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(54) Braided tape contact disk

(57) The invention relates to a contact device (200) for a switching pole (100) of an electric and/or electronic application, such as a circuit breaker, with an inner terminal (211, 221, 231, 241, 251) for electrically connecting the contact device (200) to a moving contact (103) of the switching pole (100), and an outer terminal (212, 222, 232, 242, 252) for electrically connecting the contact device (200) to a terminal (105, 107) of the switching pole (100). The proposed solution offers the combination of a low electrical resistance with a high mechanical flexibility.

A braided flexible structure (213, 223, 233) is provided extending in a plane for electrically connecting the inner terminal (211, 221, 231, 241, 251) with the outer terminal (212, 222, 232, 242, 252) such that the inner terminal (211, 221, 231, 241, 251) is movable relative to the outer terminal (212, 222, 232, 242, 252) and in a direction (224) traverse to the plane from an off-position (290) to an on-position (292) of the switching pole (100).

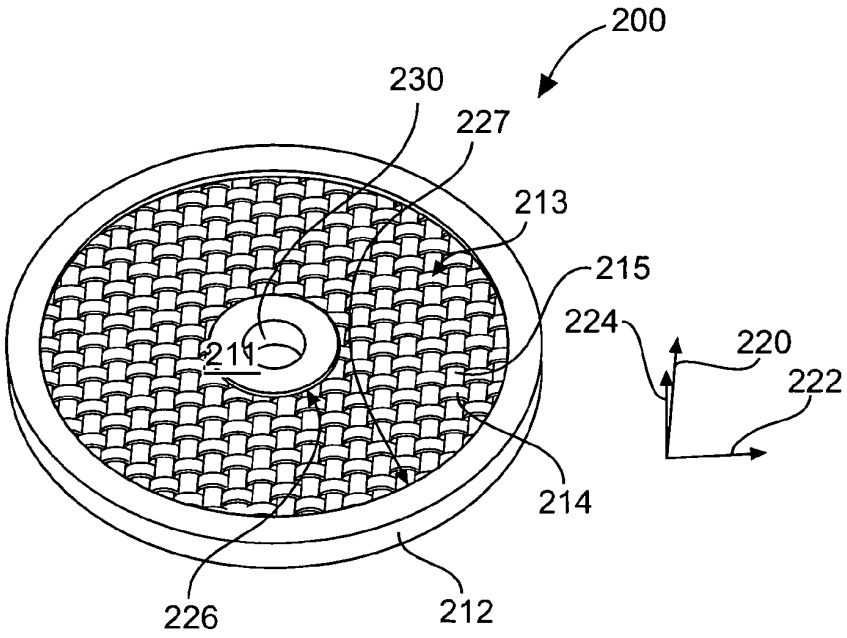

Fig. 2

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Description

Field of the invention

[0001] The invention relates to switching poles of electric and electronic applications. In particular, the present invention relates to a contact device for a switching pole of an electric and/or electronic application, to a switching pole for an electric and/or electronic application with the contact device, to a method of manufacturing the contact device, and to a method of manufacturing the switching pole.

Technical background of the invention

[0002] Switching poles usually contain at least one movable contact. The movement of this contact from one position to another position will close or open an electric circuit. One of the technical key issues of such a pole is the transfer of the electrical current from the moving pole to the non-moving network.

[0003] A flexible conductor of a switching pole comprises usually a stack of thin conductors forming a band or a spiral spring, or one or more bands with multiple contact points in a cylindrical arrangement.

[0004] Band-shaped flexible conductors may have a relatively high electrical resistance. Spiral spring contacts may have a relatively low number of contact points, and may require large and costly parts at the moving contact and at the non-moving network to host them. Bands with multiple contacts may have a relatively low electrical resistance with relatively high costs for the contact bands themselves as well as for the parts hosting them, and may require relatively tight axial tolerances of the involved parts.

[0005] US 2010/0181291 A1 describes a pole part of a low-voltage, medium-voltage and/or high voltage switching device with a vacuum interrupter chamber having a fixed contact and a movable contact, which includes an electrical contact piece.

[0006] WO 2010/079106 A1 relates to a moving element for a low voltage switching device with an elastic element which interacts with an electrical contact.

Summary of the invention

[0007] It may be seen as an object of the invention to provide an improved, flexibly adjustable and efficient switching pole for an electric and/or electronic application, offering an electrical connection for the fixed and movable parts of said pole. The object of the invention combines a low electrical reistance, due to the large achieveable cross-section of the conductor, with a high mechanical flexibility due to the braided structure. The mechanical flexibility is advantageous for the drive of the pole, as it does not require high forces for being operated. This also reduces the mechanical stress to the material of the conductor and increases its mechanical lifetime.

[0008] This object is achieved by the subject matter of the independent claims. Exemplary embodiments are evident from the dependent claims and the following description.

[0009] According to an aspect of the invention, a contact device for a switching pole of an electric and/or electronic application is provided comprising an inner terminal for electrically connecting the contact device to a moving contact of the switching pole, and an outer terminal for electrically connecting the contact device to a terminal of the switching pole. The contact device further comprises a braided flexible structure extending in a plane for electrically connecting the inner terminal with the outer terminal such that the inner terminal is moving relative to the outer terminal and in a direction traverse to the plane from an off-position to an on-position of the switching pole.

[0010] The braided flexible structure may comprise braided tape or tapes according to another aspect of the invention. The electric and/or electronic application may be an application in an air insulated or gas insulated medium voltage circuit breaker. The braided tape may comprise copper wire.

[0011] In other words, a contact device with a braided flexible conductor for a switching pole is provided that may be made from braided tape or tapes. The braided flexible conductor has the shape of a circular disc, an elliptical disc, or a rectangle and may efficiently exploit the potentially available cross section in the switching pole for the flow of the electrical current at the outer terminal that is connected to the (fixed) terminal of the pole. The flexibility of the braided tapes may allow for the required movement of the moving contact. Due to a relatively large cross section, the outer terminal may effectively reduce the electrical resistance and ohmic loss of the flexible conductor compared to a band-shaped flexible conductor, for example, when the terminal of the pole is shaped such that it may easily engage with the outer terminal.

[0012] Such a contact device with braided tape(s) such as flat braided tape(s) may be relatively simply manufactured, e.g. by dye cutting, and may provide for a flexible conductor with large cross sections that may be suitable and cost effective for switching poles of electric and/or electronic applications, such as medium voltage applications.

[0013] According to another aspect of the invention, the braided flexible structure has a shape selected from the group comprising at least a part of an at least partially circular disc shape, at least a part of an at least partially elliptical disc shape, at least a part of an at least partially triangular shape, at least a part of an at least partially rectangular shape, at least a part of an at least partially polygonal shape, and a combination thereof.

[0014] In other words, the braided flexible structure may have the shape of a circular disk, an elliptical disk or a polygon or may comprise a segment of a circular or elliptical disk or of a polygon.

[0015] According to another aspect of the invention, the inner terminal comprises an inner link such as a recess for electrical connecting the inner terminal to the moving contact and/or to an actuating device such as a push rod of the moving contact of the switching pole.

[0016] According to another aspect of the invention, the inner terminal comprises metal and is connected to the braided flexible structure by being pressed or press-welded to an inner cut of the braided flexible structure.

[0017] According to another aspect of the invention, the outer terminal comprises metal and is connected to the braided flexible structure by being pressed or press-welded to an outer cut of the braided flexible structure.

[0018] According to another aspect of the invention, the outer terminal comprises at least one outer link for electrically and mechanically connecting the outer terminal to the terminal of the switching pole. The at least one outer link is selected from the group comprising at least one axial recess in an axial direction for receiving fixing screws, at least one radial recess in a radial direction transversal to the axial direction, or in a traverse direction transversal to the axial direction for receiving fixing screws, at least one protrusion for fixedly engaging with a groove of the terminal of the switching pole via a mounting component such as a ring with an outside thread pressing the outer terminal into the groove, and at least one friction welding component for friction welding the outer terminal to the terminal of the switching pole.

