one, two or more directions. Different types of such unit cells can for example be known from crystallography.

[0017] In a particularly advantageous embodiment, the cross-section of the housing in a plane perpendicular to the connection direction is substantially hexagonal. This allows a very compact and at the same time very flexible stacking, in which a housing is supported by a high number of neighbouring housings. In particular, the cross-section can have the shape of a regular hexagon, resulting in a honeycomb-like structure of the stacked housings.

[0018] If two pairs of outer faces are used, it is particularly advantageous if the two stacking directions are 90° to each other. If three pairs of outer faces are used, 60° between each pair of two stacking directions is very advantageous. This results in a high fraction of space being used for the cable and only little space being used for the housing material.

[0019] In a particular advantageous embodiment, the housing has a rotational symmetry around the connection direction. In particular, a housing can have a twofold, a threefold, a fourfold or a sixfold rotational symmetry. In such embodiments, a housing can be put onto or put next to further housings in two, three, four or six different rotational orientations, whereby the installation process is even further simplified. Further, manufacturing such a housing is easier. In an advantageous embodiment, the two outer faces of a pair of outer faces are not only complementary but also identical. This makes the assembly of the housing and the installation of the housing simpler.

[0020] The housing can define a connection axis, the

connection axis being parallel to the connection direction and, in contrast to the connection direction, being fixed in space relative to the housing. The connection axis can for example lie inside a receptacle for a cable. It can in particular run through the centre of the housing and/or the receptacle. The outer faces of a pair of complementary outer faces can be opposite to each other relative to the connection axis. This allows a compact design.

[0021] The housing can have at least one positioning protrusion that protrudes perpendicular to the connection direction away from an outer face. Such a positioning protrusion can be adapted for adjusting the position along or counter to the connection direction, for adjusting the position perpendicular to the connection direction, for adjusting the position regarding a rotation about the connection direction, and/or for adjusting the position regarding a tilting relative to the connection direction. Such a positioning protrusion can have at least one stop face for each direction in which the housing is supposed to be positioned. The housing can further have a corresponding recess in a location that corresponds to the positioning protrusion when several housings are stacked along the at least two stacking directions. In particular, such a corresponding recess can be located on a face that is opposite to the outer face from which the positioning protrusion protrudes. A corresponding recess can either be adapted to receive the positioning protrusion entirely or only in parts. In particular, several recesses can be located on different faces which in the stacked state result in a combined recess for receiving a single positioning protrusion. In this way, a single positioning protrusion can help to adjust the position of more than one neighbouring housing. In turn, a single recess can be adapted to receive two or more positioning protrusions.

[0022] The housing can have a catch for fixing the housing to another housing. The housing can also have a catch for fixing the housing to an external element. The catch can serve to fix the housing to the other housing in a direction perpendicular to the connection direction. The catch can be adapted to fix the housing to an identically embodied housing. The catch can be shaped like a hook. Thus, the housing can have a corresponding receptacle for the catch. Such a receptacle can in particular comprise undercuts to allow a safe connection.

[0023] The housing can have a cable sealing, a plug sealing and/or a terminal sealing for a tight connection of the housing and the cable, for a tight connection of the two housings, or for a tight connection of the housing and a terminal respectively. In particular, when all of the aforementioned sealings are present, the assembled set of a housing for a connector and the housing for a counter connector can be tight, for example gas-tight or water-tight. The sealing can for example be a crimpable sealing, like a tube-like part, or an elastic element, like an O-ring.

[0024] An inventive set comprises a housing for a connector and a housing for a counter connector, wherein at least one of the housings is an inventive housing. Preferably, both housings are according to the invention.

Such a set allows a very compact stacking.

[0025] In a preferred embodiment, the housing for the connector has a stop face that abuts a counter stop face and blocks separating movement between the connector and the counter connector along the connection direction when then connector has been plugged in to the counter connector along the connection direction and the connector has been rotated relative to the counter connector about the connection direction. The two housings are thus locked to each other and an unintentional separation is avoided. The rotational relative movement necessary for achieving the locking can for example be a quarter turn (90°). Other values are of course also possible, for example values between 10° and 160°.

[0026] In a particularly preferred embodiment, the housings have rotational stop faces that abut each other and prevent rotation beyond a predefined relative position when the housing for the connector has been plugged into the housing for the counter connector and the housings have been rotated relative to each other. This has the advantage that the predefined relative position between the two housings can easily and safely be achieved.

[0027] The housings can have indicator means for indicating the correct rotational position. This gives the user a feedback and thus simplifies the assembly. Such indicator means can for example be outer faces on the two housings that are flush when the two housings are in the predefined/correct rotational position to each other. Another example of indicator means could be markings like arrows that point towards each other when the correct rotational position is achieved.

[0028] In a preferred embodiment, the housing for the connector and the housing for the counter connector both have one pressing face, wherein at least one of the pressing faces has a surface that is inclined to the connection direction. The pressing faces allow the housings to be pressed or pushed towards and/or against each other, in particular in an automated manner. As the housings can be rigidly connected to terminals within them, such terminals can then be pressed against each other to achieve a good electrical connection with a low resistance. In such a squeezed or pressed state, the housing for the connector and the housing for the counter connector are not necessarily in contact with each other.

[0029] The pressing faces are accessible from outside. Such housings can be pressed against each other when the pressing faces move along external faces in a direction perpendicular to the connection direction. Such external faces can for example be found on a support or a base. External faces can also be found on neighbouring housings, for example on positioning protrusions, so that the housing for the connector and the housing for the counter connector are pushed against each other when a second, neighbouring pair of a housing for a connector and a housing for a counter connector are pushed against a first pair in a direction perpendicular to the connection direction.

[0030] In a further preferred embodiment, the pressing faces are such that the housing for the connector is pressed against the housing for the counter connector when the housings are rotated above the connection direction relative to each other. In this embodiment, the connector can be plugged into the counter connector and then be rotated relative to the counter connector whereby the two housings are automatically pressed against each other through the rotation. In a particularly preferred embodiment, the housings are locked to each other and pressed against each other by the rotation. Thus, the housings can have stop faces and pressing faces. Preferably, the stop faces and the pressing faces are the same faces or located on the same part of the housing. This allows a very compact design. The pressing faces can be for example located at undercuts. Such undercuts can project behind corresponding parts of the other housing. This can make a simple design of the housing possible.

[0031] In order to avoid a potentially dangerous connection of non-matching connectors and counter connectors, at least one housing can have coding elements so that the connector can only be plugged into a matching counter connector. For example, the connector can only be allowed to be connected to one type of counter connector. In another embodiment, the connector can be allowed to be connected to a multitude of different types of counter connectors that are all safe for connection with the connector. This selective connection can be achieved by coding elements that have different lengths, widths or heights or are located at different positions. Further, the relative positions of two or more coding elements can also allow such a selective connection. An advantageous embodiment, the coding elements also have further functions. They could for example have pressing faces, stop spaces or rotational stop faces on them, thus allowing a compact design of the housings.

[0032] Two or more functions can be achieved by one element. These functions are in particular the locking by the stop faces, the rotational locking by the rotational stop faces, the pressing by the pressing faces and the coding by the coding elements.

[0033] An inventive connector or a counter connector comprises an inventive housing. The connector or counter connector can further comprise a terminal for connection to a cable and to the housing. The terminal can be fixed to the end of a cable and then be introduced into the housing. The terminal can for example allow a tight connection to the cable and/or to the housing. This can for example be achieved by a terminal that can be crimped onto the cable and onto the housing or fit tightly into the housing. As an alternative or in addition, the terminal could also be soldered into the cable. Further, sealing elements can be present between the cable and the terminal, between the terminal and the housing, and/or between the housing and the cable. Such sealing elements can be elastic rings or the like.

[0034] The inventive solution also comprises a set

comprising a housing and a base element with at least one receiving face that is complementary to an outer face of a housing. Such a base element can serve to support and fix at least one housing. Preferably, the base element has at least one receiving face that is complementary to the outer faces of a pair of housings. This allows a good support and fixing of a pair of housings.

[0035] In order to achieve a better support and fixing, the base element can have at least two neighbouring receiving faces that are complementary to two outer faces of one housing.

[0036] In a further preferred embodiment, the base element in a set comprising a housing and a base element has at least two neighbouring receiving faces for receiving two abutting, neighbouring housings. Thus, two neighbouring houses can be stacked in a compact way with sufficient support. In particular, the two neighbouring receiving faces are adapted for receiving two outer faces of two different pairs of outer faces so that a stacking is possible in the at least two stacking directions.

[0037] The base element can be adapted to be connected to further base elements. For example the base element can have matching faces that allow a compact stacking of the base elements. Further, fixing means can be provided for fixing the base elements to each other.

[0038] Different types of base elements can be provided that can each be connected to each other thus allowing a modular assembly of a base. For example one type of base element can serve to support the housings in a planar fashion and a second type of base element can be designed to stack the housings in a stepped manner, thus also providing support in a second stacking direction.

[0039] The invention also comprises a set comprising a housing and a base, the base comprising at least one base element. Preferably, the base is made up of several, modular base elements.

[0040] In a preferred embodiment, the base also comprises a tensioning means, wherein the base is adapted to surround the housings entirely around their connection direction and the tensioning means is adapted to push at least one housing onto the base element and/or onto further housings. The tensioning mean thus allows an easy fixing of the housings on the base. The base and/or the tensioning means can comprise a hook for closing or opening the connection between the base and the tensioning means in this way, the base can be wrapped around the housings easily.

[0041] The tensioning means can comprise a flexible belt or belt-like element that adapts to different configurations and numbers of housings on the base. The tensioning means can allow for an adjustment of the length around the connection direction to adapt to different configurations of different numbers of housings on the base. For example, the belt-like element could be elastic. This has the further advantage that holding forces are automatically exerted by such a belt-like element.

[0042] The invention will now be described by way of

advantageous embodiments and with reference to the drawings.

[0043] In the drawings:

- | | | |
|----|----------------|---|
| 5 | Fig. 1 | shows a schematic perspective view of two pairs of housings illustrating the locking mechanism; |
| 10 | Fig. 2 | shows a schematic perspective view of a housing for a connector and a housing for a counter connector in a connected state; |
| 15 | Fig. 3A and 3B | show different schematic perspective views of a first embodiment of a base for housings; |
| 20 | Fig. 4A and 4B | show different schematic perspective views of a second embodiment of a base with and without housings; |
| 25 | Fig. 5A and 5B | show different schematic perspective views of a third embodiment of a base with and without housings; |
| 30 | Fig. 6A | shows a schematic perspective view of the attachment of a first housing to a second housing; |
| 35 | Fig. 6B | shows a schematic cross-section of a detail of the assembly step of Fig. 6A; |
| 40 | Fig. 7 | shows a schematic cross-section through two pairs of housings; |
| 45 | Fig. 8A | shows a schematic perspective front view of three pairs of stacked housings; |
| 50 | Fig. 8B | shows an enlarged detail of Fig. 8A; |
| 55 | Fig. 8C | shows a detail of the stacked housings of Fig. 8A from a different angle; |
| | Fig. 9A | shows a schematic perspective view of a first step of the stacking process; |
| | Fig. 9B | shows a schematic perspective view of a second step of the stacking process; |
| | Fig. 9C | shows a schematic perspective view of a third step of the stacking process; |
| | Fig. 9D | shows the third step of the stacking process according to Fig. 9C from a different angle; |
| | Fig. 9E | shows a detail of Fig. 9D; |
| | Fig. 10 | shows a schematic side view of the pressing mechanism. |

[0044] In Fig. 1 two pairs of connectors 11 and counter connectors 12 are shown.

[0045] Each connector 11 can be plugged into the corresponding counter connector 12 along a connection direction C. The movement of the connection takes place along the connection axis A which is defined by the terminals 21 and 22 of the connector 11 and the counter connector 12, respectively.

[0046] The upper pair of a connector 11 and a counter connector 12 is shown in the insertion position, in which the connector 11 can be plugged into the counter con-

connector 12. The lower pair of a connector 11 and the counter connector 12 shows the relative position of the two after the connector 11 has been rotated a quarter turn about the connection direction C, the movement M being indicated by an arrow. Fig. 1 is only illustrative to show the movement M. In reality, the connector 11 would be inserted in the counter connector 12 when the movement M takes place.

