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(54) **An auxiliary contact device for mv switching apparatuses**

Hilfskontaktvorrichtung für Mittelspannungsschaltvorrichtungen

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Description

[0001] The present invention relates to an auxiliary contact device for medium voltage (MV) switching apparatuses, such as circuit breakers, contactors, disconnectors and the like.

[0002] For the purposes of the present application, the term "medium voltage" is referred to apparatuses working in the range of between 1 and 50 kV. The document "EP 2 028 674 A2" discloses an auxiliary contact device for MV switching apparatuses, according to the preamble of claim 1.

[0003] It is widely known the use of auxiliary contact devices in MV switchboards.

[0004] In a MV switchboard, an auxiliary contact device is typically operatively associated to a main switching apparatus.

[0005] In particular, the auxiliary contact device is coupled with an actuating member of the main switching apparatus and is driven by said actuating member to switch between different switching states that correspond to different switching conditions of the main switching apparatus.

[0006] Typically, an auxiliary contact device comprises a plurality of pairs of fixed contacts and a plurality of movable contacts.

[0007] The movable contacts are arranged on a driving shaft that is coupled with the actuating member of the main switching apparatus.

[0008] Depending on the switching conditions of the main switching apparatus, the actuating member transmits a translational movement to the driving shaft and the movable contacts are shifted in a coupling or an uncoupling position with the corresponding fixed contacts.

[0009] The coupling/uncoupling of a movable contact with the corresponding fixed contacts determine the passage/interruption of a signaling current through the fixed contacts.

[0010] The signaling current is received or monitored by a signaling device that is thus capable of signalling the transition of the main switching apparatus towards a certain switching condition. Currently available auxiliary contact devices have some drawbacks.

[0011] On the field experience has widely shown that chattering phenomena often arise at the electric contacts of the auxiliary contact device, particularly when the driving shaft is subject to undesired vibrations or other mechanical stresses.

[0012] This problem may lead to a wrong signaling of the switching condition of the main switching apparatus, with consequent possible malfunctions of the MV switchboard.

[0013] Another drawback of traditional auxiliary contact devices consists in that they are often characterized by a relatively low interruption capacity.

[0014] The practice has shown that discharges between the electric contacts may occur even when the movable contact is in an uncoupling position with respect

of the corresponding fixed contact. Such an inconvenience may lead to a wrong signaling of the switching condition of the main switching apparatus or determine the arising of electric faults.

[0015] It is an object of the present invention to provide an auxiliary contact device for MV switching apparatuses that allows to overcoming the above-mentioned problems.

[0016] More in particular, it is an object of the present invention to provide an auxiliary contact device, which allows to obtaining a reliable signaling of a switching condition of the main switching apparatus, to which the auxiliary contact device is operatively associated.

[0017] Yet another object of the present invention is to provide an auxiliary contact device, which has an improved interruption capacity with respect to currently available auxiliary contact devices. Another object of the present invention is to provide an auxiliary contact device, which can be easily manufactured at industrial and at competitive costs.

[0018] The present invention thus provides an auxiliary contact device for MV switching apparatuses, according to the following claim 1 and related dependent claims.

[0019] In a general definition, the auxiliary contact device, according to the invention, comprises a fixed contact sub-assembly, which comprises at least a pair of fixed contacts, a movable contact sub-assembly, which comprises at least a movable contact that is rotary couplable with said fixed contacts, and an operating shaft that comprises a first shaft portion, operatively coupled with a linear actuator, and a second shaft portion, operatively coupled with said movable contact sub-assembly.

[0020] According to the invention, the first and second shaft portions of said shaft are coupled each other and move linearly together between a first position and a second position, said second shaft portion being free to rotate with respect to said first shaft portion, between a third and fourth position.

[0021] In a preferred embodiment of the present invention, the fixed contact sub-assembly comprises a base, with which said second shaft portion is coupled, so as to determine a rotation of said second shaft portion between said third and fourth position.

[0022] Preferably, said second shaft portion is operatively coupled with the base of the fixed contact sub-assembly by means of a screw coupling arrangement.

[0023] Preferably, said first shaft portion comprises a first end that is operatively coupled with a third end of said second shaft portion by means of a coupling arrangement that is configured to prevent a relatively motion of said first and second shaft portions along a linear movement direction.

[0024] In a preferred embodiment of the present invention, said movable contact sub-assembly comprises an insulating support, operatively coupled with said second shaft portion, and at least a conductive contact blade rigidly coupled with said insulating support.

[0025] Preferably, said movable contact sub-assembly

comprises a pair of conductive contact blades rigidly coupled with said insulating support.

[0026] Preferably, said second shaft portion is operatively coupled with said movable contact sub-assembly, so that a rotary movement only is transmitted between these elements.

[0027] In particular, said second shaft portion comprises a fourth end inserted in a cavity of said insulating support, said fourth end travelling idle and linearly in said cavity and being shaped so that the rotary motion between said third and fourth position is transmitted between said fourth end and said insulating support.

[0028] In a preferred embodiment of the present invention, said fixed contact sub-assembly comprises a plurality of pairs of fixed contacts and said movable contact sub-assembly comprises a plurality of corresponding movable contacts, each rotary couplable with a corresponding pair of fixed contacts.

[0029] Preferably, said movable contact sub-assembly comprises a plurality of insulating supports and corresponding conductive contact blades stacked each other along an axis parallel to the linear movement direction of said first and second shaft portions.

[0030] Preferably, a pair of conductive contact blades is rigidly coupled with one or more of said insulating supports, each pair of conductive contact blade forming a movable contact rotary couplable with a corresponding pair of fixed contacts.