[0019] According to another aspect of the invention, the braided flexible structure comprises at least one segment which is adapted to be manufactured as a single piece and separately from a method of manufacturing the whole contact device. The at least one segment is adapted to be electrically connected to one of the inner terminal and the outer terminal, at least one inner segment part of the inner terminal and at least one outer segment part of the outer terminal, the inner terminal and the at least one outer segment part, and the at least one inner segment part and the outer terminal.

[0020] According to another aspect of the invention, the inner terminal comprises an inner connecting face for electrically connecting the inner terminal to the braided flexible structure. The outer terminal comprises an outer connecting face for electrically connecting the outer terminal to the braided flexible structure. The size of the inner connecting face is independent from the size of the outer connecting face. The inner connecting face may have the same size as the outer connecting face according to a further aspect of the invention. This would result in a constant cross-section or a constant electrical resistance of the flexible conductor over the radius of the pole. As the inner connecting face can be higher than the outer connecting face, it can be avoided that the specific electrical resistance increases in the center of the pole, which could result in an excessive local increase of temperature when the nominal current is flowing.

[0021] The inner connecting face has a size which is about 50 % of the size of the outer connecting face in advantageous embodiment. The inner connecting face may have the same size as the outer connecting face according to a further aspect of the invention.

[0022] According to an exemplary embodiment of the invention, a switching pole for an electric and/or electronic application is provided, comprising a terminal, a movable contact, a fixed contact electrically connected to another terminal of the switching pole, and a contact device according to anyone of the exemplary embodiments and aspects described above and in the following. The contact device is provided for electrically connecting the terminal with a movable contact such that the movable contact is movable relative to the terminal to an on-position to electrically connect the movable contact to the fixed contact when the switching pole is switched on or to an off-position to electrically disconnect the movable contact from this fixed contact when the switching pole is switched off. The movable contact may be actuated by an actuator, which may be an insulating push rod.

[0023] By providing such a switching pole with a contact device comprising a braided flexible structure, ohmic losses and an electrical resistance of the contact device may be efficiently reduced as the braided flexible structure may exploit the potentially available cross-section of the switching pole for the flow of the electrical current at the outer terminal that is connected to the terminal of the switching pole efficiently.

[0024] According to a further aspect of the invention, the switching pole further comprises at least one fixing device for fixing the contact device to the terminal. The fixing device comprises at least one of at least one fixing screw for electrically and mechanically connecting the outer terminal of the contact device to the terminal of the switching pole, a mounting component such as a ring with an outside thread to press the outer terminal into a groove of the terminal, wherein the terminal comprises a corresponding internal thread to host the threaded mounting component, and a friction welding component for friction welding the outer terminal of the contact device to the terminal of the switching pole.

[0025] According to a further aspect of the invention, the switching pole comprises a cover which may be arranged at at least one of a top side of the contact device and at a bottom side below the top side of the contact device. By providing such a cover, a risk for flashovers, which may be caused after many mechanical operations by broken single wires of the braided flexible structure which may point outwards the braided flexible structure, may be avoided. The cover may be made of a flexible material like rubber, which may be fixed, e.g. by gluing, to the inner and outer terminal, or it may be made by coating the relevant side of the contact device, e.g. with silicone.

[0026] According to another exemplary embodiment, a method of manufacturing a contact device for a switching pole of an electric and/or electronic application according to anyone of the exemplary embodiments and aspects described above and in the following is provided.

The method comprises a step of manufacturing a braided flexible structure, a step of electrically connecting an inner terminal to the braided flexible structure, and a step of electrically connecting an outer terminal to the braided flexible structure.

[0027] According to a further exemplary embodiment of the invention, a method of manufacturing a switching pole according to anyone of the exemplary embodiments and aspects described above and in the following is provided. The method comprises the step of manufacturing a contact device according to the method mentioned above, a step of electrically connecting the outer terminal of the contact device to the terminal of the switching pole, and a step of electrically connecting the inner terminal of the contact device to the moving contact of the switching pole.

[0028] These and other aspects of the invention will be apparent from and illustrated with reference to the embodiments, described herein after.

Brief description of the drawings

[0029] Below, exemplary embodiments of the present invention are described in more detail with reference to the attached drawings.

Fig. 1 shows a perspective view of a switching pole of an electric and/or electronic application.

Fig. 2 shows a perspective view of a contact device for a switching pole of an electric and/or electronic application, according to an embodiment of the invention.

Fig. 3 shows a perspective view of a switching pole for an electric and/or electronic application with a contact device according to an embodiment of the invention.

Fig. 4 shows a perspective view of a switching pole for an electric and/or electronic application with a contact device according to another embodiment of the invention.

Fig. 5 shows a perspective view of a switching pole for an electric and/or electronic application with a contact device according to another embodiment of the invention.

Fig. 6 shows a perspective view of a switching pole for an electric and/or electronic application with a contact device according to another embodiment of the invention.

Fig. 7 shows a perspective view of a switching pole for an electric and/or electronic application with a contact device according to another embodiment of the invention.

Fig. 8 shows a side view of a contact device for a switching pole of an electric and/or electronic application according to another embodiment of the invention.

Fig. 9 shows a perspective view of the contact device of fig. 8.

Fig. 10 shows a perspective view of a segment of a braided flexible structure of a contact device for a switching pole of an electric and/or electronic application according to another embodiment of the invention.

Fig. 11 shows a perspective view of a contact device for a switching pole of an electric and/or electronic application according to another embodiment of the invention.

Fig. 12 shows a perspective view of a contact device for a switching pole of an electric and/or electronic application according to another embodiment of the invention.

Fig. 13 shows a perspective view of a contact device shaped like a segment of a circular disk for a switching pole of an electric and/or electronic application according to another embodiment of the invention.

Fig. 14 shows a perspective view of a switching pole for an electric and/or electronic application with the contact device of fig. 13 according to another embodiment of the invention.

Fig. 15 shows a perspective view of a switching pole for an electric and/or electronic application with a cover according to another embodiment of the invention.

Fig. 16 shows a flow chart of a method of manufacturing a contact device for a switching pole of an electric and/or electronic application according to an embodiment of the invention.

Fig. 17 shows a flow chart of a method of manufacturing a switching pole according to an embodiment of the invention.

[0030] All drawings are schematic and not to scale.

Detailed description of the drawings

[0031] Fig. 1 shows a switching pole 100 for an electric and/or electronic application comprising a lower terminal 105 and an upper terminal 101. A fixed contact 102 is attached to the upper terminal 101. A moving contact 103 is attached to the lower terminal 105 via a flexible conductor 104. A switching movement 190 of the switching

pole 100 is initiated by a drive (not shown) and transferred to the moving contact 103 by means of an actuator 106 which may be an insulating push rod. The electrical connection of the moving contact 103 to the fixed lower terminal 105 is realized with the flexible conductor 104 which enables the moving contact 103 to move from an off-position 290 to an on-position 292 such that the moving contact 103 contacts the fixed contact 102 and a current may flow from the lower terminal 105 via the flexible conductor 104 and a connecting rod 110 to the moving contact 103, the fixed contact 102, and the upper terminal 101. The flexible conductor 104 extends in a longitudinal direction 220 and a horizontal direction 222 traverse to the longitudinal direction 220. The moving contact 103 may be moved in a vertical direction 224 traverse to the longitudinal and horizontal directions 220, 222 by the actuator 106.

[0032] The flexible conductor 104 may be a stack of thin, rectangular metal foils, e.g. of copper or aluminium, such that it may be easily bended to enable to move the moving contact 103.

