



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
13.05.2015 Bulletin 2015/20

(51) Int Cl.:
H01R 9/03 (2006.01) **H01R 4/44 (2006.01)**
H01R 4/24 (2006.01)

(21) Application number: **13290276.8**

(22) Date of filing: **08.11.2013**

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

• **Dossmann, Julien**
21220 Gevrey-Chambertin (FR)
• **Falempin, Jean-Claude**
21110 Izeure (FR)

(71) Applicant: **Tyco Electronics Simel S.A.S.**
21220 Gevrey-Chambertin (FR)

(74) Representative: **Grünecker Patent- und Rechtsanwälte**
PartG mbB
Leopoldstraße 4
80802 München (DE)

(72) Inventors:
• **Marlien, Franck**
21170 Esbarres (FR)

(54) **Preformed Plate for an Insulation-Piercing Connector**

(57) The invention relates to a preformed contact member (300, 400) for use with an insulation-piercing connector (100), wherein said insulation-piercing connector (100) comprises one or more electrically conductive insulation-piercing means (105a, 108a, 105b, 108b) for piercing an insulation layer (110, 113) of at least one insulated electrical conductor (109, 112) arranged therein, wherein the preformed contact member (300, 400) is electrically conductive and is configured for being provided on said one or more electrically conductive insulation-piercing means (105a, 108a, 105b, 108b), in particular between said one or more electrically conductive insulation-piercing means (105a, 108a, 105b, 108b) and a bare electrical conductor (512) arranged in the insulation-piercing connector (100). Said preformed contact member (300, 400) 2, further comprises one or more electrically conductive contact elements (301, 302), in particular for providing electrical contact between a respective electrically conductive insulation-piercing means (105a, 108a, 105b, 108b) of the one or more electrically conductive insulation-piercing means (105a, 108a, 105b, 108b) and a bare electrical conductor (512) while preventing direct contact therebetween.

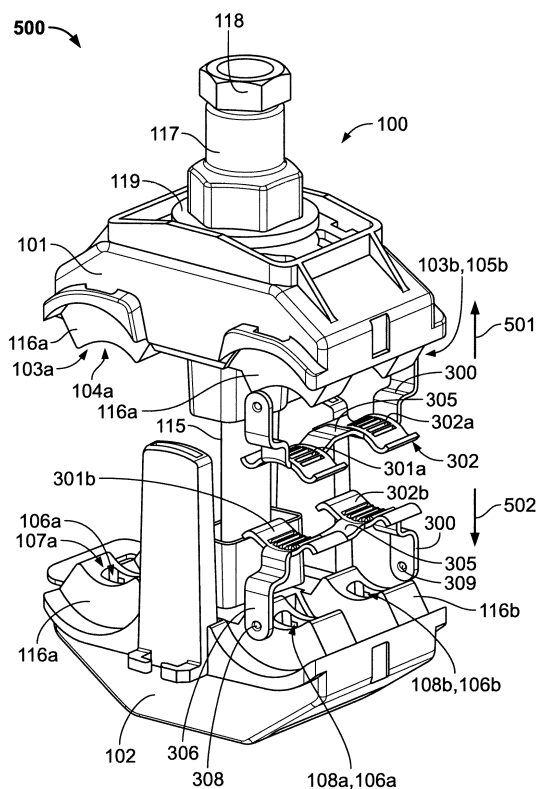


Fig. 5

Description

[0001] The invention relates to the use of insulation-piercing connectors for connecting two conductors in suspended low and intermediate voltage electrical lines. The invention further relates to a preformed contact plate for an insulation-piercing connector.

[0002] Since their first installation in the mid 1950's, aerial low or intermediate voltage electrical lines used for the transport of electricity, also called suspended low or intermediate voltage insulated overhead lines, have been known to use insulated aerial bundled cables (or ABCs hereafter) for the transport of electricity. These insulated ABCs typically comprise an outer insulating layer surrounding a bundle of electrical conductors carrying the electricity and have been used in order to progressively replace bare bundled conductors used in older suspended lines and modernize the latter, in response to the evolution of national, regional or international standards.

[0003] For the modern suspended lines using insulated ABCs, it is known to use insulation-piercing connectors (or IPCs hereafter) in order to electrically connect two insulated ABCs to each other, for instance for connecting a service line to a live line. IPCs known in the art typically comprise two clamping halves that sandwich a respective contact portion of the two ABCs arranged next, in particular parallel, to each other in a longitudinal direction of the IPC. It is also known in the art that the two clamping halves can be tightened to maintain the ABCs by a tightening bolt by a person carrying out the installation of the IPC on the suspended line.

[0004] In order to pierce the insulation layer of the ABCs and establish an electrical connection between the respective underlying bundled conductors, IPCs known in the art comprise sets of pairs of electrically conductive blades, also called piercing contact blades or contact blades, that are arranged respectively in each clamping half, in a transversal direction of the IPC substantially perpendicular to the longitudinal direction and thus to the two ABCs. In turn, these piercing contact blades comprise each two sets of parallel piercing contact teeth arranged on each end thereof, that, upon tightening of the two clamping halves by action of the installer on the tightening bolt, can keep the two ABCs substantially parallel to each other, pierce the respective outer insulating layer of each ABC and contact the underlying bundled electrical conductors, thereby electrically connecting the two ABCs to one another. For safety of the installer, it is also known in the art that the two clamping halves can be made of an insulating material, and that the tightening bolt can be electrically insulated from the piercing contact blades. An example of a standard IPC 100 known in the art is illustrated in Figures 1A and 1B and will be detailed below.

[0005] However, the modernization of suspended low or intermediate voltage lines has been progressive and is still an ongoing subject. In particular, older aerial low or intermediate voltage electrical lines still use bare bundled conductors, in other words bundles of electrical conductors without an outer insulating layer, unlike insulated ABCs.

[0006] While upgrading such older suspended lines using bare bundled conductors, or in order to connect them to the more modern suspended low or intermediate voltage insulated overhead lines using insulated ABCs, it is necessary to electrically connect bare bundled cables to insulated ABCs.

[0007] However, IPCs used for connecting insulated ABCs on modern insulated overhead lines cannot be used in the case of bare bundled conductor to insulated ABC transition lines, as the piercing contact teeth result in damaging and even breaking the bare bundled conductors.

[0008] Thus, it is also known in the art to use dedicated bare bundled line to insulated ABC line transition connectors, also referred to as "bare-to-ABC transition connectors" or just "transition connectors" hereafter, that are specifically manufactured for connecting an insulated ABC to a bare bundled conductor. The structure of these transition connectors is similar to that of IPCs, with the main difference being that, on the side contacting the bare bundled conductor, in order not to damage the latter, the pairs of electrically conductive blades comprise contact plates pressing the bare bundled conductor instead of the sets of piercing contact teeth, such that the bare bundled conductor is sandwiched between the two contact plates. It is further known that these contact plates are substantially of similar length as the length of the whole contact portion of the bare bundled conductor that is sandwiched in the connector. In turn, on the side contacting the insulated ABC, the pairs of electrically conductive blades still comprise sets of piercing contact teeth like a regular IPC. An example of a bare-to-ABC transition connector 200 known in the art is illustrated in Figures 2A and 2B and will also be detailed below.

[0009] However, these transition connectors known in the art can require more than one tightening bolt in order to produce enough force to pierce the insulated ABC with the piercing contact teeth on one side, while simultaneously sandwiching the bare bundled conductor with the contact plates on the other side. Thus, the installation of such transition connectors requires that the installer carries out more steps than when installing an IPC for connecting two insulated ABCs on suspended insulated overhead lines.

[0010] Furthermore, it has been observed that the electricity transmission between the bare bundled conductor and the insulated ABC is not as good as expected in suspended bare-to-ABC transition lines. In particular, it has been observed that the electrical contact between the contact plates and the bare bundled conductor is not as good as expected.

[0011] Furthermore, unlike IPCs, which are commonly mass-produced in standardized manufacturing lines and widely distributed and used around the world, bare-to-ABC transition connectors are manufactured essentially on-demand and

present therefore much higher production costs than standardized IPCs. However, the industry requires more and more the manufacturers to move towards standardized solutions and automated manufacturing lines.

[0012] There is therefore a need for a standardized and cost-efficient solution for connecting bare bundled conductors to insulated ABCs on suspended low or intermediate voltage electrical lines, as well as for improving the electricity transmission between the bare bundled conductors and the insulated ABCs compared to the existing bare-to-ABC transition connectors.

[0013] A further requirement is also that the installer should not have to carry out more installation steps during the connection of a bare bundled conductor to an insulated ABC than what is currently the case for connecting two insulated ABCs with standard IPCs on suspended insulated overhead lines.

[0014] It is therefore an objective of the present invention to solve the above mention problems. In particular, an objective of the present invention is to allow using a standard mass-produced insulation-piercing connector also in cases where an insulated ABC needs to be connected to a bare bundled conductor.

[0015] The objective of the invention is achieved with a preformed contact member according to claim 1, for use with an insulation-piercing connector, wherein said insulation-piercing connector comprises one or more electrically conductive insulation-piercing means for piercing an insulation layer of at least one insulated electrical conductor arranged therein, wherein the preformed contact member is electrically conductive and is configured for being provided on said one or more electrically conductive insulation-piercing means, in particular between said one or more electrically conductive insulation-piercing means and a bare electrical conductor arranged in the insulation-piercing connector.

[0016] Thus, the inventive preformed contact member, or preformed plate, presents an advantageous solution that allows using standardized mass-produced IPCs that are normally used only for connecting two insulated ABCs also in the specific case of a bare bundled conductor to insulated ABC transition, which was not possible until now, as they were damaging and even breaking the bare bundled conductor. Indeed, by using at least one preformed contact member, in particular a pair of preformed contact members, in combination with an existing standard IPC, it is possible to advantageously prevent the piercing contact teeth of the IPC on the side of the bare bundled conductor to penetrate into the latter and damage it during the installation. Indeed, the inventive preformed contact member can be arranged so that it covers and contacts the piercing teeth of contact blades of a standard IPC. The invention therefore allows also replacing high cost dedicated bare-to-ABC transition connectors by standard IPCs provided with at least one preformed contact member, in particular with two preformed contact members arranged opposite each other in a respective clamping half of the IPC, covering the respective piercing contact teeth.

[0017] Preferably, the preformed contact member can comprise attaching means for attaching, in particular by clipping, said preformed contact member to said insulation-piercing connector. Thus, it is possible to attach an inventive preformed contact member, or detach it if the electrical line is upgraded with a second insulated conductor to replace the bare bundled conductor.

