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(54) **A POLE CONTACT ARM FOR AN ELECTRIC POLE UNIT**

(57) A pole contact arm (10A, 10B) for an electric pole unit (1), said pole contact arm being intended to be fixed to a main body (1A) of said electric pole unit and comprising:

- a conductor element (11) having a first contact arm terminal (111) and a second contact arm terminal (112), said first contact arm terminal coupling with a corresponding pole terminal (3, 4) of said main body (1A), when said pole contact arm is fixed to said main body, said second contact arm terminal being intended to couple to a corresponding line conductor of an electric line;
- an insulating bushing (12) enclosing said conductor el-

ement (11) and comprising a first contact arm port (121) and a first bushing portion (123) defining said first contact arm port, said first bushing portion coupling with a corresponding housing portion (53, 54) and a corresponding pole terminal (3, 4) of said main body (1A), when said pole contact arm is fixed to said main body.

Said first bushing portion (123) is made of a soft electrically insulating material and it is subject to a deformation at one or more coupling surfaces (123A, 123B) when coupling with said corresponding housing portion (53, 54) and said corresponding pole terminal (3, 4).

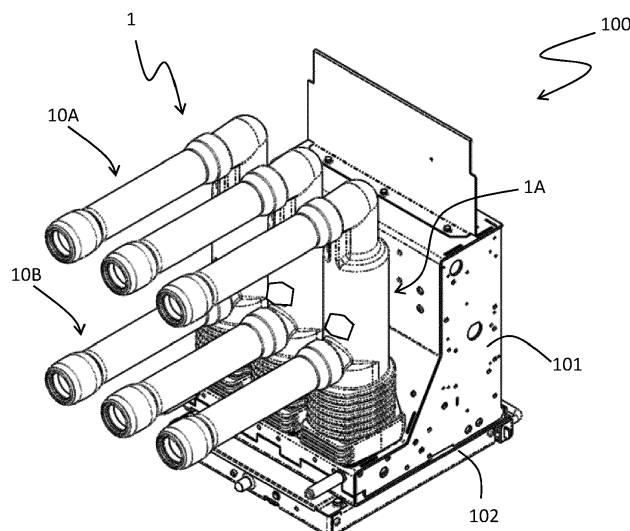


FIG. 1

Description

[0001] The present invention relates to the field of switching apparatuses for electric power distribution grids, such as circuit breakers, contactors, disconnectors and the like.

[0002] More particularly, the present invention relates to a pole contact arm for an electric pole unit adapted to be arranged in a switching apparatus, particularly in a medium voltage switching apparatus.

[0003] For the purposes of the present application, the term "medium voltage" (MV) is referred to apparatuses operating at voltages higher than 1 kV AC and 1.5 kV DC up to some tens of kV, e.g. up to 72 kV AC and 100 kV DC.

[0004] As is known, a switching apparatus comprises one or more electric pole units.

[0005] Generally, an electric pole unit comprises a main body including a current breaking unit, pole terminals electrically connected to said current breaking unit and intended to be electrically connected to line conductors and an insulating housing enclosing said current breaking unit and said pole terminals.

[0006] In many applications, particularly of the MV type, an electric pole unit comprises also pole contact arms fixed to its main body.

[0007] Each pole contact arm is adapted to electrically connect a pole terminal with a corresponding line conductor. To this aim, a pole contact arm has a conductor element electrically and mechanically connected with a corresponding pole terminal and an insulating bushing enclosing said conductor element and mechanically coupled with a corresponding housing portion of the main body of the electric pole unit.

[0008] In most cases, there are no special arrangements to ensure a dielectric sealing of the mechanical junction between the insulating bushing of each pole contact arm and the corresponding housing portion of the main body of the electric pole unit.

[0009] In fact, dielectric distances between the electric pole units of the switching apparatus are normally designed in such a way to prevent electric discharges between live parts, e.g. between the pole terminals of two adjacent pole units or between the pole terminals of a same electric pole unit or between an external conductor and a pole terminal.

[0010] However, when the overall size of the switching apparatus needs to be compacted for some reasons, e.g. due to the presence of relatively small installation spaces, electric discharges may occur, if no remedies are taken to ensure a suitable electric insulation of the conductive parts with respect to the external environment. As is known, these discharging phenomena may cause relevant structural and functional damages and they may be very dangerous for operators.

[0011] A first solution to deal with this technical issue may consist in arranging one or more gasket elements at the mechanical junction between the insulating bushing of the pole contact arm and the corresponding hous-

ing portion of the main body of the electric pole unit in such a way to seal such a mechanical junction from a dielectric point of view.

[0012] This approach necessarily entails the design of special arrangements to hold the above gasket elements in a suitable position. In addition, the manufacturing process of the electric pole unit becomes more complicated since the above-mentioned gasket elements need to be carefully positioned in order to ensure a suitable electric insulation of the conductive parts.

[0013] Another solution to mitigate the above-mentioned technical problems may consist in covering (e.g. through a spraying or sputtering process) the coupling surfaces of the different insulating parts to be joined with a silicone material (e.g. a silicone foam) when said insulating parts are mechanically coupled.

[0014] Although being rather effective in electrically insulating the conductive parts, this approach entails some drawbacks.

[0015] First of all, the pole contact arms cannot be removed from the electric pole unit once they are assembled to the main housing of the electric pole unit. This circumstance may severely complicate possible maintenance interventions on the switching apparatus.

[0016] In addition, the manufacturing process of the electric pole unit becomes remarkably time consuming since it is necessary to wait for a relatively long time (e.g. 12-24 h) to obtain a suitable polymerization of the deposited silicone material.

[0017] In the state of the art, it is quite felt the need for innovative technical solutions capable of providing a suitable electric insulation in electric pole units for switching apparatuses, in particular for MV switching apparatuses, which are provided with pole contact arms.

[0018] In order to respond to this need, the present invention provides a pole contact arm for an electric pole unit, according to the following claim 1 and the related dependent claims.

[0019] In general terms, the pole contact arm, according to the invention, is intended to be fixed to a main body of said electric pole unit.

[0020] In a broad definition, the pole contact arm, according to the invention comprises:

- a conductor element having a first contact arm terminal and a second contact arm terminal. Said first contact arm terminal is intended to couple with a corresponding pole terminal of the main body of the electric pole unit, when said pole contact arm is fixed to said main body. Said second contact arm terminal is intended to be coupled to a corresponding line conductor of an electric line during the operation of said electric pole unit.
- an insulating bushing enclosing said conductor element and comprising a first contact arm port and a first bushing portion defining said first contact arm port. Said first bushing portion is intended to couple with a corresponding housing portion and a corre-

sponding pole terminal of the main body of the electric pole unit, when said pole contact arm is fixed to said main body.

[0021] According to the invention, said first bushing portion is made of a soft insulating material, preferably an elastically deformable material.

[0022] Conveniently, said first bushing portion is subject to a deformation (preferably in an elastic manner) at one or more coupling surfaces when it couples with the corresponding housing portion and the corresponding pole terminal of the main body of the electric pole unit.

[0023] The (preferably elastic) deformation of said first bushing portion makes a mechanical junction, which is formed by said first bushing portion and said corresponding housing portion, dielectrically sealed, i.e. without air gaps or air paths between the outer environment and the conductive parts at said mechanical junction.

[0024] In this way, the conductor element of said pole contact arm and the corresponding pole terminal of the main body of said electric pole unit are electrically insulated from the outer environment.

[0025] Preferably, the above-mentioned elastically deformable material is an elastomeric material, e.g. a silicone rubber.

[0026] Preferably, said first contact arm terminal comprises first contact arm coupling surfaces intended to couple with corresponding pole coupling surfaces of a pole terminal of said main body, when said pole contact arm is fixed to said main body.

[0027] Preferably, said first bushing portion comprises second contact arm coupling surfaces intended to couple with corresponding pole coupling surfaces of a housing portion of the main body of said electric pole unit, when said pole contact arm is fixed to said main body. Preferably, said first bushing portion comprises third contact arm coupling surfaces intended to couple with corresponding pole coupling surfaces of a pole terminal of the main body of said electric pole unit, when said pole contact arm is fixed to said main body.

[0028] Preferably, said insulating bushing is fully made of the above-mentioned elastically deformable material.

