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(54) **Insulation-piercing connector**

(57) The invention relates to a connector for electrically connecting respective conductors of at least two insulated conductor cables sandwiched therein, the connector comprising: at least three connector parts; tightening means for tightening the at least three connector parts such that at least one insulated conductor cable, preferably two insulated conductor cables, is sandwiched by a first connector part and a second connector part in a first sandwiching area and at least one other insulated conductor cable, preferably two other insulated conductor cables, is sandwiched by a third connector part and the second connector part in a second sandwiching area; wherein said second connector part is provided with insulation piercing means extending, preferably perpendicularly, therethrough and protruding into said first and second sandwiching areas, for piercing respective insulation layers of said at least one insulated conductor cable and of said at least one other insulated conductor cable and contact the respective conductors. The connector is further provided with anti-rotation means configured for preventing a relative rotation of the connector parts with respect to one another during the tightening of the connector parts by said tightening means.

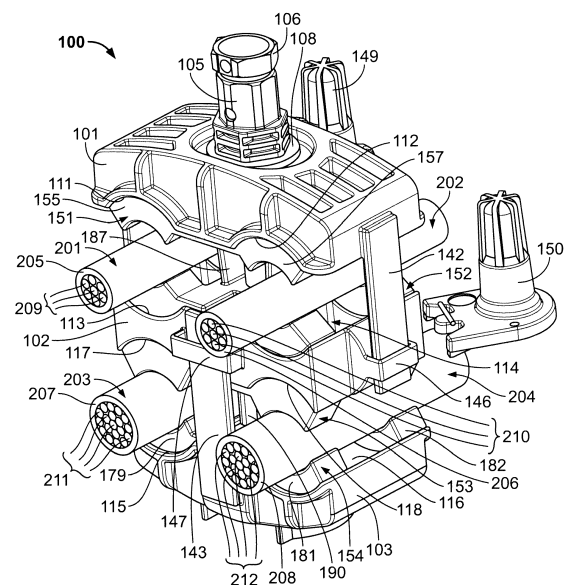


Fig. 3

Description

[0001] The invention relates to a connector for electrically connecting respective conductors of at least two insulated cables to one another. The invention relates in particular to an insulation-piercing connector for connecting at least two insulated bundled cables of suspended electrical lines.

[0002] Modern suspended electrical lines used for the transport of electricity are known to use insulated bundled cables, also called insulated aerial bundled cables (ABCs hereafter). Typically, these insulated ABCs comprise an outer insulation layer surrounding a bundle of electrical conductors. The diameter of the insulated ABCs, and in particular of the bundle of electrical conductors, can then vary depending on the voltage of the line. For instance, it is known that main lines use thicker cables, and thus thicker bundles of electrical conductors, than branch lines.

[0003] Insulation-piercing connectors are known in the art, for instance from EP 1 139 496 A2, for connecting two insulated ABCs, for instance when tapping a main line with a branch line or with another main line. For instance, connectors are known in the art that comprise two clamping halves designed to clamp two insulated ABCs arranged therebetween parallel to one another. In order to connect the respective bundles of electrical conductors of the two clamped insulated ABCs, it is known that each clamping half usually comprises two parallel long insulation-piercing blades that extend along a transversal direction of the connector. In turn, these insulation-piercing blades comprise teeth protruding from their two extremities perpendicularly to the transversal direction. Thus, depending on the type of insulation-piercing connector, two, four or up to eight long insulation-piercing blades are used for piercing the insulation layers of the two insulated ABCs sandwiched therebetween, from above and from below simultaneously, and thereby electrically connect the respective bundles of electrical conductors.

[0004] It is also known that, in such connectors, the length of the teeth of the insulation-piercing blades needs to be adapted depending on the diameter of the ABCs to be connected. Thus, the manufacturing costs of the insulation-piercing blades can amount to up to 40% of the cost of an entire connector.

[0005] Furthermore, tapping electrical lines usually requires connecting more than just one main cable to one branch cable, as main lines usually use several main cables. Thus, it can be necessary to install up to four such connectors at a given branching point of a main line.

[0006] Other connectors are also known in the art, for instance also from EP 1 139 496 A2, for connecting at least two pairs of insulated wires to one another and use shorter insulation-piercing blades that extend through a connector block rather than in a transversal direction thereof. These connectors, however, are not used for connecting ABCs of different diameters, as these would

cause an asymmetry in the connector. Furthermore, the person working on the suspended lines and installing such connectors would have no means for knowing where main or branch cables should be arranged between the connector blocks.

[0007] Furthermore, insulation-piercing connectors are generally known to use a central screw and bolt system for tightening the different connector parts sandwiching the insulated ABCs. Thus, when the person installing an insulation-piercing connector between suspended lines starts tightening the screw and bolt system, the connector parts can rotate relatively to one another. The more connector parts, the more problematic the relative rotation will become for the person carrying out the installation.

[0008] Thus, there is a need for an insulation-piercing connector for connecting more than only two insulated ABCs to one another, in particular for connecting thicker main line cables to thinner branch line cables at branching points of suspended electrical lines, while keeping in mind all the problems mentioned above, in particular regarding the production costs and ease of installation.

[0009] The objective of the present invention is therefore to provide an insulation-piercing connector for connecting more than two insulated ABCs to one another, in particular taking into account that insulated ABCs of main and branch lines can have different diameters, while improving the relative manufacturing costs of the blades with respect to the connector, as well as improving the ease of installation.

[0010] The objective is achieved with a connector according to claim 1 for electrically connecting respective conductors of at least two insulated conductor cables sandwiched therein, the connector comprising: at least three connector parts; tightening means for tightening the at least three connector parts such that at least one insulated conductor cable, preferably two insulated conductor cables, is sandwiched by a first connector part and a second connector part in a first sandwiching area and at least one other insulated conductor cable, preferably two other insulated conductor cables, is sandwiched by a third connector part and the second connector part in a second sandwiching area; wherein said second connector part is provided with insulation piercing means extending, preferably perpendicularly, therethrough and protruding into said first and second sandwiching areas, for piercing respective insulation layers of said at least one insulated conductor cable and of said at least one other insulated conductor cable and contact the respective conductors. According to the invention, the connector is further provided with anti-rotation means configured for preventing a relative rotation of the connector parts with respect to one another during the tightening of the connector parts by said tightening means.