[0033] Fig. 2 shows a contact device 200 for a switching pole of an electric and/or electronic application with an inner terminal 211 for electrically connecting the contact device 200 to a moving contact of the switching pole, and an outer terminal 212 for electrically connecting the contact device 200 to a terminal of the switching pole. The terminal may be fixed. A braided flexible structure 213 extends in a plane, which may be defined by a horizontal direction 222 and a longitudinal direction 220 traverse to the horizontal direction 222, for electrically connecting the inner terminal 211 with the outer terminal 212 such that the inner terminal 211 is movable relative to the outer terminal 212 in a direction 224 traverse to the plane from an off-position to an on-position or from an on-position to an off-position of the switching pole. The braided flexible structure 213 comprises braided tape with first tapes 215 which may extend in the longitudinal direction 220 and second tapes 214 arranged traverse to the first tapes 215, which second tapes 214 may extend in the horizontal direction 222. The braided flexible structure 213 may be a flexible conductor and has the shape of a circular disk. The material of the braided tape may be copper wire. The contact device 200 may be provided for a switching pole of applications in air-insulated medium voltage circuit breakers.

[0034] The shape of the braided flexible structure 213 is not limited to the shape shown in Fig. 2 but may be a shape selected from the group comprising a circular disk shape, an elliptical disk shape, a triangular shape, a rectangular shape, a polygonal shape or a combination thereof or a part of such shapes.

[0035] The inner terminal 211 comprises an inner link 230 which may be a recess 230 adapted to match with an actuating device. The inner link 230 is adapted to electrically connect the inner terminal 211 to the moving contact and/or to the actuating device of the switching pole.

[0036] The inner terminal 211 may comprise metal and may be pressed or press-welded like a rivet around an inner cut 226 of the braided flexible structure 213, which may be a braided tape circular disk 213, to form a terminal that electrically and mechanically holds the single conducting filaments of the disk, and which terminal may be easily connected to the moving contact and the insulating push rod of the switching pole. The outer terminal 212 may comprise metal and may be pressed or press-welded around an outer cut 227 of the braided flexible structure 213 to form a terminal that electrically and mechanically holds the single conducting filaments of the disk and that may be easily connected to the (lower) terminal of the switching pole.

[0037] Due to a large cross-section, this outer terminal 212 may effectively reduce the electrical resistance and ohmic loss of the flexible conductor, when the (lower) terminal of the pole is shaped such that it may easily engage with the outer terminal 212. The flexibility of the braided tapes (214, 215) allows for the required movement of the moving contact.

[0038] Fig. 3 and 4 show a perspective view of a switching pole 100 for an electric and/or electronic application with a contact device 200 according to Fig. 2. As is also illustrated in Fig. 1 another terminal 101 or an upper terminal 101 and a fixed contact 102 are provided as well as a terminal 107 or lower terminal 107 and a movable contact 103. The fixed contact 102 is electrically connected to the other terminal 101 of the switching pole 100. The contact device 200 is adapted to electrically connect the terminal 107 with a movable contact 103 such that the movable contact 103 is movable relative to the terminal 107 to an on-position 292 to electrically connect the movable contact 103 to the fixed contact 102 when the switching pole 100 is switched on or to an off-position 290 to electrically disconnect the movable contact 103 from the fixed contact 102 when the switching pole 100 is switched off. An actuator 106, which may be an insulating push rod, is provided for actuating the movable contact 103. The lower terminal 107 is extending to a terminal ring 109 that holds the fixed side of the braided flexible structure 213 of the contact device 200. The inner terminal 211 is electrically and mechanically connected to the moving contact 103 or to a connecting rod 110 which is electrically and mechanically connected to the moving contact 103.

[0039] Fig. 5 and Fig. 6 show ways of connecting the contact device 200 to the terminal 107 of the switching pole 100 in perspective views according to two further exemplary embodiments.

[0040] In Fig. 5 at least one fixing device 208 for fixing the contact device 200 to the terminal 107 is provided comprising a plurality of fixing screws 208 for electrically and mechanically connecting the outer terminal 212 of the contact device 200 to the terminal 107 of the switching pole 100. The outer terminal 212 comprises a plurality of outer links 228 in form of axial recesses 228 in an axial direction 224 to receive the fixing screws 208 for electrically and mechanically connecting the outer terminal 212

to the terminal 107.

[0041] In Fig. 6 the outer terminal 212 comprises at least one outer link 229 in form of a radial recess 229 in a radial direction 222 transversal to the axial direction 224 to receive the fixing screws 208 for electrically and mechanically connecting the outer terminal 212 of the contact device 200 to the terminal 107 of the switching pole 100.

[0042] Fig. 7 shows a switching pole 100 with at least one fixing device 216 in form of a mounting component 216 such as a ring 216 with an outside thread to press the outer terminal 212 into a groove 285 of the terminal 107, wherein the terminal 107 comprises a corresponding internal thread to host the threaded mounting component 216. The outer terminal 212 comprises at least one outer link 225 in form of one protrusion 225 for fixedly engaging with the groove 285 of the terminal 107 of the switching pole 100. The ring 216 comprises recesses 217 to engage with a mounting tool which is adapted to tighten the ring to the terminal 107. The ring 216 may have the form of a circular band 218 as shown in Fig. 7.

[0043] As is illustrated in Fig. 7 the switching pole 100 may comprise at least one fixing device 286 in form of a friction welding component 286 for friction welding the outer terminal 212 of the contact device 200 to the terminal 107 of the switching pole 100. Friction welding may be realized by rotating the contact device disk 200 with high-speed while pressing it against the terminal 107 and/or to the moving contact 103 to provide the necessary electrical and mechanical connection.

[0044] By manufacturing a flat braided tape of the braided flexible structure, some wires may be pressed or press-welded to both, the inner terminal and the outer terminal of the contact device, and other wires may only be pressed or press-welded to the outer terminal, due to the fact that the cross section of the disc-shaped contact device may be larger at the outer terminal than at the inner terminal. These wires may be also electrically connected to the inner terminal, as they may be weaved with the other wires in the braided tape but this connection may be not as good as the pressed or press-welded connection. To optimize the design of the contact device in a way that every wire of the disc is directly pressed or press-welded to both, the inner and the outer terminal of the flexible conducting disc, the thickness of the outer terminal may be decreased, and the thickness of the inner terminal may be increased, such that the cross section of the outer terminal, and the inner terminal may be essentially similar as shown in Fig. 8.

[0045] Fig. 8 shows a side view of a contact device with an optimized disk shape which enables that every wire of the braided flexible structure 223 is directly pressed or press-welded to both, the inner terminal 221 and the outer terminal 222 of the contact device 200. The thickness of the outer terminal 222 is decreased and the thickness of the inner terminal 221 is increased such that the cross-section at the outer terminal 222 and at the inner terminal 221 is similar.

[0046] According to Fig. 8 and 9, the braided flexible structure 223, comprises a plurality of segments 202 which are adapted to be manufactured as a single piece, possibly by being wound or woven, separately from the manufacturing process of the whole contact device 200. The segments 202 may be pressed or press-welded with the inner terminal 221 and the outer terminal 222, as shown in Fig. 9.

[0047] The inner terminal 221 comprises an inner connecting face 270 for electrically connecting the inner terminal 221 to the braided flexible structure 223, and the outer terminal 222 comprises an outer connecting face 272 for electrically connecting the outer terminal 222 to the braided flexible structure 223 as is also shown in Fig. 13. The inner connecting face 270 may have a size which is independent from the size of the outer connecting face 272. When the inner connecting face 270 is higher than the outer connecting face 272, the inner connecting face 270 may have e.g. the same size as the outer connecting face 272. This would result in a constant cross-section or a constant electrical resistance of the flexible conductor over the distance from the outer terminal to the inner terminal.

[0048] Fig. 10 shows a perspective view of a segment 202 pressed or press-welded at the end of its woven braided tape 233 as a single piece with an inner segment part 231 of the inner terminal, which inner segment part 231 may be an inner metal clamp 231, and an outer segment part 232 of the outer terminal, which outer segment part 232 may be an outer metal clamp 232.

[0049] Fig. 11 shows a complete circular disk-shaped contact device 200 which is formed of a plurality of segments 202 of Fig. 10. The disk-shaped contact device 200 may be directly installed in the switching pole, or it may be pressed or press-welded with an additional inner terminal 241 and an additional outer terminal 242 for easier handling as shown in Fig. 12.