[0029] Preferably, said conductor element and said insulating bushing form a monolithic structure. Preferably, said conductor element and said insulating bushing are co-molded to form said monolithic structure.

[0030] Another aspect of the invention relates to an electric pole unit for a switching apparatus, preferably a medium voltage switching apparatus.

[0031] The electric pole unit, according to the invention, comprises:

- a main body including:
 - a current breaking unit positioned in the internal volume of said electric pole unit;
 - first and second pole terminals electrically connected to said current breaking unit;

- an insulating housing enclosing said breaking unit and said first and second pole terminals. Said insulating housing comprises first and second housing ports at said first and second pole terminals, respectively, and first and second housing portions defining said first and second housing ports, respectively;
- a first pole contact arm fixed to said main body for electrically connecting said first pole terminal with a corresponding first line conductor;
- a second pole contact arm fixed to said main body for electrically connecting said second pole terminal with a corresponding second line conductor.

[0032] At least one of said first and second pole contact arms is a pole contact arm, according to the invention.

[0033] Another aspect of the invention relates to a switching apparatus, preferably a medium voltage switching apparatus, comprising an electric pole unit, according to the invention.

[0034] Another aspect of the invention relates to a switching apparatus, preferably a medium voltage switching apparatus, comprising one or more pole contact arms, according to the invention, which are included in one or more electric pole units of said switching apparatus.

[0035] Additional features and advantages of the invention will emerge from the description of preferred, but not exclusive, embodiments, non-limiting examples of which are provided in the attached drawings, wherein:

- Figure 1 schematically shows a medium voltage switching apparatus incorporating a plurality of pole contact arms, according to the invention;
- Figures 2-3 schematically show an electric pole unit for a medium voltage switching apparatus, which incorporates a plurality of pole contact arms, according to the invention;
- Figures 4-5 schematically show a pole contact arm, according to the invention;
- Figure 6-9 schematically show additional parts of an electric pole unit incorporating a pair of pole contact arms, according to the invention.

[0036] Referring to the cited figures, the present invention relates to a pole contact arm 10A, 10B for an electric pole unit 1 of a medium voltage (MV) switching apparatus 100.

[0037] Figure 1 shows a MV switching apparatus 100 incorporating a plurality of pole contact arms 10A, 10B according to the invention.

[0038] The MV switching apparatus 100 comprises a current breaking section including one or more pole units 1, an actuation section 101 including the actuation components (not shown) for moving the movable contacts of the electric pole units, and a base section 102 for mechanically supporting the electric pole units 1 and the

actuation section 101.

[0039] If the MV switching apparatus is of the withdrawable type, the base section 102 may be conveniently mounted on a movable carriage.

[0040] Taking as a reference a normal installation position of the switching apparatus, as shown in figure 1, the base section 102 extends parallel to a laying plane of the switching apparatus while the pole units 1 and the actuation section 101 extend perpendicularly with respect to aforesaid base section.

[0041] Preferably, the switching apparatus 1 comprises an electric pole unit 1 for each electric phase of the electric power distribution grid, in which it is intended to be installed.

[0042] Preferably, the switching apparatus 100 is of the multi-phase type, more particularly of the three-phase type. In this case, it comprises three pole units 1, as shown in figure 1.

[0043] Figures 2-3, 6-9 show an electric pole unit 1 of a MV switching apparatus 100.

[0044] The electric pole unit 1 comprises a main body 1A adapted to be fixed (in a known manner) to the base section 102 of the switching apparatus.

[0045] The main body 1A of the electric pole unit 1 comprises a current breaking unit 2 arranged in an internal volume.

[0046] Preferably, the breaking unit 2 comprises a fixed contact assembly 23 including at least a fixed contact 21 (figures 3, 6-7) and movable contact assembly 24 including at least a movable contact 22 (figures 3, 8-9). The movable contact 22 is adapted to be coupled with or separated from the fixed contact 21, during a switching operation of the switching apparatus. The main body 1A of the electric pole unit 1 comprises first and second pole terminals 3 and 4, which are electrically connected (in a known manner) to the fixed contact assembly 23 and to the movable contact assembly 24 of the current breaking unit 2, respectively.

[0047] Preferably, the first pole terminal 3 is the end portion of a corresponding shaped conductive member (e.g. made of copper), which is electrically and mechanically coupled with the fixed contact assembly 23.

[0048] Preferably, the first pole terminal 3 has a cylindrical shape.

[0049] Preferably, the first pole terminal 3 comprises first pole coupling surfaces 3A and second pole coupling surfaces 3B intended to couple with a conductor and an insulating bushing of a corresponding pole contact arm, respectively, when such pole contact arm is fixed to the main body 1A of the electric pole unit (figures 6-7).

[0050] Preferably, the first pole terminal 3 comprises a first coupling cavity 30 (e.g. a threaded cavity) intended to receive suitable coupling means (e.g. a screw) for mechanically and electrically coupling said pole terminal with a conductor of a corresponding pole contact arm. Preferably, the second pole terminal 4 is the end portion of a corresponding shaped conductive member (e.g. made of copper), which is electrically and mechanically

coupled with the movable contact assembly 23.

[0051] Preferably, the second pole terminal 4 has a cylindrical shape.

[0052] Preferably, the second pole terminal 4 comprises third pole coupling surfaces 4A and fourth pole coupling surfaces 4B intended to couple with a conductor and an insulating bushing of a corresponding pole contact arm, respectively, when such pole contact arm is fixed to the main body 1A of the electric pole unit (figures 8-9).

[0053] Preferably, the second pole terminal 4 comprises a second coupling cavity 40 (e.g. a threaded cavity) intended to receive suitable coupling means (e.g. a screw) for electrically and mechanically coupling said pole terminal with a conductor of a corresponding pole contact arm.

[0054] The main body 1A of the electric pole unit 1 further comprises an insulating housing 5 that encloses the breaking unit 2 and the pole terminals 3 and 4.

[0055] Conveniently, the insulating housing 5 defines an internal volume, in which the above-mentioned internal components of the electric pole unit are accommodated.

[0056] Preferably, the insulating housing 5 is made of a relatively rigid insulating material, e.g. a thermoplastic material, such as polyamide or polycarbonate, or a thermosetting material, such as polyester or epoxy resins, and the like.

[0057] Preferably, the insulating housing 5 is formed by an elongated (e.g. cylindrical) hollow member of insulating material, which is fixed to the base section 102 of the switching apparatus.

[0058] The insulating housing 5 has a first housing port 51 at the first pole terminal 3. In this way, the first pole terminal 3 is accessible from outside.

[0059] Preferably, the first housing port 51 has a substantially circular geometry.

[0060] The main insulating housing 5 conveniently comprises a first housing portion 53 defining the first housing port 51.

[0061] Preferably, the first housing portion 53 is formed by a corresponding first shaped coupling edge of the insulating housing 5, which optionally has an ring shape and a tapered thickness with a rounded profile.

[0062] Preferably, the first housing portion 53 is coaxial with the first pole terminal 3 and it is arranged in such a way that this latter slightly protrudes from the first housing port 51.

[0063] Preferably, the first housing portion 53 comprises fifth pole coupling surfaces 53A (defining the above-mentioned first coupling edge) intended to couple with an insulating bushing of a corresponding pole contact arm, when such pole contact arm is fixed to the main body 1A of the electric pole unit (figures 6-7).

[0064] The main insulating housing 5 has a second housing port 52, at which the second pole terminal 4 is made accessible from outside.

[0065] Preferably, the second housing port 52 has a

substantially circular geometry.

[0066] The insulating housing 5 conveniently comprises a second housing portion 54 defining the second housing port 52.

[0067] Preferably, the second housing portion 54 is formed by a corresponding second shaped coupling edge of the insulating housing 5, which optionally has an ring shape and tapered thickness with a rounded profile.

[0068] Preferably, the second housing portion 54 is coaxial with the second pole terminal 4 and it is arranged in such a way that this latter slightly protrudes from the second housing port 52.

[0069] Preferably, the second housing portion 54 comprises sixth pole coupling surfaces 54A (defining the above-mentioned second coupling edge) intended to couple with an insulating bushing of a corresponding pole contact arm, when said pole contact arm is fixed to the main body 1A of the electric pole unit (figures 8-9).