[0011] The inventive connector can advantageously connect at least one ABC, preferably two ABCs, arranged in the first sandwiching area to a corresponding ABC arranged in the second sandwiching area, wherein both

sandwiching areas are on either side of the middle connector part. Thus, in branching points between a main electrical line and a tapping electrical line, the inventive connector can advantageously replace at least two insulation-piercing connectors known in the art for connecting only two ABCs to one another. Thus, instead of having to install up to four prior art connectors on a branching point, an installer will only need to install one or two inventive connectors.

[0012] Furthermore, the inventive connector comprises insulation-piercing means that extend through the middle connector part. Therefore, in an advantageous embodiment, the inventive connector can comprise short insulation-piercing blades that extend through the middle connector part. In particular, even if the respective diameter of the insulated ABCs that will be connected by the inventive connector is different between main and branch line cables, the invention can always advantageously allow using only one type of standardized short insulation-piercing blades. Thus, it is also possible to decrease the relative production costs in comparison to connectors known in the art using long transversal insulation-piercing blades.

[0013] Furthermore, the anti-rotation means provide the beneficial advantage that the person that will carry out the installation of the inventive connector between electrical lines will be able to tighten the tightening means, for instance a screw and bolt system, without worrying about manually keeping the connector parts from rotating relatively to one another. Thus, the inventive connector also improves the ease of installation for the installer.

[0014] Furthermore, in a preferred variant of an embodiment, the arrangement of the anti-rotation means can advantageously also facilitate further the ease of installation of the inventive connector on branching points, as this feature can also be used by the installer to easily distinguish the sandwiching area receiving the insulated ABCs of the main line from the sandwiching area receiving the insulated ABCs of the branch line.

[0015] Further advantages and variants of the inventive connector are described in the dependent claims and will become clearer with the description of advantageous embodiments and with reference to the accompanying figures, wherein:

Figure 1 schematically illustrates an exemplary embodiment of a connector according to the invention, in an exploded view;

Figure 2 schematically illustrates the connector of Figure 1, assembled and from a different perspective;

Figure 3 schematically illustrates an assembly of the connector of Figures 1 and 2, in a different perspective than in Figure 2, with insulated conductor cables;

Figure 4 corresponds to a cross-section view of the assembly illustrated in Figure 3, with the insulated conductor cables now sandwiched in the connector; and

Figure 5 corresponds to a different cross-section view of the assembly illustrated in Figure 4.

[0016] Figures 1 and 2 schematically illustrate a connector 100 according to an exemplary embodiment the invention. Figure 1 illustrates the connector 100 in an exploded view, while Figure 2 illustrates the assembled connector 100. In this embodiment, the connector 100 is an insulation-piercing connector for connecting aerial bundled cables of suspended electrical lines. In particular, as illustrated in Figures 3 to 5, the connector 100 can be used to electrically connect the bundle of electrical conductors 211 of a first insulated main line cable 203 to the bundle of electrical conductors 209 of a first insulated branch line cable 201. As further illustrated in Figures 3 to 5, the connector 100 can also be used to simultaneously connect the bundle of electrical conductors 212 of a second insulated main line cable 204 to the bundle of electrical conductors 210 of a second insulated branch line cable 202. Thus, the connector 100 can be advantageous for an installation on a branching point of a main electrical line in comparison to insulation-piercing connectors known in the art, as it can accommodate up to four cables 201, 202, 203, 204 and connect two main line cables 203, 204 to two corresponding branch or main line cables 201, 202.

[0017] As illustrated in Figures 1 and 2, the connector 100 comprises three connector parts: a first or upper connector part 101, a second or middle connector part 102, and a third or lower connector part 103. When the connector 100 is assembled, like in Figures 2 and 3, at least one electrical cable, preferably two electrical cables, can be arranged and sandwiched between two connector parts 101, 102, 103. For instance, Figure 3 illustrates that two insulated ABCs 201, 202 are arranged between the upper connector part 101 and the middle connector part 102 in a first sandwiching area, while two other insulated ABCs 203, 204 are arranged between the middle connector part 102 and the lower connector part 103 in a second sandwiching area.

[0018] As detailed in particular in Figures 1 and 2, each connector part 101, 102, 103 can further comprise cable receiving sections that can be rounded in order to facilitate the installation. Thus, in the first sandwiching area, the first or upper connector part 101 can comprise the two cable receiving sections 111, 112 and the second or middle connector part 102 can comprise the two cable receiving sections 113, 114, such that the first and second branch line ABCs 201, 202 can be arranged therein, as illustrated in Figures 3 to 5. Similarly, in the second sandwiching area, the middle connector part 102 can also comprise the two cable receiving sections 117, 118, and the third or lower connector part 103 can comprise

the two cable receiving sections 115, 116, such that the first and second main line ABCs 203, 204 can be arranged therein. The receiving sections 111, 112 and 115, 116 can also comprise respective small transversal protrusions 117, 121 and 118, 122, as well as 119, 123 and 120, 124 protruding in the first and second sandwiching areas in order to facilitate the cable retention.

[0019] In order to keep the cables 201, 202, 203, 204 clamped or sandwiched in the sandwiching areas, the connector 100 comprises tightening means. In the embodiment illustrated in Figures 1 to 5, the tightening means comprise a central or axial screw 104 inserted through the lower connector part 103, and extending through the middle connector part 102, and finally through and out of the upper connector part 101, where a bolt 105 can be used for the tightening. Thus, as illustrated in Figures 1 to 5, the screw 104 can be inserted essentially along a central vertical axis of the connector 100. As further illustrated, a first spacer 107 can also be used between the head 110 of the screw 104 and the lower connector part 103, and a second spacer 108 can be used between the bolt 105 and the upper connector part 101. It is also possible that, once the connector 100 is assembled, like in Figure 2, the end part 109 of the screw 104 is deliberately damaged so that the connector 100 can no longer be disassembled. Furthermore, it is also possible to use a shear-head bolt 105, such that the person carrying out the installation on the electrical lines will stop tightening the bolt 105 once its shear-head 106 breaks. Figure 3 illustrates the connector 100 with the four insulated ABCs 201, 202, 203, 204 arranged therein, but not yet tightened by the screw 104 and bolt 105. In turn, Figures 4 and 5 illustrate the connector 100 sandwiching the four insulated ABCs 201, 202, 203, 204, with the screw 104 and bolt 105 at least partially or fully tightened.