[0031] Further characteristics and advantages of the invention will emerge from the description of preferred, but not exclusive, embodiments of the auxiliary contact device, according to the invention, non-limiting examples of which are provided in the attached drawings, wherein:

Figure 1 shows a schematic exploded view of the auxiliary contact device, according to the invention, in a preferred embodiment;

Figure 2 shows some schematic views of the auxiliary contact device shown in Figure 1;

Figure 3 shows a schematic exploded view of a sub-assembly in the auxiliary contact device shown in Figure 1;

Figure 4 shows a further schematic exploded view of the sub-assembly shown in Figure 3;

Figure 5 shows some views of a component of the auxiliary contact device shown in Figure 1;

Figure 6 shows some views of a component of the auxiliary contact device shown in Figure 1;

Figure 7 shows some views of a component of the auxiliary contact device shown in Figure 1;

Figure 8 shows further views of the component shown in Figure 7;

Figure 9 shows a view of a component of the auxiliary contact device shown in Figure 1;

Figure 10 shows a view of a component of the auxiliary contact device shown in Figure 1.

[0032] Referring to the cited figures, the present inven-

tion relates to an auxiliary contact device 1 for MV switching apparatuses.

[0033] When installed in a MV switchboard, the auxiliary contact device 1 is operatively associated with a linear actuator (not shown) of a main switching apparatus, i.e. with an actuator that is able to transmit a translational motion along a linear movement direction 100 (figure 1).

[0034] The auxiliary contact device 1 comprises a fixed contact sub-assembly 2 and a movable contact sub-assembly 3.

[0035] Preferably, the fixed contact sub-assembly 2 comprises a base 23 and a cover 24 that is coupled with said base, so as to define an internal volume 10 for accommodating the movable contact sub-assembly 3.

[0036] The fixed contact sub-assembly 2 comprises at least a pair of fixed contacts 21, which preferably have a first portion 211 inside the internal volume 10 and a second portion 212 outside said internal volume.

[0037] Conveniently, the portions 211 and 212 may have L-shaped profiles, as shown in figure 9, in order to reduce the overall size of the fixed contact sub-assembly 2.

[0038] However, the electric contacts 21 may be differently shaped, according to the needs. Preferably, the fixed contacts 21 are operatively associated with a signalling device (not shown), which is advantageously capable of receiving or monitoring a signalling current possibly flowing through said fixed contacts.

[0039] The movable contact sub-assembly 3 comprises at least a movable contact 31A, 31B that is rotary couplable with the fixed contacts 21.

[0040] In a preferred embodiment, the fixed contact sub-assembly 2 comprises a plurality of pairs of fixed contacts 21 and the movable contact sub-assembly 3 comprises a plurality of corresponding movable contacts 31A, 31B rotary couplable with said fixed contacts.

[0041] The auxiliary contact device 1 comprises also an operating shaft 4, which is operatively coupled with the mentioned linear actuator (not shown) and the movable contact sub-assembly 2.

[0042] The shaft 4 comprises a first shaft portion 41 that is operatively coupled with the linear actuator, and a second shaft portion 42, which is operatively coupled with the movable contact sub-assembly 2.

[0043] According to the invention, the shaft portions 41, 42 are coupled each other and move linearly together between a first and a second position.

[0044] As is apparent from figure 4, the shaft portions 41, 42 may advantageously extend along different longitudinal axes 410 and 420 that are parallel with the linear movement direction 100.

[0045] Such a solution allows to reducing the overall size of the fixed contact sub-assembly 2 for a given internal volume 10 needed for accommodating the mobile contact sub-assembly 3. However, as an alternative, the shaft portions 41, 42 may be aligned along a same axis. Preferably, the first shaft portion 41 comprises a first end 411 and a second end 412.

[0046] Such first end 411 is advantageously operatively coupled with a third end 421 of the shaft portion 42.

[0047] Preferably, the first end 411 is shaped so as to define a retaining surface 413 that matches a coupling surface 424 of the third end 421 of the shaft portion 42.

[0048] The coupling arrangement 413, 424 between the ends 411, 421 of the shaft portions 41, 42 is advantageously configured to prevent a relative motion (or separation) of the shaft portions 41, 42 along the linear movement direction 100.

[0049] Such coupling arrangement 413, 424 thus ensures that the shaft portions 41, 42 move rigidly together along the linear movement direction 100.

[0050] The second end 412 of the first shaft portion 41 is operatively coupled with the linear actuator. As shown in the attached figures, the second end 412 may comprise a fork-shaped head configured to be coupled with a motion transmission member of the linear actuator.

[0051] However, the second end 412 may comprise a differently shaped head, such as a polygonal head or a rounded head, according to the needs.

[0052] The second shaft portion 42 preferably comprises the above mentioned third end 421, which is advantageously shaped so as to define the coupling surface 424 matching with the coupling surface 413 of the first end 411 of the first shaft portion 41.

[0053] The second shaft portion 42 comprises also a fourth end 422 that is operatively coupled with the mobile contact sub-assembly 3.

[0054] According to the invention, the second shaft portion 42 is free to rotate with respect to the first shaft portion 41, between a third and fourth position.

[0055] In a preferred embodiment, the second shaft portion 42 is operatively coupled with the base 23 of the fixed contact sub-assembly 2, in such a way to determine the rotation of the second shaft portion 42 between a third and fourth position, when the first and second shaft portions 41, 42 move linearly together between a first and second position.