[0050] The braided flexible structure 233 of the contact device 200 may comprise at least one segment 202 which is adapted to be electrically connected to one of the inner terminal and the outer terminal, at least one inner segment part 231 of the inner terminal, and at least one outer segment part 232 of the outer terminal, the inner terminal and the at least one outer segment part 232, and the at least one inner segment part 231 and the outer terminal.

[0051] Fig. 13 shows a contact device 200 with a shape of a segment of a circular disk, which may be advantageous, as the terminal of the switching pole may be designed smaller, which may result in reduced costs compared to a contact device 200 with the shape of a full circular disk. Five segments 202 are provided with a braided flexible structure, each segment 202 connected to an inner segment part of an inner terminal which is connected to a further inner terminal 251. Each segment is connected to an outer segment part of an outer terminal which is connected to a further outer terminal 252. The inner terminal 251 comprises an inner connecting face 270 and the outer terminal 252 comprises an outer con-

necting face 272. The actuator 106 is connected to a lower part 250 of the inner terminal 251, and an upper part 253 of the inner terminal 251 is electrically and mechanically connected to a connecting rod which is electrically and mechanically connected to a moving contact of the switching pole as is shown in Fig. 14.

[0052] Fig. 14 shows a switching pole 100 for an electric and/or electrical application with the contact device 200 of Fig. 13. The terminal ring 109 of the terminal 107 matches to the circular segmented contact device 200

[0053] In Fig. 15 a switching pole 100 for an electric and/or electronic application with a contact device 200 is illustrated. The switching pole 100 comprises a cover 260 arranged at a bottom side of the contact device 200 in a plane, which may be defined by a horizontal direction 222 and a longitudinal direction 220 traverse to the horizontal direction 222, below a top side of the contact device 200. The cover 260 may be made of a flexible material like rubber, that may be fixed, e.g. by gluing, to the inner and outer terminal of the contact device 200 or it may be made by coating the relevant side of the contact device 200, e.g. with silicon. By providing such a cover 260 it is possible to avoid the risk of flashovers due to broken single wires of the braided flexible structure that may point outwards the contact device 200 after a plurality of mechanical operations of the switching pole 100.

[0054] Fig. 16 shows a flow-chart of a method 300 of manufacturing a contact device for a switching pole of an electric and/or electronic application according to anyone of the exemplary embodiments and aspects described above and in the following, the method 300 comprising a step of manufacturing 301 a braided flexible structure, a step of electrically connecting 302 an inner terminal to the braided flexible structure, and a step of electrically connecting 303 an outer terminal to the braided flexible structure.

[0055] Fig. 17 shows a flow-chart of a method 400 of manufacturing a switching pole according to anyone of the exemplary embodiments and aspects described above and in the following, the method 400 comprising the step of manufacturing 300 a contact device according to method 300 of Fig. 16, a step of electrically connecting 402 the outer terminal of the contact device to the terminal of the switching pole , and a step of electrically connecting 403 the inner terminal of the contact device to the moving contact of the switching pole .

[0056] While the invention has been illustrated and described in detail in the drawings and the foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the invention is not limited to the disclosed embodiments. Other variations to the disclosed embodiments can be understood and effected by those skilled in the art and practicing the claimed invention, from study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. Any reference symbols in the claims should not be construed as limiting the scope.

Claims

1. Contact device (200) for a switching pole (100) of an electric and/or electronic application, the contact device (200) comprising:

   - an inner terminal (211, 221, 231, 241, 251) for electrically connecting the contact device (200) to a moving contact (103) of the switching pole (100);
   - an outer terminal (212, 222, 232, 242, 252) for electrically connecting the contact device (200) to a terminal (105, 107) of the switching pole (100);
   - a braided flexible structure (213, 223, 233) extending in a plane for electrically connecting the inner terminal (211, 221, 231, 241, 251) with the outer terminal (212, 222, 232, 242, 252) such that the inner terminal (211, 221, 231, 241, 251) is movable relative to the outer terminal (212, 222, 232, 242, 252) and in a direction (224) traverse to the plane from an off-position (290) to an on-position (292) of the switching pole (100).

2. The contact device (200) of claim 1, wherein the braided flexible structure (213, 223, 233) has the shape of a circular disk, an elliptical disk or a segment of a circular or elliptical disk.

3. The contact device (200) of claim 1, wherein the braided flexible structure (213, 223, 233) has a rectangular shape, a triangular shape or a segment of a rectangular or triangular shape.

4. The contact device (200) of anyone of claims 1 to 3, wherein the inner terminal (211, 221, 231, 241, 251) comprises an inner link (230) for electrically connecting the inner terminal (211, 221, 231, 241, 251) to the moving contact (103) and/or to an actuating device (106) of the moving contact (103) of the switching pole (100).

5. The contact device (200) of anyone of claims 1 to 4, wherein the inner terminal (211, 221, 231, 241, 251) comprises metal and is connected to the braided flexible structure (213, 223, 233) by being pressed or press-welded to an inner cut (226) of the braided flexible structure (213, 223, 233); and/or
   wherein the outer terminal (212, 222, 232, 242, 252) comprises metal and is connected to the braided flexible structure (213, 223, 233) by being pressed

or press-welded to an outer cut (227) of the braided flexible structure (213, 223, 233).

6. The contact device (200) of anyone of claims 1 to 5, wherein the outer terminal (212, 222, 232, 242, 252) comprises at least one outer link (228, 229) for electrically and mechanically connecting the outer terminal (212, 222, 232, 242, 252) to the terminal of the switching pole (100); wherein the at least one outer link (228, 229) is at least one axial recess (228) in an axial direction (224) for receiving fixing screws (208) or at least one radial recess (229) in a radial direction (222) transversal to the axial direction (224).

7. The contact device (200) of anyone of claims 1 to 6, wherein the braided flexible structure (213, 223, 233) comprises at least one segment (202) which is adapted to be manufactured as a single piece; and wherein the at least one segment (202) is adapted to be electrically connected to one of

a) the inner terminal (211, 221, 231, 241, 251) and the outer terminal (212, 222, 232, 242, 252),
b) at least one inner segment part (231) of the inner terminal (211, 221, 231, 241, 251) and at least one outer segment part (232) of the outer terminal (212, 222, 232, 242, 252),
c) the inner terminal (211, 221, 231, 241, 251) and the at least one outer segment part (232), and
d) the at least one inner segment part (231) and the outer terminal (212, 222, 232, 242, 252).

8. The contact device (200) of anyone of claims 1 to 7, wherein the inner terminal (211, 221, 231, 241, 251) comprises an inner connecting face (270) for electrically connecting the inner terminal (211, 221, 231, 241, 251) to the braided flexible structure (213, 223, 233);
wherein the outer terminal (212, 222, 232, 242, 252) comprises an outer connecting face (272) for electrically connecting the outer terminal (212, 222, 232, 242, 252) to the braided flexible structure (213, 223, 233),wherein the inner connecting face (270) is higher than the outer connecting face (272) and can therefore enable a disk-shaped flexible conductor with an electrical cross-section that does not have to become smaller in the vicinity of the centre of the pole.

9. Switching pole (100) for an electric and/or electronic application, comprising:

- a terminal (105, 107);
- a movable contact (103);
- a fixed contact (102) electrically connected to another terminal (101) of the switching pole (100);
- a contact device (200) according to anyone of claims 1 to 8 for electrically connecting the terminal (105, 107) with the movable contact (103) such that the movable contact (103) is movable relative to the terminal (105, 107) to an on-position (292) to electrically connect the movable contact (103) to the fixed contact (102) when the switching pole (100) is switched on or to an off-position (290) to electrically disconnect the movable contact (103) from the fixed contact (102) when the switching pole (100) is switched off.