[0020] The electrical connection between the bundle of conductors 211, 212 of the first and second main line ABCs 203, 204 and of the bundle of conductors 209, 210 of the first and second branch line ABCs 201, 202, respectively, can be established with electrically conductive insulation-piercing means. Thus, as illustrated in particular in Figures 1, 2 and 4, the connector 100 comprises sets of electrically conductive short straight blades 125, 126, 127, 128 provided in the second or middle connector part 102, and extending through openings 129, 130, 131, 132 thereof, such that the blades 125, 126, 127, 128 protrude in both sandwiching areas essentially in a perpendicular manner from the middle connector part 102. As further illustrated, the blades 125, 126, 127, 128 each comprise sets of insulation-piercing teeth 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140 at both of their respective extremities. The cross-section view of Figure 4 illustrates in particular that, when the screw 104 and bolt 105 are tightened, the teeth 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140 pierce the respective insulation layer 205, 206, 207, 208 of the cables 201, 202, 203, 204, and contact the underlying bundles

of conductors 209, 210, 211, 212. Thus, Figure 4 also illustrates that, when the screw 104 and bolt 105 are tightened, an electrical contact is established between the first main line ABC 203 and the first branch line ABC 201, as well as between the second main line ABC 204 and the second branch line ABC 202.

[0021] In order to establish an electrical contact between a cable 201, 202 in the first sandwiching area and a corresponding cable 203, 204 in the second sandwiching area, the invention requires at least one insulation-piercing blade 125, 126, 127, 128. For instance, in other embodiments, the blade 125 could alone establish an electrical contact between the main line ABC 204 and the branch line ABC 201. It is nevertheless preferable to use two blades 125, 126 in order to improve the electrical contact. In the preferred embodiment illustrated in Figures 1 to 5, two pairs of blades 125, 126 and 127, 128 are therefore used in order to connect advantageously the two branch line ABCs 201, 202 to a respective main line ABC 203, 204.

[0022] Furthermore, as also illustrated in Figure 1, the blades 125, 126, 127, 128 can advantageously be all identical, such that a standardized manufacturing is possible for low cost compared to long transversal blades known in the art. However, the blades 125, 126, 127, 128 do not need to be identical. Thus, in further advantageous variants, the size and shape of one or more of the blades could vary depending on the user requirements. For instance, some applications could require that the blades 125, 126 on the left side of Figure 1 be different from the blades 127, 128 on the right side.

[0023] As further illustrated in Figures 1 to 5, the connector 100 comprises means for preventing a relative rotation of the connector parts 101, 102, 103 when a person tightens the bolt 105 on the screw 104 during the installation of the connector 100 on an electrical line. In this embodiment, the upper connector part 101 comprises two stems 141, 142 protruding from opposite lateral sides thereof towards the middle connector 102. Furthermore, the lower connector part 103 also comprises two stems 143, 144 protruding from opposite lateral sides thereof towards the middle connector part 102. Following a preferred variant of an embodiment of the invention, the second or middle connector part 102 comprises slots 145, 146 and 147, 148 for receiving the stems 141, 142 and 143, 144 once the connector 100 is assembled, as can be seen in Figures 2 and 3. When the connector 100 is tightened, since the stems 141, 142 and 143, 144 are already in the slots 145, 146 and 147, 148, a relative rotation of the different connector parts 101, 102, 103 is prevented. As illustrated in Figures 4 and 5, when the connector 100 is tightened, the stems 141, 142 and 143, 144 slide in the slots 145, 146 and 147, 148, respectively.

[0024] As can be seen in Figures 1 to 5, and in particular in Figures 3 to 5, the stems 141, 142 of the first connector part 101 can be provided in the middle of the sides of the connector 100 that extend along the longitudinal direction of the four ABCs 201, 202, 203, 204.

However, the stems 143, 144 of the third connector part 103 can in turn be provided in the middle of the sides of the connector 100 that extend in a transversal direction of the four ABCs 201, 202, 203, 204. In other words, the stems 143, 144 can be provided on the sides of the lower connector part 103 along a cross-section of the four ABCs 201, 202, 203, 204.

[0025] The above described configuration of the stems 141, 142, 143, 144 and slots 145, 146, 147, 148 illustrated in Figures 1 to 5 provides several advantages to the inventive connector 100 over insulation-piercing connectors known in the art:

[0026] First, the prevention of a relative rotation of the connector parts 101, 102, 103 can be improved even more with respect to embodiments in which the stems 141, 142 are provided on the first connector part 101 on the same sides as the stems 143, 144 of the third connector part 103.

[0027] Furthermore, as can be seen in particular in Figures 3 and 4, the two stems 141, 142 prevent a lateral insertion of a cable in the first sandwiching area and therefore allow only a frontal insertion of cables therein. In turn, as can be seen in particular in Figures 3 and 5, the two stems 143, 144 allow a lateral insertion of cables therein. Thus, it will be clear to the person carrying out the installation of the inventive connector 100 on a branching point of an electrical line in which sandwiching area the main line ABCs 203, 204 and the branch line ABCs 201, 202 need to be arranged and also how. Indeed, it is known that main line cables can extend over several kilometers and be much longer, and also thicker, than branch line cables. A branching point is therefore usually chosen somewhere along the main line cables, and the branch line cables then start from the branching point. With the variant of an inventive connector 100 illustrated in Figures 1 to 5, the installer will arrive at the branching point with the assembled connector 100, for instance like illustrated in Figure 2. Knowing that the only way to install main line cables in a connector would be laterally, the installer would then automatically know that the main line ABCs 203, 204 can only be installed in the second sandwiching area between the lower connector part 103 and the middle connector part 102. Thus, the installer will also automatically know that the tip of the branch line ABCs 201, 202 should be inserted frontally in the first sandwiching area between the upper connector part 101 and the middle connector part 102, as the branch line will then start from the branching point where the installation occurs.

[0028] As illustrated in Figures 1 to 3 and in Figure 5, the connector 100 can then also comprise as many insulation caps 149, 150 as branch line ABCs 201, 202 in order to provide for an insulation of the end of the branch line ABCs 201, 202.

[0029] In further embodiments, one long stem, or even two long stems, could be provided only on one connector part 101, 102, 103, with the other two connector parts 101, 102, 103 comprising respective slots. In further em-

bodiments, the upper connector part 101 and the lower connector part 103 could comprise only one stem each protruding towards the middle connector part 102 that would in turn comprise only two slots instead of four. Any other combination of stems and slots is also possible, as long as the arrangement thereof provides for an anti-rotation solution for the plurality of connector parts upon tightening of the tightening means. Yet, the variant illustrated in Figures 1 to 5 is preferred, as it is even more advantageous since it not only prevents a relative rotation of the connector parts 101, 102, 103, but it also improves the ease of installation, as the installer will not be confused as to where the four ABCs 201, 202, 203, 204 could and should be arranged. The stems 141, 142, 143, 144 can also be used advantageously for assembling the connector 100, as they can be used as guiding means in combination with the respective slots 145, 146, 147, 148.