[0018] In particular, it is possible to mount, in particular by clipping, at least one preformed contact member, in particular a pair of opposite preformed contact members, on the side of the IPC's clamping halves that will hold the bare bundled conductor. This mounting can be carried out at the end of existing standardized IPC manufacturing lines such that cost expensive new or dedicated manufacturing lines are not required. As a consequence, the person installing the standard IPC provided with at least one inventive preformed contact member, in particular with a pair of opposite preformed contact members, on a suspended line will only need to carry out the same amount of installation steps as in a modern suspended insulated overhead line.

[0019] Preferably, the preformed contact member can further comprise one or more electrically conductive contact elements, in particular for providing electrical contact between a respective electrically conductive insulation-piercing means of the one or more electrically conductive insulation-piercing means and a bare electrical conductor while preventing direct contact therebetween. Thus, the preformed contact member will advantageously protect a bare bundled conductor from said piercing teeth, while at the same time providing for electrical contact between the piercing teeth and the bare bundled cable. It is also possible to adapt the number of contact elements as a function of the number of contact blades of an IPC, in particular of the number of parallel contact blades to be covered simultaneously by the inventive preformed contact member.

[0020] Advantageously, the one or more electrically conductive preformed contact element can comprise first and second opposite surfaces, wherein the first surface can be configured for contacting said electrically conductive insulation-piercing means, and the second surface can be a positioning surface configured for contacting a bare electrical conductor and positioning it in the insulation-piercing connector. It is thus possible to advantageously perform the first and second surfaces for better contact with the piercing teeth of a standard IPC, and for better contact and clamping of a bare bundled conductor, respectively.

[0021] Preferably, the first surface can be convex, in particular in a direction towards said electrically conductive insulation-piercing means when the preformed contact member is attached to the insulation-piercing connector. Thus, it is possible to perform the first surface such that piercing teeth of a standard IPC will apply sufficient force on it for clamping and electrically connecting the bare bundled conductor.

[0022] Preferably, the second surface can be concave, in particular in a direction towards said bare electrical conductor when the preformed contact member is attached to the insulation-piercing connector. Thus, it is possible to also perform the second surface and thereby provide an advantageous clamping mechanism of a bare bundled conductor.

[0023] Advantageously, the first surface comprises a plurality of longitudinal grooves. It is thus possible to perform the first surface such that piercing teeth of a standard IPC will fall in the longitudinal grooves and thereby improve the connection and the force applied to the preformed contact member.

[0024] Advantageously, the second surface can comprise a plurality of protruding longitudinal stripes. Similarly, it is also possible to improve the contact between the second surface and a bare bundled conductor by using longitudinal stripes for breaking any oxide such as aluminum oxide that can form on the surface of bare bundled conductors.

[0025] Advantageously, the longitudinal stripes on the second surface can be preformed protrusions corresponding to the grooves on the first surface. It is thereby possible to combine both advantages and perform both surfaces, for instance with only one stamping process.

[0026] Preferably, when the preformed contact member comprises more than one electrically conductive contact elements, the preformed contact member can further comprise a recess area between two successive electrically conductive contact elements in a direction facing away from the bare electrical conductor when the preformed contact member is attached to the insulation-piercing connector. Thus, the surface of the preformed contact member electrically contacting the bare bundled conductor can be limited to only the second surface of the contact elements. Thus, a standard IPC comprising a standard centered clamping mechanism such as a centered screw and a shear head bolt can be used, and the force of the clamping will be transmitted only from the piercing teeth to the contact elements underneath and in turn to the small pressed sections of the bare bundled conductor. With this variant of the inventive preformed contact member having only small preformed contact elements arranged between a bare bundled conductor and corresponding sets of piercing teeth of a standard IPC, a better electric connection has been observed in comparison to dedicated bare-to-ABC transition connectors known in the art that comprise long contact plates.

[0027] Furthermore, compared to dedicated specifically designed and thus high cost bare-to-ABC transition connectors known in the art, the inventive solution of a preformed plate used in combination with a standard IPC has the advantage that the force applied by the piercing contact teeth on the preformed contact members, in particular on the surface of their contact elements, allows a better clamping, in other words better pressing or sandwiching, of the bare bundled cable between the preformed plates than the long contact plates of the dedicated bare-to-ABC transition connectors known in the art.

[0028] Furthermore, the size and dimensions of the contact surfaces of the inventive preformed contact member can be advantageously designed such that the sandwiching of the bare bundled conductor allows better electrical contact and thus better electricity transmission than the dimensions of the contact plates of existing dedicated bare-to-ABC transition connectors.

[0029] Preferably, the preformed contact member can be made of or comprises a metal or a metal alloy, in particular aluminum, copper, brass, tinned copper or the like.

[0030] The objective of the invention is also achieved with a connector assembly according to claim 12, in particular for suspended low or intermediate voltage electrical lines, for electrically connecting an insulated conductor to a bare conductor, the connector assembly comprising: an insulation-piercing connector for electrically connecting first and second insulated electrical conductors to one another, the insulation-piercing connector comprising one or more electrically conductive insulation-piercing means with first and second piercing extremities, wherein the first piercing extremity is configured for piercing an insulation layer of the first insulated electrical conductor, and the second piercing extremity is configured for piercing an insulation layer of the second insulated electrical conductor. According to an aspect of the invention, the connector assembly further comprises: at least one inventive preformed contact member according to any of its variants, wherein said at least one preformed contact member is provided on the first or the second piercing extremity of the one or more electrically conductive insulation-piercing means.

[0031] Thus, the invention advantageously allows using mass-produced standard IPCs for a task for which they are not designed, namely also clamping bare bundled conductors. This new use has been found to be more advantageous than the use of dedicated bare-to-ABC transition connectors known in the art. In particular, it has been observed that the inventive use results in lower manufacturing costs and also in better electrical contact than the transition connectors known in the art.

[0032] Preferably, the connector assembly can further comprise an insulated conductor and a bare conductor arranged in the insulation-piercing connector, wherein the bare conductor can be arranged on a side of the insulation-piercing connector provided with said at least one preformed contact member. Thus, the assembly also presents all the advantages discussed above for the preformed contact member.

[0033] Advantageously, when the second surface of the contact elements comprises longitudinal grooves, the latter can be provided on the first or second piercing extremity. The pressure applied by piercing teeth of a standard IPC on the contact elements and thus on a bare bundled conductor will thereby be better than in transition connectors known in the art.

[0034] Finally, the objective is also achieved by using an insulation-piercing connector for electrically connecting an insulated conductor and a bare conductor to one another, in particular on a suspended low or intermediate voltage electrical line, wherein: the insulation-piercing connector is for electrically connecting first and second insulated electrical conductors to one another and comprises one or more electrically conductive insulation-piercing means with first and second piercing extremities, wherein the first piercing extremity is configured for piercing an insulation layer of the first insulated electrical conductor, and the second piercing extremity is configured for piercing an insulation layer of the second insulated electrical conductor; and wherein at least one preformed contact member according to claim 1 or any of its variants is attached to the insulation-piercing connector.

[0035] Thus, with the new use of standard insulation-piercing connectors achieved with the present invention allows replacing expensive dedicated bare-to-ABC transition connectors by mass-produced and therefore cheaper standard IPCs. It has also been observed that the inventive protecting preformed contact member provides for a better electrical connection than prior art bare-to-ABC transition connectors.

[0036] The invention will be described in more detail in the following, based on advantageous embodiments described in combination with the following figures:

Figures 1A and 1B illustrate a prior art standard insulation-piercing connector for connecting two insulated aerial bundled cables;

Figures 2A and 2B illustrate a prior art bare-to-ABC transition connector;

Figures 3A and 3B illustrate an example of a preformed plate in a first embodiment according to an aspect of the invention;

Figures 4A and 4B illustrate another example of a preformed plate in a second embodiment according to an aspect of the invention;

Figure 5 illustrates an example of providing a standard IPC with inventive preformed plates in a third embodiment according to an aspect of the invention; and

Figures 6A and 6B illustrate an example of the inventive use of the standard IPC provided with the inventive preformed plates for connecting an insulated ABC to a bare bundled conductor in a fourth embodiment according to an aspect of the invention.

[0037] Figures 1A and 1B illustrate a standard insulation-piercing connector or IPC 100 known in the art for connecting two insulated aerial bundled cables or ABCs 109, 112 of a suspended low or intermediate voltage electrical line. Both Figures 1A and 1B illustrate a cross-section view of the IPC 100 with the two insulated ABCs 109, 112 arranged, in particular sandwiched, therein respectively before and after piercing their respective insulation layer 110, 113. The normal use of a standard IPC 100 known in the art for connecting two insulated ABCs 109, 112 of a suspended insulated overhead line such as illustrated in Figures 1A and 1B does not form part of the present invention but is useful for its understanding.

[0038] As illustrated in Figures 1A and 1B, an insulated ABC can comprise an outer insulating layer surrounding a plurality of bundled conductors. Thus, in Figures 1A and 1B, the first insulated ABC 109 and the second insulated ABC 112 comprise respectively an outer insulating layer or sheath 110 or 113 surrounding a plurality of bundled conductors 111 or 114. The relative number of bundled conductors 111 or 114 is not relevant for the purpose of this application. For instance, the two insulated ABCs 109, 112 could comprise same or different amounts of bundled conductors 111 or 114 underneath their respective outer insulating layer 110 or 113. Furthermore, it is known in the art that the two insulated ABCs 109, 112 are arranged substantially parallel to each other in a longitudinal direction of the IPC 100.

[0039] As further illustrated in Figures 1A and 1B, the standard IPC 100 comprises an upper clamping member 101 and a lower clamping member 102, for instance made of or comprising an insulating material such as plastic, as well as at least one pair of upper and lower electrically conductive blades 103a, 106a, or contact blades, wherein the upper electrically conductive blade 103a is arranged in the upper clamping member 101, facing the lower electrically conductive blade 106a arranged in the lower clamping member 102. It is known in the art that the blades 103a, 106a can be made of a conductive material such as a metal or a metal alloy, for instance aluminum, copper, brass, tinned copper or the like.