10. The switching pole (100) of claim 9, further comprising:

- at least one fixing device (208, 216, 286) for fixing the contact device (200) to the terminal (105, 107), the fixing device (208, 216, 286) comprising at least one of:

a) at least one fixing screw (208) for electrically and mechanically connecting the outer terminal (212, 222, 232, 242, 252) of the contact device (200) to the terminal (105, 107) of the switching pole (100),
b) a mounting component (216) such as a ring (216) with an outside thread to press the outer terminal (212, 222, 232, 242, 252) into a groove (285) of the terminal (105, 107), wherein the terminal (105, 107) comprises a corresponding internal thread to host the threaded mounting component (216), and/or
c) a friction welding component (286) for friction welding the outer terminal (212, 222, 232, 242, 252) of the contact device (200) to the terminal (105, 107) of the switching pole (100).

11. Method (300) of manufacturing a contact device (200) for a switching pole (100) of an electric and/or electronic application according to anyone of claims 1 to 8, the method (300) comprising the steps of:

- manufacturing (301) a braided flexible structure (213, 223, 233);
- electrically connecting (302) an inner terminal (211, 221, 231, 241, 251) to the braided flexible structure (213, 223, 233);
- electrically connecting (303) an outer terminal (212, 222, 232, 242, 252) to the braided flexible structure (213, 223, 233).

12. Method (400) of manufacturing a switching pole (100) according to claim 9 or 10, the method (400) comprising the steps of:

- manufacturing (300) a contact device (200) according to the method (300) of claim 11;
- electrically connecting (402) the outer terminal (212, 222, 232, 242, 252) of the contact device (200) to the terminal of the switching pole (100); and
- electrically connecting (403) the inner terminal (211, 221, 231, 241, 251) of the contact device (200) to the moving contact (103) of the switching pole (100).

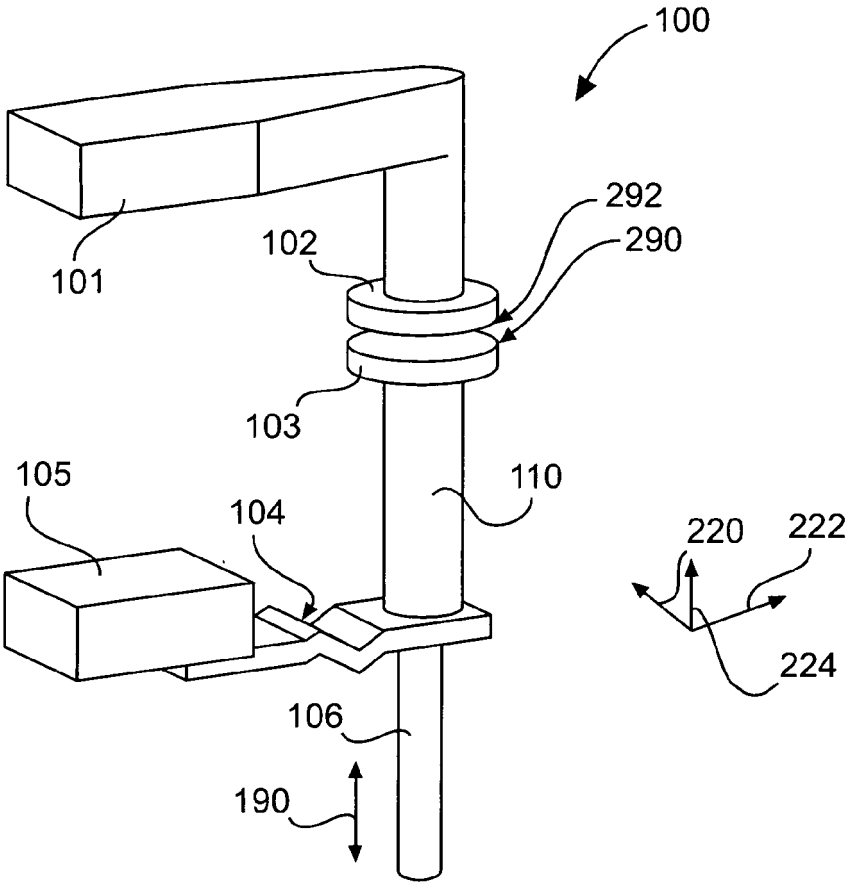
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Fig. 1

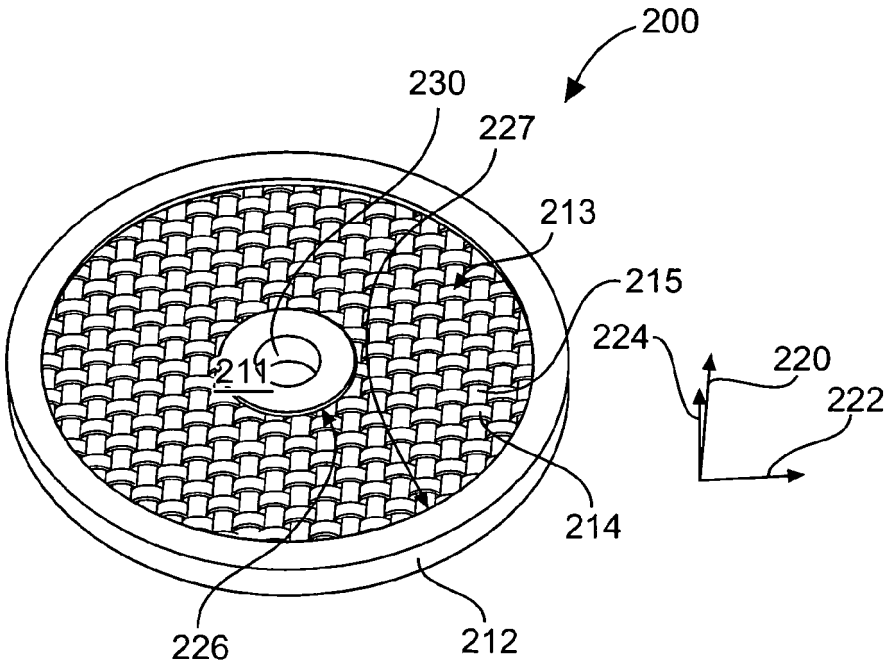
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Fig. 2

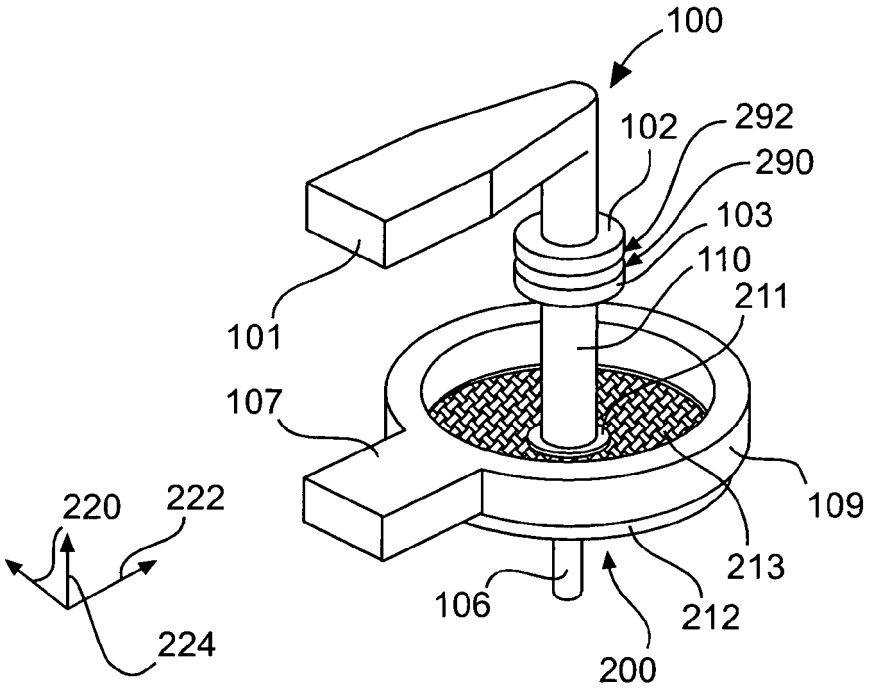
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Fig. 3