[0030] As further illustrated in Figures 1 to 5, and according to a preferred variant of an advantageous embodiment the present invention, each sandwiching area, in particular respective faces of the upper, middle and lower connector parts 101, 102, 103, can be provided with respective insulation means 151, 152, 153, 154 for facilitating the retention of the cables 201, 202, 203, 204 in the sandwiching area, while also insulating the areas where the insulation-piercing teeth 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140 pierce the respective insulation layers 205, 206, 207, 208 of the cables 201, 202, 203, 204. In the embodiment illustrated in Figures 1 to 5, each of the insulation means 151, 152, 153, 154 can comprise four insulation elements that can be adapted to the receiving sections 111, 112, 113, 114, 115, 116 and provided with a respective opening. In particular, the insulation means 151 can comprise insulation elements 155, 156, 157, 158 with a respective opening 159, 160, 161, 162 through which the protrusions 117, 118, 121, 122 of the upper connector part 101 can protrude into the first sandwiching area, respectively, as illustrated in particular in Figures 1, 2 and 4. The insulation means 154 can be substantially identical to the insulation means 151 and therefore comprise similar insulation elements 179, 180, 181, 182 with a respective opening 183, 184, 185, 186 through which the protrusions 119, 120, 123, 124 of the lower connector part 103 can protrude into the second sandwiching area, respectively. In turn, as also illustrated in particular in Figures 1, 2 and 4, the insulation means 152 can comprise insulation elements 163, 164, 165, 166 with a respective opening 167, 168, 169, 170 through which the insulation-piercing blades 125, 126, 127, 128, in particular the piercing teeth 133, 135, 137, 139, respectively, can protrude from the second connector part 102 into the first sandwiching area. The insulation means 153 can be substantially identical to the insulation means 152 and therefore also comprise insulation elements 171, 172, 173, 174 with a respective opening 175, 176, 177, 178 through which the piercing teeth 134, 136, 138, 140 can protrude from the second connector part 102 into the second sandwiching

area.

[0031] Furthermore, according to a preferred variant of an advantageous embodiment of the invention, and as illustrated in particular in Figures 1 to 5, the two insulation means 152, 153 provided on either side of the middle connector part 102 can also comprise tongues 187, 188, 189, 190, respectively, protruding into the first and second sandwiching areas. Thus, as illustrated in Figure 1, the tongues 187, 188 of the insulation means 152 protrude in a direction from the second connector part 102 towards the first connector part 101. Similarly, the tongues 189, 190 of the insulation means 153 protrude in a direction from the second connector part 102 towards the third connector part 103. As illustrated in Figure 2, the tongues 187, 188 and 189, 190 of the insulation means 152 and 153 can thus advantageously keep the connector 100 open after its assembly by abutting against the insulation means 151 and 154 or directly against the upper and lower connector parts 101, 103. In other words, the tongues 187, 188, 189, 190 can prevent the connector parts 101, 102, 103 from collapsing on one another when no cable is arranged in the sandwiching areas and therefore further facilitate the ease of installation of the inventive connector 100. For instance, as can be understood from Figure 3, since the tongues 187, 188, 189, 190 advantageously prevent the connector parts 101, 102, 103 from closing, the installer can perform the lateral insertion of the two main line ABCs 203, 204, as well as the frontal insertion of the two branch line ABCs 201, 202, without having to simultaneously worry about manually keeping the connector parts 101, 102, 103 from falling on top of one another. The material of the insulation means 151, 152, 153, 154 and in particular of the tongues 187, 188, 189, 190 can be chosen to be rigid enough to keep the connector parts 101, 102, 103 from collapsing, but sufficiently flexible so that the tongues 187, 188, 189, 190 can still bend when the connector parts 101, 102, 103 are tightened, as illustrated in Figures 4 and 5.

[0032] In the embodiment described with reference to Figures 1 to 5, since the connector 100 is thought for an installation on suspended electrical lines, the first and third connector parts 101, 103 can be made of or comprise a reinforced polyamide material. In turn, the middle connector part 102, which can be less subject to pressure than the upper and lower connector parts 101, 103, can either be made of or comprise a polyamide material and/or a reinforced polyamide material and/or a reinforced polypropylene material. It is even possible to choose a polyolefin type of material so that the middle connector part 102 can chemically bond with the insulation means 152, 153, thereby increasing the sealing properties of the connector 100. The screw 104 can be made of or comprise a metal or metal alloy, for instance steel or the like, while the shear-head bolt 105, 106 can be made of or comprise a Zn or Al alloy or the like or even be made of or comprise a plastic material. The blades 125, 126, 127, 128 can in turn be made of or comprise

a metal or metal alloy, such as Cu or Al or brass, preferably protected against oxidation or corrosion. The insulation means 151, 152, 153, 154 can be made of or comprise a rubber composition such as an elastomer or the like. These materials should however not be seen as limiting the present invention by the skilled person and can be adapted depending on the user requirements.

[0033] The invention, through its various embodiments, allows installing only one or two inventive connectors only on a branching point of an electrical line, where it would be otherwise necessary to install up to four connectors known in the art. During the installation, the rotation of connector parts relative to one another will be prevented. In advantageous variants of the invention, it is also possible for the installer to directly identify where to insert the main or the branch line cables. The inventive connector further allows direct transmission of the tightening and piercing force from the main line cable to the branch line cable. Furthermore, the asymmetries due to differences in the cable diameters disappear in a connector according to the invention, thereby allowing a wider range of applications than insulation-piercing connectors known in the art. Since the middle connector part is not subject to as many constraints as the upper and lower connector parts, its material can be adapted. For instance, it is possible to choose a polyolefin type material that can allow chemical bonding with the sealing material of the insulation means.

[0034] In further advantageous embodiments, a connector according to the invention could also comprise more than three connector parts, for example four or more connector parts. In such alternative embodiments, a connector according to the invention would then comprise an upper and a lower connector part, and more than one middle connector part, such that more than two sandwiching areas would be available for connecting more than four cables.