[0070] The electric pole unit 1 comprises a first pole contact arm 10A, according to the invention, which is fixed to the main body 1A for electrically connecting the first pole terminal 3 with a corresponding first line conductor, and a second pole contact arm 10B, according to the invention, which is fixed to the main body 1A for electrically connecting the second pole terminal 4 with a corresponding second line conductor.

[0071] Figures 4-5, 6-7 show a pole contact arm 10A, 10B according to the invention, which is incorporated in an electric pole unit 1 of MV switching apparatus 100.

[0072] The pole contact arm 10A, 10B comprises a conductor element 11.

[0073] Preferably, the conductor element 11 is formed by an elongated conductive member (e.g. made of copper).

[0074] Preferably, the conductor element 11 has a tubular shape.

[0075] The conductor element 11 comprises first and second contact arm terminals 111, 112 that are preferably formed by the opposite ends of said conductive member.

[0076] The first contact arm terminal 111 of the conductor element 11 is adapted to electrically and mechanically couple with a corresponding pole terminal 3, 4 of the main body 1A of the electric pole unit 1.

[0077] Preferably, the first contact arm terminal comprises first contact arm coupling surfaces 111A intended to couple with corresponding first pole coupling surfaces 3A of a first pole terminal 3 or with corresponding third pole coupling surfaces 4A of a second pole terminal 4, when the pole contact arm 10A, 10B is fixed to the main body 1A of the electric pole unit.

[0078] Preferably, the conductor element 11 is provided with suitable coupling means 15 (e.g. a screw) at the first contact arm terminal 111. The coupling means 15 are adapted to be coupled with a coupling cavity 30, 40 (e.g. a threaded cavity) of the corresponding pole terminal 3, 4 for electrically and mechanically coupling this latter with said conductor element.

[0079] The second contact arm terminal 112 of the conductor element 11 is intended to be electrically coupled (in a known manner) to a corresponding line conductor of an electric line. In general, such a line conductor may be adapted to connect the electric pole unit with an electric power source or with an electric load.

[0080] The pole contact arm 10A, 10B comprises an insulating bushing 12 enclosing the conductor element 11.

[0081] Preferably, the conductor element 11 and the insulating bushing 12 form a monolithic structure. To this aim, they may be conveniently co-molded through an industrial process of known type.

[0082] The insulating bushing 12 comprises a first contact arm port 121, at the first contact arm terminal 111. In this way, the first contact arm terminal 111 is accessible from outside.

[0083] The insulating bushing 12 conveniently comprises a first bushing portion 123 defining the first contact arm port 121.

[0084] The first bushing portion 123 is intended to mechanically couple with a corresponding housing portion 53 or 54 and with a corresponding pole terminal 3 or 4 of the main body 1A of the electric pole unit, when the pole contact arm 10A, 10B is fixed to said main body.

[0085] The first bushing portion 123 comprises second contact arm coupling surfaces 123A intended to couple with corresponding fifth pole coupling surfaces 53A of a first housing portion 53 of the insulating housing 5 or with corresponding sixth pole coupling surfaces 54A of a second housing portion 54 of the insulating housing 5, when the pole contact arm 10A, 10B is fixed to the main body 1A of the electric pole unit.

[0086] Preferably, the second contact arm coupling surfaces 123A define a pass-through third coupling cavity 1230 adapted to receive the first housing portion 53 or the second housing portion 54 of the insulating housing 5, when the pole contact arm 10A, 10B is fixed to the main body 1A of the electric pole unit.

[0087] Preferably, the third coupling cavity 1230 has a grooved ring shape and it is arranged coaxially with the first contact arm terminal 111 in such a way to define an outer region of the first contact arm port 121 (i.e. an ring region having a diameter larger than the diameter of the first pole contact 3 or the second pole contact 4).

[0088] Preferably, the third coupling cavity 1230 has an outer diameter slightly shorter (of few mms) than the outer diameter of the first housing portion 53 or the second housing portion 54 of the insulating housing 5.

[0089] Preferably, the third coupling cavity 1230 has a shape (e.g. with a squared profile) that does not fully fit with the shape (e.g. with a rounded profile) of the first housing portion 53 (namely the above-mentioned first coupling edge) or the second housing portion 54 (namely the above-mentioned second coupling edge).

[0090] Thanks to these arrangements, the first housing portion 53 or the second housing portion 54 can be inserted into the third coupling cavity 1230 with a certain

level of mechanical interference (either in radial and longitudinal direction).

[0091] The first bushing portion 123 comprises third contact arm coupling surfaces 123B intended to couple with corresponding second pole coupling surfaces 3B of a first pole terminal 3 or with corresponding fourth pole coupling surfaces 4B of a second pole terminal 4, when the pole contact arm 10A, 10B is fixed to the main body 1A of the electric pole unit.

[0092] Preferably, the third contact arm coupling surfaces 123B define a blind fourth coupling cavity 1231 in cooperation with the first contact arm coupling surfaces 111A of the contact arm terminal 111.

[0093] The fourth coupling cavity 1231 is adapted to receive the first pole terminal 3 or the fourth pole terminal 4, when the pole contact arm 10A, 10B is fixed to the main body 1A of the electric pole unit.

[0094] Preferably, the fourth coupling cavity 1231 is arranged coaxially with the first contact arm terminal 111 in such a way to define an inner circular region of the first contact arm port 121 (e.g. having a diameter corresponding to the diameter of the first pole terminal 3 or the second pole terminal 4).

[0095] Preferably, the fourth coupling cavity 1230 has a shape (e.g. frustro-conical) that does not fully fit with the shape (e.g. cylindrical) of the of the first pole terminal 3 or the second pole terminal 4.

[0096] In this way, the first pole terminal 3 or the second pole terminal 4 can be inserted into the fourth coupling cavity 1231 with a certain level of mechanical interference (mainly in radial direction).

[0097] Preferably, the insulating bushing 12 comprises a second contact arm port 122 (preferably with a circular shape) at the second contact arm terminal 112.

[0098] Preferably, the insulating bushing 12 conveniently comprises a second bushing portion 124 defining the second contact arm port 122.

[0099] Preferably, the second bushing portion 124 (preferably with a ring profile) surrounds the second contact arm terminal 112 and it is arranged in such a way that this latter protrudes from the second contact arm port 122.

[0100] An important aspect of the pole contact arm 10A, 10B according to the invention consists in that the first bushing portion 123 of the insulating bushing 12 is made of a relatively soft insulating material.

[0101] For the sake of clarity, the expression "relatively soft insulating material" identifies an electrically insulating material that is softer than the electrically insulating materials normally used for this kind of applications, for example an electrically insulating material that is softer than the (relatively rigid) insulating material (e.g. of thermosetting or thermoplastic type) of the insulating housing 5 of the main body 1A.

[0102] Preferably, such a soft insulating material is an elastically deformable material, for example an elastomeric material, e.g. a silicone rubber.

[0103] Preferably, the insulating bushing 12 of the pole

contact arm 10A, 10B is fully made of an elastically deformable material.

[0104] According to some embodiments of the invention, however, only the first bushing portion 123 is made of a soft material (preferably elastically deformable) while the remaining portions of the insulating bushing 12 are made of a relatively rigid insulating material, similarly to the insulating housing 5 of the main body 1A of the electric pole unit.

[0105] Being made of a relatively soft material (preferably elastically deformable), the first bushing portion 123 is subject to a deformation (preferably elastic) when it mechanically couples with a corresponding housing portion 53, 54 (made of a relatively hard material) and a corresponding pole terminal 3, 4 of the main body 1A of the electric pole unit.

[0106] The deformation of the first bushing portion 123 makes the mechanical junction, which is formed by said first bushing portion and a corresponding housing portion 53, 54 of the main body 1A, dielectrically sealed, i.e. with no air gaps or air paths between the outer environment and the conductive parts at said mechanical junction (i.e. the conductor element 11 and the a corresponding pole terminal 3, 4).

[0107] The conductor element 11 of the pole contact arm 10A, 10B and the corresponding pole terminal 3, 4 of the main body 1A of the electric pole unit are therefore electrically insulated from the outer environment.

[0108] Figures 6-7 schematically show the assembly of the first pole contact arm 10A to the main body 1A of the electric pole unit.