[0056] Preferably, the shaft portion 42 is coupled with the base 23 through a screw coupling arrangement 424, 231.

[0057] Conveniently, the shaft portion 42 comprises a groove 423 that has a helical profile extending along the axis 420. The groove 423, which apparently forms a female thread, is advantageously coupled with a tooth 231 protruding from the base 23 and forming a corresponding male thread.

[0058] The illustrated screw coupling arrangement above illustrated may be differently designed, for example such that a female thread is obtained at the base 23 and a male thread is obtained at the second shaft portion 42.

[0059] The described screw coupling arrangement between the shaft portion 42 and the base 23 causes a rotary movement of the second shaft portion 42, when the shaft portions 41, 42 move linearly.

[0060] The free rotation of the shaft portion 42 is not

prevented by the described coupling arrangement between the ends 411, 421 of the shaft portions 41, 42, which is configured to merely maintain coupled the shaft portions 41, 42 along the linear movement direction 100.

[0061] In this manner, when the shaft portions 41, 42 move linearly together between a first and second position (in parallel with the linear movement direction 100), the second shaft portion 42 freely rotates around its axis 420 between a third and fourth position.

[0062] Therefore, while the first shaft portion 41 performs a translational movement only, the second shaft portion 42 performs a rotary-translational movement.

[0063] Preferably, the movable contact sub-assembly 3 comprises at least an insulating support 31 and at least a conductive contact blade 31A, 31B, rigidly coupled with said insulating support. Said at least a contact blade 31A, 31B forms a movable contact of the movable contact sub-assembly 3, which is rotary couplable with a corresponding pair of fixed contacts 21 of the fixed contact subassembly 3.

[0064] Preferably, the insulating support 31 has a central body 312 with a first surface 3121 and a second surface 3124.

[0065] Preferably, the first surface 3121 is provided with first engaging means 3122 matching with second engaging means 3123 that are positioned on the second surface 3124.

[0066] Preferably, the first engaging means 3122 are protrusions obtained on the first surface 3121 while the second engaging means 3123 are seats obtained on the second surface 3124 and matching the protrusions 3122.

[0067] The insulating support 31 advantageously comprises a cavity 311, which preferably passes through the entire length of said insulating support.

[0068] Preferably, the insulating support 31 is operatively coupled with the second shaft portion 42, at the fourth end 422 of this latter.

[0069] The end 422 of the second shaft portion 42 is inserted in the cavity 311 and is advantageously capable of travelling idle and linearly along said cavity.

[0070] Thanks to such an idle travelling of the end 422 along the cavity 311, even if the second shaft portion 42 performs a rotary-translational motion as illustrated above, there is no transmission of translational motion between the second shaft portion 42 and the insulating support 31 (and, more generally, the movable contact sub-assembly 3).

[0071] However, the second shaft portion 42 is coupled with the insulating support 31, so that a rotary motion can be transmitted between the second shaft portion 42 and the insulating support 31 (and, more generally, the movable contact sub-assembly 3).

[0072] In fact, the end 422 of the second shaft portion 42 is shaped in such a way that a rotary motion between said third and fourth position, is transmitted between the second shaft portion 42 and the insulating support 31.

[0073] Preferably, the end 422 comprises a shaped head 422A that matches with a corresponding internal

surface 311A of the cavity 311, in such a way that a rotary motion between the second shaft portion 42 and the insulating support 31 can be transmitted.

[0074] Preferably, as shown in the attached figures, the shaped head 422A and the coupling surface 311A have square-shaped profiles matching each other.

[0075] However, other matching profiles may be conveniently selected to ensure an effective transmission of the rotary motion between the second shaft portion 42 and the insulating support 31.

[0076] According to a preferred embodiment, as shown in the cited figures, the movable contact sub-assembly 3 comprises a plurality of insulating supports 31 and corresponding conductive contact blades 31A, 31B, which are stacked each other along an axis parallel to the linear movement direction 100.

[0077] Preferably, the insulating supports 31 and the corresponding contact blades 31A, 31B are stacked along the same axis 420 of the second shaft portion 42.

[0078] The stacking of the insulating supports 31 may be advantageously obtained by juxtaposing the first surface 3121 of each insulating support with the second surface 3124 of the following one, according to a distal direction from the second shaft portion 42.

[0079] The first engaging means 3122 of each insulating support can thus be coupled with the second engaging means 3123 of the following one.

[0080] As mentioned above, at least a contact blade 31A, 31B is rigidly coupled with a corresponding insulating support 31, at the first surface 3121 of this latter.

[0081] Preferably, the movable contact sub-assembly 3 comprises a pair of conductive contact blades 31A, 31B rigidly coupled with one or more insulating supports 31, at the first surface 3121 of said insulating supports.

[0082] Each pair of contact blades 31A, 31B forms a movable contact that is rotary couplable with a corresponding pair of fixed contacts 21.

[0083] Each pair of contact blades 31A, 31B can be coupled with the first surface 3121 of the corresponding insulating support 31, according to different positions shifted of a predefined angle, preferably of 90°.

[0084] In this manner, the contact blades 31A, 31B associated to each insulating support 31 may be conveniently arranged, so as to be coupled or uncoupled with a corresponding pair of fixed contacts 21 of the fixed contact assembly 2, when the associated insulating support 31 occupies a third or fourth position.

[0085] The movable contacts 31A, 31B of the movable contact assembly 3 will be of a "normally-on" type or a "normally-off" type depending on the circumstance that they are coupled or uncoupled with the corresponding fixed contacts 21, when the auxiliary contact device 1 is in a normal operative condition, corresponding to a normal switching condition of the main switching apparatus.