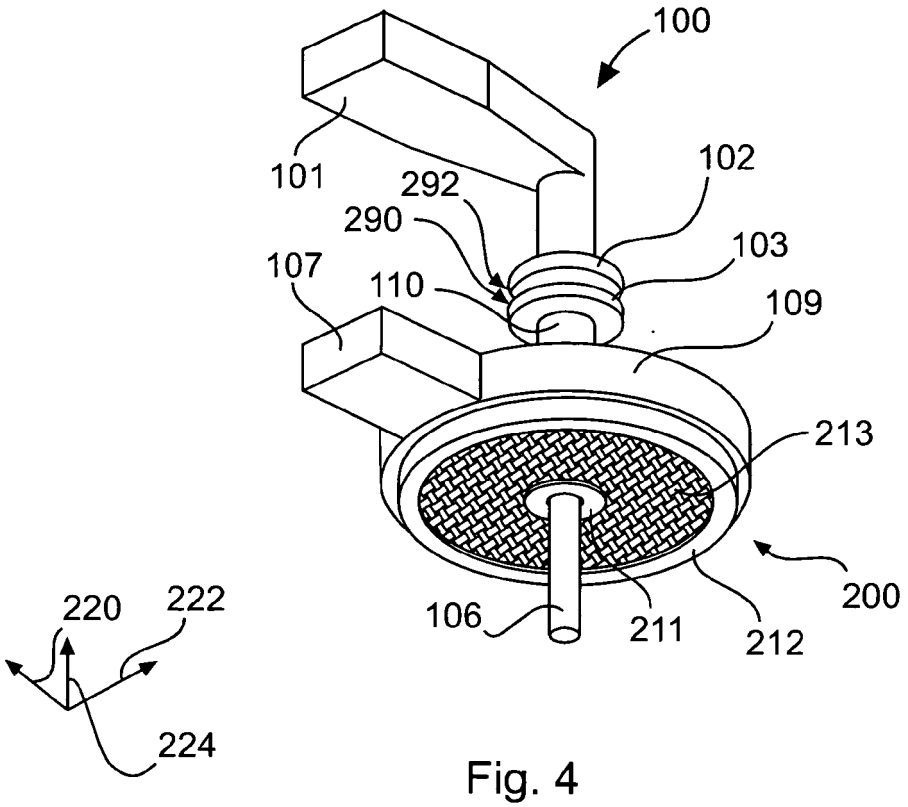
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Fig. 4

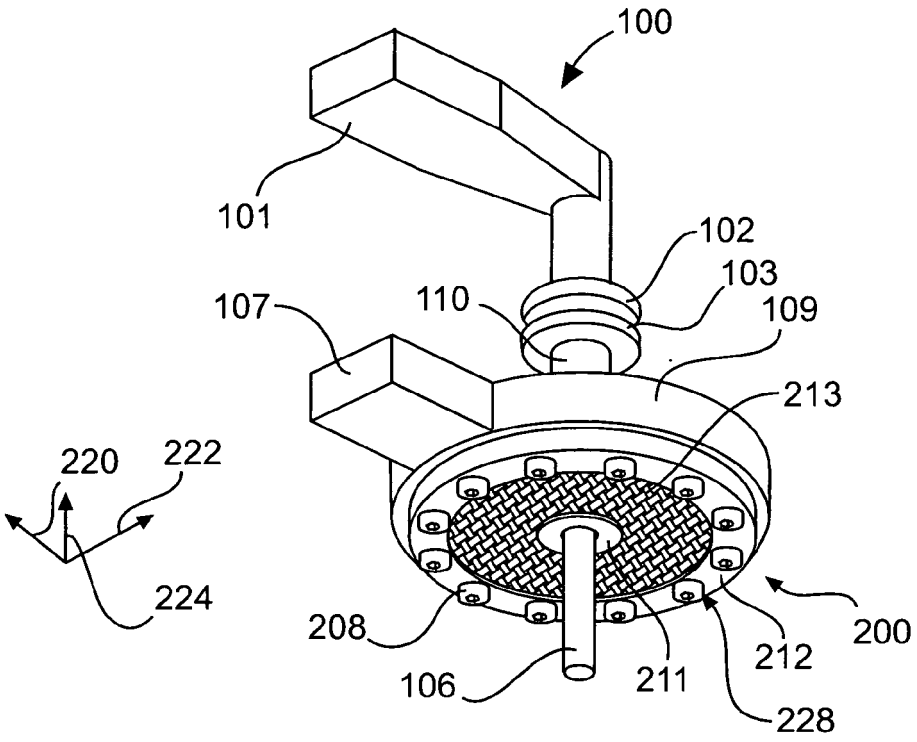
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Fig. 5

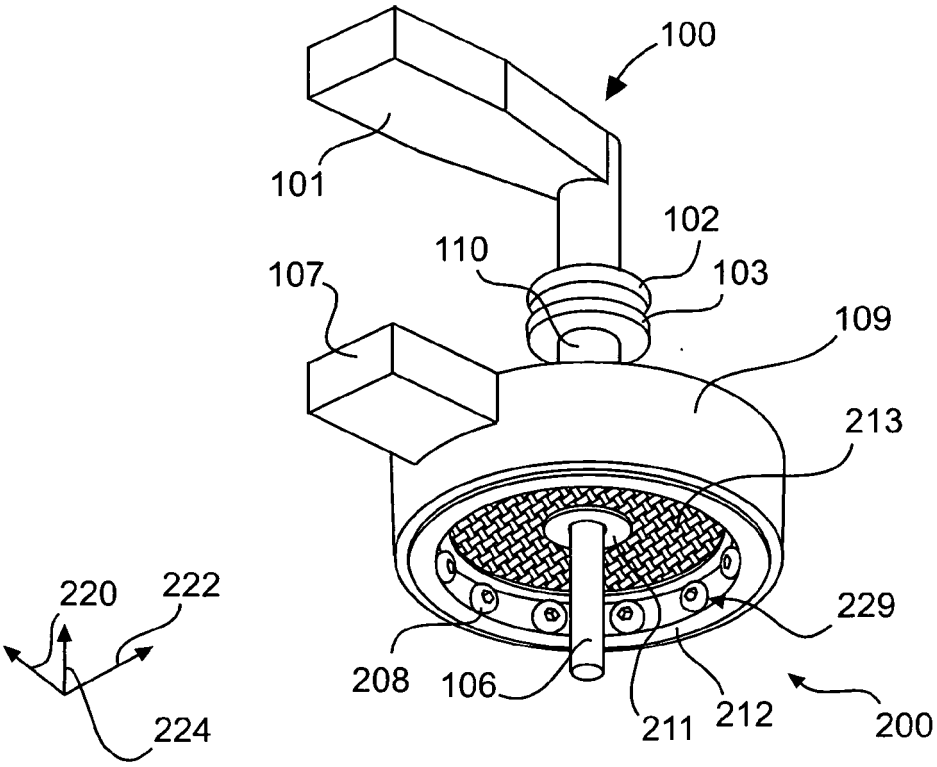
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Fig. 6