[0040] As illustrated in the cross-section views of Figures 1A and 1B, the opposing pairs of electrically conductive blades 103a, 106a are arranged essentially in a transversal direction of the IPC 100, perpendicular to the two insulated ABCs 109, 112 and thus clamping, piercing and connecting the latter in a first section. For better clamping and electrical connection between the two ABCs 109, 112, the IPC 100 can comprise at least a second pair of opposing electrically conductive blades 103b, 106b arranged parallel to the first pair of electrically conductive blades 103a, 106a, but further

down along the longitudinal direction of the IPC 100 (hardly visible in the cross section views) in order to clamp, pierce and connect the ABCs 109, 112 in at least a second section. In order to pierce the insulation layers 110, 113 of the ABCs 109, 112, each of the electrically conductive blades 103a, 103b, 106a, 106b comprises at its respective ends a set of piercing contact teeth 104a and 105a, 104b and 105b, 107a and 108a, 107b and 108b, respectively. In the cross-section view of Figures 1A and 1B, the contact blades 103a, 106a with their respective sets of teeth 104a, 105a and 107a, 108a are visible, but the second pair of opposing contact blades 103b, 106b parallel to the blades 103a, 106a, respectively, can also comprise respective sets of teeth 104b, 105b and 107b, 108b, arranged further down in the longitudinal direction of the IPC 100. The second contact blades 103b, 106b and teeth 104b, 105b and 107b, 108b will be more visible in an embodiment of the present invention, for instance in Figure 5.

[0041] Thus, as illustrated in Figures 1A and 1B, and particularly in Figure 1B, the sets of opposing piercing contact teeth 104a, 107a and 105a, 108a will clamp, pierce and electrically connect the two insulated ABCs 109, 112 in first sections, while the sets of opposing piercing contact teeth 104b, 107b and 105b, 108b will clamp, pierce and electrically connect the two insulated ABCs 109, 112 in respective second sections further down in the longitudinal direction. In particular, the connection happens since, after piercing the insulation layers 110, 113, the piercing teeth 104a, 107a, 104b, 107b and 105a, 108a, 105b, 108b are in contact with the bundled conductors 111 and 114, respectively.

[0042] It is also known in the art that the number, the spacing and the length of the piercing contact teeth of each set 104a and 105a, 104b and 105b, 107a and 108a, 107b and 108b can be configured depending on the respective diameter of the insulated ABC 109 or 112 and does therefore not need to be always symmetric, as the two cables 109, 112 do not always have the same diameter. Thus, for instance if the first insulated ABC 109 is a main phase cable and the second insulated ABC 112 is a tap phase cable of different diameter than the main phase cable 109, like in Figures 1A and 1B, the piercing contact blades 103a, 106a, 103b, 106b can be asymmetric, in other words each of the piercing contact teeth in the sets of piercing contact teeth 105a and 108a, 105b and 108b sandwiching the tap phase cable 112 could, respectively, be more or less numerous and/or closer or further apart to one another and/or longer or shorter than the piercing contact teeth 104a and 107a, 104b and 107b sandwiching the main phase cable 109.

[0043] As further illustrated in Figures 1A and 1B, one or more inner sealing members 116a, 116b can also be provided in order to prevent any moisture ingress. Inner sealing members 116a, 116b can also be made of an insulating material such as a rubber material or the like. Furthermore, as illustrated in Figures 1A and 1B, they can accommodate a respective pair of piercing contact blades 103a and 106a, and 103b and 106b. The sealing members 116a, 116b can advantageously also be flexible such that they bend with the tightening of the two clamping members 101, 102, as illustrated in particular in Figure 1B. A sealing member 116a, 116b can also advantageously be molded such that it provides further support to the sets of piercing contact teeth 104a, 105a, 107a, 108a or 104b, 105b, 107b, 108b for maintaining the two insulated ABCs 109, 112 parallel to each other between the upper and the lower clamping members 101, 102.

[0044] As also illustrated in Figures 1A and 1B, the standard IPC 100 can comprise tightening means for tightening the two clamping members 101, 102 and thus press the two clamping members 101, 102 towards each other, such that the two insulated ABCs 109, 112 are sandwiched between them. Figures 1A and 1B illustrate an example of tightening means known in the art and commonly used by installers on suspended insulated overhead lines, comprising a tightening screw 115 and shear head bolt 117 centered on the connector 100, and a spacer or a seal 119. For safety of the installer, the tightening screw 115 is preferably insulated from the electrically conductive blades 103a, 106a and 103b, 106b. Figure 1A illustrates the standard IPC 100 with the two insulated ABCs 109, 112 when the tightening means 115, 117 is not tightened, and thus before the piercing contact teeth 104a, 105a, 107a, 108a and 104b, 105b, 107b, 108b have pierced the insulation layers 110, 113. In turn, Figure 1B illustrates the standard IPC 100 when the installer has applied the required cantilever load with a tightening tool, such that the shear head 118 of the shear head bolt 117 is broken and the two clamping members 101, 102 firmly clamp or sandwich the two insulated ABCs 109, 112, while ensuring that the two insulated ABCs 109, 112 are not damaged by too strong forces. At the stage of Figure 1B, the pressure applied by the tightening results in that the piercing contact teeth 104a, 105a, 107a, 108a and 104b, 105b, 107b, 108b have pierced the respective outer insulation layers 109, 113 of the two insulated ABC lines 109, 112 and are in direct with the underlying respective bundled conductors 111, 114, establishing electrical contact between the two insulated ABC lines 109, 112.

[0045] It is also known that standard IPCs such as the standard IPC 100 illustrated in Figures 1A and 1B, or other commonly known IPCs, are usually mass-produced in manufacturing lines that are essentially automated or can be automated, and are widely distributed for installation and use in low or intermediate voltage suspended insulated overhead lines, for instance by the applicant. Since it can be mass-produced, its production costs are thus lower than those of a dedicated connector only manufactured on-demand for a limited use.

[0046] However, as mentioned above, it will be clear to the person skilled in the art that such a standard IPC 100 would damage and even break a bare bundled conductor, as the latter does not have an outer insulating layer that could keep the bare bundled conductors together, unlike the two insulated ABCs 109, 112 illustrated in Figures 1A and 1B. Thus, it will be clear to the skilled person that standard IPCs such as the standard IPC 100 illustrated in Figures 1A and 1B are used only for connecting insulated conductors to one another, but they are not known to be used for connecting

an insulated conductor to a bare conductor.

[0047] Figures 2A and 2B illustrate a dedicated bare-to-ABC transition connector 200 known in the art specifically designed for connecting a bare bundled cable line to an insulated ABC line. Such dedicated bare-to-ABC transition connectors are also known to be manufactured by the applicant. However, they are not mass-produced given their limited functionality. Dedicated bare-to-ABC transition connectors such as the connector 200 illustrated in Figures 2A and 2B do not form part of the present invention but are useful for its understanding.

[0048] Figure 2A illustrates the bare-to-ABC transition connector 200 sandwiching an insulated ABC 209 on one side and a bare bundled conductor 212 on the other side, in particular arranged like the two insulated ABCs 109, 112, namely parallel to each other between the two clamping members 201, 202 of the bare-to-ABC transition connector 200 in a longitudinal direction of the connector 200. Thus, like in Figures 1A and 1B, Figure 2A illustrates that the insulated ABC 209 comprises an outer insulation layer or insulation sheath 210 surrounding a bundle of conductors 211. In contrast, the bare bundled conductor 212 is only a bundle of a plurality of entangled or coiled bare conductors 214 without any insulation sheath. Again, like for the insulated ABCs 109, 112 of the example illustrated in Figures 1A and 1B, the relative number of insulated or bare bundled conductors 211 or 214 is not directly relevant for the purpose of this application. For instance, the insulated ABC 209 and the bare bundled conductor 212 could comprise same or different amounts of bundled conductors 211 or 214. Figure 2B illustrates a different view of the prior art bare-to-ABC transition connector 200, without the insulated ABC 209 or the bare bundled conductor 212, in order to emphasize some of the differences with a standard IPC such as the standard IPC 100 illustrated in Figures 1A and 1B.

[0049] As illustrated in Figures 2A and 2B, the specifically designed bare-to-ABC transition connector 200 known in the art can comprise features that are substantially similar to those of the standard IPC 100 illustrated in Figures 1A and 1B and have similar roles. For instance, the bare-to-ABC transition connector 200 also comprises two clamping members 201, 202, wherein each of the upper clamping member 201 and the lower clamping member 202 is provided with at least one respective transversally arranged upper electrically conductive blade 203a or lower electrically conductive blade 206a, and in this case also second upper and lower electrically conductive blade 203b, 206b, for connecting the insulated ABC 209 to the bare bundled conductor 212. Like for the standard IPC 100, the blades 203a, 203b, 206a, 206b can be made of a conductive material such as a metal or a metal alloy, for instance aluminum, copper, brass, tinned copper or the like. The bare-to-ABC transition connector 200 can also comprise one or more inner sealing members 216a, 216b similar to the inner sealing members 116a, 116b of the standard IPC 100.

[0050] Furthermore, Figure 2B illustrates that on the side of the bare-to-ABC transition connector 200 clamping or sandwiching the insulated ABC 209, both the upper and lower electrically conductive blades 203a, 203b, 206a, 206b comprise sets of piercing contact teeth 204a, 204b, 207a, 207b for clamping and piercing two sections of the insulated ABC 209 like in the case of the standard IPC 100. However, in contrast to the standard IPC 100 illustrated in Figures 1A and 1B, Figure 2B also illustrates that on the side of the bare-to-ABC transition connector 200 clamping or sandwiching the bare bundled conductor 212, both the upper and lower electrically conductive blades 203a, 203b, 206a, 206b are joined by a respective upper or lower contact plate 205, 208 instead of the second sets of piercing contact teeth 105a, 105b, 108a, 108b of the standard IPC 100. As further illustrated in Figure 2B, the two opposing contact plates 205, 208 can be partially rounded so as to partially adopt the shape of the bare bundled conductor 212 and prevent disengaging of the latter from the bare-to-ABC transition connector 200. It is also known in the art that the two opposing contact plates 205, 208 extend substantially over the entire length of the portion of bare bundled conductor 212 that is sandwiched in the bare-to-ABC transition connector 200, such that when the system is tightened, they press substantially against the whole length of the portion of bare bundled conductor 212 covered by the bare-to-ABC transition connector 200 and sandwiched therein.

[0051] Furthermore, Figures 2A and 2B illustrate that, like the standard IPC 100, the two clamping members 201, 202 of the bare-to-ABC transition connector 200 can be tightened with tightening means. Some bare-to-ABC transition connectors known in the art use a single centered tightening screw and bolt system like in the standard IPC 100. However, it is known that such systems transmit less pressure to tighten the contact plates 205, 208 and therefore also less current. Thus, instead of the single centered tightening screw and bolt system 115, 117 of the standard IPC 100, in order to provide more pressure on the bare bundled conductor 212 over the length of the contact plates 205, 208, the bare-to-ABC transition connector 200 comprises two tightening screws 215a, 215b with a respective shear head bolt 217a, 217b and a respective spacer or seal 219a, 219b. Like for the standard IPC 100 illustrated in Figure 1B, the shear heads 218a, 218b can break when the cantilever force applied by the installer is enough to tighten the system and ensure that the piercing contact teeth 204a, 204b, 207a, 207b have pierced the insulating layer 210 and are in contact with the bundled conductors 211, and that the contact plates 205, 208 press the bare bundled conductor 212. This solution, however, is known to increase the number of operations carried out by the person installing the connector 200 on a suspended line in comparison to the number of operations needed for installing a standard IPC 100.