[0086] From the above, it is apparent that the movable contact sub-assembly 3 comprises a modular structure 300, extending along an axis parallel to the linear movement direction 100.

[0087] In such a modular structure, the insulating support 31, positioned in the closest position with respect to the second shaft portion 42, is operatively coupled with the second end 422 of the second shaft portion 42.

[0088] All the insulating supports 31 are stacked each other along an axis (e.g. the axis 420) and are capable of transmitting each other a rotary motion, between said a third and fourth position. Each pair of contact blades 31A, 31B of the modular structure 300 rotates together with the corresponding insulating support 31, with which it is rigidly coupled.

[0089] The adoption of said modular structure provides relevant advantages in terms of reduction of time and costs for manufacturing at industrial level the auxiliary contact device 1.

[0090] According to a preferred embodiment, each contact blade of a movable contact 31A, 31B is formed by a flat central ring 315, from which two symmetric T-shaped wings 316 extend outwardly and transversally with respect to said central ring.

[0091] The contact blades 31A, 31B are coupled each other at their central rings 315 along a common contact plane (not shown) when the movable contacts are formed by pairs of contact blades. Advantageously, the contact blades 31A, 31B are reciprocally positioned, so that the T-shaped wings 316 of each contact blade diverge from said common contact plane, at opposite sides thereof.

[0092] When coupled along said common contact plane, the contact blades 31A, 31B are reciprocally positioned, so that each T-shaped wing 316 of the contact blade 31A is placed at an opposite position with respect to a corresponding T-shaped wing 316 of the contact blade 31B, taking said common contact plane as a reference plane.

[0093] Each couple of opposite T-shaped wings 316 is configured to be coupled with a L-shaped portion 211 of the electric contact 21.

[0094] As shown in figure 10, the profile of the T-shaped wings 316 may thus be properly arranged, so that stable coupling between the opposite T-shaped wings 316 and the corresponding electric contact 21 can be established.

[0095] Preferably, the auxiliary contact device 1 comprises a first return spring 51 that is operatively coupled with the second shaft portion 42 and the movable contact assembly 2, so as to oppose the linear movement of the shaft portions 41 and 42 from said first position towards said second position, or viceversa.

[0096] The first return spring 51 is advantageously coaxially coupled with the end 422 of the second shaft portion 42.

[0097] As shown in figure 1, the first return spring 51 may be placed externally with respect to the movable contact sub-assembly 3.

[0098] Alternatively, the first return spring 51 may be positioned inside the cavity 311 of the insulating support 31 that is coupled with the end 422 of the second shaft portion 42.

[0099] Preferably, the auxiliary contact device 1 comprises also a second return spring 52 that is operatively coupled with movable contact sub-assembly 3 and the fixed contact sub-assembly 2, so as to oppose the rotary movement of the insulating supports 31 from said third position towards said fourth position, or viceversa.

[0100] Advantageously, the second return spring 52 is a helicoidal spring that is operatively coupled with the first surface 3121 of the insulating support 31 that is positioned at the farthestmost position with respect to the second shaft portion 42.

[0101] The operation of the auxiliary contact device 1 is now described in more details.

[0102] In a normal working condition, which may correspond to a normal first switching condition (for example an ON switching condition) of the main switching apparatus, the shaft portions 41, 42 occupy a first position (along the linear movement direction 100) and the shaft portion 42 and the movable contact assembly 3 occupy a third position (in relation to their rotary movement around the axis 420).

[0103] When the main switching apparatus passes from the first switching condition to a second switching condition (for example an OFF switching condition), the linear actuator transmits a linear movement to the shaft 4, along the linear movement direction 100.

[0104] The first shaft portion 41 and the second shaft portion 42 move together with a linear movement from the first position to a second position, due to the coupling arrangement 413, 424 between their ends 411 and 421.

[0105] The end portion 422 of the second shaft portion 42 idle travels along the cavity of 311 of the insulating support 31 operatively coupled with it, so that no translational movement is transmitted to the movable contact sub-assembly 3.

[0106] The linear movement of the first shaft portions 41, 42 determines also a compression of the first return spring 51, which stores elastic energy.

[0107] During the linear movement of the shaft portions 41, 42, the second shaft portion 42 freely rotates around the axis 420 from the third position to a fourth position, thanks to its screw coupling with the base 23.

[0108] Such a rotational movement towards said fourth position is transmitted to all the insulating supports 31 of the movable contact assembly 3, which thus rotates towards the fourth position as well.

[0109] Also the movable contacts (preferably each formed by a pair of contact blades 31A, 31B) of the movable contact assembly 3 rotate towards said fourth position, given the fact that each pairs of contact blades 31A, 31B is rigidly coupled with a corresponding insulating support 31. During the rotary movement of the movable contact assembly 3, the second returns spring is subject to a torsional stress and stores elastic energy.

[0110] When the rotary movement towards the fourth position is completed, the movable contacts of the movable contact assembly 3 are in a coupling or an uncoupling position with the corresponding pair of fixed con-

tacts 21, depending on the coupling position with which each pair of contact blades 31A, 31B is coupled with the corresponding insulating support at the first surface 3121 of this latter.

[0111] If a movable contact is of the "normally off" type, it is now in a coupling position with the corresponding fixed contacts 21 and a signaling current circulates between the fixed contacts 21.

[0112] A signalling device, operatively associated with said fixed contacts, detects the flowing of said signaling current and can thus signal the transition of the main switching apparatus towards the mentioned second switching condition.