LIST OF REFERENCE SIGNS

[0035]

100	connector
101	first or upper connector block
102	second or medium connector block
103	third or lower connector block
104	central screw
105	bolt
106	bolt shear-head
107	spacer
108	spacer
109	screw end part
110	screw head
111	cable receiving section
112	cable receiving section
113	cable receiving section
114	cable receiving section
115	cable receiving section

116 cable receiving section
 117 transversal protrusion
 118 transversal protrusion
 119 transversal protrusion
 120 transversal protrusion
 121 transversal protrusion
 122 transversal protrusion
 123 transversal protrusion
 124 transversal protrusion
 125 insulation-piercing blade
 126 insulation-piercing blade
 127 insulation-piercing blade
 128 insulation-piercing blade
 129 opening
 130 opening
 131 opening
 132 opening
 133 insulation-piercing teeth
 134 insulation-piercing teeth
 135 insulation-piercing teeth
 136 insulation-piercing teeth
 137 insulation-piercing teeth
 138 insulation-piercing teeth
 139 insulation-piercing teeth
 140 insulation-piercing teeth
 141 stem
 142 stem
 143 stem
 144 stem
 145 stem slot
 146 stem slot
 147 stem slot
 148 stem slot
 149 insulation cap
 150 insulation cap
 151 insulation means
 152 insulation means
 153 insulation means
 154 insulation means
 155 insulation element
 156 insulation element
 157 insulation element
 158 insulation element
 159 opening
 160 opening
 161 opening
 162 opening
 163 insulation element
 164 insulation element
 165 insulation element
 166 insulation element
 167 opening
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 170 opening
 171 insulation element
 172 insulation element
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174 insulation element
 175 opening
 176 opening
 177 opening
 5 178 opening
 179 insulation element
 180 insulation element
 181 insulation element
 182 insulation element
 10 183 opening
 184 opening
 185 opening
 186 opening
 187 tongue
 15 188 tongue
 189 tongue
 190 tongue

20 Claims

1. Connector (100) for electrically connecting respective conductors (209, 210, 211, 212) of at least two insulated conductor cables (201, 202, 203, 204) sandwiched therein, the connector (100) comprising:
 - at least three connector parts (101, 102, 103);
 - tightening means (104, 105) for tightening the at least three connector parts (101, 102, 103) such that at least one insulated conductor cable (201, 202), preferably two insulated conductor cables, is sandwiched by a first connector part (101) and a second connector part (102) in a first sandwiching area and at least one other insulated conductor cable (203, 204), preferably two other insulated conductor cables, is sandwiched by a third connector part (103) and the second connector part (102) in a second sandwiching area;
 - wherein said second connector part (102) is provided with insulation piercing means (125, 126, 127, 128) extending, preferably perpendicularly, therethrough and protruding into said first and second sandwiching areas, for piercing respective insulation layers (205, 206, 207, 208) of said at least one insulated conductor cable (201, 202) and of said at least one other insulated conductor cable (203, 204) and contact the respective conductors (205, 206, 207, 208);
 - characterized in that**
 - the connector (100) is further provided with anti-rotation means (141, 142, 143, 144, 145, 146, 147, 148) configured for preventing a relative rotation of the connector parts (101, 102, 103) with respect to one another during the tightening of the connector parts (101, 102, 103) by said tightening means (104, 105).

2. Connector (100) according to claim 1, wherein the anti-rotation means (141, 142, 143, 144, 145, 146, 147, 148) comprises one or more stems (141, 142, 143, 144) provided on at least one connector part (101, 103), preferably on two connector parts (101, 103), and protruding in a direction towards at least one other connector part (102). 5
3. Connector (100) according to claim 2, wherein the stems (141, 142, 143, 144) are provided on two opposite sides of said at least one connector part (101, 103), preferably of said two connector parts (101, 103). 10
4. Connector (100) according to any of claims 2 to 3, wherein said at least one other connector part (102) comprises slots (145, 146, 147, 148) for receiving the stems (141, 142, 143, 144) of said at least one connector part (101, 103), preferably of said two connector parts (101, 103). 15 20
5. Connector (100) according to any of claims 2 to 4, wherein the stems (141, 142, 143, 144) are provided on the first connector part (101) and on the third connector part (103) and protrude towards the second connector part (102). 25
6. Connector (100) according to claim 5, in combination with claim 4, wherein the second connector part (102) comprises slots (145, 146, 147, 148) configured for receiving said stems (141, 142, 143, 144). 30
7. Connector (100) according to any of claims 5 to 6, in combination with claim 3, wherein the two opposite sides comprising stems (141, 142) on the first connector part (101) are substantially perpendicular to the two opposite sides comprising stems (143, 144) on the third connector part (103). 35
8. Connector (100) according to any of the preceding claims, wherein the insulation-piercing means (125, 126, 127, 128) comprise at least one substantially straight blade (125, 126, 127, 128), preferably two blades, more preferably four blades, the extremities thereof being provided with teeth (129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140) extending in a longitudinal direction thereof. 40 45
9. Connector (100) according to any of the preceding claims, further comprising insulation means (151, 152, 153, 154) provided on each connector part (101, 102, 103) for insulating said first and second sandwiching areas. 50
10. Connector (100) according to claim 9, wherein the insulation means (151, 152, 153, 154) is made of or comprises a flexible insulating material. 55
11. Connector (100) according to claim 10, wherein the insulation means (151, 152, 153, 154) are further configured for keeping said first and second sandwiching areas from closing when the connector parts (101, 102, 103) are not tightened by the tightening means (104, 105).
12. Connector (100) according to claim 11, wherein the insulation means (151, 152, 153, 154) comprise tongues (187, 188, 189, 190) protruding in said first and second sandwiching areas.
13. Connector (100) according to any of claims 9 to 12, in combination with claim 8, wherein the blades (125, 126, 127, 128) extend through insulation means (152, 153) provided on either side of the second connector part (102).
14. Connector (100) according to any of the preceding claims, wherein the tightening means (104, 105) comprises a bolt (105), in particular a shear head bolt (105, 106), and a screw (104) provided on a central axis of the connector (100).
15. Connector (100) according to any of the preceding claims, further comprising at least one conductor end insulation cap (149, 150), preferably two conductor end insulation caps.