[0047] As can be seen, the connector 11 has coding elements 41 that protrude perpendicular to the connection direction C away from a cylindrical section. The coding elements 41 serve to allow only an insertion of a certain type of connector 11 into a matching counter connector 12. Further, stop faces 31 can be found on the coding elements 41. The stop faces 31 face counter to the connection direction and prevent that the two housings 1, 2 of the connector 11 and the counter connector 12, respectively, can be separated along the connection direction when the connector 11 has been inserted into the counter connector 12 and rotated 90° around the connection direction C and the connection axis A. However, the exact value of the angle of rotation is not decisive. Other values might also be chosen, for example between approx. 10° and 160°. Small angles allow an easy operation. Greater angles provide higher levels of safety, in particular an unwanted disengaging is less likely for greater angles. To achieve this, the stop faces 31 engage corresponding stop faces 32 (not shown in Fig. 1) inside the housing 2 of the counter connector 12. The coding elements 41 also have rotational stop faces 33 on their sides to prevent rotation beyond a predefined relative position between the housing 1 and the counter housing 2.

[0048] Each of the housings 1, 2 has three pairs of complementary outer faces. For the sake of brevity, the principle of the complementary outer faces is explained only with reference to the connector 1. However, the same principle applies for the three pairs 410, 420, 430 of pairwise complementary opposing outer faces 411, 412, 421, 422, 431, 432 of the housing 2 of the counter connector 12 and the stacking directions P4, P5, P6.

[0049] The first pair 110 comprises a first outer face 111 and a second outer face 112. The two outer faces 111, 112 are complementary to each other. The two outer faces 111, 112 are basically planar and parallel to the connection direction C. The second outer face 112 lies opposite the first outer face 111 relative to a first stacking direction P1 that is perpendicular to the connection direction C. In other words, the second outer face 112 is on the opposite side of the housing 1 relative to the first outer face 111 with respect to the stacking direction P1. The complementary design of the two outer faces 111, 112 allows a stacking of several housings 1 in the first stacking direction P1 without leaving free space between abutting outer faces 111, 112. Moreover, the outer faces 111, 112 support each other over a big area and thus allow a stable stacking. The same principle applies for the second pair of outer faces 120 comprising a first outer

face 121 and a second outer face 122. The two outer faces 121, 122 lie opposite each other in a second stacking direction P2. The second stacking direction P2 is also perpendicular to the connection direction C, but differs from the first stacking direction P1. An angle of 60° can be found between the first stacking direction P1 and the second stacking direction P2 in this embodiment. As the first outer face 121 and the second outer face 122 are again complementary to each other and lie opposite to each other relative to the second stacking direction P1, a compact and gap-free stacking in the second stacking direction P2 is possible.

[0050] The housing 1 has a third pair 130 of outer faces 130 comprising a first outer face 131 and a second outer face 132 which are again complementary to each other and lie opposite each other in a third stacking direction P3. The third stacking direction P3 is again perpendicular to the connection direction C and differs from the first stacking direction P1 and the second stacking direction P2. The third stacking direction P3 has an angle of 60° to the first stacking direction P1 and to the second stacking direction P2.

[0051] The outer faces 111, 112, 121, 122, 131, 132 define the complete outer shape of the housing 1 in the circumferential direction around the connection direction C. Thus, all outer faces of the housing are complementary to their opposing outer faces, at least in the circumferential direction and in the areas that are accessible when the connector 11 is connected to the counter connector 12. A part of the housing 1 that is plugged into the housing 2 of the counter connector 12 does not have complementary opposing faces but is rather cylindrical.

[0052] The outer shape of the housing 1 and the outer shape of the housing 2 and also the combination of the two housings 1, 2 represents a unit cell for two-dimensional stacking. Thus, when several of these housings 1, 2 are stacked in the stacking directions P1, P2 and/or P3, no space or very little space is left between the housings 1, 2. The cross-section of the housings 1, 2 is substantially hexagonal, in particular the cross-section has the shape of a regular hexagon, resulting in a honeycomb-like structure of the stacked housings. This allows a very compact design with very little material for the housing being wasted.

[0053] Housings 1, 2 each have a prismatic shape, at least in the sections that are accessible in the combined state of the connector 11 and the counter connector 12.

[0054] In Fig. 2 it can be seen that the housing 1 for the connector 11 and the housing 2 for the counter connector 12 each have several positioning protrusions 61 and 62, respectively. The positioning protrusions 61, 62 protrude perpendicularly away from outer faces of the housings 1, 2. The positioning protrusions 61, 62 serve to position the housings 1, 2, and particularly a combination of the two housings 1, 2 in several directions. To achieve this, the positioning protrusions 61 each have several stop faces 70 facing in different directions. The positioning protrusions 61, 62 can at least partially be

received in corresponding recesses 66, 67, 68 of one or more abutting housings 1, 2 when the housings 1, 2 are stacked. The recesses 66, 67 are opposite the positioning protrusion 61, 62 in a direction that is perpendicular to the connection direction C. In the shown example, the recesses 66, 67 are opposite relative to the third stacking direction P3. Further recesses 68 allow an engagement in a sideways fashion with a third stacked housing 1, 2, thus allowing a mashing of not only two neighbouring housings 1, 2 but of three neighbouring housings 1, 2.

[0055] In Figs. 3A and 3B, a base for housings 1, 2, in particular for a combination of the housings 1 and 2 is shown. The base 200 is made from a single base element 201 and also comprises a part of a tensioning means 210.

[0056] The base element 201 has several receiving faces 202 that are each complementary to an outer face of the housings 1, 2. Several of the receiving faces are adapted to receive only one housing 1, 2. For example, the three receiving faces 202 in the centre are adapted to receive one housing. Other neighbouring receiving faces 202 are adapted to engage different housings 1, 2 that are stacked on and in the base 200. Thus, a step is located between such two receiving faces 202. These receiving faces 202 thus have a convex outer combined surface, whereas the receiving faces 202 that are adapted to receiving only a single housing have a concave outer shape.

[0057] The base 200 serves to support the housings 1, 2 and to fix the housings 1, 2 for example to a floor 300. The base 200 has recesses 320 for receiving fixing means, for example screws to fix the base 200 to the floor 300.

[0058] In Figs. 4A and 4B a different kind of base 200 is shown. This base 200 comprises several modular base elements 201. The base elements 201 can be connected or attached to each other for example by latching them to each other to build a base 200. In the depicted example, the base elements 201 all have stepped upper sides and thus limit the stacking in these directions and further support the housings 1, 2 in several stacking directions.

[0059] As can be seen in Fig. 4B, the housings 1, 2 can be stacked in the three stacking directions P1, P2 and P3.

[0060] In Figs. 5A and 5B a different base 200 is shown. This base 200 comprises several modular base elements 201 that are placed next to each other and connected to each other. In contrast to the base 200 of Figs. 4A and 4B, the base 200 of Figs. 5A and 5B also comprises base elements 201 that allow a linear or planar arrangement of housings 1, 2 next to each other. Like in the preceding embodiment, the base 200 also comprises recesses 91 that are adapted to match a catch 90 on the housing 2. With the help of this catch 90, the housing 2 can be fixed to the base 200. The catch 90 has the shape of a hook and thus secures the housing 2 from being separated from the base 200. Further, the catches 90 on the housings 2 also serve to secure the housings 2 relative to each other.

[0061] In Figs. 6A and 6B, the connection of two housings 2 to each other and the insertion of a catch 90 into a recess 92 on a neighbouring housing 2 is shown. In order to connect the two housings 2, the upper housing 2 is tilted relative to the connection direction C of the lower housing 2 in order to avoid that the positioning protrusions 61, 62 inhibit a movement in the connection direction C and an insertion of the catch 90 into the recess 92. Once the catch 90 has been introduced into the recess 92, the two housings can be tilted to abut each other, whereby the positioning protrusions 61, 62 engage corresponding recesses 66, 67 and secure the housings 2 against relative movement.

[0062] In Fig. 7 a cross-section through two pairs of housings 1 and 2 is depicted. In particular, it can be seen that the connectors 11 and 12 comprise terminals 21 and 22, respectively, for connecting the housings 1, 2 to cables 3. The terminal 22 of the counter connector 12 has a pin-shaped configuration, whereas the terminal 21 of the connector 1 is designed to receive the terminal 22. The connectors 11, 12 further comprise cable sealings 52 for sealing the housings 1, 2 relative to the cables 3. The terminals 21, 22 can for example be connected to the contacting part of the cable 3 by crimping in a connection section 52 or by soldering. The connector 1 further comprises a plug sealing 51 for sealing the housing 1 relative to the housing 2. Moreover, the housings 1, 2 can comprise interlocking elements 53 for holding the terminals 21, 22 relative to the housings 1, 2. The housings 1, 2 are made from an insulating material and allow an insulation. The cables 3 each have an outer shell 35 made from an insulating material and electrically conducting core 36 for transmitting electrical current, in particular high electrical current.

[0063] The outer shell 35 is sealed against the housings 1, 2 by way of the terminal sealings 53, which can for example be o-rings or a crimpable sealings, like crimp sections.

[0064] The inventive connectors 11, 12 are easy to assemble. First, the terminals 21, 22 are attached to the cores 36 of the cables 3. Afterwards, the terminals 21 and 22 are inserted into the housings 1, 2. Subsequently, the housings 1, 2 and thus the connectors 11 and 12 are connected along the connection direction C. This assembling procedure requires little space and is simple. Furthermore, the resulting multitude of connectors 11, 12 can easily be stacked in different configuration due to the inventive outer shape which allows a stacking in several stacking directions P1, P2, P3.

[0065] In Figs. 8A, 8B and 8C details of the positioning by way of the positioning protrusions 61, 62 and the corresponding recesses 66, 67, 68 is shown. For the sake of a better understanding, the upper right housing 1 of Fig. 8A is shown partially transparent.

[0066] The positioning protrusion 61 that protrudes from the left lower side of the upper right housing 1 engages not only with a recess 66 on the housing 1 below, but also with a recess 68 that is found on the side of the

housing 1 on the left side. In Fig 3, such a combined recess for the position protrusion 61 can be seen with the upper right housing 1 removed. Thus, a very stable positioning and securing of the housings 1 to each other is achieved.

[0067] In Fig. 8C it can furthermore be seen that the housings 1, 2 each have an indicator means 95 that indicate the correct rotational position relative to each other. The indicator means are embodied as arrows that are pointing to each other when the correct rotational position is reached.

[0068] In Figs. 9A, 9B and 9C three subsequent steps of an assembly of different housings 1, 2 and a fixing to base 200 are shown. In the first step of Fig. 9A, several housings 1, 2 are put into and onto the base 200 and on top of other housings 1, 2. The housings are moved along the third stacking direction P3 so that the positioning protrusions 61, 62 can be inserted into the corresponding recesses 66, 67, 68. However, in order to fix the housings 2 to each other into the base 200, the hooks 90 have to be introduced into the corresponding recesses 91 on the base 200 and the recesses 92 and the housings 2 in the way shown in Figs. 6A and 6B by tilting relative to the connection direction C. Once all housings 1, 2 are stacked, a belt-like element 220 can be wrapped around the housings 2. A hook 221 attached to the belt-like element 220 is hooked to a lever-like tensioning device 222 and the lever-like tensioning device 222 is then operated to tension the belt-like element 220 and thus fix the housings 1, 2 to the base element 201. Hence, the housings 1, 2 are fixed to the floor 300 via the base element 201 which is screwed to the floor 300 by way of screws. The belt-like element 220 can be flexible and can in particular be elastic so that the belt-like element 220 exerts a holding force. In Fig. 9, it is the belt-like element 220 that provides the force for holding the elements together by pushing the housings 2 onto the base 200. However, this is just exemplary. In addition or in an alternative, such a holding force could also be exerted by other elements, for example by the lever-like tensioning device 222 or the hook 221. Further, other means for providing the holding force can also be used, for example screws that are tightened or elements that are connected to such screws.

[0069] In Fig. 10 a side view of two neighbouring pairs of housings 1, 2 is shown. The housings 1, 2 each comprise pressing faces 301, 302, 311, 312 located on the positioning protrusions 61, 62 and in the recesses 66, 67, 68. The pressing faces are slanted relative to the connection direction C and thus have a surface normal N1, N2 that is inclined to the connection direction C. The two surface normals N1, N2 are also inclined to each other. This design results in squeezing forces S that press or push the housings 1 towards the housings 2, when a tensioning force F is applied perpendicular to the connection direction C, for example by the belt-like element 220. As the housings 1, 2 are rigidly connected to the terminals 21, 22, the terminals will be pressed against each other, thus giving a low electrical resistance be-

tween them. However, the housing 1 for the connector 11 does not have to be in direct, pressing contact with its corresponding housing 2 for the counter connector 12. The pressing faces 301, 302, 311, 312 are accessible from the outside and can for example be engaged with external elements that can be found on the base 200 or with pressing faces 301, 302, 311, 312 of other housings 1, 2 in order to achieve a squeezing effect.