[0113] If a movable contact is of the "normally on" type, it is now in an uncoupling position with the corresponding fixed contacts 21 and the signaling current, which was previously circulating through the electric contacts 21, stops flowing.

[0114] A signalling device, operatively associated with said fixed contacts, detects the interruption of said signaling current and can thus signal the transition of the main switching apparatus towards the mentioned second switching condition.

[0115] When the main switching apparatus returns to the first switching condition, if the linear actuator is arranged to actively actuate the shaft 4 in an inverse manner, an inverse linear movement is transmitted to the shaft 4.

[0116] In this case, the shaft portions 41, 42 and the movable contact assembly 3 merely perform inverse movements with respect to those described above.

[0117] The shaft portions 41, 42 return to the first position along the linear movement direction 100 and the shaft portion 42 and the movable contact assembly 3 rotate towards the third position. The return springs 51, 52 release their stored elastic energy and favour the movement of the shaft portions 41, 42 and the movable contact assembly 3.

[0118] If the linear actuator is arranged to simply release the shaft 4, the energy for inversely moving the shaft portions 41, 42 and the movable contact assembly 3 is provided by the return springs 51, 52 only.

[0119] The return spring 52 releases its elastic energy and forces the movable contact assembly 3 to rotate towards the third position.

[0120] Such a rotary movement is transmitted to the second shaft portion 42 that freely rotates towards the third position as well.

[0121] The rotation of the shaft portion 42 forces the shaft portions 41, 42 to move together linearly towards the first position, thanks to the screw coupling of the second shaft portion 42 with the base 23.

[0122] Such a translation towards the first position is favoured by the action of the first return spring 51, which releases its elastic energy as soon as the linear actuator releases the shaft 4 and pushes the shaft portions 41, 42 towards the first position.

[0123] In both the above described cases, when the

rotary movement towards the third position is completed, the shaft portions 41, 42 reach the first position and complete their reverse translation along the linear movement direction 100.

[0124] As to the movable contacts of the movable contact assembly 3, they are in a coupling or an uncoupling position with the corresponding pair of fixed contacts 21, depending on the coupling position with which the pair of blades 31A, 31B is coupled with the corresponding insulating support 31.

[0125] Thus, if a movable contact is of the "normally off" type, it is now in an uncoupling position and the signalling device detects the interruption of the signalling current flowing through the fixed contacts 21 and can thus signal the return of the main switching apparatus towards the first switching condition.

[0126] If a movable contact is of the "normally on" type, it is now in a coupling position and the signalling device detects the flowing of a signalling current through the fixed contacts 21 and can thus signal the return of the main switching apparatus towards the mentioned first switching condition.

[0127] The auxiliary contact device 1 of the invention has a number of advantages with respect to similar units of known type.

[0128] The described motion transmission mechanism between the shaft 4 and the movable contact assembly 3 ensures a remarkable reduction of chattering phenomena when the movable contacts of the movable contact assembly 3 are brought in a coupling position with the corresponding pair of fixed contacts 21.

[0129] On the field tests have also shown that the described motion transmission mechanism further increases the interruption capacity of the auxiliary contact device, according to the invention, with respect to known auxiliary contact devices.

[0130] The rotational movement of the movable contact sub-assembly, in fact, allows to increasing the distance between the electric contacts when the movable contacts are in an uncoupling position with respect to the corresponding fixed contacts.

[0131] As it can be appreciated from the cited figures, the auxiliary contact device 1 has a relatively simple structure, which is substantially modular and can be easily manufactured, at competitive costs.

[0132] The auxiliary contact device 1 is characterized by a remarkable flexibility in use.

[0133] This makes quite easy the installation of the auxiliary contact device 1 in a MV switchboard, in association with circuit breakers, contactors, disconnectors, and similar switching apparatuses.

Claims

1. An auxiliary contact device (1) for MV switching apparatuses **characterised in that** it comprises:

- a fixed contact sub-assembly (2) comprising at least a pair of fixed contacts (21);
- a movable contact sub-assembly (3) comprising at least a movable contact (31A, 31B) that is rotary couplable with said fixed contacts;
- an operating shaft (4) comprising a first shaft portion (41), operatively coupled with a linear actuator, and a second shaft portion (42), operatively coupled with said movable contact sub-assembly, said first and second shaft portions (41, 42) being coupled each other and moving linearly together between a first position and a second position, said second shaft portion (42) being free to rotate with respect to said first shaft portion (41), between a third and fourth position.

2. An auxiliary contact device, according to claim 1, **characterised in that** said fixed contact sub-assembly (2) comprises a base (23), said second shaft portion (42) being coupled with said base, so as to determine a rotation of said second shaft portion between said third and fourth position.
3. An auxiliary contact device, according to claim 2, **characterised in that** said second shaft portion (42) is coupled with said base (23), through a screw coupling arrangement (424, 231).
4. An auxiliary contact device, according to one or more of the previous claims, **characterised in that** said first shaft portion (41) comprises a first end (411) that is shaped so as to define a retaining surface (413) matching with a coupling surface (423) of a third end (421) of said second shaft portion (42).
5. An auxiliary contact device, according to one or more of the previous claims, **characterised in that** said movable contact sub-assembly (3) comprises an insulating support (31) and at least a conductive contact blade (31A, 31B) rigidly coupled with said insulating support, said insulating support being operatively coupled with said second shaft portion (42).
6. An auxiliary contact device, according to claim 5, **characterised in that** said movable contact sub-assembly (3) comprises a pair of conductive contact blades (31A, 31B) rigidly coupled with said insulating support (31).
7. An auxiliary contact device, according to one or more of the claims from 5 to 6, **characterised in that** said second shaft portion (42) comprises a fourth end (422) inserted in a cavity (311) of said insulating support (31), said fourth end travelling idle and linearly in said cavity and being shaped, so that the rotary motion between said third and fourth position is transmitted between said fourth (422) end and said insulating support (31).