[0052] As mentioned above, it has been observed that the electric connection in dedicated bare-to-ABC transition connectors known in the art, like for instance the bare-to-ABC transition connector 200 illustrated in Figures 2A and 2B, is not as good as expected. In particular, it has been observed that the electrical contact between the plates 205, 208

and the bare bundled conductor 212 is not as good as expected.

[0053] Furthermore, in contrast to standard IPCs, for instance like the standard IPC 100 illustrated in Figures 1A and 1B, specifically designed bare-to-ABC transition connectors such as the bare-to-ABC transition connector 200 illustrated in Figures 2A and 2B, are specifically designed for cases where a transition from a bare line to an insulated line is required and therefore not mass-produced. As a consequence, their production costs are higher than those of standardized and mass-produced IPCs. There is also no push in the industry to mass-produce such specifically dedicated transition connectors, as they only are of limited use, as the number of suspended lines that require such transition connectors will decrease with time as they get upgraded with insulated conductors. On the contrary, there is a requirement to standardize the connectors used in the field of low or intermediate voltage suspended lines and to replace specifically designed non-standard connectors.

[0054] Figures 3A and 3B, as well as Figures 4A and 4B, illustrate examples of a first embodiment of a preformed contact member 300 and of a second embodiment of a preformed contact member 400 according to an aspect of the present invention, for use with a standard IPC that is used for connecting an insulated ABC to a bare bundled conductor rather than to another insulated ABC. According to an aspect of the present invention, at least one preformed contact member 300, 400 can be attached to a standard IPC, for instance the standard IPC 100 illustrated in Figures 1A and 1B, in order to protect a bare bundled conductor from being damaged by piercing contact teeth 105a, 108a, 105b, 108b, which advantageously allows using any standard IPC also for electrically connecting an insulated ABC to a bare bundled conductor. According to a preferred variant of an embodiment, the preformed contact member 300 can be totally or partially made of an electrically conductive material that is also hard enough to resist the pressure of piercing contact teeth 105a, 108a, 105b, 108b while providing the electrical contact to a bare bundled conductor. Thus, the preformed contact member 300 can be made of or comprise a metal or a metal alloy, for instance aluminum, copper, brass, tinned copper or the like.

[0055] According to an aspect of the present invention, at least one preformed contact member 300, 400 of the embodiments illustrated in Figures 3A and 3B or 4A and 4B, respectively, can be used to protect a bare bundled conductor from being damaged by the piercing means, for instance the piercing contact teeth 104a, 105a, 107a, 108a, 104b, 105b, 107b, 108b in the case of the standard IPC 100 illustrated in Figures 1A and 1B, while contacting said bare bundled conductor and electrically connecting it to another cable sandwiched in the standard IPC, which could be an insulated ABC or another bare bundled conductor also protected by at least one inventive preformed contact member 300, 400.

[0056] As illustrated in Figures 3A and 3B, the preformed contact member 300 can comprise at least one preformed contact element 301, 302, and in particular as many preformed contact elements 301, 302 as a standard IPC comprises sets of parallel contact blades with piercing teeth. For instance, in the embodiments of the invention detailed hereafter, the preformed contact member 300 comprises two preformed contact elements 301, 302 since it will be used with the standard IPC 100 illustrated in Figures 1A and 1B that comprises two parallel upper contact blades 103a, 103b or parallel lower contact blades 106a, 106b on which a bare bundled conductor can be arranged, as it will become clear from Figures 6A and 6B.

[0057] Figures 3A and 3B also illustrate that the preformed contact member 300 can comprise a recess 305 between the two preformed contact elements 301, 302. Furthermore, the preformed contact member 300 can comprise also two stems or arms 306, 307 arranged at each side of the contact elements 301, 302 and that, in turn, comprise clipping points 308, 309 for being attached to an outer surface of the standard IPC 100. The recess area 305 can be advantageous for reducing the surface of the preformed contact member 300 contacting a bare bundled conductor 512, for instance as illustrated in Figures 6A and 6B. As a consequence of reducing the contact surface to the bare conductor 512, the recess area 305 improves the pressure transmitted by the piercing teeth 105a, 105b and/or 108a, 108b to the underlying contact elements 301, 302, and in turn the underlying bare bundled conductor 512. Thus, the electrical contact to the bare bundled conductor 512 is also improved. It has been found that this presents an advantage and a significant improvement compared to prior art dedicated transition connectors such as the bare-to-ABC transition connector 200.

[0058] Furthermore, according to preferred variants of an aspect of the invention, the preformed contact elements 301, 302 can, respectively, comprise first and second surfaces 301a, 301b and 302a, 302b. In turn, following advantageous variants, the first surfaces 301a, 302a, which are the surfaces that will be in direct contact with the piercing contact teeth 105a, 108a, 105b, 108b of the standard IPC 100, can be rounded and in particular convex in the direction facing the piercing contact teeth 105a, 108a, 105b, 108b when the preformed contact member 300 is mounted and attached to the IPC 100, for instance like in Figures 5, 6A and 6B.

[0059] Figure 3B illustrates yet another advantageous variant, according to which the first surfaces 301a, 302a can also comprise longitudinal grooves 310, 311 for receiving the piercing contact teeth 105a, 108a, 105b, 108b. The longitudinal direction of the grooves 310, 311 is, as can be also seen in combination with Figures 5, 6A and 6B, defined like in Figures 1A and 1B and corresponds thus to the longitudinal direction of the IPC 100, which is also the longitudinal dimension of the cables 109, 112 in Figures 1A and 1B, of the cables 509, 512 in Figures 6A and 6B, and finally simply the longitudinal dimension of the preformed contact member itself 300.

[0060] Following another advantageous variant, the second surfaces 301b, 302b, which are the surfaces that will be

in direct contact with the bare bundled conductor, for instance the bare bundled conductor 512 like illustrated in Figures 6A and 6B, can also be rounded but this time concave in the direction facing the bare bundled conductor 512. Thus, further to protecting and electrically contacting the bare bundled conductor 512, the preformed contact member 300 can also be a positioning means for positioning the bare bundled conductor 512 with respect to the clamping half 101 or 102 to which the preformed contact member 300 is attached, in particular clipped.

[0061] Figure 3A illustrates a further advantageous variant, according to which the second surfaces 301 b, 302b can also comprise longitudinal stripes 303, 304 that, in yet another advantageous variant could be preformed in one step as the counterpart of the grooves 310, 311 of the first surfaces 301 a, 302a. The longitudinal stripes 303, 304 will be the parts of the preformed contact member 300 that will first contact the bare bundled conductor 512 in the embodiment illustrated in Figures 6A and 6B and can therefore be advantageous in order to break any surface oxide, for instance aluminum oxide, that may have formed on the bundled conductors 514 forming the bare bundled conductor or cable 512.

[0062] Figures 4A and 4B illustrate a second embodiment of an inventive preformed contact member 400 comprising all the features described in the first embodiment with reference to Figures 3A and 3B. Thus, the preformed contact member 400 can also be used with a standard IPC 100 like the one described with reference to Figures 1A and 1B in order to use the latter for a bare-to-ABC transition connection.

[0063] Thus, as can be seen in Figures 4A and 4B, the preformed contact member 400 also comprises first and second preformed contact elements 401, 402, which can in turn also comprise first and second preformed surfaces 401 a, 401 b and 402a, 402b, wherein the first surfaces 401a, 402a can be convex and comprise longitudinal grooves 410, 411, while the second surfaces 401 b, 402b can be concave and comprise longitudinal stripes 403, 404 that can be the counterpart of the grooves 410, 411. Further illustrated in Figures 4A and 4B, the preformed contact member 400 of the second embodiment can also comprise a recess 405 like in the first embodiment, as well as stems or arms 406, 407 with means 408, 409 for attaching the preformed contact member 400 to a standard IPC 100. The only difference with the first embodiment is that the means 408, 409 for attaching the preformed contact member 400 are curved ends 408, 409 of the stems 406, 407 instead of the clipping points 308, 309 illustrated in Figures 3A and 3B.

[0064] Thus, in variants of preferred embodiments, it is possible to provide a preformed contact member 300, 400 that could be clipped or locked with different types of attachment means 308, 309 or 408, 409 that can be chosen depending on the upper and lower clamping halves of a standard IPC. For instance, both the clipping points 308, 309 of the preformed contact member 300 of the first embodiment and the curved ends 408, 409 of the stems 406, 407 of the preformed contact member 400 of the second embodiment could be used for attaching respectively any of the preformed contact members 300 or 400 to the first or the second clamping half 101, 102 of the standard IPC 100 illustrated in Figures 1A and 1B.

[0065] Finally, in the first and second embodiments illustrated in Figures 3A and 3B, and in Figures 4A and 4B, respectively, the preformed contact member 300, 400 can be preformed with a thickness, in particular of the stems 306, 307 or 406, 407, sufficient for preventing the piercing contact teeth 105a, 105b, 108a, 108b of a standard IPC 100 from piercing a bare bundled conductor 512, for instance like illustrated in Figures 6A and 6B.

[0066] It is also preferable that the preformed contact member 300, 400 are preformed with a width, for instance of the stems 306, 307 or 406, 407, that will prevent rotation once a preformed contact member 300, 400 is assembled to a standard IPC 100, like illustrated in Figures 5, 6A and 6B.

[0067] A further embodiment of an aspect of the invention is illustrated in Figure 5, representing a connector assembly 500 comprising the standard IPC 100 and at least one preformed contact member 300 similar to that of the first embodiment illustrated in Figures 3A and 3B. As detailed above, the standard IPC 100 is not known in the art for being used in bare-to-ABC transition connections, as it is known that the piercing teeth 104a, 105a, 107a, 108a, 104b, 105b, 107b, 108b of its piercing contact blades 103a, 106a, 103b, 106b would damage and eventually break a bare bundled conductor arranged therein.

[0068] However, by attaching, in particular clipping, an inventive preformed contact member 300 on the upper clamping half 101, for instance following the direction 501 illustrated in Figure 5, and another inventive preformed contact member 300 on the lower clamping half 102, for instance following the direction 502 illustrated in Figure 5, it will be possible to use a standard IPC 100 also in the particular case of a bare-to-ABC transition connection.