10 Reference Signs

[0070]

1	housing for connector
2	housing for the counter connector
3	cable
11	connector
12	counter connector
21	terminal for connector
22	terminal for counter connector
31	stop face on connector
32	stop face on counter connector
33	rotational stop face
35	outer shell
36	core
41	coding element
51	plug sealing
52	cable sealing
53	interlocking element
61	positioning protrusion on connector housing
62	positioning protrusion on counter connector housing
66	recess on connector housing
67	recess on counter connector housing
68	recess on a side
70	stop face
90	catch
91	recess for a catch on a base
92	recess for a catch on a housing
95	indicator means
110	first pair of outer faces
111	first outer face
112	second outer face
120	second pair of outer faces
121	first outer face
122	second outer face
130	third pair of outer faces
131	first outer face
132	second outer face
200	base
201	base element
202	receiving face
210	tensioning means
220	belt-like element
221	hook
222	lever-like tensioning device
300	floor
301	pressing face

302 pressing face
 311 pressing face
 312 pressing face
 320 recess
 410 first pair of outer faces
 411 first outer face
 412 second outer face
 420 second pair of outer faces
 421 first outer face
 422 second outer face
 430 third pair of outer faces
 431 first outer face
 432 second outer face
 A connection axis
 C connection direction
 F tensioning force
 M movement
 N1 surface normal
 N2 surface normal
 P1 first stacking direction
 P2 second stacking direction
 P3 third stacking direction
 P4 first stacking direction
 P5 second stacking direction
 P6 third stacking direction

Claims

1. Housing (1, 2) for a connector (11) that can be plugged into a counter connector (12) along a connection direction (C) or for a counter connector (12) into which a connector (11) can be plugged along a connection direction (C), wherein the housing (1, 2) has a first pair (110, 410) of outer faces (111, 112, 411, 412), the outer faces (111, 112, 411, 412) of the first pair (110, 410) being complementary to each other and lying opposite each other in a first stacking direction (P1, P4) that is perpendicular to the connection direction (C), and wherein the housing (1, 2) has a second pair (120, 420) of outer faces (121, 122, 421, 422), the outer faces (121, 122, 421, 422) of the second pair (120, 420) being complementary to each other and lying opposite each other in a second stacking direction (P2, P5) that is perpendicular to the connection direction (C), wherein the first stacking direction (P1, P4) differs from the second stacking direction (P2, P5), wherein the housing (1, 2) has at least one pressing face (301, 311, 302, 312) that has a surface normal (N1, N2) that is inclined to the connection direction (C) and is accessible from outside, **characterized in that** the housing (1, 2) has a first pressing face (301, 302, 311, 312) that is accessible from outside and a second pressing face (311, 312, 301, 302) that is accessible from outside, wherein the second pressing face is adapted for cooperating with the first pressing face (301, 302, 311, 312) of a neighboring, identically em-

bodied housing (1, 2) in the assembled state and at least one of the first pressing face (301, 302, 311, 312) and the second pressing face (311, 312, 301, 302) has a surface normal (N1, N2) that is inclined to the connection direction (C).

2. Housing (1, 2) according to claim 1, comprising further outer faces (121, 122, 131, 132, 421, 422, 431, 432) wherein all outer faces (111, 112, 121, 122, 131, 132 or 411, 412, 421, 422, 431, 432) of the housing are complementary to their opposing outer faces, (112, 111, 122, 121, 132, 131 or 412, 411, 422, 421, 432, 431), respectively.

3. Housing (1, 2) according to any of claims 1 or 2, wherein the cross section of the housing (1, 2) in a plane perpendicular to the connection direction (C) is substantially hexagonal.

4. Housing (1, 2) according to any of claims 1 to 3, wherein the housing (1, 2) has at least one positioning protrusion (61, 62) that protrudes perpendicular to the connection direction (C) away from an outer face (111, 112, 121, 122, 131, 132 or 411, 412, 421, 422, 431, 432).

5. Housing (1, 2) according to any of claims 1 to 4, wherein the housing (2) has a catch (90) for fixing the housing (2) to another housing (2).

6. Housing (1, 2) according to any of claims 1 to 5, wherein the housing (1, 2) has a cable sealing (52), a plug sealing (51) and/or a terminal sealing.

7. Set comprising a housing (1) for a connector (11) and a housing (2) for a counter connector (12), wherein the housing (1) for the connector (11) is according to any of claims 1 to 6 and/or the housing (2) for the counter connector (12) is according to any of claims 1 to 6, wherein the housing (1) for the connector (11) has a stop face (31) that abuts a counter stop face (32) on the housing (2) for the counter connector (12) and blocks a separating movement between the connector (11) and the counter connector (12) along the connection direction (C) when the connector (1) has been plugged into the counter connector (12) along the connection direction (C) and the connector (11) has been rotated relative to the counter connector (12) about the connection direction (C).

8. Set according to claim 7, wherein the housings (1, 2) have rotational stop faces (33) that abut each other and prevent rotation beyond a predefined relative position, when the housing (1) for the connector (11) has been plugged into the housing (2) for the counter connector (12) and the housings (1, 2) have been rotated relative to each other.

9. Connector (11) or counter connector (12) comprising a housing (1, 2) according to any of claims 1 to 6 and a terminal for connection to a cable (C) and to the housing (1, 2).
10. Set comprising a housing (1, 2) according to one of claims 1 to 8 and a base element (201) with at least one receiving face (202) that is complementary to an outer face (111, 112, 121, 122, 131, 132) of the housing (1, 2).
11. Set comprising a housing (1, 2) according to one of claims 1 to 8 and a base element (201) with at least two neighbouring receiving faces (202) adapted for receiving two abutting neighbouring housings (1, 2).
12. Set comprising a housing (1, 2) according to one of claims 1 to 8 and a base (200) comprising at least one base element (201) according to one of claims 10 or 11, and a tensioning means (210), wherein the base (200) is adapted to surround the housings (1, 2) entirely around the connection direction (C) and the tensioning means (210) is adapted to push at least one housing (2) onto the base element (201) and/or onto further housings (2).

Patentansprüche

1. Gehäuse (1, 2) für einen Verbinder (11), der in einer Verbindungsrichtung (C) in einen Gegenverbinder (12) eingesteckt werden kann, oder für einen Gegenverbinder (12), in den ein Verbinder (11) in einer Verbindungsrichtung (C) eingesteckt werden kann, wobei das Gehäuse (1, 2) ein erstes Paar (110, 410) äußerer Flächen (111, 112, 411, 412) aufweist, die die äußeren Flächen (111, 112, 411, 412) des ersten Paares (110, 410) komplementär zueinander sind und einander in einer ersten Schichtungsrichtung (P1, P4) gegenüberliegen, die senkrecht zu der Verbindungsrichtung (C) ist, und wobei das Gehäuse (1, 2) ein zweites Paar (120, 420) äußerer Flächen (121, 122, 421, 422) aufweist, wobei die äußeren Flächen (121, 122, 421, 422) des zweiten Paares (120, 420) komplementär zueinander sind und einander in einer zweiten Schichtungsrichtung (P2, P5) gegenüberliegen, die senkrecht zu der Verbindungsrichtung (C) ist, wobei sich die erste Schichtungsrichtung (P1, P4) von der zweiten Schichtungsrichtung (P2, P5) unterscheidet, das Gehäuse (1, 2) wenigstens eine Pressfläche (301, 311, 302, 312) aufweist, die eine Oberflächennormale (N1, N2) hat, die zu der Verbindungsrichtung (C) geneigt und von außen zugänglich ist, **dadurch gekennzeichnet, dass** das Gehäuse (1, 2) eine erste Pressfläche (301, 302, 311, 312), die von außen zugänglich ist, und eine zweite Pressfläche (311, 312, 301, 302) hat, die von außen zugänglich ist, wobei die zweite Pressfläche so eingerichtet ist, dass sie in dem zusammengebauten Zustand mit der ersten Pressfläche (301, 302, 311, 312) eines benachbarten, identisch ausgebildeten Gehäuses (1, 2) zusammenwirkt und die erste Pressfläche (301, 302, 311, 312) oder/und die zweite Pressfläche (311, 312, 301, 302) eine Oberflächennormale (N1, N2) hat/haben, die zu der Verbindungsrichtung (C) geneigt ist.
2. Gehäuse (1, 2) nach Anspruch 1, das weitere äußere Flächen (121, 122, 131, 132, 421, 422, 431, 432) umfasst, wobei alle äußeren Flächen (111, 112, 121, 122, 131, 132 oder 411, 412, 421, 422, 431, 432) des Gehäuses jeweils komplementär zu ihren gegenüberliegenden äußeren Flächen (112, 111, 122, 121, 132, 131 oder 412, 411, 422, 421, 432, 431) sind.
3. Gehäuse (1, 2) nach einem der Ansprüche 1 oder 2, wobei der Querschnitt des Gehäuses (1, 2) in einer Ebene senkrecht zu der Verbindungsrichtung (C) im Wesentlichen sechseckig ist.
4. Gehäuse (1, 2) nach einem der Ansprüche 1 bis 3, wobei das Gehäuse (1, 2) wenigstens einen Positionier-Vorsprung (61, 62) aufweist, der senkrecht zu der Verbindungsrichtung (C) von einer äußeren Fläche (111, 112, 121, 122, 131, 132 oder 411, 412, 421, 422, 431, 432) weg vorsteht.
5. Gehäuse (1, 2) nach einem der Ansprüche 1 bis 4, wobei das Gehäuse (2) eine Nase (90) zum Fixieren des Gehäuses (2) an einem anderen Gehäuse (2) aufweist.
6. Gehäuse (1, 2) nach einem der Ansprüche 1 bis 5, wobei das Gehäuse (1, 2) eine Kabel-Dichtung (52), eine Stecker-Dichtung (51) und/oder eine Anschluss-Dichtung aufweist.
7. Set, umfassend ein Gehäuse (1) für einen Verbinder (11) und ein Gehäuse (2) für einen Gegenverbinder (12), wobei das Gehäuse (1) für den Verbinder (11) einem der Ansprüche 1 bis 6 entspricht und/oder das Gehäuse (2) für den Gegenverbinder (12) einem der Ansprüche 1 bis 6 entspricht, das Gehäuse (1) für den Verbinder (11) eine Anschlagfläche (31) aufweist, die an einer Gegen-Anschlagfläche (32) an dem Gehäuse (2) für den Gegenverbinder (12) anliegt und eine Trennbewegung zwischen dem Verbinder (11) und dem Gegenverbinder (12) in der Verbindungsrichtung (C) blockiert, wenn der Verbinder (1) in der Verbindungsrichtung (C) in den Gegenverbinder (12) eingesteckt worden ist und der Verbinder (11) relativ zu dem Gegenverbinder (12) um die Verbindungsrichtung (C) herum gedreht worden ist.
8. Set nach Anspruch 7, wobei die Gehäuse (1, 2) Dreh-

Anschlagflächen (33) aufweisen, die aneinander anliegen und Drehung über eine vorgegebene relative Position hinaus verhindern, wenn das Gehäuse (1) für den Verbinder (11) in das Gehäuse (2) für den Gegenverbinder (12) eingesteckt worden ist und die Gehäuse (1, 2) relativ zueinander gedreht worden sind.