8. An auxiliary contact device, according to claim 7, **characterised in that** the fourth end (422) of the second shaft portion (42) of said shaft (4) has a shaped head (422A) matching with a corresponding internal surface (311A) of said cavity (311). 5
9. An auxiliary contact device, according to one or more of the claims from 5 to 8, **characterised in that** said insulating support (31) has a central body (312) with a first surface (3121) having first engaging means (3122) matching second engaging means (3123) positioned on a second surface (3124) of said central body. 10
10. An auxiliary contact device, according to claim 9, **characterised in that** said first engaging means (3122) are protrusions on said first surface (3121) and said second engaging means (3123) are seats matching said protrusions on said second surface (3124). 15
11. An auxiliary contact device, according to one or more of the claims from 5 to 10, **characterised in that** said movable contact sub-assembly (3) comprises a plurality of insulating supports (31) and corresponding conductive contact blades (31A, 31B) stacked each other along an axis parallel to the linear movement direction (100) of said first and second shaft portions (41, 42). 20
12. An auxiliary contact device, according to one or more of the previous claims, **characterised in that** said fixed contact sub-assembly (2) comprises a plurality of pairs of fixed contacts (21) and said movable contact sub-assembly (3) comprises a plurality of corresponding movable contacts (31A, 31B) rotary coupleable with said fixed contacts. 25
13. An auxiliary contact device, according to claims 11 and 12 **characterised in that** said movable contact sub-assembly (3) comprises a pair of conductive contact blades (31A, 31B) rigidly coupled with one or more of said insulating supports (31). 30

Patentansprüche

1. Hilfskontakteinrichtung (1) für MV-Schaltvorrichtungen, **dadurch gekennzeichnet, dass** sie aufweist: 40
- eine Festkontakt-Untergruppe (2), die zumindest ein Paar Festkontakte (21) aufweist;
 - eine Bewegungskontakt-Untergruppe (3), die zumindest einen Bewegungskontakt (31A, 31B) aufweist, der drehend mit den Festkontakten gekoppelt werden kann;
 - eine Betriebswelle (4), die einen ersten Wellenabschnitt (41), der operativ mit einem Linea-

raktuator gekoppelt ist, und einen zweiten Wellenabschnitt (42), der operativ mit der Bewegungskontakt-Untergruppe gekoppelt ist, aufweist, wobei die ersten und zweiten Wellenabschnitte (41, 42) miteinander gekoppelt sind und sich zusammen linear zwischen einer ersten Position und einer zweiten Position bewegen, wobei der zweite Wellenabschnitt (42) im Verhältnis zu dem ersten Wellenabschnitt (41) zwischen einer dritten und einer vierten Position frei drehend ist.

2. Hilfskontakteinrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Festkontakt-Untergruppe (2) eine Basis (23) aufweist, wobei der zweite Wellenabschnitt (42) mit der Basis gekoppelt ist, um eine Drehung des zweiten Wellenabschnitts zwischen der dritten und vierten Position zu bestimmen.
3. Hilfskontakteinrichtung nach Anspruch 2, **dadurch gekennzeichnet, dass** der zweite Wellenabschnitt (42) durch eine Schraubkopplungsanordnung (424, 231) mit der Basis (23) gekoppelt ist.
4. Hilfskontakteinrichtung nach einem oder mehreren der vorgenannten Ansprüche, **dadurch gekennzeichnet, dass** der erste Wellenabschnitt (41) ein erstes Ende (411) aufweist, das so geformt ist, dass es eine Rückhaltefläche (413) abgrenzt, die zu einer Kopplungsfläche (423) eines dritten Endes (421) des zweiten Wellenabschnitts (42) passt. 30
5. Hilfskontakteinrichtung nach einem oder mehreren der vorgenannten Ansprüche, **dadurch gekennzeichnet, dass** die Bewegungskontakt-Untergruppe (3) einen Isolierträger (31) und zumindest eine leitende Kontaktlamelle (31A, 31B) aufweist, die fest mit dem Isolierträger gekoppelt ist, wobei der Isolierträger operativ mit dem zweiten Wellenabschnitt (42) gekoppelt ist. 35
6. Hilfskontakteinrichtung nach Anspruch 5, **dadurch gekennzeichnet, dass** die Bewegungskontakt-Untergruppe (3) ein Paar leitender Kontaktlamellen (31A, 32B) aufweist, die fest mit dem Isolierträger (31) gekoppelt sind. 40
7. Hilfskontakteinrichtung nach einem oder mehreren der Ansprüche 5 bis 6, **dadurch gekennzeichnet, dass** der zweite Wellenabschnitt (42) ein viertes Ende (422) aufweist, das in eine Aussparung (311) des Isolierträgers (31) eingeführt wird, wobei sich das vierte Ende in Ruhe und linear in der Aussparung bewegt und so geformt ist, dass die Drehbewegung zwischen der dritten und vierten Position zwischen dem vierten (422) Ende und dem Isolierträger (31) übertragen wird. 45