[0069] Figures 6A and 6B illustrate, in the same embodiment as Figure 5, the connector assembly 500 also comprising an insulated ABC 509 and a bare bundled conductor 512 that are both essentially similar to the insulated ABCs 109, 112 or 209, and to the bare bundled conductor 212 detailed previously with reference to Figures 1A and 1B, as well as with reference to Figures 2A and 2B. Thus, the insulated ABC 509 comprises an outer insulation layer 510 surround a bundle of conductors 511, while the bare bundled conductor 512 only comprises a plurality of substantially coiled conductors 514 without any insulation layer or sheath. Figure 6A illustrates the connector assembly 500 whole, while Figure 6B illustrates it in a cross-section view essentially corresponding to the cross-section view illustrated in Figure 1A. Details of the standard IPC 100 will thus not be repeated and it is referred back to the description above.

[0070] Figure 5 illustrates that one preformed contact member 300 can be attached, in particular clipped, to the upper clamping half 101 such that the first surfaces 301 a and 302a will be in direct contact with the extremity of the upper

electrically conductive contact blades 103a and 103b, in particular in direct contact respectively with the piercing contact teeth 105a and 105b. More in particular, Figures 6A and 6B illustrate that, as a result of the assembly, the piercing contact teeth 105a will be in contact with the longitudinal grooves 310 of the first contact element 301, while the piercing contact teeth 105b will be in contact with the longitudinal grooves 311 of the second contact element 302 of the preformed contact member 300.

[0071] Similarly, Figures 5, 6A and 6B illustrate that a second preformed contact member 300 can be attached, in particular clipped, to the lower clamping half 102 such that, in the same way as for the contact member 300 attached to the upper clamping half 101, the first surfaces 301 a and 302a will be in direct contact with the extremity of the lower electrically conductive contact blades 106a and 106b, in particular in direct contact respectively with the piercing contact teeth 108a and 108b. More in particular, the piercing contact teeth 108a will be in contact with the longitudinal grooves 310 of the first contact element 301, while the piercing contact teeth 105b will be in contact with the longitudinal grooves 311 of the second contact element 302 of the preformed contact member 300.

[0072] Thus, the invention now allows that, as illustrated in Figures 6A and 6B, the IPC 100 connects the insulated ABC 509 to the bare bundled conductor 512 with all the advantages described above. In particular, it is also possible to take advantage of the recess area 305 to reduce the area of the preformed contact members 300 in direct contact with the bare bundled conductor 512, so that the pressure for clamping the latter is transmitted by the teeth 105a, 105b, 108a, 108b directly to the underlying grooves 310, 311 and in turn to the protruding stripes 303, 304 for breaking any surface oxide layer that may have formed on the bare bundled conductor 512 and thereby improve the electrical contact of the assembly 500 in comparison to the prior art dedicated bare-to-ABC transition connector 200.

[0073] Figures 6A and 6B also illustrates the advantageous geometries of the first and second surfaces 301 a, 302a and 301 b, 302b. For instance, the concave geometry of the second surfaces 301 b, 302b can improve the positioning of the bare bundled conductor 512 being clamped compared to the prior art dedicated transition connector 200. This effect is also possible due to the convex geometry of the first surfaces 301 a, 302a which also improves the transmission of pressure applied by the piercing contact teeth 105a, 105b and 108a, 108b to the bare bundled conductor 512 protected in particular by the first and second preformed elements 301, 302.

[0074] Thus, the invention has the advantage that it enables using standardized insulation-piercing connectors, for instance such as the IPC 100 illustrated in Figures 1A and 1B, also for bare-to-ABC transition connections. This use is new to the applicant, as it is known in the art that IPCs are not used for transition connections given that their piercing teeth will damage bare cables. This presents an advantage compared to existing dedicated expensive bare-to-ABC transition connectors, for instance the connector 200 illustrated in Figures 2A and 2B, as they can now be replaced by standardized IPCs that are already mass-produced in existing manufacturing lines.

[0075] In summary, the invention allows customization of existing standardized mass-produced IPCs without having to require any longer to higher costing dedicated bare-to-ABC transition connectors known in the art. Thanks to the inventive preformed contact members, existing standard IPCs or IPC-type connectors could be used for connecting an insulated ABC to a bare bundled conductor without damaging the latter.

[0076] Since methods for manufacturing preformed metal plates are known in the art, it will be simple to adapt existing standardized IPC manufacturing lines to add, whenever necessary, one or more inventive preformed contact members at the end of the manufacturing line. This will also present an economical advantage compared to manufacturing on-demand a whole dedicated bare-to-ABC transition connector such as the connector 200 illustrated in Figures 2A and 2B.

[0077] Furthermore, since the assembly can be done at the end of the manufacturing line, for the person installing an inventive connector assembly comprising an IPC and one or more preformed contact members, there won't be any additional installation steps compared to the current installation of a standard IPC between two insulated lines. Compared to existing solutions using dedicated bare-to-ABC transition connectors with one or even with two tightening bolts, the invention presents a further advantage in that, used in combination with a standard IPC that comprises only one tightening means, the installation of the inventive connector assembly on suspended lines will still required to tighten only one screw and bolt system while improving the transmission of current between the main and tap lines. Indeed, the invention allows a better transmission of the pressure applied by only one centered tightening means to the bare bundled conductor than that of existing dedicated transition connectors comprising long contact plates and one or even two tightening means, and thus the invention also improves the transmission of current between main and tap suspended lines while keeping the installation simple.

[0078] The invention further presents the advantage that it can be compatible with existing national, regional or international specifications regarding electrical contact and tensile strength of suspended low or intermediate voltage electrical lines, in particular because it can use already standardized IPCs.

LIST OF REFERENCE SIGNS

[0079]

	100	standard IPC (prior art)
	101	first or upper clamping member
	102	second or lower clamping member
	103a	first upper electrically conductive blade
5	103b	second upper electrically conductive blade
	104a	piercing contact teeth
	104b	piercing contact teeth
	105a	piercing contact teeth
	105b	piercing contact teeth
10	106a	first lower electrically conductive blade
	106b	second lower electrically conductive blade
	107a	piercing contact teeth
	107b	piercing contact teeth
	108a	piercing contact teeth
15	108b	piercing contact teeth
	109	first insulated ABC
	110	insulating layer
	111	bundled conductors
	112	second insulated ABC
20	113	insulating layer
	114	bundled conductors
	115	tightening screw
	116a	inner sealing member
	116b	inner sealing member
25	117	shear head bolt
	118	shear head
	119	spacer or seal
	200	dedicated bare-to-ABC transition connector (prior art)
	201	first or upper clamping member
30	202	second or lower clamping member
	203a	first upper electrically conductive blade
	203b	second upper electrically conductive blade
	204a	piercing contact teeth
	204b	piercing contact teeth
35	205	contact plate
	206a	first lower electrically conductive blade
	206b	second lower electrically conductive blade
	207a	piercing contact teeth
	207b	piercing contact teeth
40	208	contact plate
	209	insulated ABC
	210	insulating layer
	211	bundled conductors
	212	bare bundled conductor
45	214	bundled conductors
	215a	first tightening screw
	215b	second tightening screw
	216a	inner sealing member
	216b	inner sealing member
50	217a	first shear head bolt
	217b	second shear head bolt
	218a	first shear head
	218b	second shear head
	219a	first spacer or seal
55	219b	second spacer or seal
	300	preformed contact member
	301	first preformed contact element
	301a	first surface

	301b	second surface
	302	second preformed contact element
	302a	first surface
	302b	second surface
5	303	longitudinal stripes
	304	longitudinal stripes
	305	recess area
	306	arm or stem
	307	arm or stem
10	308	clipping point
	309	clipping point
	310	longitudinal grooves
	311	longitudinal grooves
	400	preformed contact member
15	401	preformed contact member
	402	first preformed contact element
	401a	first surface
	401b	second surface
	402	second preformed contact element
20	402a	first surface
	402b	second surface
	403	longitudinal stripes
	404	longitudinal stripes
	405	recess area
25	406	arm or stem
	407	arm or stem
	408	clipping stem
	409	clipping stem
	500	connector assembly
30	501	mounting direction for upper preformed contact member
	502	mounting direction for lower preformed contact member
	509	insulated ABC
	510	insulating layer
	511	bundled conductors
35	512	bare bundled conductor
	514	bundled conductors

Claims

- 40
1. Preformed contact member (300, 400) for use with an insulation-piercing connector (100), wherein said insulation-piercing connector (100) comprises one or more electrically conductive insulation-piercing means (105a, 108a, 105b, 108b) for piercing an insulation layer (110, 113) of at least one insulated electrical conductor (109, 112) arranged therein,
45 wherein the preformed contact member (300, 400) is electrically conductive and is configured for being provided on said one or more electrically conductive insulation-piercing means (105a, 108a, 105b, 108b), in particular between said one or more electrically conductive insulation-piercing means (105a, 108a, 105b, 108b) and a bare electrical conductor (512) arranged in the insulation-piercing connector (100).
 2. Preformed contact member (300, 400) according to claim 1, comprising attaching means (308, 309) for attaching,
50 in particular by clipping, said preformed contact member (300, 400) to said insulation-piercing connector (100).
 3. Preformed contact member (300, 400) according to any of claims 1 or 2, further comprising one or more electrically
55 conductive contact elements (301, 302), in particular for providing electrical contact between a respective electrically conductive insulation-piercing means (105a, 108a, 105b, 108b) of the one or more electrically conductive insulation-piercing means (105a, 108a, 105b, 108b) and a bare electrical conductor (512) while preventing direct contact therebetween.