9. Steckverbinder (11) oder Gegensteckverbinder (12), der ein Gehäuse (1, 2) nach einem der Ansprüche 1 bis 6 sowie einen Anschluss für Verbindung mit einem Kabel (C) und mit dem Gehäuse (1, 2) umfasst.
10. Trägerelement (201) mit wenigstens einer Aufnahme­fläche (202), die komplementär zu einer äußeren Fläche (111, 112, 121, 122, 131, 132) des Gehäuses (1, 2) ist, wobei das Trägerelement (201) ein Außen­element umfasst, das zum Zusammenwirken mit einer Pressfläche (301, 302, 311, 312) eines Gehäuses (1, 2) eingerichtet ist, **dadurch gekennzeichnet, dass** die Pressfläche (301, 302, 311, 312) eine Oberflächennormale (N1, N2) hat, die zu der Verbindungsrichtung (C) geneigt ist.
11. Trägerelement (201) mit wenigstens zwei benachbarten Aufnahme­flächen (202), die zum Aufnehmen zweier aneinander anliegender benachbarter Gehäuse (1, 2) eingerichtet sind, wobei das Trägerelement (201) ein Außenelement umfasst, das zum Zusammenwirken mit einer Pressfläche (301, 302, 311, 312) eines Gehäuses (1, 2) eingerichtet ist.
12. Träger (200), der wenigstens ein Trägerelement (201) nach einem der Ansprüche 10 oder 11 sowie eine Spanneinrichtung (210) umfasst, wobei der Träger (200) so eingerichtet ist, dass er die Gehäuse (1, 2) um die Verbindungsrichtung (C) herum vollständig umschließt, und die Spanneinrichtung (210) so eingerichtet ist, dass sie wenigstens ein Gehäuse (2) auf das Trägerelement (201) und/oder auf weitere Gehäuse (2) aufdrückt.

Revendications

1. Boîtier (1, 2) pour un connecteur (11) qui peut être enfiché dans un contre-connecteur (12) selon une direction de connexion (C) ou pour un contre-connecteur (12) dans lequel peut être enfiché un connecteur (11) selon une direction de connexion (C), dans lequel le boîtier (1, 2) comporte une première paire (110, 410) de faces externes (111, 112, 411, 412), les faces externes (111, 112, 411, 412) de la première paire (110, 410) étant mutuellement complémentaires et disposées de manière mutuellement opposée dans une première direction d'empilement (P1, P4) qui est perpendiculaire à la direction de con-

nexion (C), et dans lequel le boîtier (1, 2) comporte une deuxième paire (120, 420) de faces externes (121, 122, 421, 422), les faces externes (121, 122, 421, 422) de la deuxième paire (120, 420) étant mutuellement complémentaires et disposées de manière mutuellement opposée dans une deuxième direction d'empilement (P2, P5) qui est perpendiculaire à la direction de connexion (C), dans lequel la première direction d'empilement (P1, P4) diffère de la deuxième direction d'empilement (P2, P5), dans lequel le boîtier (1, 2) comporte au moins une face de compression (301, 311, 302, 312) qui présente une normale à la surface (N1, N2) inclinée par rapport à la direction de connexion (C) et qui est accessible depuis l'extérieur, **caractérisé en ce que** le boîtier (1, 2) comporte une première face de compression (301, 302, 311, 312) accessible depuis l'extérieur et une deuxième face de compression (311, 312, 301, 302) accessible depuis l'extérieur, dans lequel la deuxième face de compression est adaptée pour coopérer avec la première face de compression (301, 302, 311, 312) d'un boîtier intégré voisin identique (1, 2) à l'état assemblé et au moins une face parmi la première face de compression (301, 302, 311, 312) et la deuxième face de compression (311, 312, 301, 302) présente une normale à la surface (N1, N2) inclinée par rapport à la direction de connexion (C).

2. Boîtier (1,2) selon la revendication 1, comprenant en outre des faces externes (121, 122, 131, 132, 421, 422, 431, 432), dans lequel les faces externes (111, 112, 121, 122, 131, 132 ou 411, 412, 421, 422, 431, 432) du boîtier sont respectivement complémentaires de leurs faces externes opposées (112, 111, 122, 121, 132, 131 ou 412, 411, 422, 421, 432, 431).
3. Boîtier (1, 2) selon l'une quelconque des revendications 1 ou 2, dans lequel la section transversale du boîtier (1, 2) dans un plan perpendiculaire à la direction de connexion (C) est substantiellement hexagonale.
4. Boîtier (1, 2) selon l'une quelconque des revendications 1 à 3, dans lequel le boîtier (1, 2) comporte au moins une protubérance de positionnement (61, 62) qui ressort perpendiculairement à la direction de connexion (C) opposée à une face externe (111, 112, 121, 122, 131, 132 ou 411, 412, 421, 422, 431, 432).
5. Boîtier (1, 2) selon l'une quelconque des revendications 1 à 4, dans lequel le boîtier (2) comporte un loquet (90) pour fixer le boîtier (2) à un autre boîtier (2).
6. Boîtier (1, 2) selon l'une quelconque des revendications 1 à 5, dans lequel le boîtier (1, 2) comporte une

étanchéité de câble (52), une étanchéité de fiche (51) et/ou une étanchéité de borne.

7. Ensemble comprenant un boîtier (1) pour un connecteur (11) et un boîtier (2) pour un contre-connecteur (12), dans lequel le boîtier (1) pour le connecteur (11) est un connecteur selon l'une quelconque des revendications 1 à 6 et/ou le boîtier (2) pour le contre-connecteur (12) est un boîtier selon l'une quelconque des revendications 1 à 6, dans lequel le boîtier (1) pour le connecteur (11) comporte une face d'arrêt (31) qui vient à butée contre une contre-face d'arrêt (32) sur le boîtier (2) pour le contre-connecteur (12) et bloque un mouvement de séparation entre le connecteur (11) et le contre-connecteur (12) selon la direction de connexion (C) quand le connecteur (1) a été enfiché dans le contre-connecteur (12) selon la direction de connexion (C) et le connecteur (11) a été pivoté par rapport au contre-connecteur (12) autour de la direction de connexion (C). 5
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8. Ensemble selon la revendication 7, dans lequel les boîtiers (1, 2) présentent des faces d'arrêt de rotation (33) qui viennent à butée l'une contre l'autre et évitent une rotation au-delà d'une position relative prédéfinie, quand le boîtier (1) pour le connecteur (11) a été enfiché dans le boîtier (2) pour le contre-connecteur (12) et les boîtiers (1, 2) ont été pivotés l'un par rapport à l'autre. 25
30
9. Connecteur (11) ou contre-connecteur (12) comprenant un boîtier (1, 2) selon l'une quelconque des revendications 1 à 6 et une borne de connexion à un câble (C) et au boîtier (1, 2). 35
10. Ensemble comprenant un boîtier (1, 2) selon l'une des revendications 1 à 8 et un élément de base (201) avec au moins une face de réception (202) qui est complémentaire d'une face externe (111, 112, 121, 122, 131, 132) du boîtier (1, 2). 40
11. Ensemble comprenant un boîtier (1, 2) selon l'une des revendications 1 à 8 et un élément de base (201) avec au moins deux faces de réception voisines (202) adaptées pour recevoir deux boîtiers voisins à butée (1, 2). 45
12. Ensemble comprenant un boîtier (1, 2) selon l'une des revendications 1 à 8 et une base (200) comprenant au moins un élément de base (201) selon l'une des revendications 10 ou 11 et un moyen de mise sous tension (210), dans lequel la base (200) est adaptée pour entourer les boîtiers (1, 2) entièrement autour de la direction de connexion (C) et le moyen de mise sous tension (210) est adapté pour pousser au moins un boîtier (2) sur l'élément de base (201) et/ou sur d'autres boîtiers (2). 50
55