[0109] The first housing portion 53 and the first pole terminal 3 of the main body 1A are inserted into the third and fourth coupling cavities 1230, 1231 of the first bushing portion 123 of the pole contact arm 10A.

[0110] In this way:

- the first pole coupling surfaces 3A of the first pole terminal 3 couple with the first contact arm coupling surfaces 111A of the first contact arm terminal 111;
- the second pole coupling surfaces 3B of the first pole terminal 3 couple with the third contact arm coupling surfaces 123B of the first bushing portion 123;
- the fifth pole coupling surfaces 53A of the first housing portion 53 couple with the second contact arm coupling surfaces 123A of the first bushing portion 123.

[0111] The first housing portion 53 and the first pole terminal 3 of the main body 1A couple with the first bushing portion 123 and the first contact arm terminal 111 by means of a male-female coupling arrangement.

[0112] The first housing portion 53 and the first pole terminal 3 of the main body 1A form the corresponding male parts of this male-female coupling arrangement while the third and fourth coupling cavities 1230, 1231 of the first bushing portion 123 form the corresponding female parts of this male-female coupling arrangement.

[0113] Once the above-mentioned male-female coupling process is completed, the coupling means 15 of the pole contact arm 10A are inserted into the first coupling cavity 30 of the first pole terminal 3. In this way, the first pole contact arm 10A is firmly fixed to the main body 1A of the electric pole unit.

[0114] According to the invention, the assembly of the first pole contact arm 10A to the main body 1A of the electric pole unit causes a deformation (preferably elastic) of the first bushing portion 123, particularly at the coupling surfaces 123A, 123B.

[0115] The first housing portion 53 and the first pole terminal 3 of the main body 1A are in fact coupled to the first bushing portion 123 of the pole contact arm 10A (preferably with the third and fourth coupling cavities 1230, 1231 of this latter) with a certain level of mechanical interference.

[0116] The deformation of the first bushing portion 123 at the above-mentioned coupling surfaces 123A, 123B ensure a suitable dielectric sealing of the mechanical junction between the first pole contact arm 10A and the insulating housing 5 of the main body 1A of the electric pole unit 1.

[0117] The first pole terminal 3 and the first contact arm terminal 111 are thus electrically insulated with respect to the outer environment.

[0118] Figures 8-9 schematically show the assembly of the second pole contact arm 10B to the main body 1A of the electric pole unit.

[0119] The second housing portion 54 and the second pole terminal 4 of the main body 1A are inserted into the third and fourth coupling cavities 1230, 1231 of the first bushing portion 123 of the pole contact arm 10A.

[0120] In this way:

- the third pole coupling surfaces 4A of the second pole terminal 4 couple with the first contact arm coupling surfaces 111A of the first contact arm terminal 111;
- the fourth pole coupling surfaces 4B of the second pole terminal 4 couple with the third contact arm coupling surfaces 123B of the first bushing portion 123;
- the sixth pole coupling surfaces 54A of the second housing portion 54 couple with the second contact arm coupling surfaces 123A of the first bushing portion 123.

[0121] The second housing portion 54 and the second pole terminal 4 of the main body 1A couple with the first bushing portion 123 and the first contact arm terminal 111 by means of a male-female coupling arrangement.

[0122] The second housing portion 54 and the second pole terminal 4 of the main body 1A form the corresponding male parts of this male-female insert coupling arrangement while the third and fourth coupling cavities 1230, 1231 of the first bushing portion 123 form the corresponding female parts of this male-female insert coupling arrangement.

[0123] Once the above-mentioned male-female coupling process is completed, the coupling means 15 of the pole contact arm 10A are inserted into the second coupling cavity 40 of the second pole terminal 4. In this way, the second pole contact arm 10B is firmly fixed to the main body 1A of the electric pole unit.

[0124] According to the invention, the assembly of the second pole contact arm 10B to the main body 1A of the electric pole unit causes a deformation (preferably elastic) of the first bushing portion 123, particularly at the coupling surfaces 123A, 123B.

[0125] Also The second housing portion 54 and the second pole terminal 4 of the main body 1A are coupled to the first bushing portion 123 of the pole contact arm 10B (preferably with the third and fourth coupling cavities 1230, 1231 of this latter) with a certain level of mechanical interference.

[0126] The deformation of the first bushing portion 123 at the above-mentioned coupling surfaces 123A, 123B ensure a suitable dielectric sealing of the mechanical junction between the second pole contact arm 10B and the insulating housing 5 of the main body 1A of the electric pole unit 1.

[0127] The second pole terminal 4 and the first contact arm terminal 111 are thus electrically insulated with respect to the outer environment.

[0128] The pole contact arm 10A, 10B according to the invention provides remarkable advantages with respect to state of the art.

[0129] According to the invention, the pole contact arm 10A, 10B comprises at least a first bushing portion 123 made of insulating material (preferably elastically deformable) that is softer than the material of the insulating housing 5 (in particular of the insulating housing portions 53 and 54) of the main body 1A of the electric pole unit.

[0130] Due to the (preferably elastic) deformation of such a soft insulating material, when the first bushing portion 123 is mechanically coupled with an insulating housing portion 53, 54 and a corresponding pole terminal 3, 4 of the main body 1A of the electric pole unit, the mechanical junctions between the insulating housing 5 of the main body 1A and the insulating bushing 12 of the pole contact arms 10A and 10B are dielectrically sealed, thereby providing an effective electric insulation of the conductive parts of the electric pole unit 1 at said mechanical junctions.

[0131] The pole contact arm 10A, 10B thus ensures a higher dielectric strength of the corresponding electric pole unit 1 at above-mentioned mechanical junctions.

[0132] The arrangement the first bushing portion 123 made of soft insulating material does not meaningfully complicate the manufacturing process of the electric pole unit 1.

[0133] The pole contact arm 10A, 10B may be mounted on the main body 1A according to a plug-in assembly mode and then firmly fixed to this latter by suitable coupling means 15, 30, 40.

[0134] The assembly of the pole contact arm 10A, 10B

to the main body 1A of the pole contact unit can therefore be carried in a relatively easy and quick manner (comparably with most traditional electric pole units with no dielectric sealing arrangements) and it does not require special precautions for being carried out.

[0135] In addition, the pole contact arm 10A, 10B may still be disassembled from the main body 1A of the electric pole unit in case of need, e.g. during maintenance interventions.

[0136] The pole contact arm 10A, 10B allows simplifying the assembly of electric pole units of switching apparatuses designed for installation in relatively small spaces.

[0137] The pole contact arm 10A, 10B of the invention is easy to manufacture at industrial level by means of standard industrial processes, e.g. co-moulding processes involving metal and plastic materials.

Claims

1. A pole contact arm (10A, 10B) for an electric pole unit (1), said pole contact arm being intended to be fixed to a main body (1A) of said electric pole unit and comprising:

- a conductor element (11) having a first contact arm terminal (111) and a second contact arm terminal (112), said first contact arm terminal coupling with a corresponding pole terminal (3, 4) of said main body (1A), when said pole contact arm is fixed to said main body, said second contact arm terminal being intended to couple to a corresponding line conductor of an electric line;
- an insulating bushing (12) enclosing said conductor element (11) and comprising a first contact arm port (121) and a first bushing portion (123) defining said first contact arm port, said first bushing portion coupling with a corresponding housing portion (53, 54) and a corresponding pole terminal (3, 4) of said main body (1A), when said pole contact arm is fixed to said main body;

characterised in that said first bushing portion (123) is made of a soft electrically insulating material, said first bushing portion being subject to a deformation at one or more coupling surfaces (123A, 123B) when coupling with said corresponding housing portion (53, 54) and said corresponding pole terminal (3, 4).

2. A pole contact arm, according to claim 1, **characterised in that** said soft electrically insulating material is an elastically deformable electrically insulating material.
3. A pole contact arm, according to claim 2, **characterised in that** said elastically deformable material is an elastomeric electrically insulating material.

4. A pole contact arm, according to one or more of the previous claims, **characterised in that** said first contact arm terminal (111) comprises first contact arm coupling surfaces (111A) coupling with corresponding pole coupling surfaces (3A, 4A) of a pole terminal (3, 4) of said main body (1A), when said pole contact arm is fixed to said main body.