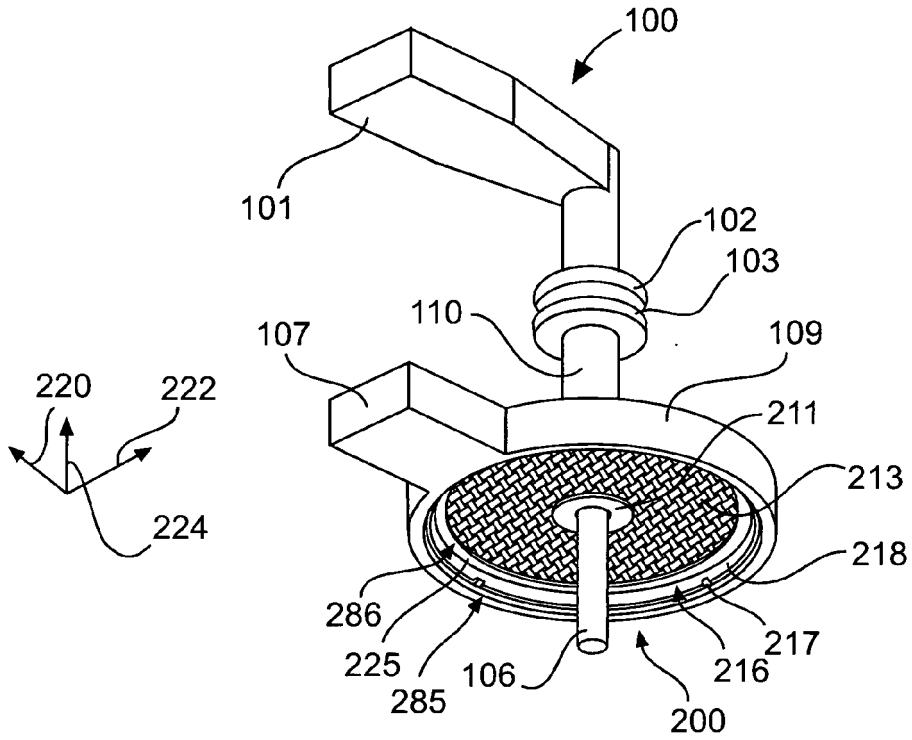

Fig. 7

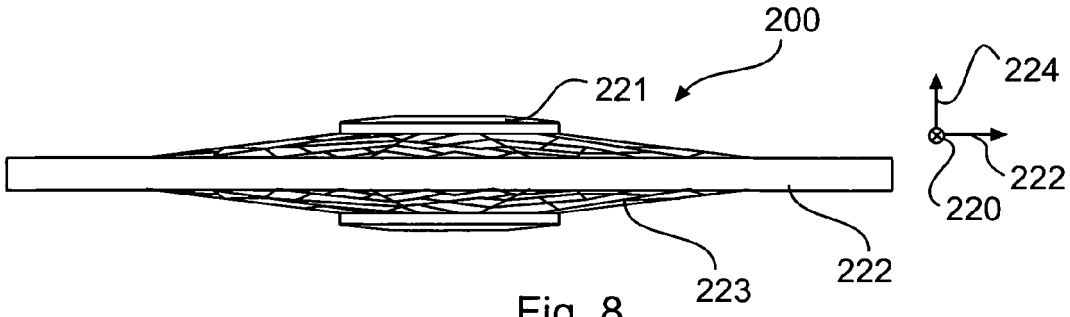

Fig. 8

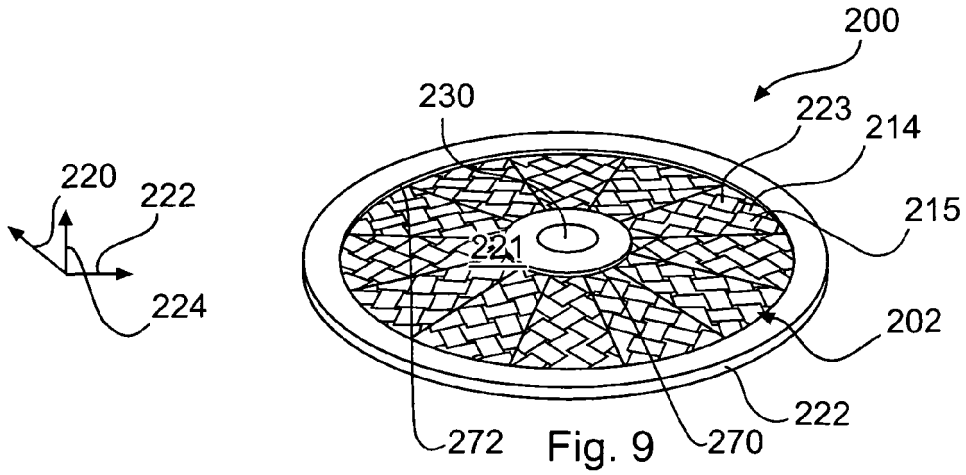

Fig. 9

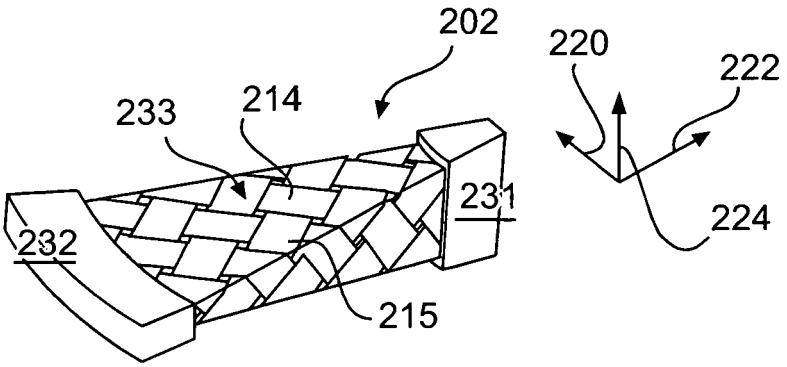

Fig. 10

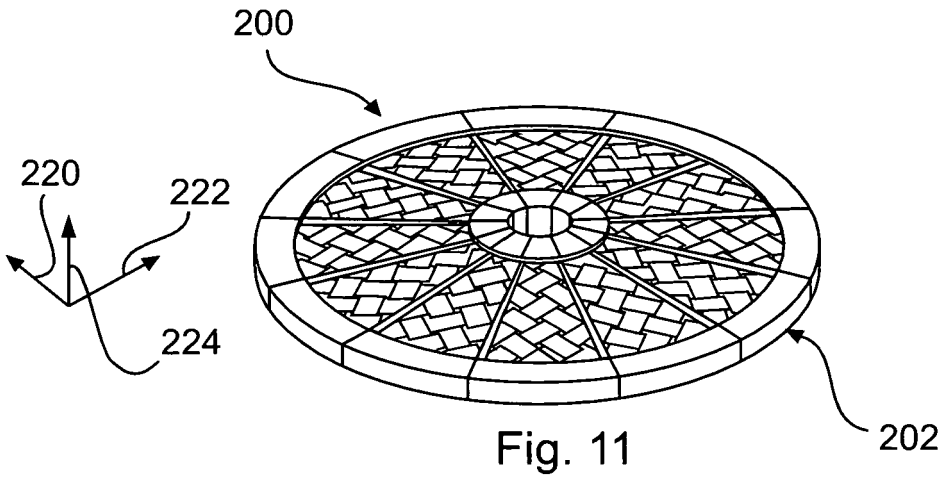

Fig. 11

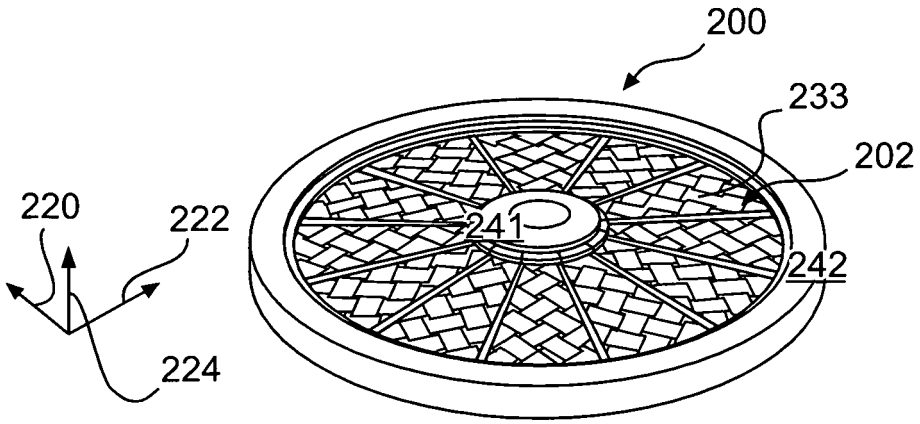

Fig. 12

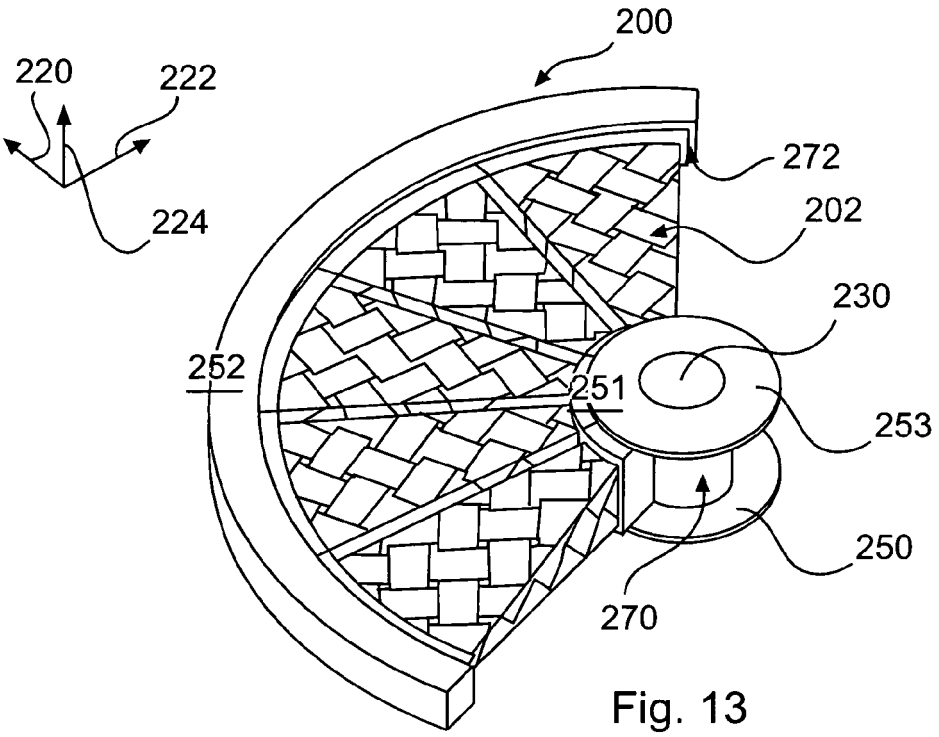

Fig. 13

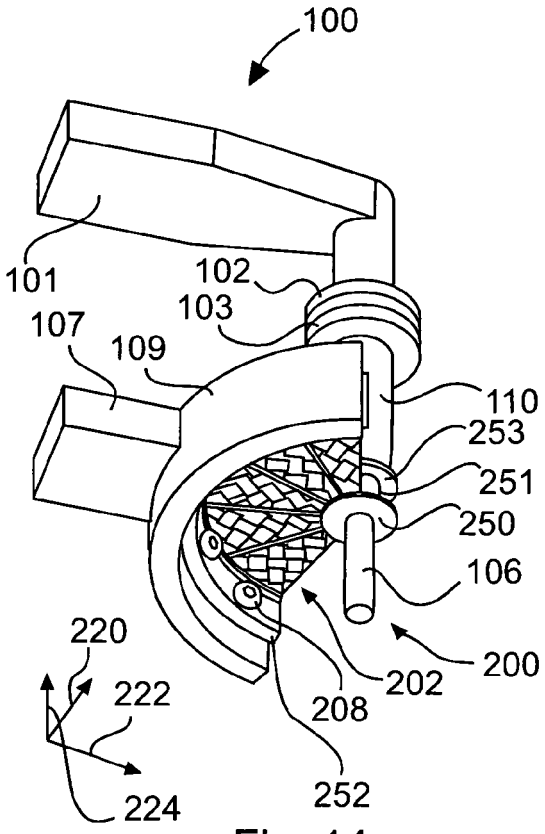

Fig. 14

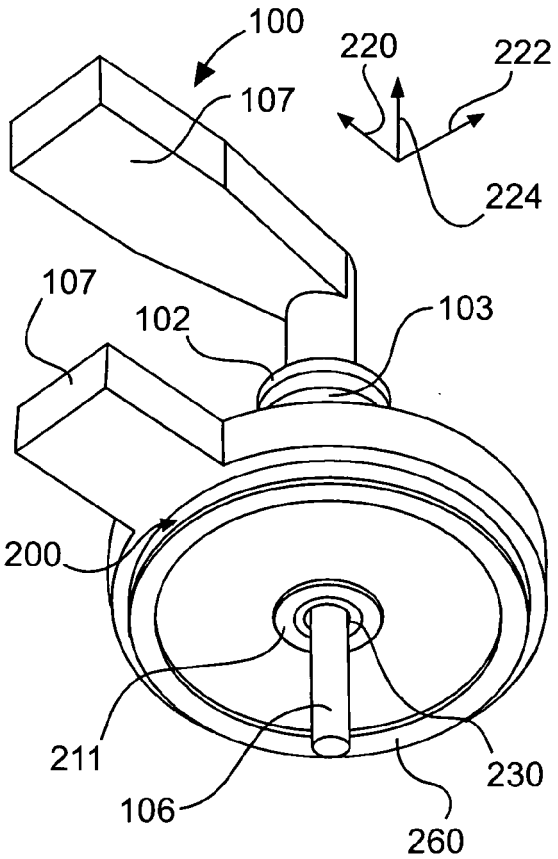

Fig. 15

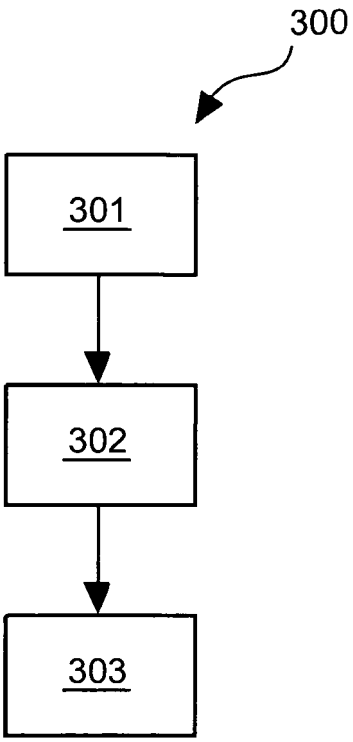

Fig. 16

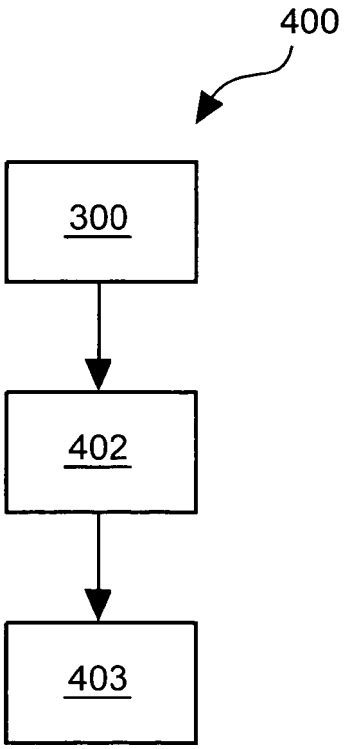

Fig. 17

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EUROPEAN SEARCH REPORT

Application Number
EP 11 00 6249

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2008/028672 A1 (SWITCHCRAFT EUROP GMBH [DE]; BODENSTEIN KLAUS [DE]; LANGE DETLEF [DE]) 13 March 2008 (2008-03-13) * page 8, line 18 - page 10, line 33; figures 3-7 *	1,2,4-12	INV. H01H1/58 ADD. H01H33/66
X	US 3 665 350 A (KLINT ROBERT V) 23 May 1972 (1972-05-23) * column 3, lines 1-49; figures 1,2 *	1,3-6, 9-12	
A	US 2005/219022 A1 (BATTEUX PIERRE [FR] ET AL) 6 October 2005 (2005-10-06) * paragraphs [0059], [0060], [0066]; figures 3,14 *	1	
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H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	3 January 2012	Glaman, C

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EPO FORM 1503 03.82 (P04C01)

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