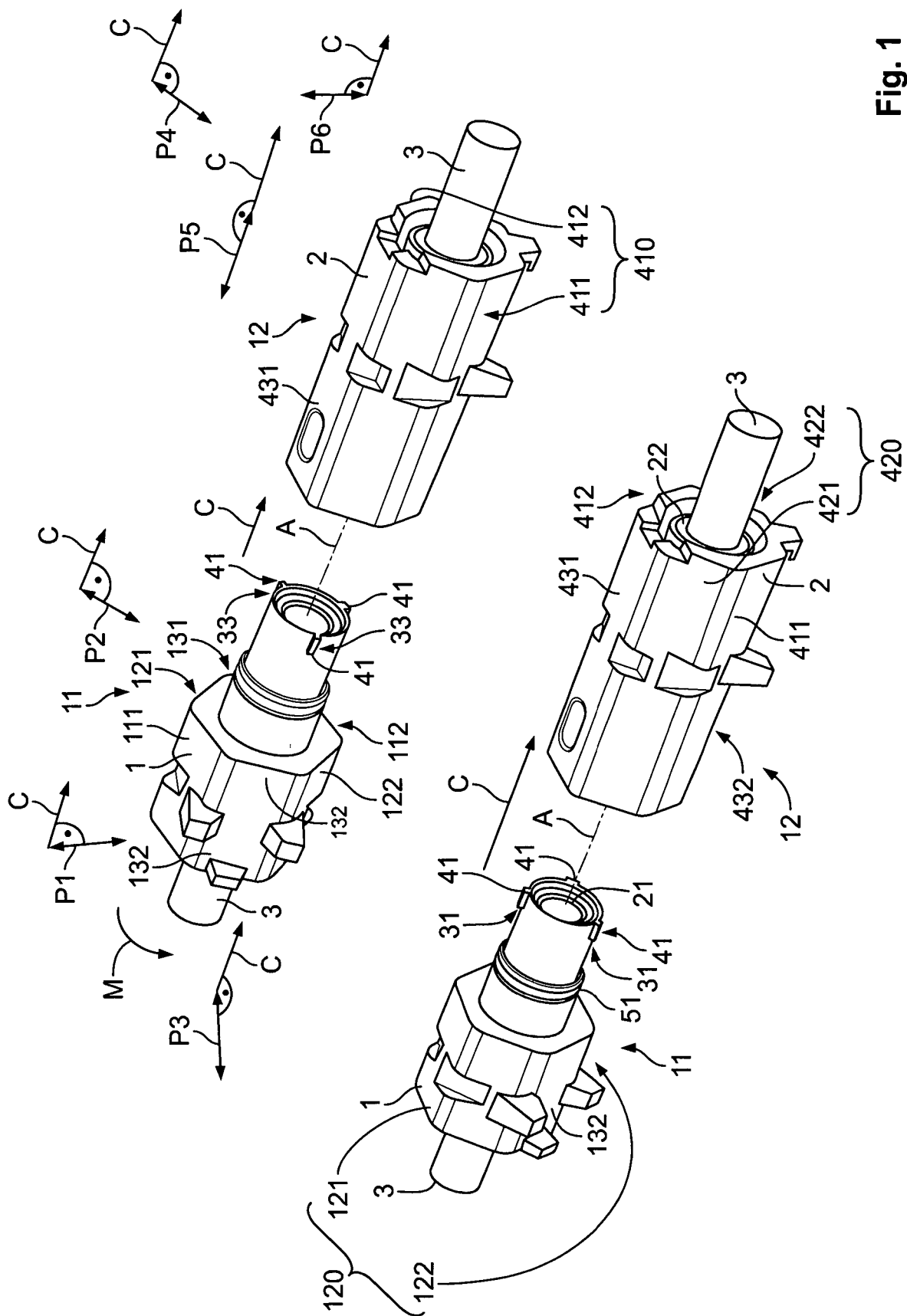


Fig. 1

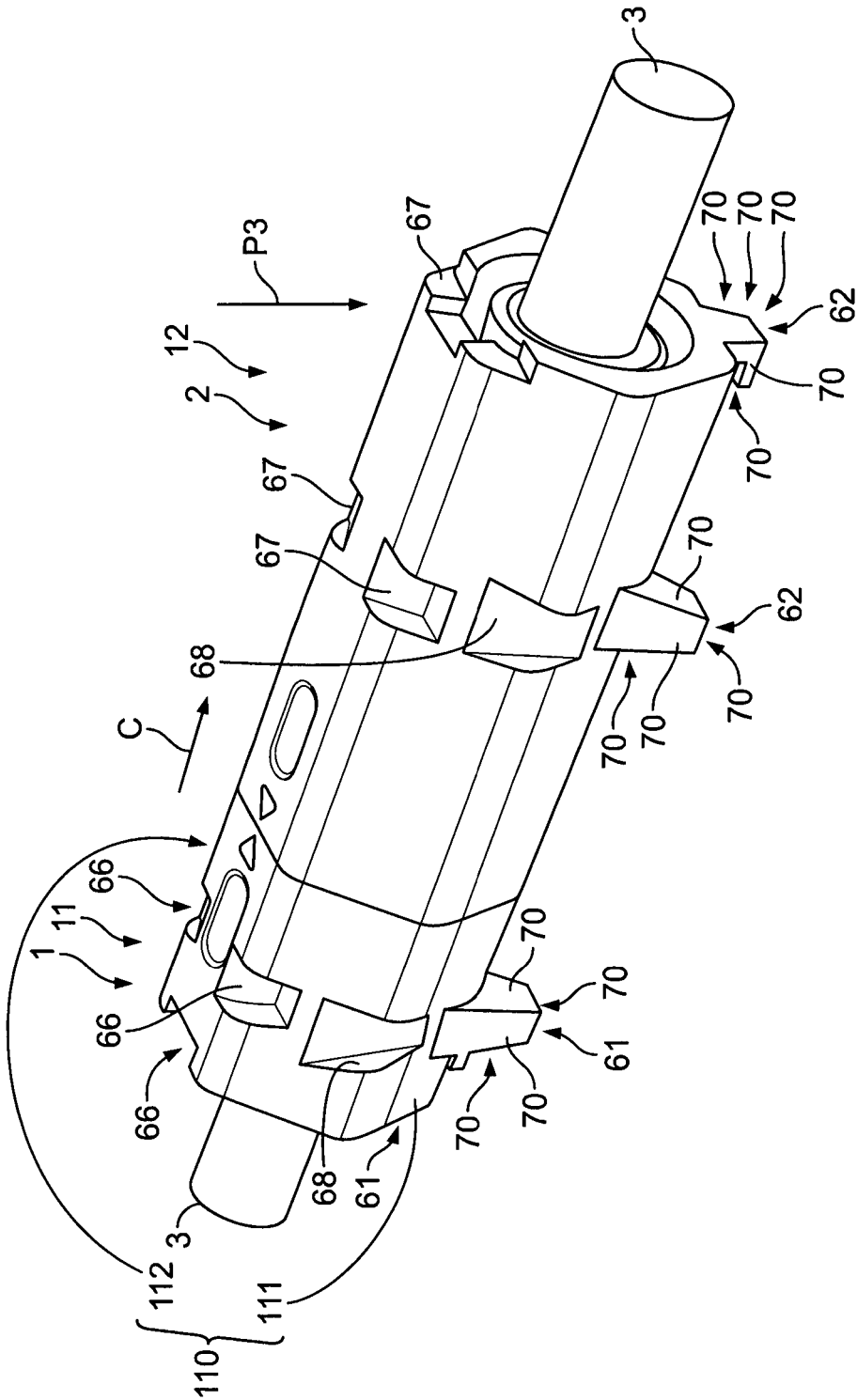
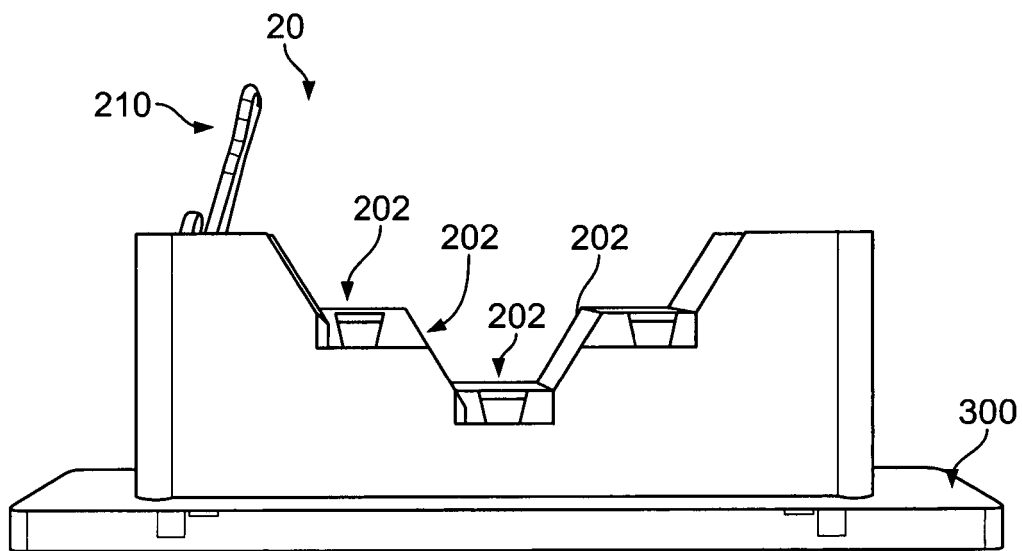
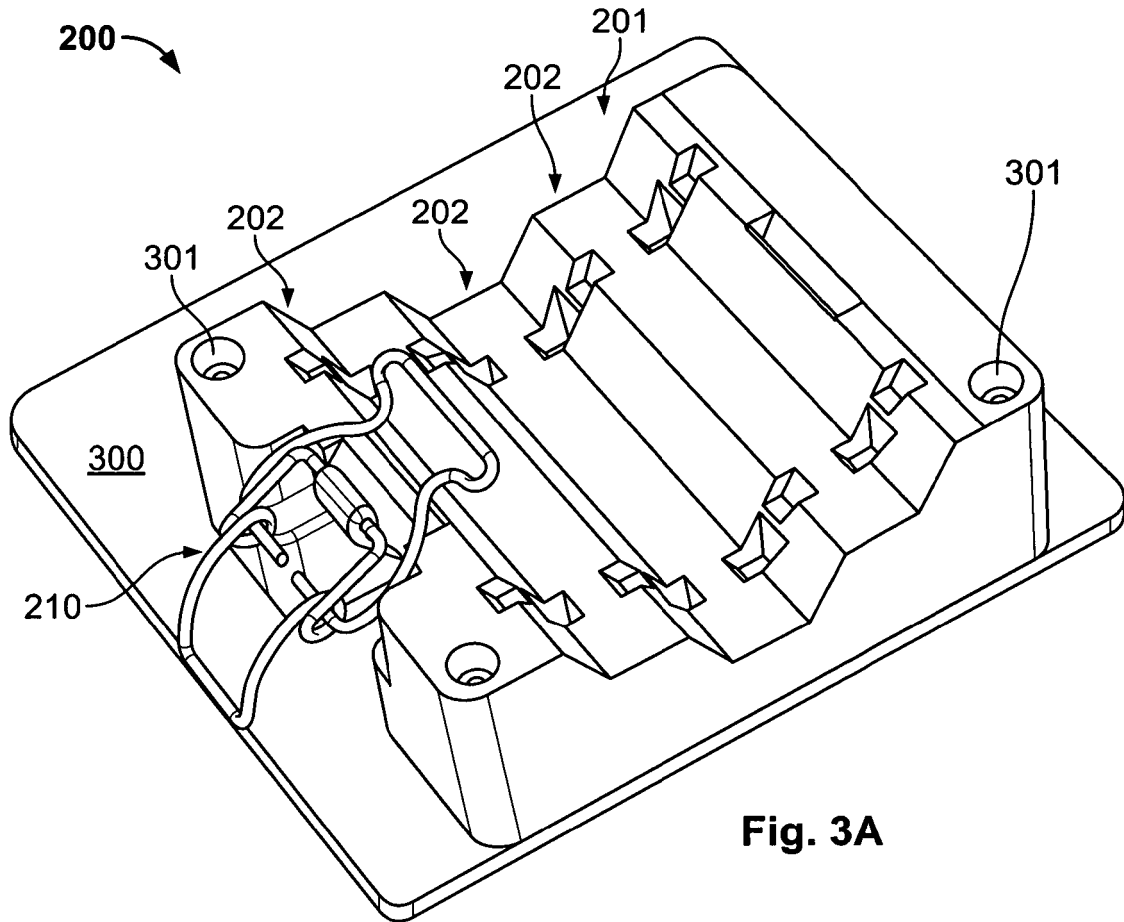