5. A pole contact arm, according to claim one or more of the previous claims, **characterised in that** said first bushing portion (123) comprises second contact arm coupling surfaces (123A) coupling with corresponding pole coupling surfaces (53A, 54A) of a housing portion (53, 54) of said main body (1A) said electric pole unit, when said pole contact arm is fixed to said main body.

6. A pole contact arm, according to one or more of the previous claims, **characterised in that** said first bushing portion (123) comprises third coupling surfaces (123B) coupling with corresponding pole coupling surfaces (3B, 4B) of a pole terminal (3, 4) of said main body (1A), when said pole contact arm is fixed to said main body.

7. A pole contact arm, according to one or more of the previous claims, **characterised in that** said insulating bushing (12) is fully made of said elastically deformable material.

8. A pole contact arm, according to one or more of the previous claims, **characterised in that** said conductor element (11) and said insulating bushing (12) form a monolithic structure.

9. A pole contact arm, according to claim 8, **characterised in that** said conductor element (11) and said insulating bushing (12) are co-molded to form said monolithic structure.

10. An electric pole unit (1) for a switching apparatus (100) comprising:

- a main body (1A) including:
- a current breaking unit (2) positioned in the internal volume of said electric pole unit;
- first and second pole terminals (3, 4) electrically connected to said current breaking unit;
- an insulating housing (5) enclosing said breaking unit (2) and said first and second pole terminals (3, 4), said insulating housing comprising first and second housing ports (51, 52) at said first and second pole terminals (3, 4), respectively, and first and second housing portions (53, 54) defining said first and second housing ports, respectively;
- a first pole contact arm (10A) fixed to said main body (1A) for electrically connecting said first

pole terminal (3) with a corresponding first line conductor;

- a second pole contact arm (10B) fixed to said main body (1A) for electrically connecting said second pole terminal (4) with a corresponding second line conductor;

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characterised in that at least one of said first and second pole contact arms is a pole contact arm (10A, 10B), according to one or more of the previous claims.

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11. A switching apparatus (100) **characterised in that** it comprises an electric pole unit (1) according to claim 10.

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12. A switching apparatus (100) **characterised in that** it comprises one or more pole contact arms (10A, 10B), according to one or more of the claims from 1 to 9, included in one or more electric pole units (1) of said switching apparatus.

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13. A switching apparatus, according to claim 11 or 12, **characterised in that** it is a medium voltage switching apparatus.

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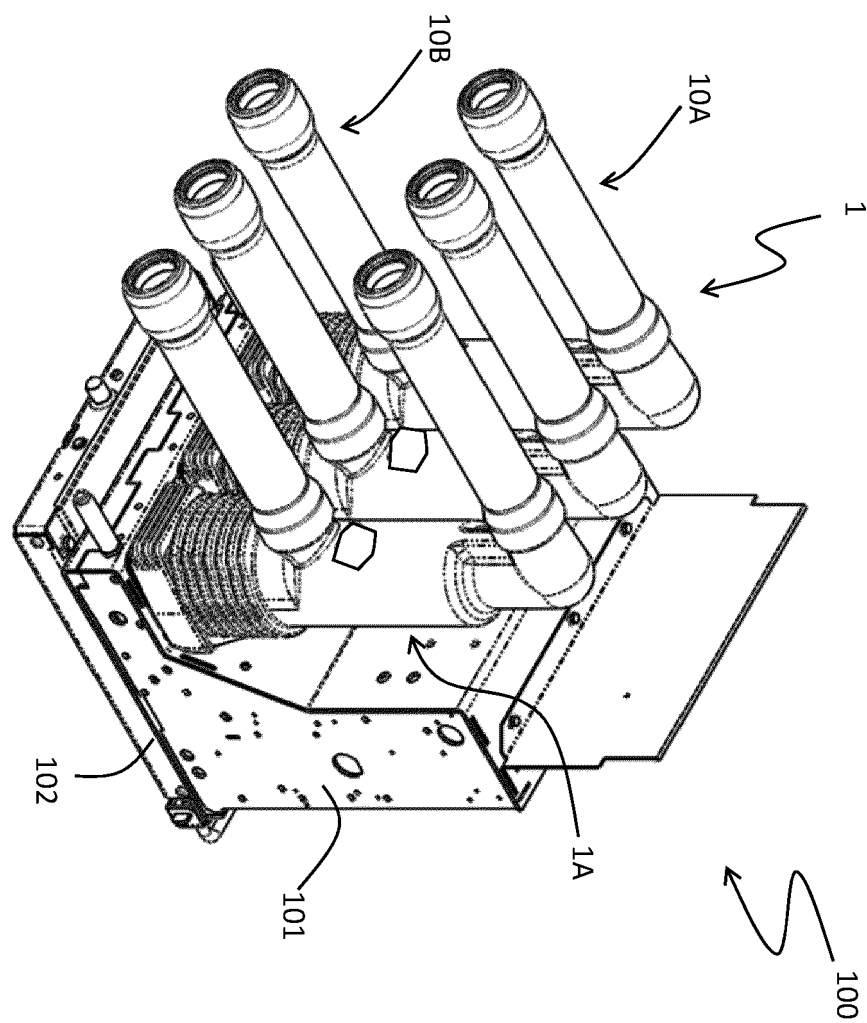