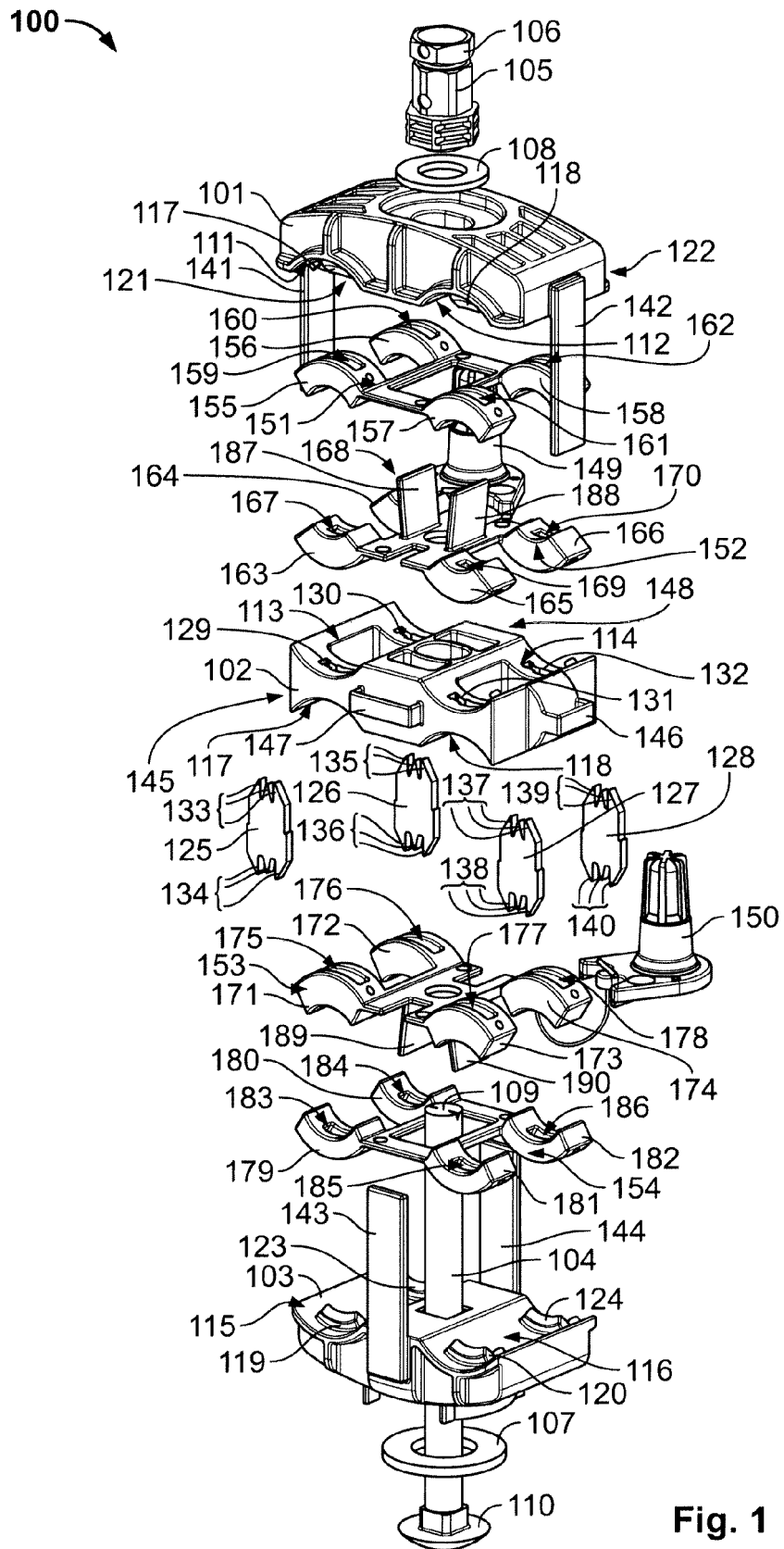


Fig. 1

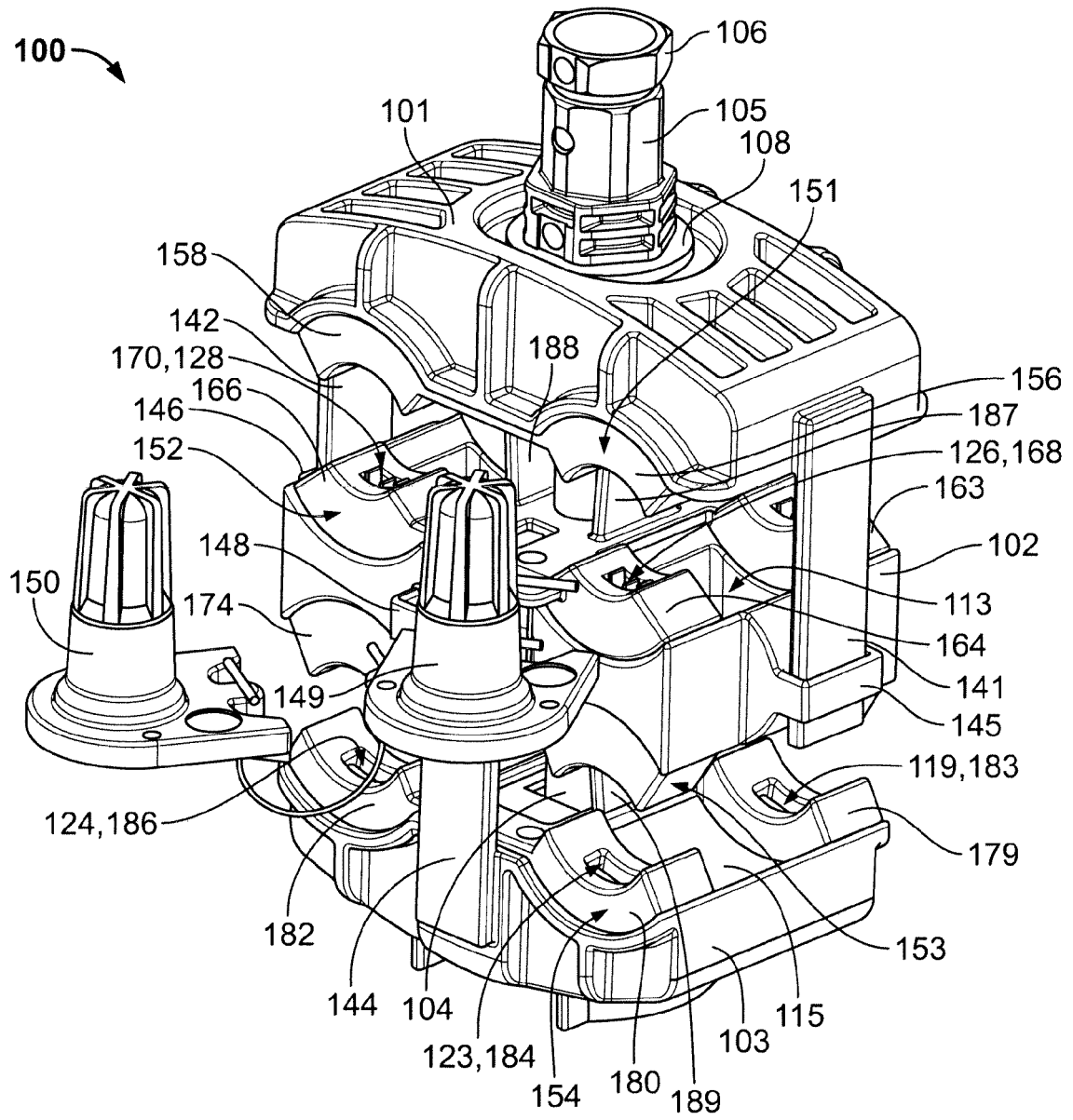


Fig. 2

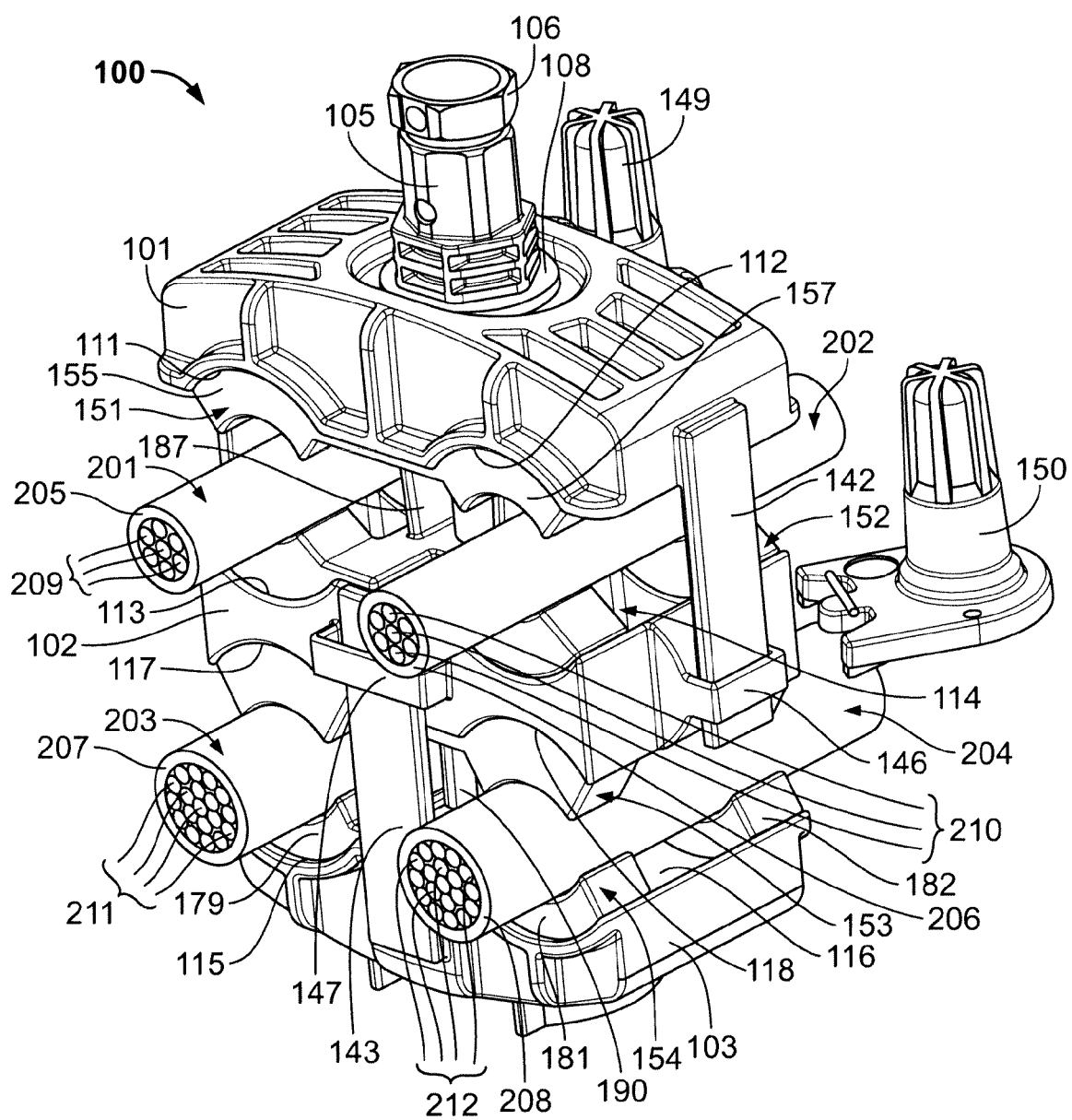


Fig. 3

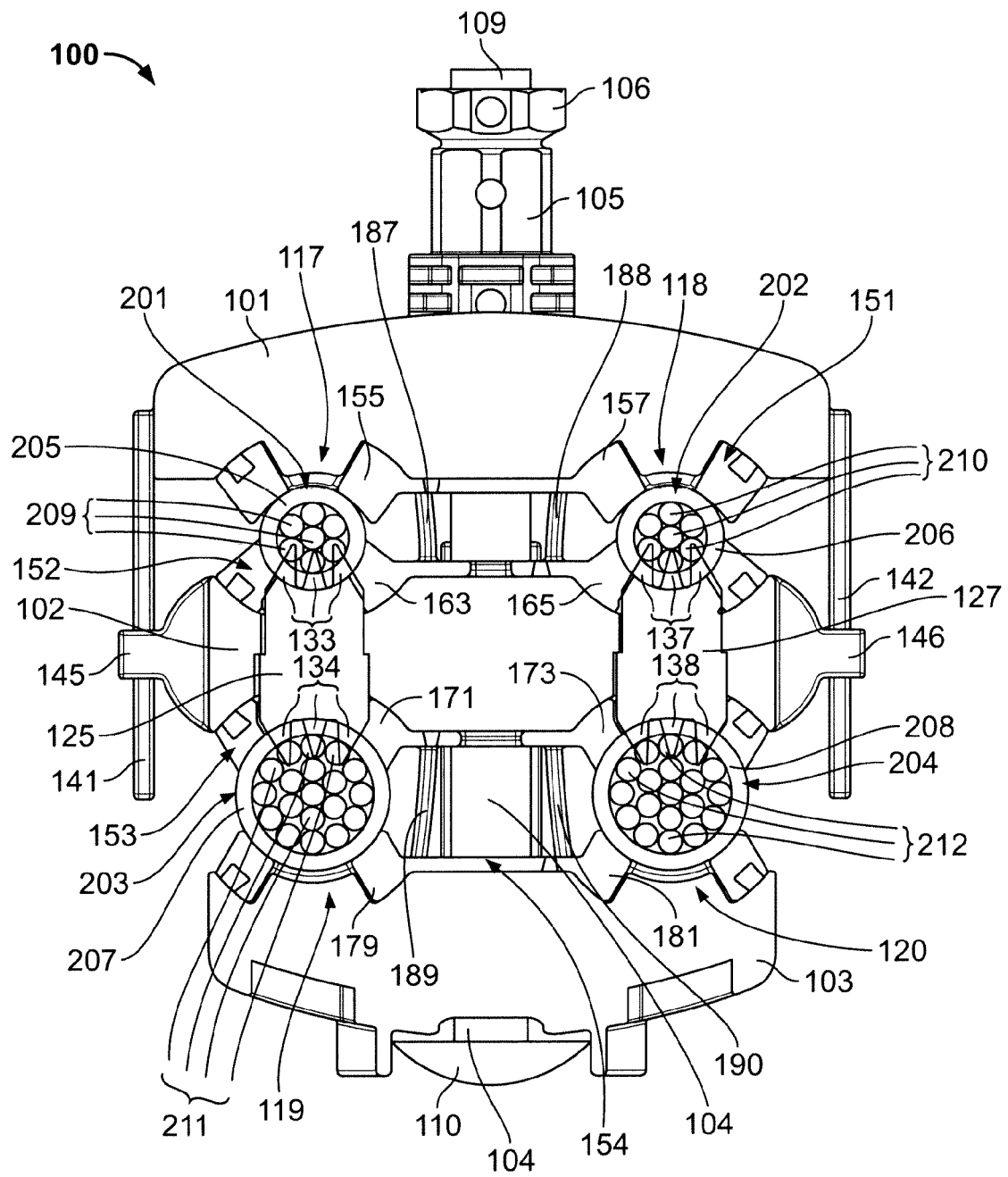