4. Preformed contact member (300, 400) according to claim 3, wherein the one or more electrically conductive preformed contact element (301, 302) comprise first and second opposite surfaces (301 a, 301 b; 302a, 302b), wherein the first surface (301 a, 302a) is configured for contacting said electrically conductive insulation-piercing means (105a, 108a, 105b, 108b), and the second surface (301 b, 302b) is a positioning surface configured for contacting a bare electrical conductor (512) and positioning it in the insulation-piercing connector (100).
5. Preformed contact member (300, 400) according to claim 4, wherein the first surface (301 a, 302a) is convex, in particular in a direction towards said electrically conductive insulation-piercing means (105a, 108a, 105b, 108b) when the preformed contact member (300, 400) is attached to the insulation-piercing connector (100).
6. Preformed contact member (300, 400) according to any of claims 4 or 5, wherein the second surface (301 b, 302b) is concave, in particular in a direction towards said bare electrical conductor (512) when the preformed contact member (300, 400) is attached to the insulation-piercing connector (100).
7. Preformed contact member (300, 400) according to any of claims 4 to 6, wherein the first surface (301 a, 302a) comprises a plurality of longitudinal grooves (310, 311).
8. Preformed contact member (300, 400) according to any of claims 4 to 7, wherein the second surface (301 b, 302b) comprises a plurality of protruding longitudinal stripes (303, 304).
9. Preformed contact member (300, 400) according to claims 7 and 8, wherein the longitudinal stripes (303, 304) on the second surface (301 b, 302b) are preformed protrusions corresponding to the grooves (310, 311) on the first surface (301 a, 302a).
10. Preformed contact member (300, 400) according to any of claims 3 to 9, wherein, when the preformed contact member (300, 400) comprises more than one electrically conductive contact elements (301, 302), the preformed contact member (300, 400) further comprises a recess area (305) between two successive electrically conductive contact elements (301, 302) in a direction facing away from the bare electrical conductor (512) when the preformed contact member (300, 400) is attached to the insulation-piercing connector (100).
11. Preformed contact member (300, 400) according to any of claims 1 to 10, wherein the preformed contact member (300, 400) is made of or comprises a metal or a metal alloy, in particular aluminum, copper, brass, tinned copper or the like.
12. Connector assembly (500), in particular for suspended low or intermediate voltage electrical lines, for electrically connecting an insulated conductor (509) to a bare conductor (512), the connector assembly (500) comprising:

an insulation-piercing connector (100) for electrically connecting first and second insulated electrical conductors (109, 112) to one another, the insulation-piercing connector (100) comprising one or more electrically conductive insulation-piercing means (103a, 106a, 103b, 106b) with first and second piercing extremities (104a, 107a, 104b, 107b; 107a, 108a, 107b, 108b), wherein the first piercing extremity (104a, 107a, 104b, 107b) is configured for piercing an insulation layer (110) of the first insulated electrical conductor (109), and the second piercing extremity (107a, 108a, 107b, 108b) is configured for piercing an insulation layer (113) of the second insulated electrical conductor (112);

characterized in that

the connector assembly (500) further comprises:

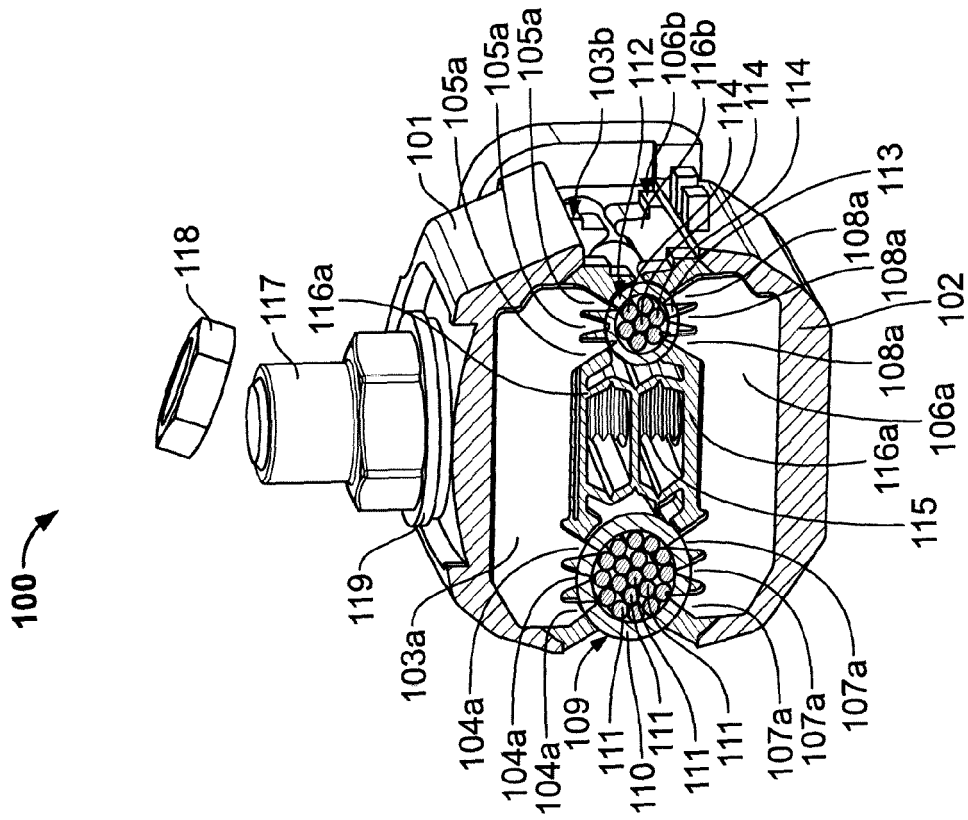
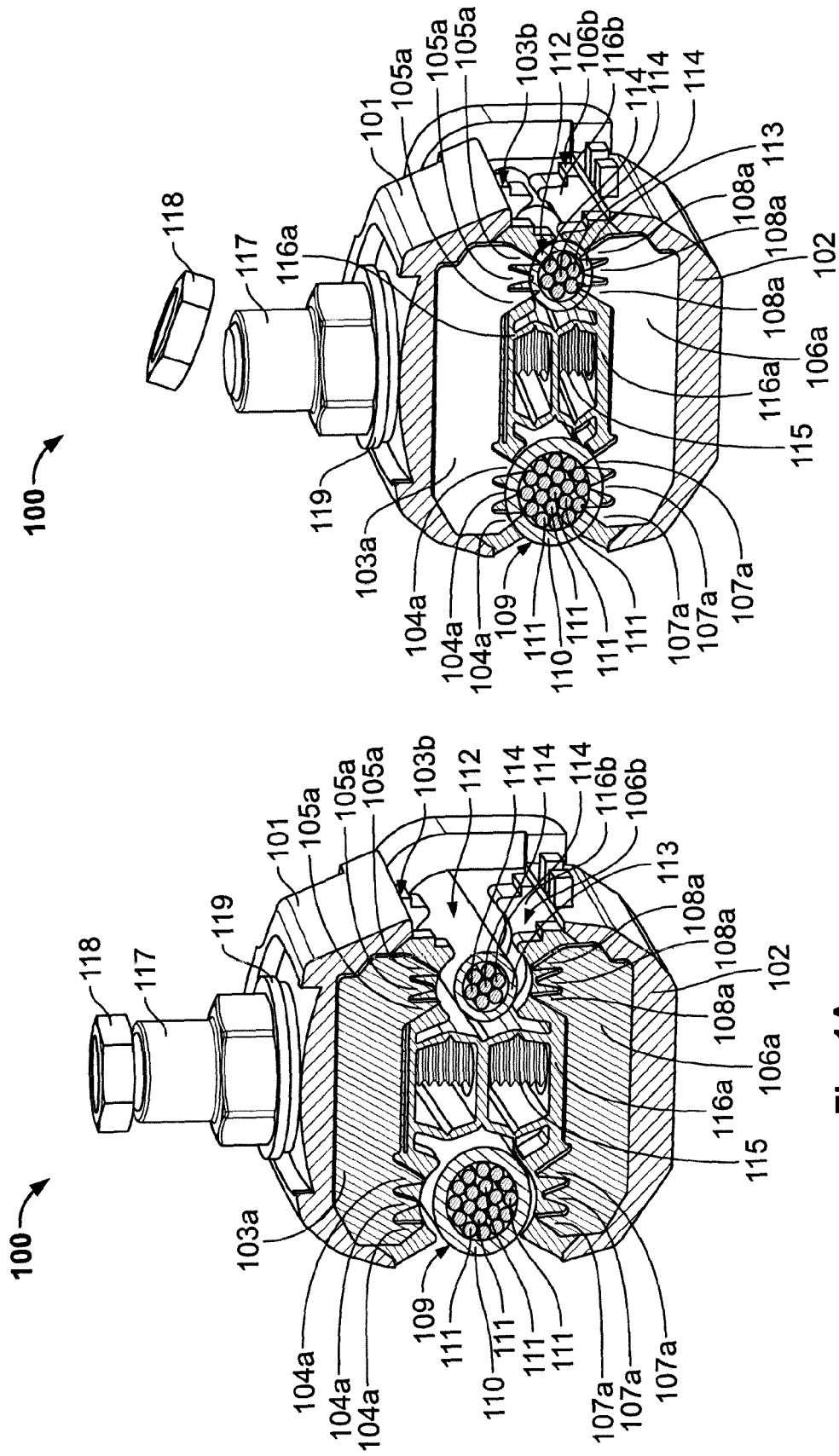
at least one preformed contact member (300, 400) according to any of claims 1 to 11, wherein said at least one preformed contact member (300, 400) is provided on the first (104a, 107a, 104b, 107b) or the second (107a, 108a, 107b, 108b) piercing extremity of the one or more electrically conductive insulation-piercing means (103a, 106a, 103b, 106b).
13. Connector assembly (500) according to claim 12, further comprising an insulated conductor (509) and a bare conductor (512) arranged in the insulation-piercing connector (100), wherein the bare conductor (512) is arranged on a side of the insulation-piercing connector (100) provided with said at least one preformed contact member (300, 400).
14. Connector assembly (500) according to any of claims 12 or 13, in combination with at least one preformed contact member (300, 400) according to claim 7, wherein the longitudinal grooves (310, 311) are provided on the first (104a,