Fig. 2



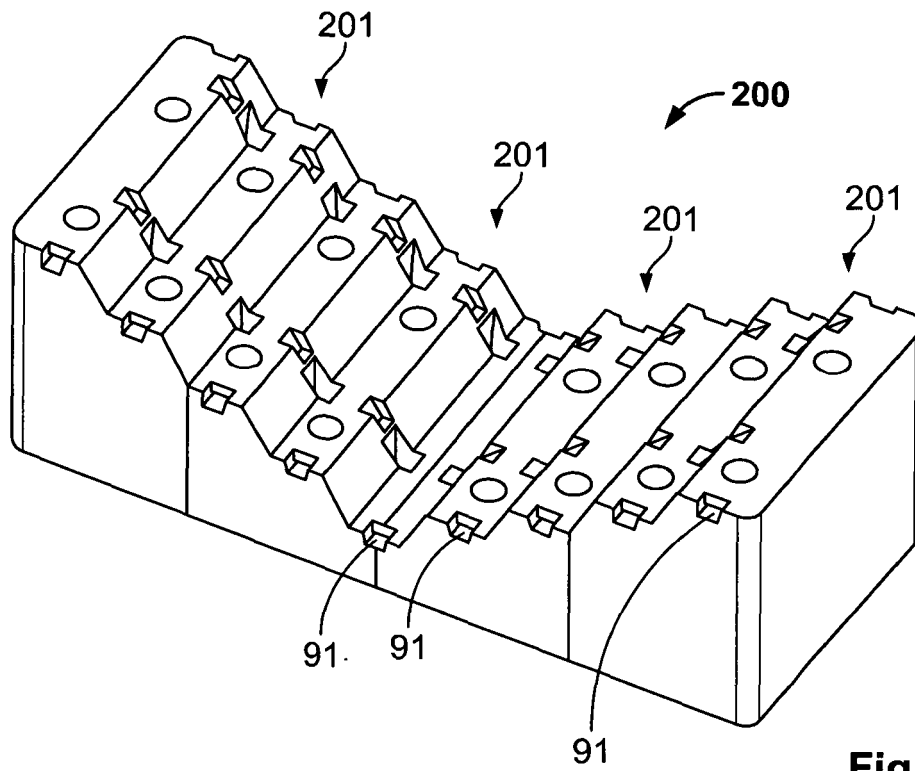


Fig. 4A

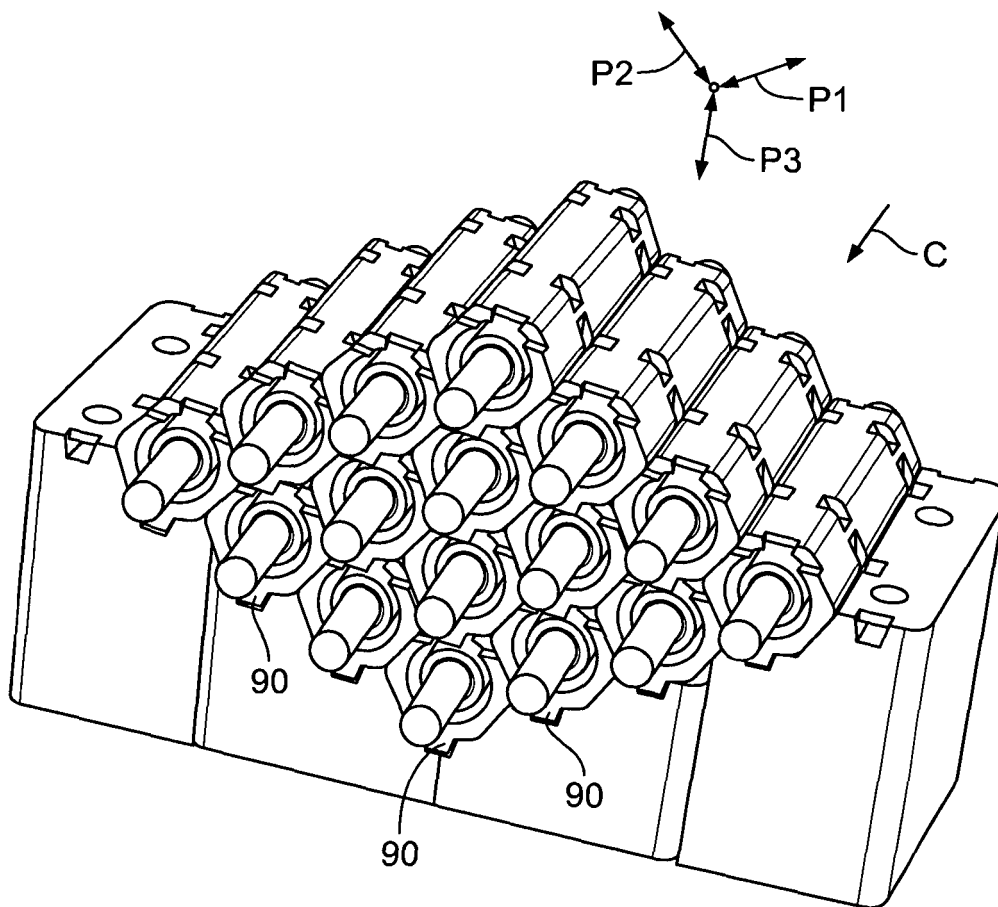


Fig. 4B

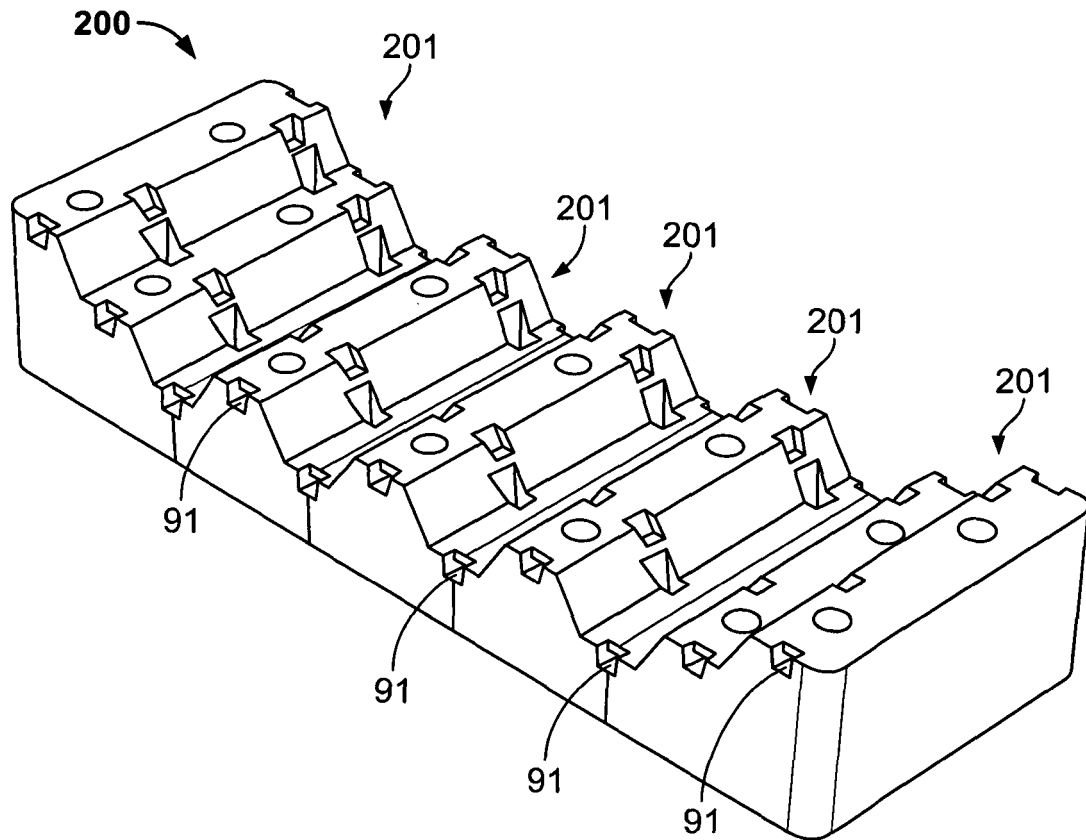


Fig. 5A

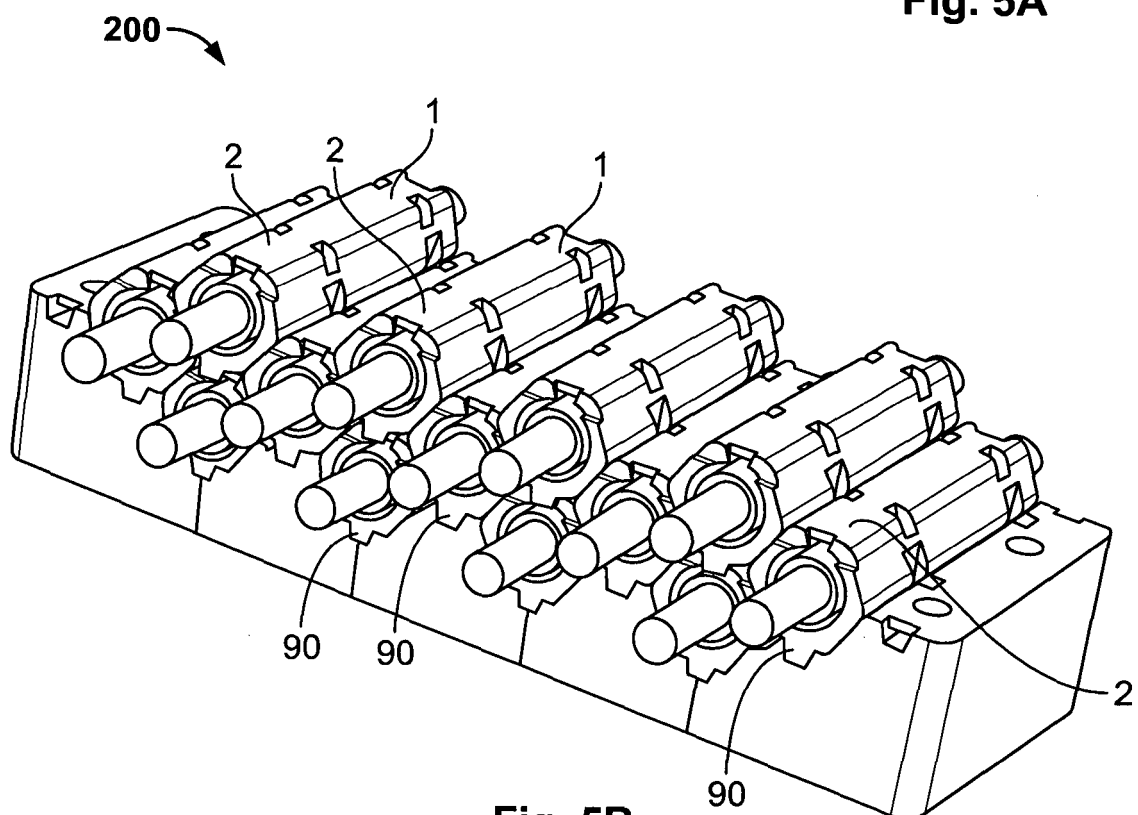


Fig. 5B

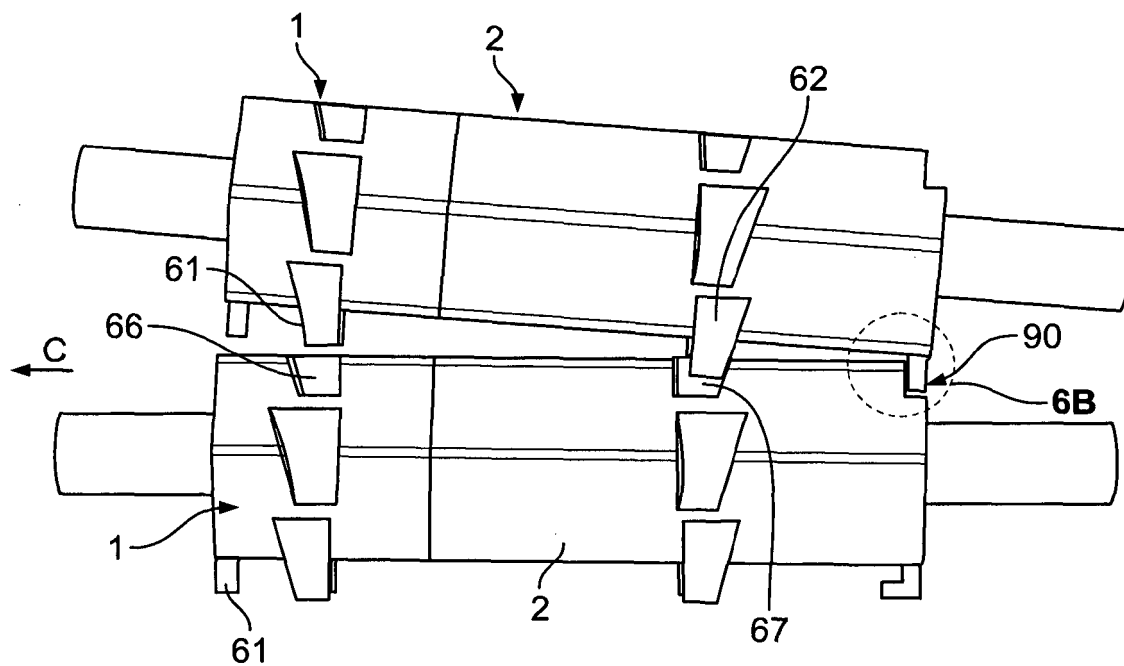