Fig. 4

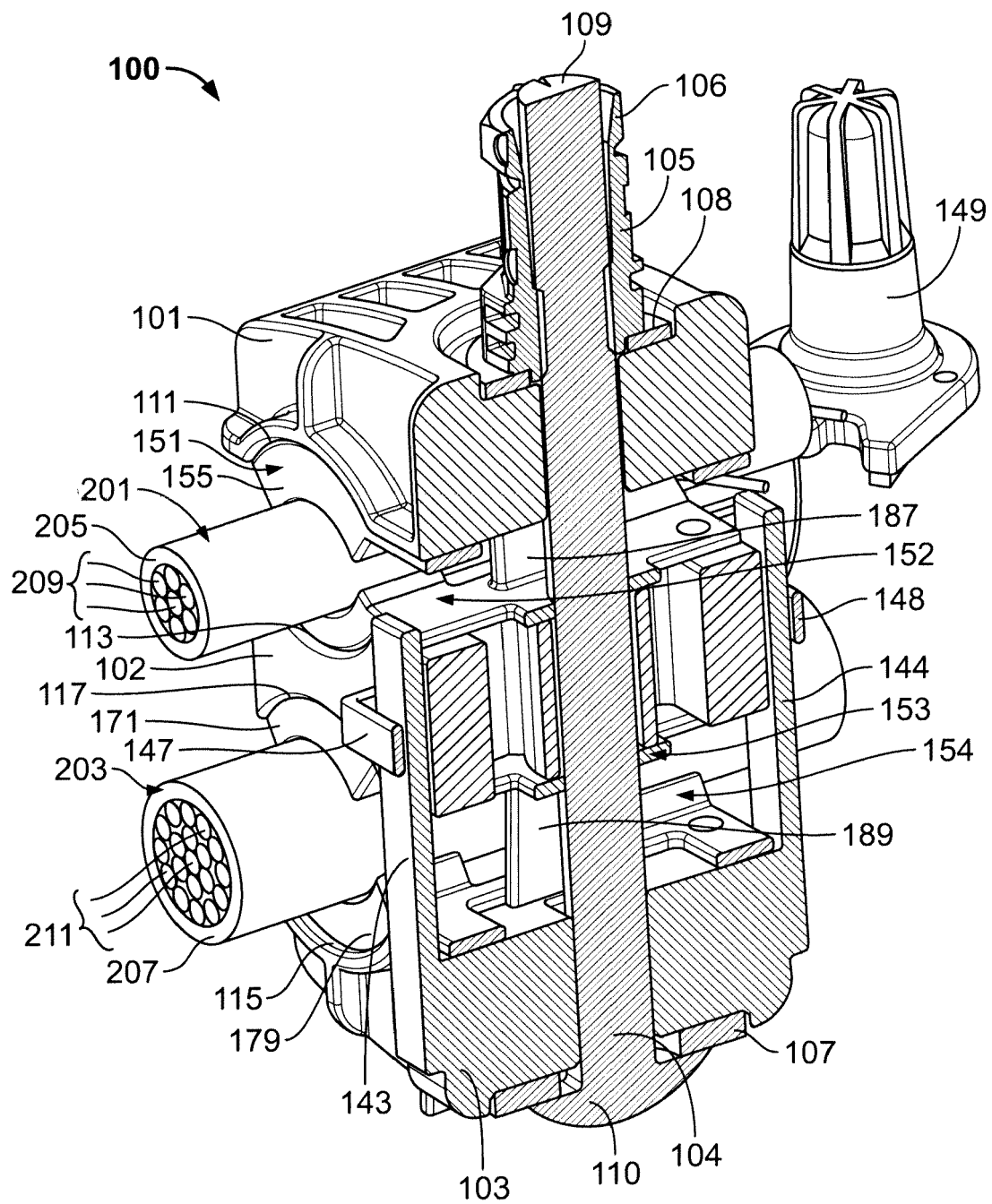


Fig. 5



EUROPEAN SEARCH REPORT

Application Number
EP 13 29 0300

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Place of search The Hague		Date of completion of the search 23 April 2014	Examiner Gomes Sirenkov E M.
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