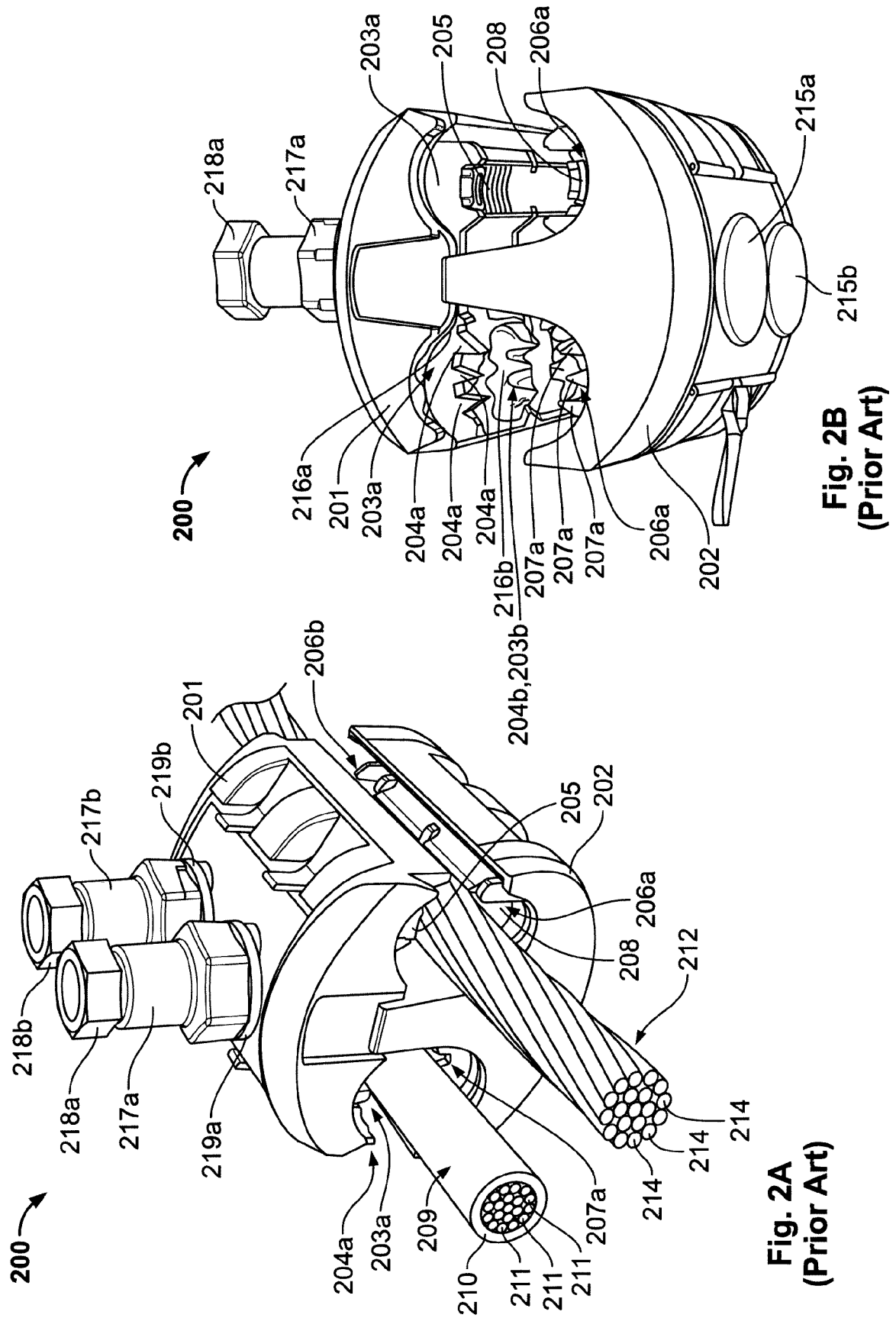
107a, 104b, 107b) or second (107a, 108a, 107b, 108b) piercing extremity.

15. Use of an insulation-piercing connector (100) for electrically connecting an insulated conductor (509) and a bare conductor (512) to one another, in particular on a suspended low or intermediate voltage electrical line, wherein:

the insulation-piercing connector (100) is for electrically connecting first and second insulated electrical conductors (109, 112) to one another and comprises one or more electrically conductive insulation-piercing means (103a, 106a, 103b, 106b) with first and second piercing extremities (104a, 107a, 104b, 107b; 107a, 108a, 107b, 108b),

wherein the first piercing extremity (104a, 107a, 104b, 107b) is configured for piercing an insulation layer (110) of the first insulated electrical conductor (109), and the second piercing extremity (107a, 108a, 107b, 108b) is configured for piercing an insulation layer (113) of the second insulated electrical conductor (112); and wherein at least one preformed contact member (300, 400) according to any of claims 1 to 11 is attached to the insulation-piercing connector (100).