Fig. 6A

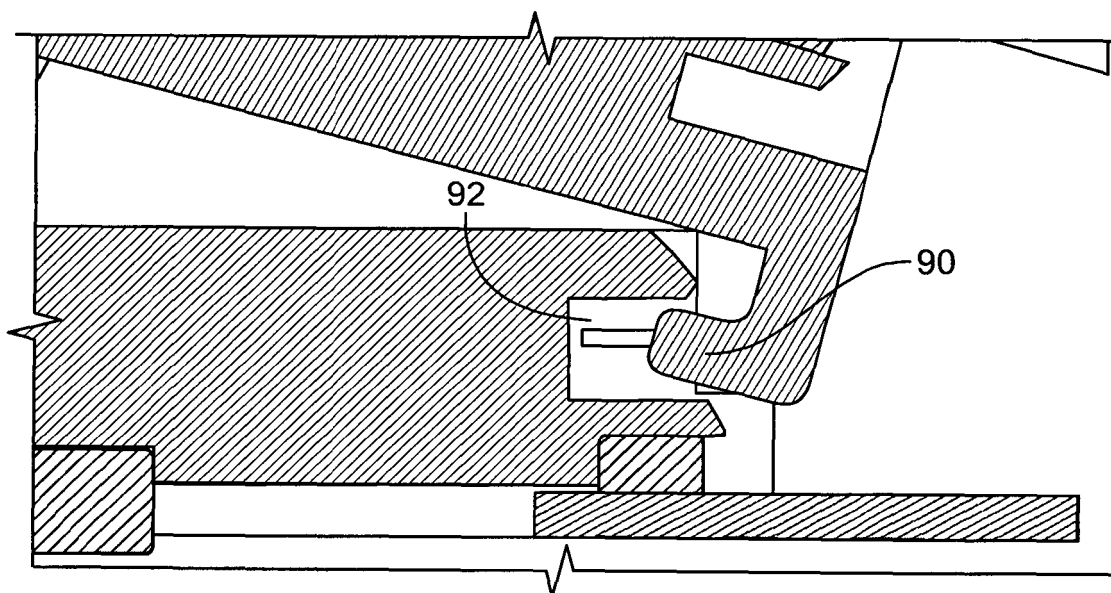


Fig. 6B

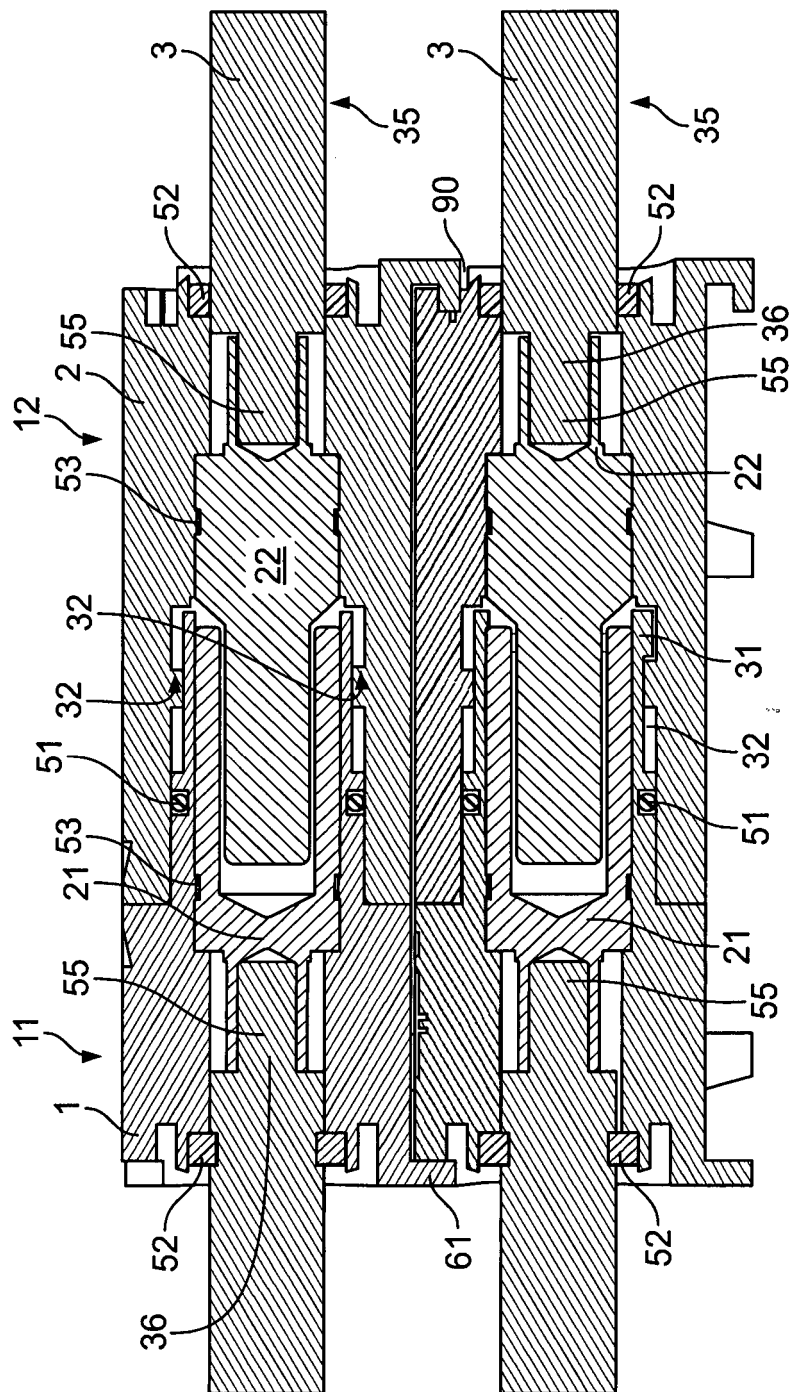
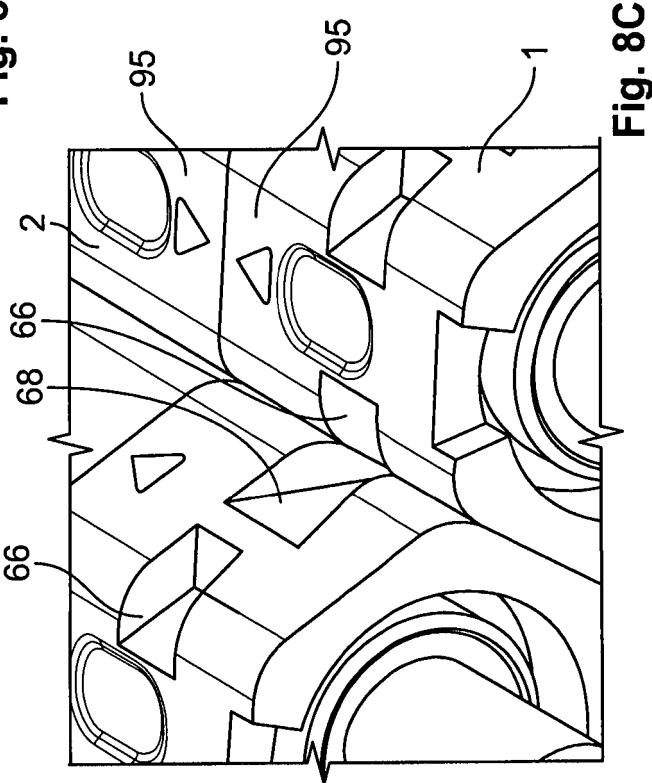
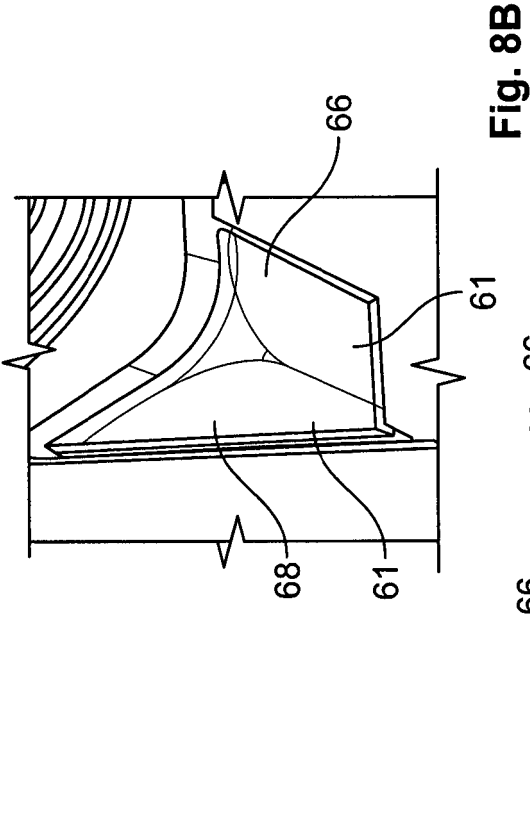
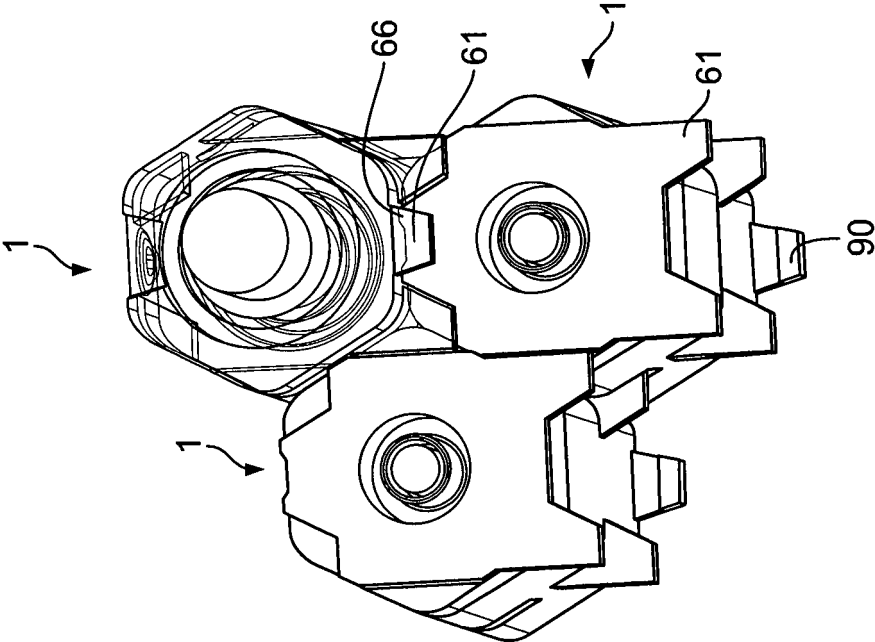