8. Hilfskontakteinrichtung nach Anspruch 7, **dadurch gekennzeichnet, dass** das vierte Ende (422) des zweiten Wellenabschnitts (42) der Welle (4) einen geformten Kopf (422A) aufweist, der zu einer entsprechenden Innenfläche (311A) der Aussparung (311) passt. 5
9. Hilfskontakteinrichtung nach einem oder mehreren der Ansprüche 5 bis 8, **dadurch gekennzeichnet, dass** der Isolierträger (31) einen Zentralkörper (312) mit einer ersten Fläche (3121) aufweist, die erste Einrastmittel (3122) aufweist, die zu zweiten Einrastmitteln (3123) passen, die sich an einer zweiten Fläche (3124) des Zentralkörpers befinden. 10
10. Hilfskontakteinrichtung nach Anspruch 9, **dadurch gekennzeichnet, dass** die ersten Einrastmittel (3122) Vorsprünge an der ersten Fläche (3121) sind und die zweiten Einrastmittel (3123) Sitze sind, die zu den Vorsprüngen an der zweiten Fläche (3124) passen. 20
11. Hilfskontakteinrichtung nach einem oder mehreren der Ansprüche 5 bis 10, **dadurch gekennzeichnet, dass** die Bewegungskontakt-Untergruppe (3) eine Mehrzahl an Isolierträgern (31) und entsprechenden leitenden Kontaktlamellen (31A, 31B) aufweist, die entlang einer Achse nacheinander gesteckt sind, die parallel zu der linearen Bewegungsrichtung (100) der ersten und zweiten Wellenabschnitte (41, 42) verläuft. 25 30
12. Hilfskontakteinrichtung nach einem oder mehreren der vorgenannten Ansprüche, **dadurch gekennzeichnet, dass** die Festkontakt-Untergruppe (2) eine Mehrzahl an Paaren von Festkontakten (21) aufweist und die Bewegungskontakt-Untergruppe (3) eine Mehrzahl an entsprechenden Bewegungskontakten (31A, 31B) aufweist, die drehend mit den Festkontakten gekoppelt werden können. 35 40
13. Hilfskontakteinrichtung nach Anspruch 11 und 12, **dadurch gekennzeichnet, dass** die Bewegungskontakt-Untergruppe (3) ein Paar leitender Kontaktlamellen (31A, 31B) aufweist, die fest mit einem oder mehreren der Isolierträger (31) gekoppelt sind. 45

Revendications

1. Dispositif de contact auxiliaire (1) destiné à des appareils de commutation moyenne tension, **caractérisé en ce qu'il comprend** :
- un sous-ensemble de contact fixe (2) qui comprend au moins une paire de contacts fixes (21) ;
 - un sous-ensemble de contact mobile (3) qui comprend au moins un contact mobile (31A,

31B) qui peut être relié de manière rotative auxdits contacts fixes ;

- un axe de commutation (4) qui comprend une première partie d'axe (41), reliée à un actionneur linéaire, et une seconde partie d'axe (42), reliée audit sous-ensemble de contact mobile, lesdites première et seconde parties d'axe (41, 42) étant reliées l'une à l'autre et se déplaçant linéairement ensemble entre une première position et une seconde position, ladite seconde partie d'axe (42) pouvant tourner par rapport à ladite première partie d'axe (41), entre une troisième et une quatrième positions.

2. Dispositif de contact auxiliaire selon la revendication 1, **caractérisé en ce que** ledit sous-ensemble de contact fixe (2) comprend une base (23), ladite seconde partie d'axe (42) étant reliée à ladite base, de façon à déterminer une rotation de ladite seconde partie d'axe entre lesdites troisième et quatrième positions. 15 20

3. Dispositif de contact auxiliaire selon la revendication 2, **caractérisé en ce que** ladite seconde partie d'axe (42) est reliée à ladite base (23), à l'aide d'un raccord à vis (424, 231). 25

4. Dispositif de contact auxiliaire selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ladite première partie d'axe (41) comprend une première extrémité (411) formée de façon à définir une surface de retenue (413) qui correspond à une surface de raccordement (423) d'une troisième extrémité (421) de ladite seconde partie d'axe (42). 30 35

5. Dispositif de contact auxiliaire selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ledit sous-ensemble de contact mobile (3) comprend un support isolant (31) et au moins une lame de contact conductrice (31A, 31B) reliée de manière rigide audit support isolant, ledit support isolant étant relié à ladite seconde partie d'axe (42). 40

6. Dispositif de contact auxiliaire selon la revendication 5, **caractérisé en ce que** ledit sous-ensemble de contact mobile (3) comprend une paire de lames de contact conductrices (31A, 31B) reliées de manière rigide audit support isolant (31). 45

7. Dispositif de contact auxiliaire selon l'une quelconque des revendications 5 ou 6, **caractérisé en ce que** ladite seconde partie d'axe (42) comprend une quatrième extrémité (422) insérée dans une cavité (311) dudit support isolant (31), ladite quatrième extrémité se déplaçant au ralenti et de manière linéaire dans ladite cavité et étant formée de sorte que le mouvement de rotation entre lesdites troisième et quatrième positions soit transmis entre ladite qua- 50 55

trième extrémité (422) et ledit support isolant (31).