FIG. 1

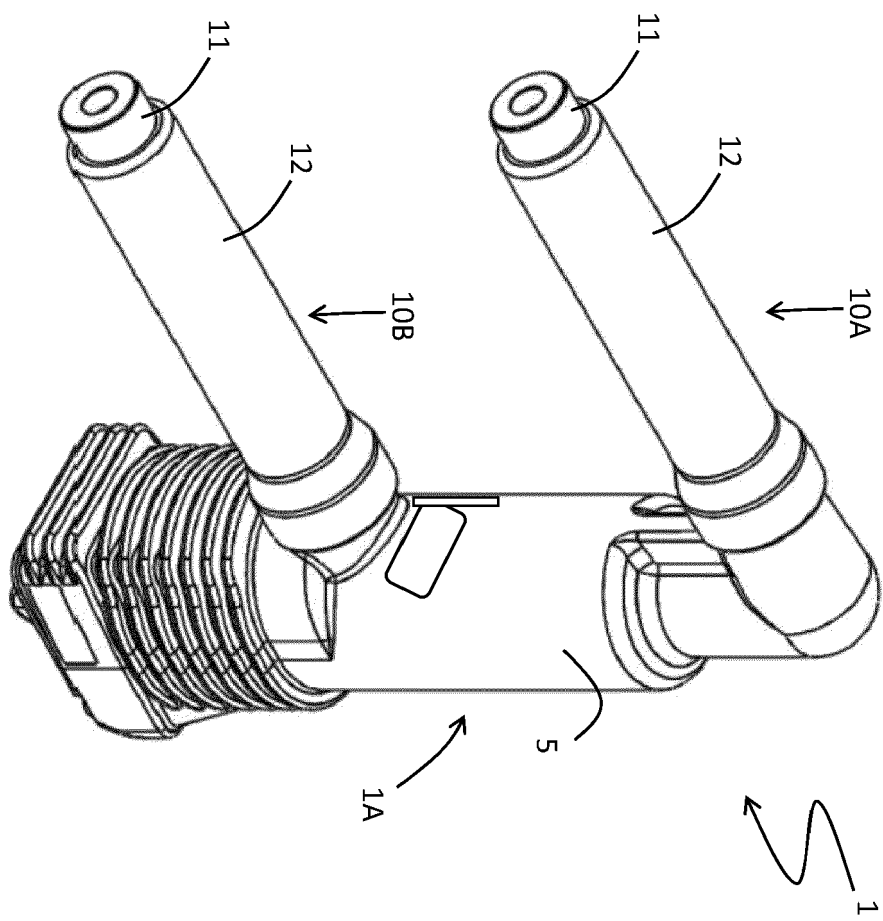


FIG. 2

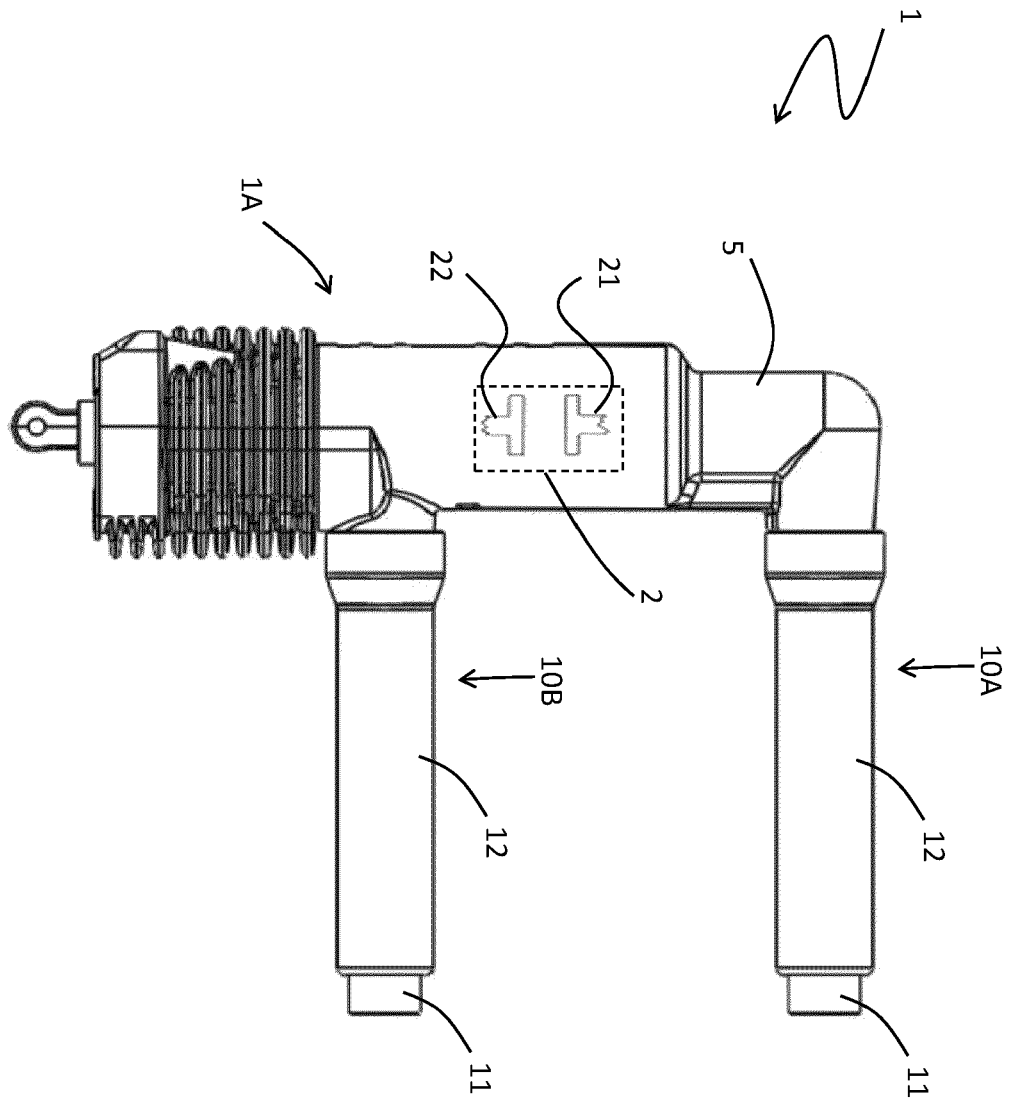


FIG. 3

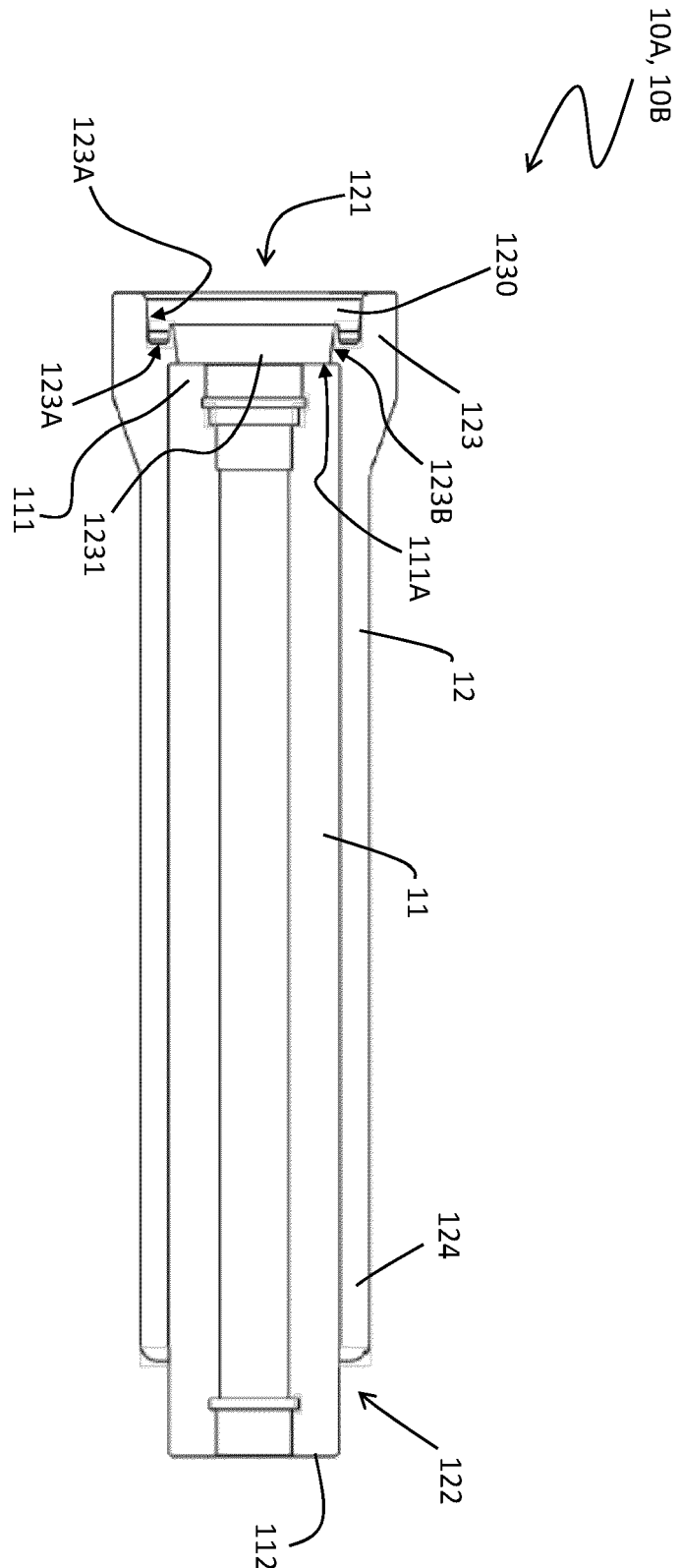


FIG. 4

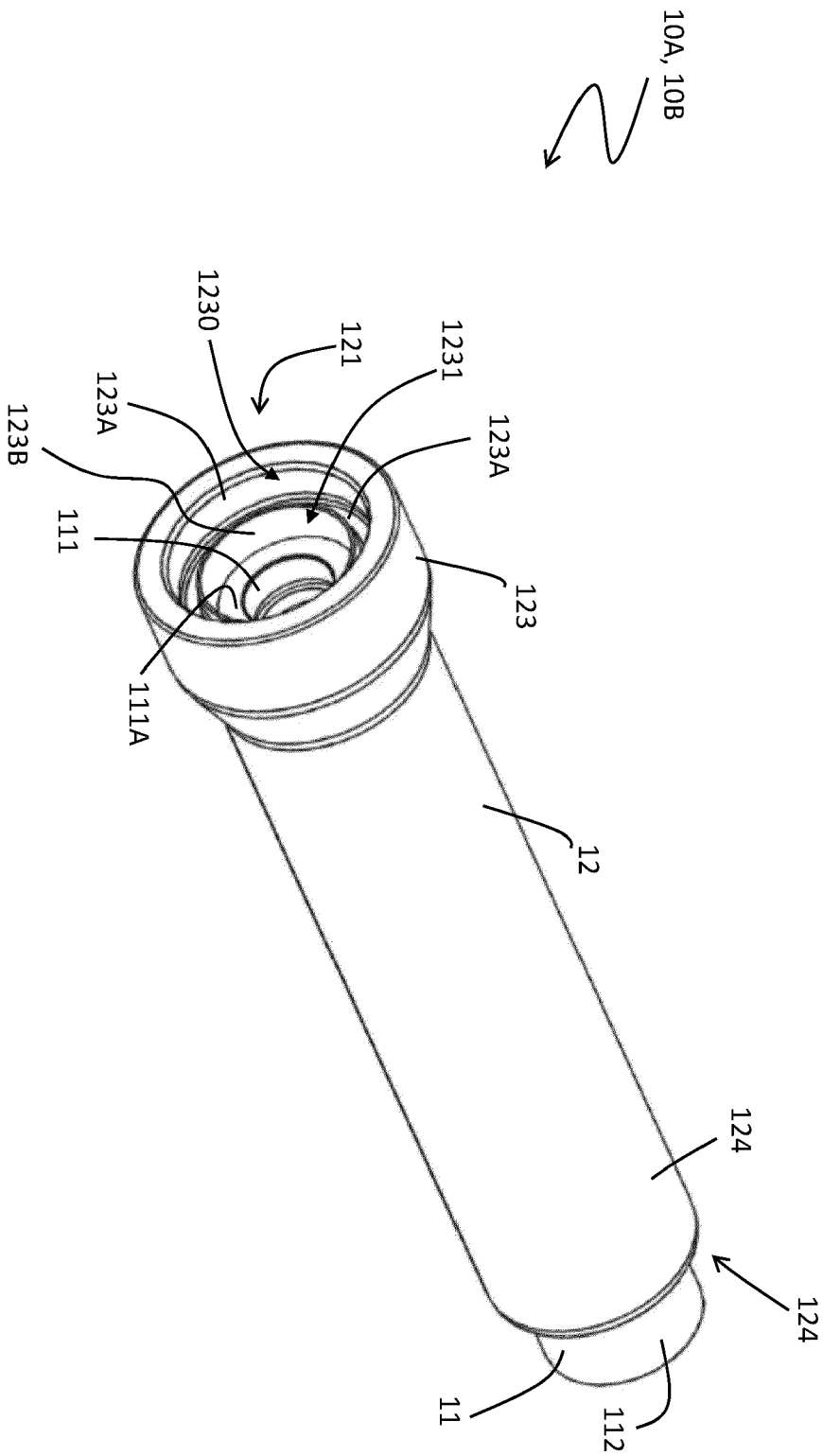


FIG. 5

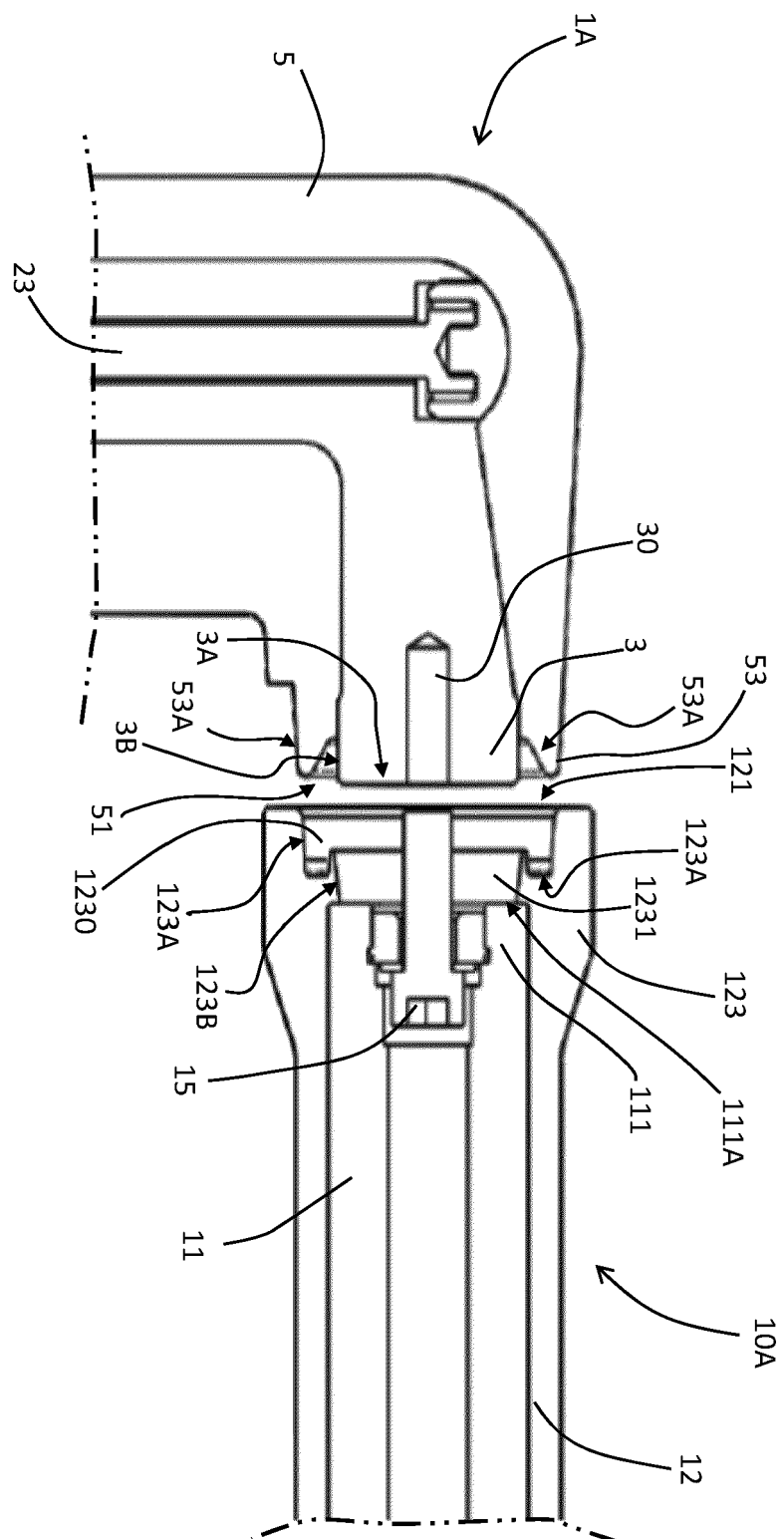


FIG. 6

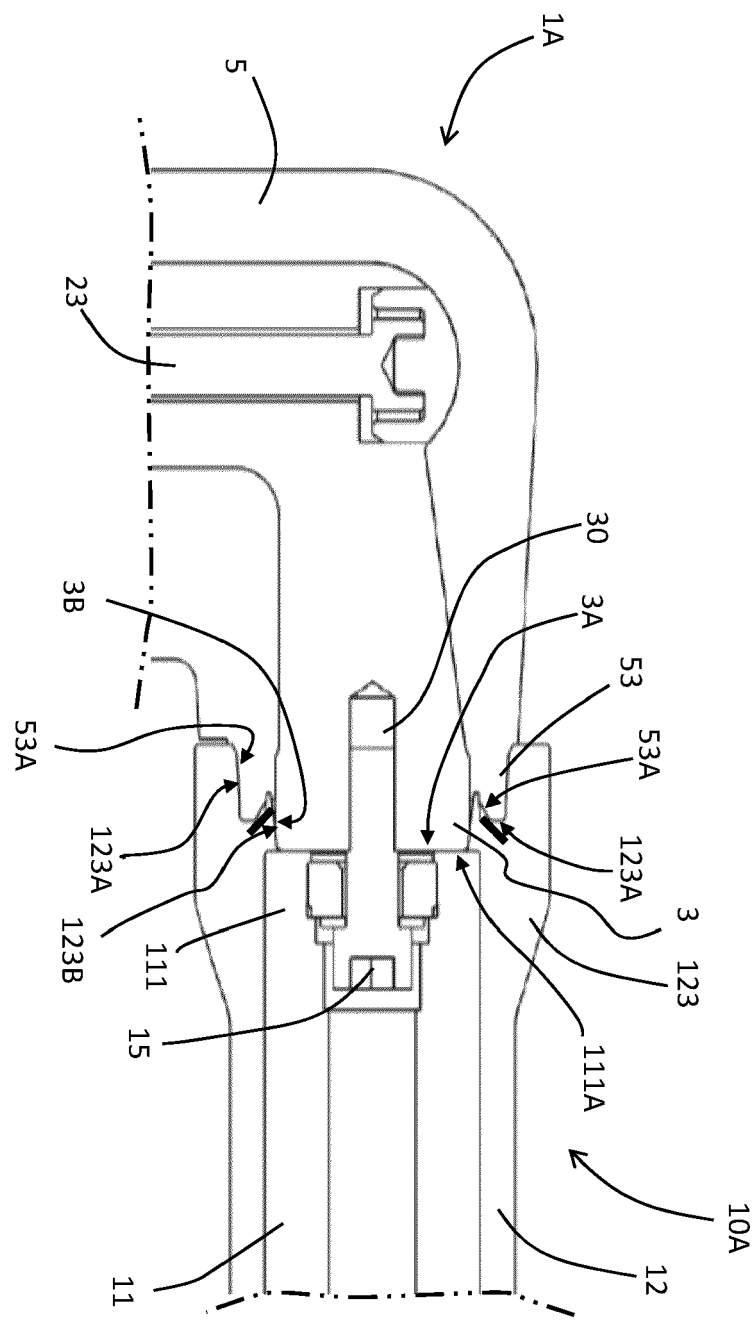