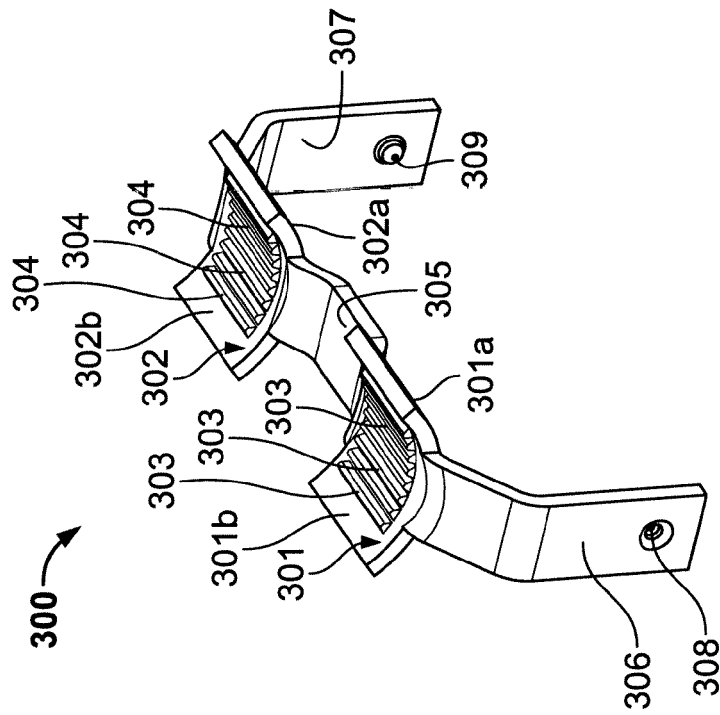


Fig. 3A

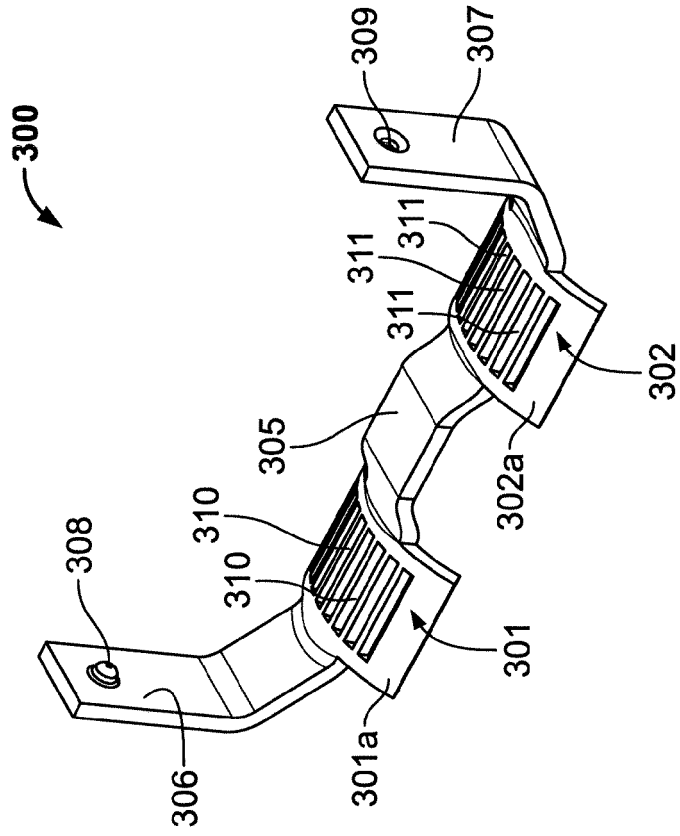


Fig. 3B

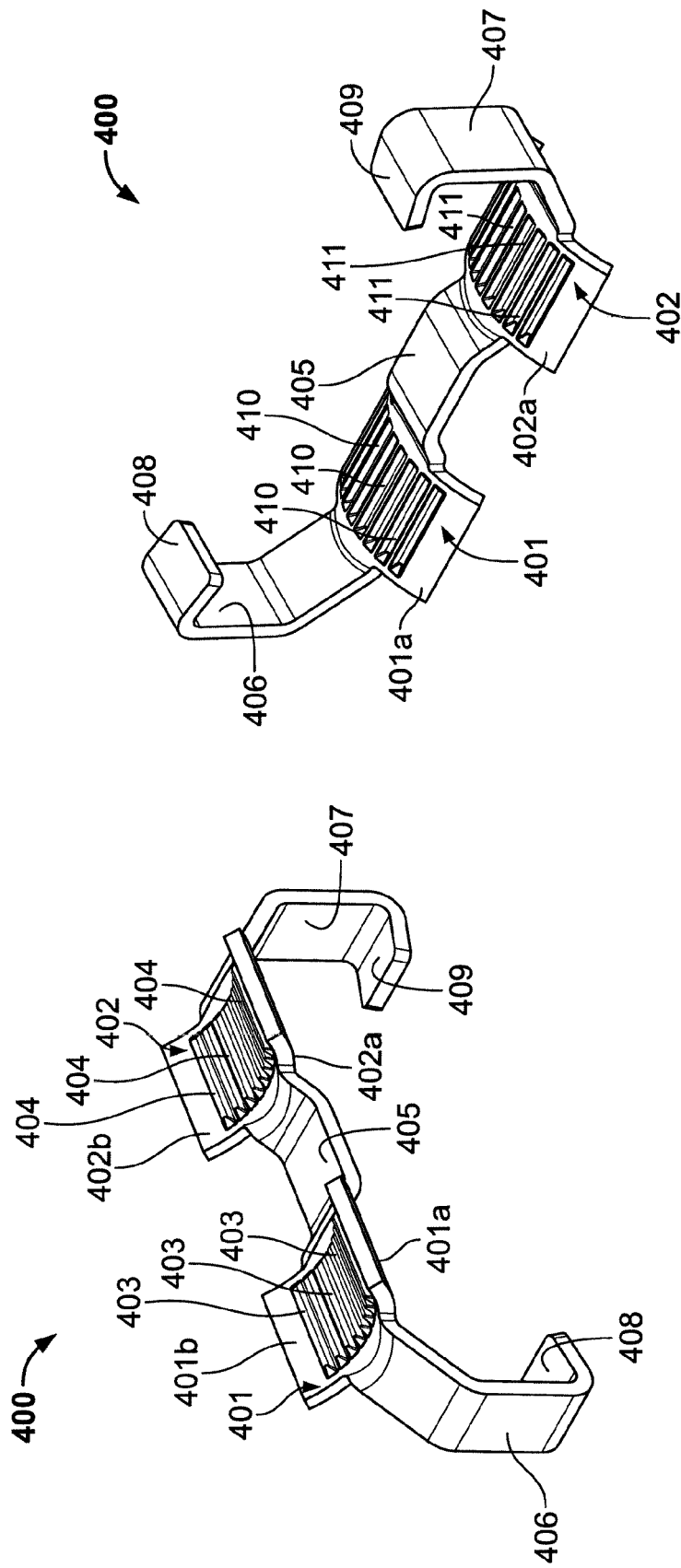


Fig. 4B

Fig. 4A

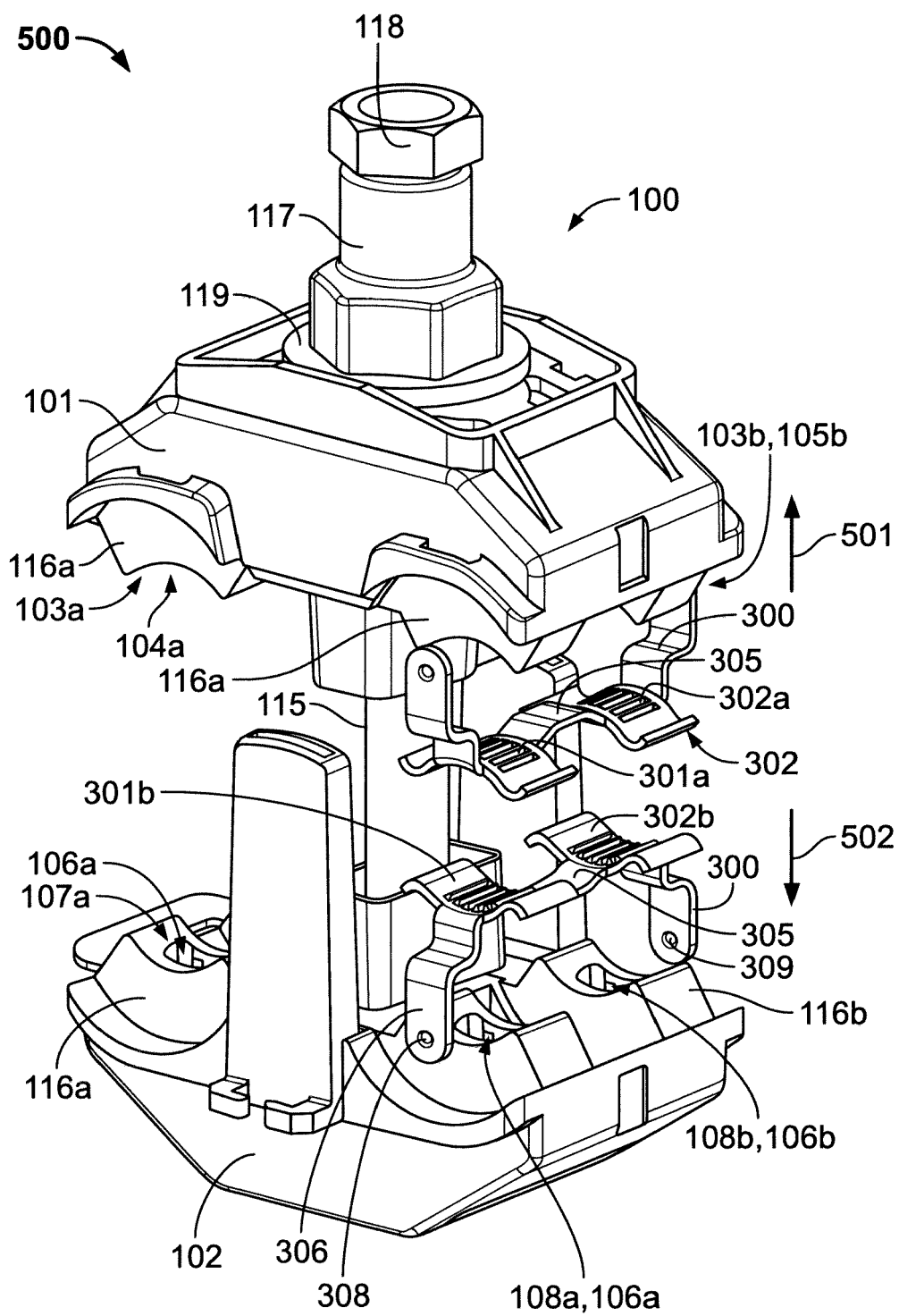


Fig. 5

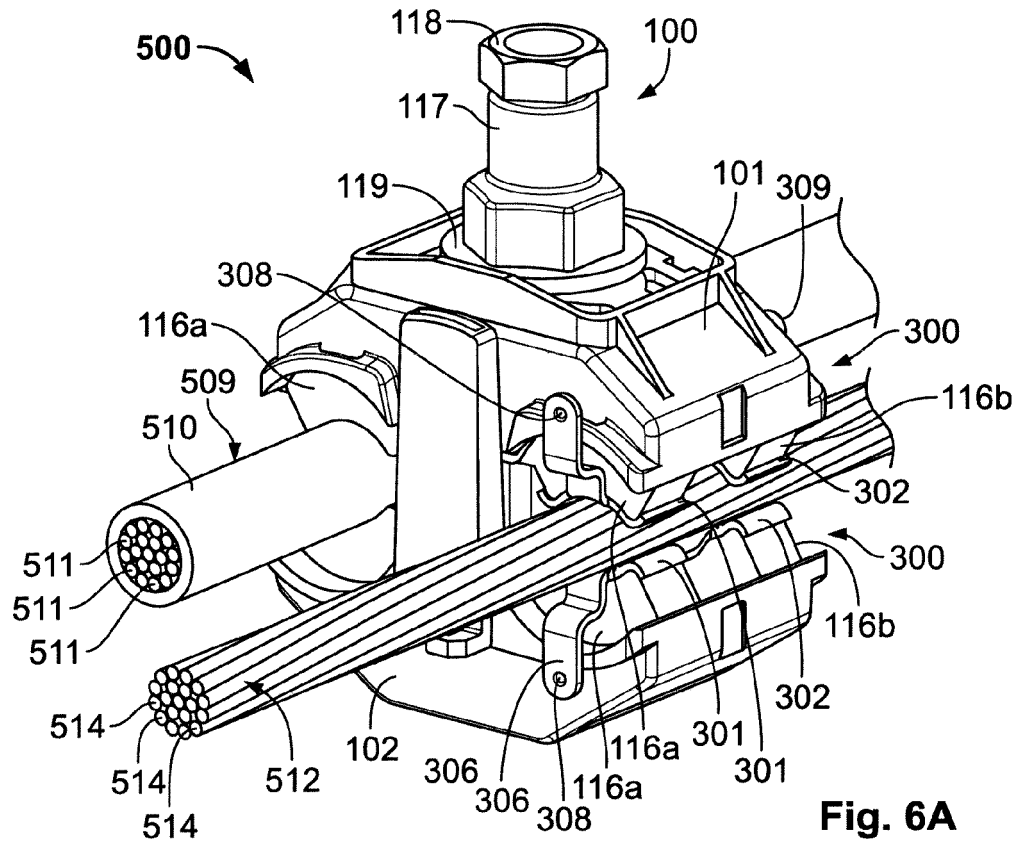


Fig. 6A

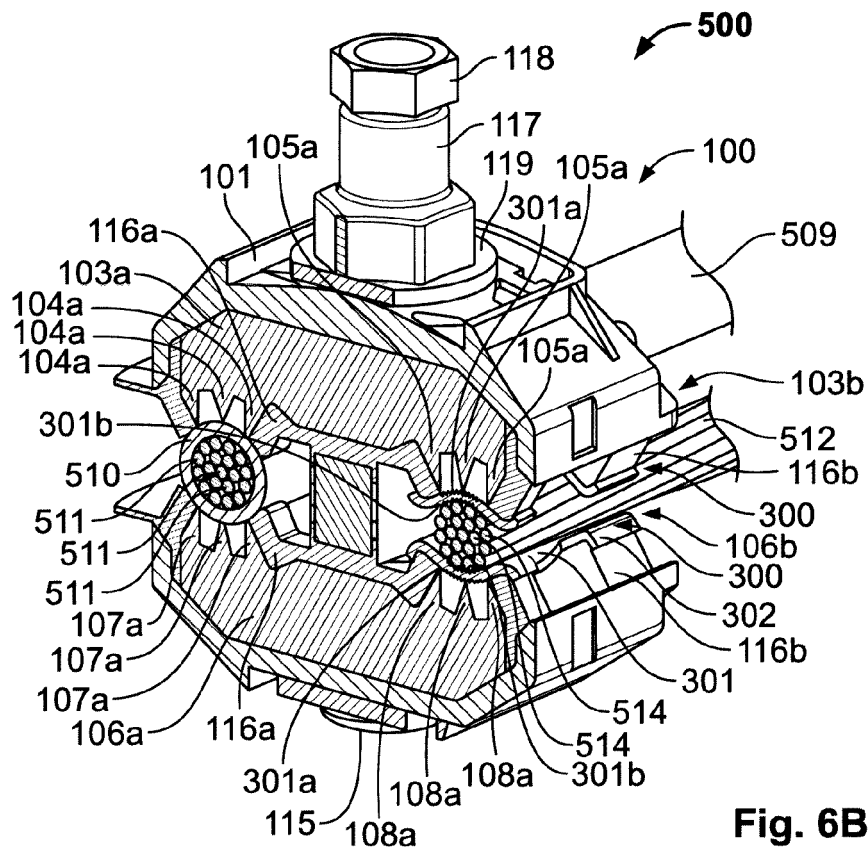


Fig. 6B



EUROPEAN SEARCH REPORT

Application Number
EP 13 29 0276

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 0 599 346 A2 (ARCUS ELEKTROTECH [DE]) 1 June 1994 (1994-06-01)	1,3-5, 11-13,15	INV. H01R9/03 H01R4/44 H01R4/24
Y	* page 5, line 1 - line 2; figures 1,5b * * page 4, lines 57-58 - page 5, lines 1-4 *	2	
X	----- AU 2009 202 376 A1 (CABLE ACCESSORIES AUSTRALIA PT CABLE ACCESSORIES AUSTRALIA PTY LTD) 2 July 2009 (2009-07-02) * figure 2 *	1	
X	----- FR 2 503 807 A1 (VERLANT ET BEAURAIN [FR]) 15 October 1982 (1982-10-15) * figure 5 *	1	
Y	----- FR 2 762 449 A1 (APP MAT ELECT CONST [FR]) 23 October 1998 (1998-10-23) * claim 3; figure 5 *	2	
			TECHNICAL FIELDS SEARCHED (IPC)
			H01R
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 11 March 2014	Examiner Vautrin, Florent
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 13 29 0276

5

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

11-03-2014

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0599346 A2	01-06-1994	DE 4240001 A1 EP 0599346 A2	01-06-1994 01-06-1994
-----	-----	-----	-----
AU 2009202376 A1	02-07-2009	AU 2007201069 A1 AU 2009202376 A1	04-10-2007 02-07-2009
-----	-----	-----	-----
FR 2503807 A1	15-10-1982	NONE	
-----	-----	-----	-----
FR 2762449 A1	23-10-1998	NONE	
-----	-----	-----	-----

15

20

25

30

35

40

45

50

55

EPO FORM P0459

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