Fig. 7



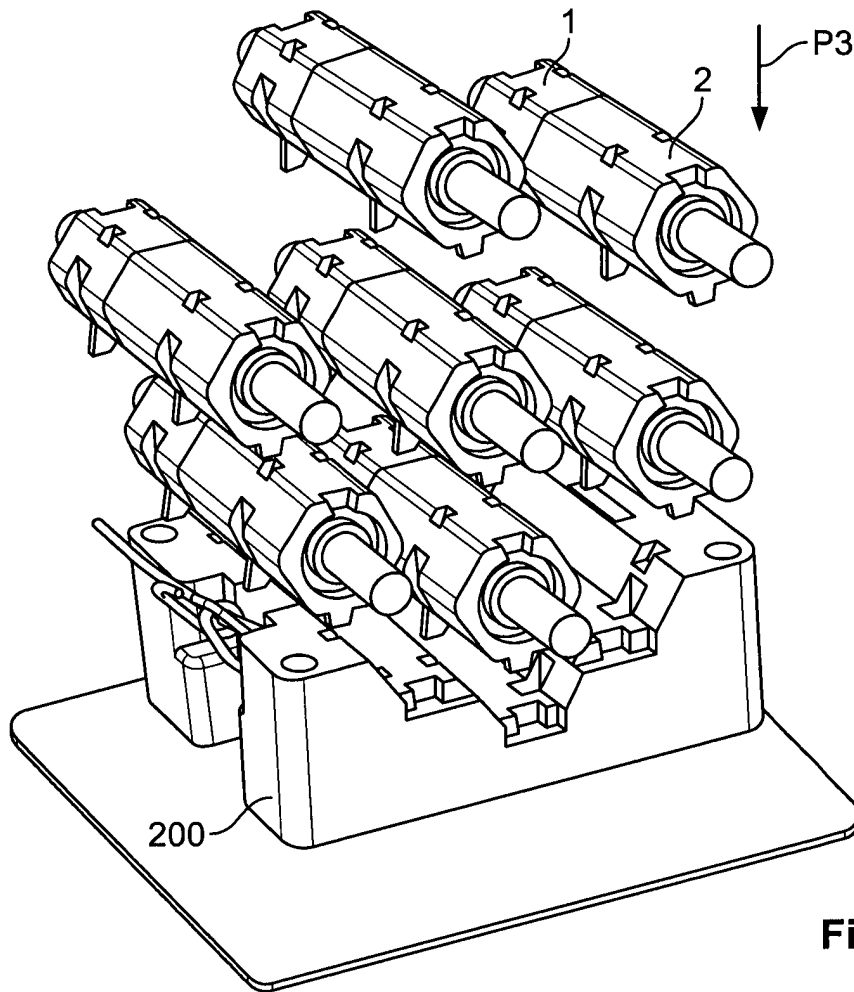


Fig. 9A

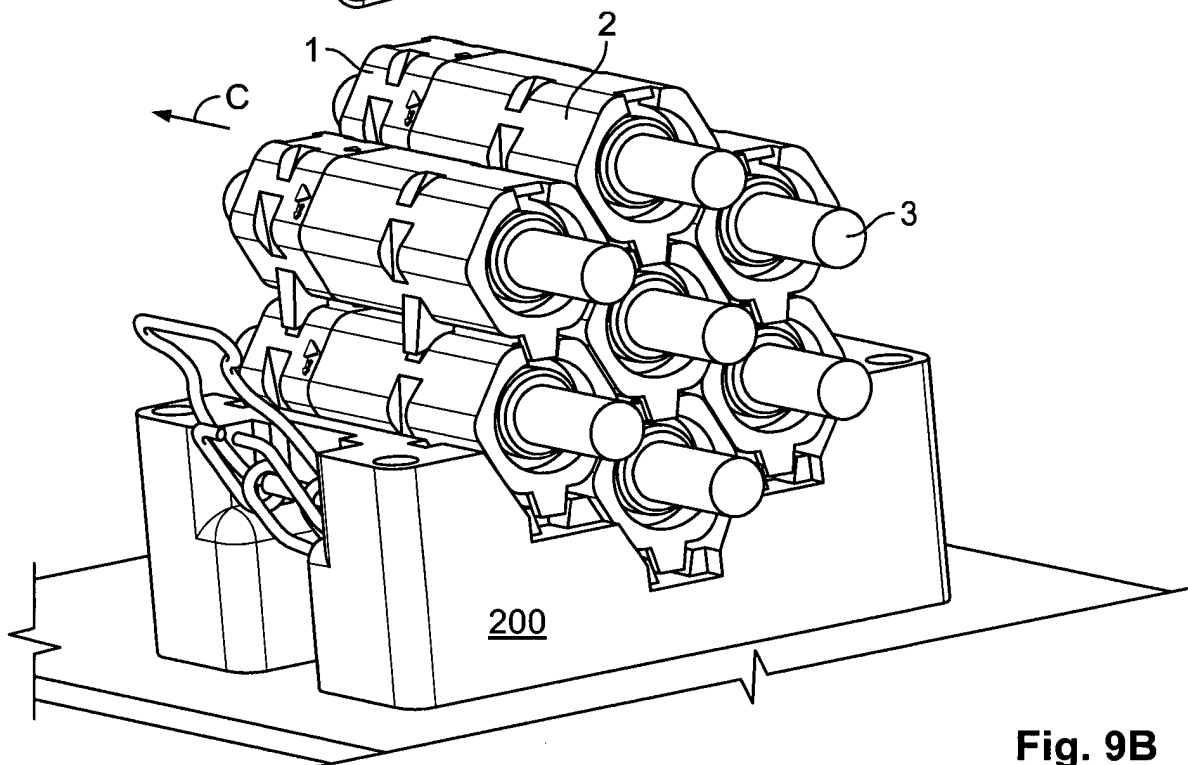
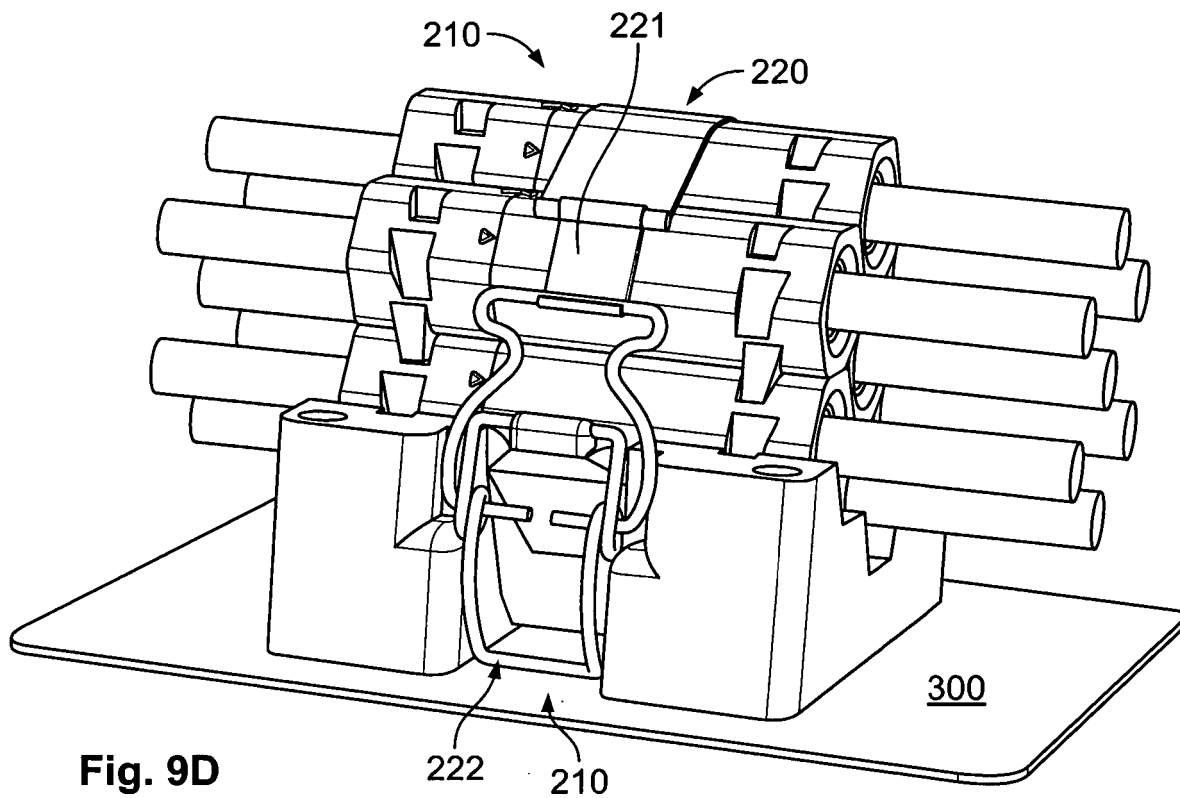
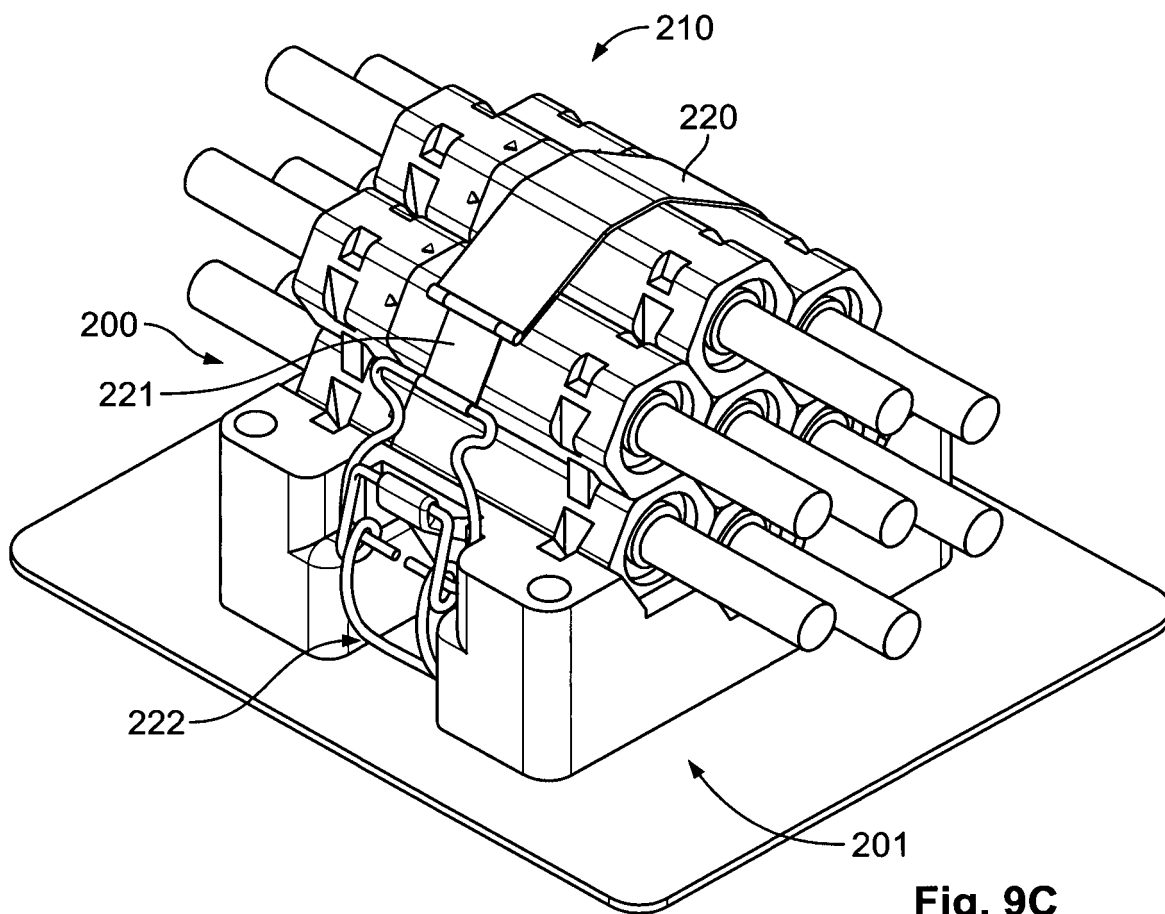


Fig. 9B



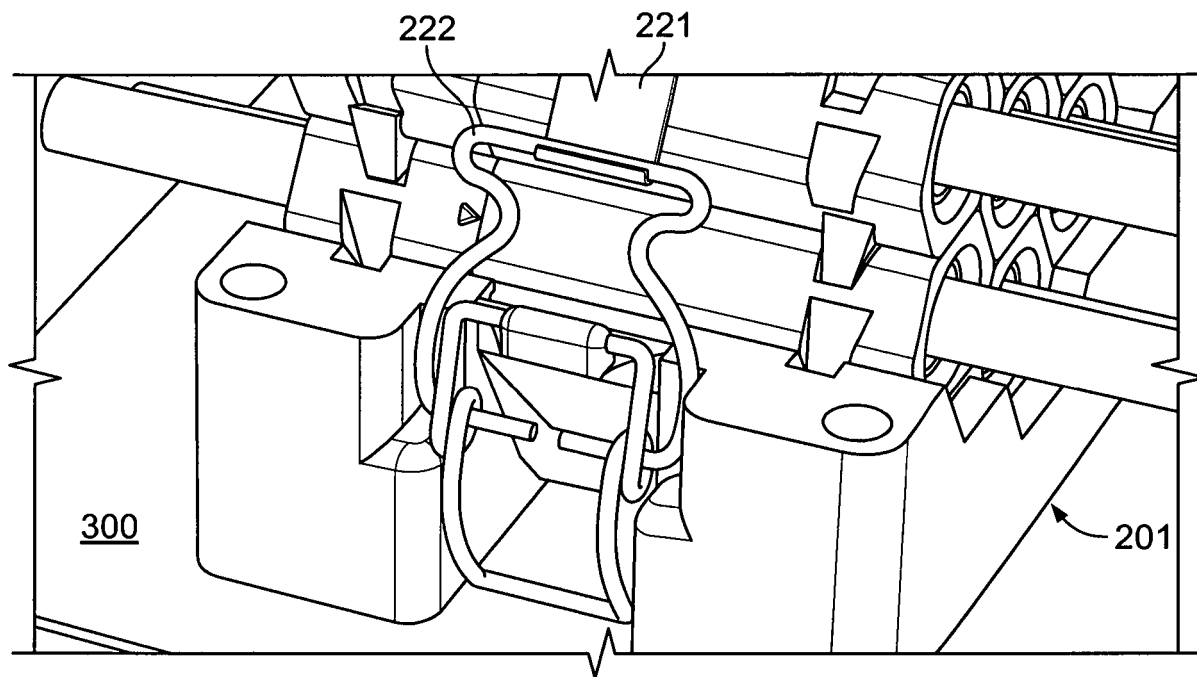


Fig. 9E

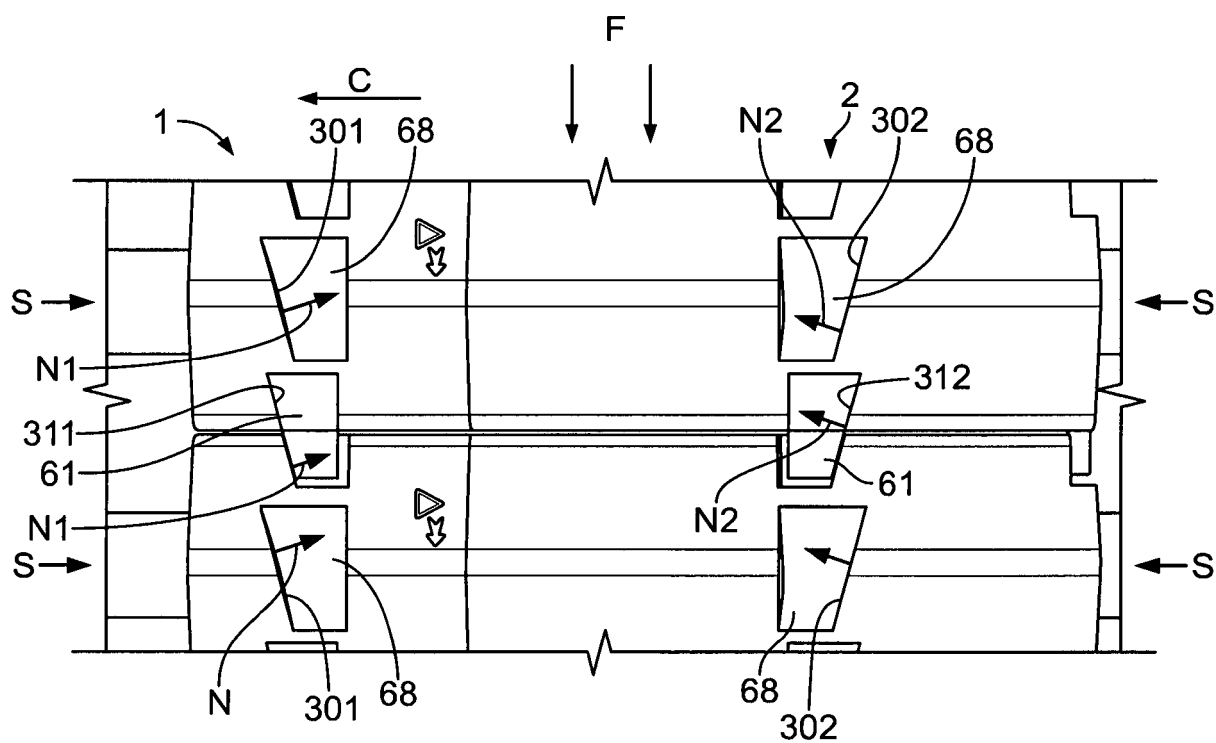


Fig. 10

REFERENCES CITED IN THE DESCRIPTION

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