FIG. 7

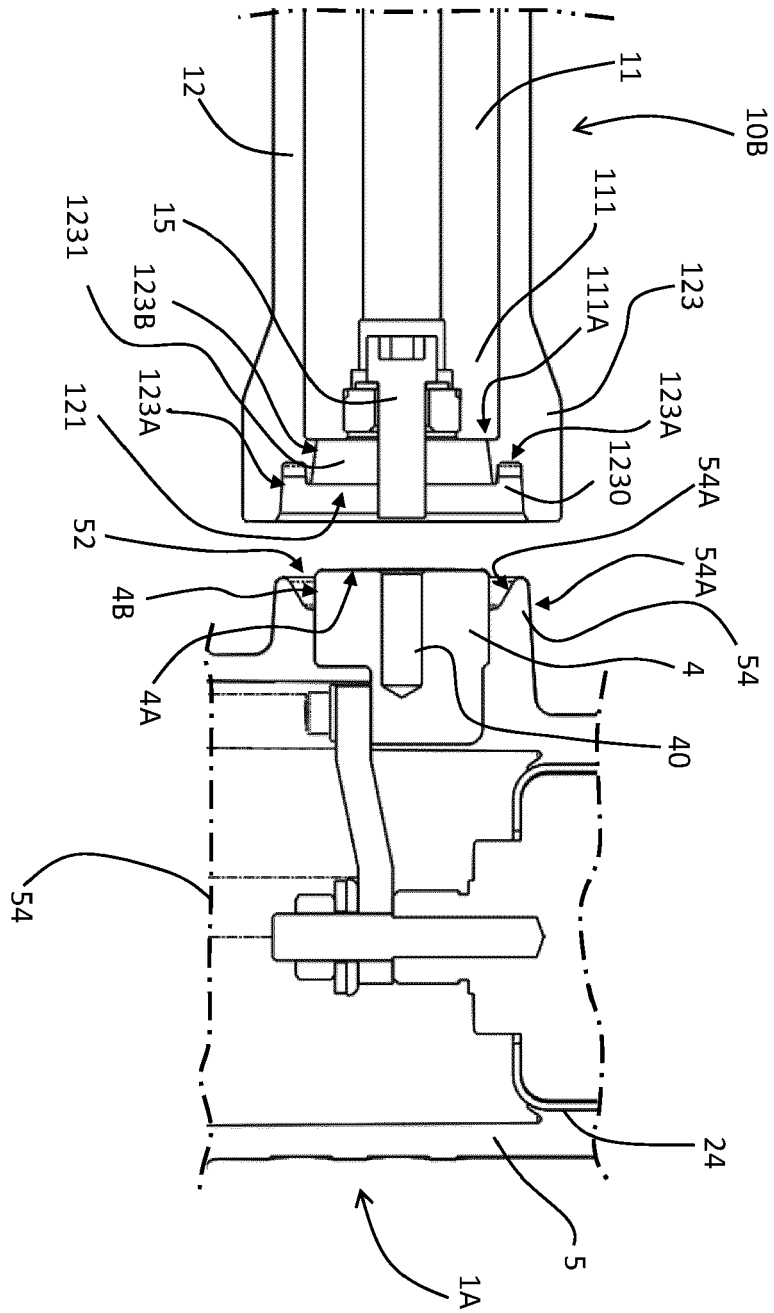


FIG. 8

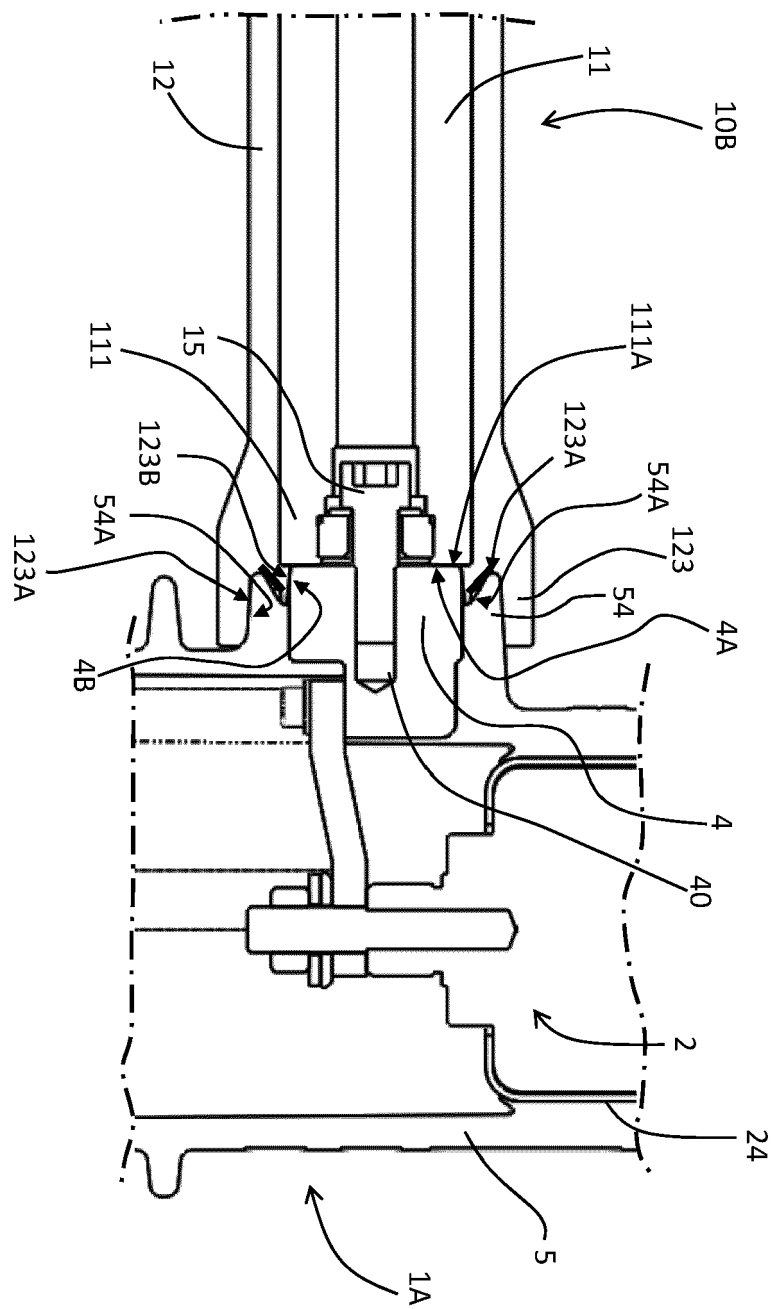


FIG. 9



EUROPEAN SEARCH REPORT

 Application Number
 EP 20 16 8230

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			TECHNICAL FIELDS SEARCHED (IPC)
			H01H H01B H01R
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 4 August 2020	Examiner Simonini, Stefano
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	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 20 16 8230

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
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