8. Dispositif de contact auxiliaire selon la revendication 7, **caractérisé en ce que** ladite quatrième extrémité (422) de ladite seconde partie d'axe (42) dudit axe (4) possède une tête formée (422A) qui correspond avec une surface interne (311A) de ladite cavité (311). 5

9. Dispositif de contact auxiliaire selon l'une quelconque des revendications 5 à 8, **caractérisé en ce que** ledit support isolant (31) possède un corps central (312) ayant une première surface (3121) munie de premiers moyens d'engagement (3122) qui correspondent avec des seconds moyens d'engagement (3123) positionnés sur une seconde surface (3124) dudit corps central. 10
15

10. Dispositif de contact auxiliaire selon la revendication 9, **caractérisé en ce que** lesdits premiers moyens d'engagement (3122) sont des saillies sur ladite première surface (3121), et lesdits seconds moyens d'engagement (3123) sont des sièges qui correspondent auxdites saillies sur ladite seconde surface (3124). 20
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11. Dispositif de contact auxiliaire selon l'une quelconque des revendications 5 à 10, **caractérisé en ce que** ledit sous-ensemble de contact mobile (3) comprend une pluralité de supports isolants (31) et des lames de contact conductrices correspondantes (31A, 31B) empilées les unes sur les autres le long d'un axe parallèle au sens de mouvement linéaire (100) desdites première et seconde parties d'axe (41, 42). 30
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12. Dispositif de contact auxiliaire selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ledit sous-ensemble de contact mobile (2) comprend une pluralité de paires de contacts fixes (21) et ledit sous-ensemble de contact mobile (3) comprend une pluralité de contacts mobiles correspondants (31A, 31B) qui peuvent être reliés de manière mobile auxdits contacts fixes. 40
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13. Dispositif de contact auxiliaire selon les revendications 11 et 12, **caractérisé en ce que** ledit sous-ensemble de contact mobile (3) comprend une paire de lames de contact conductrices (31A, 31B) reliées de manière rigide à un ou plusieurs desdits supports isolants (31). 50

55

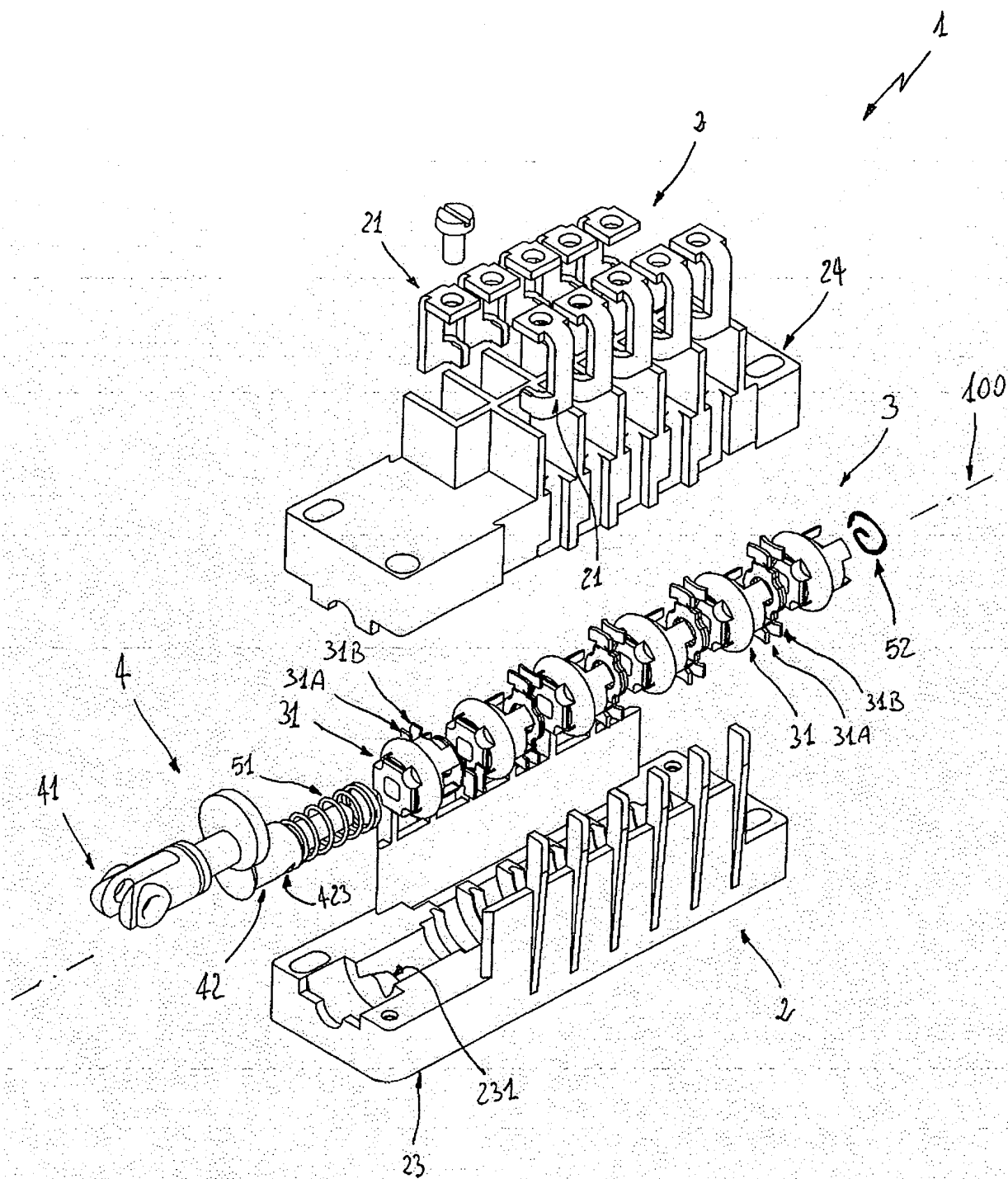


Fig. 1

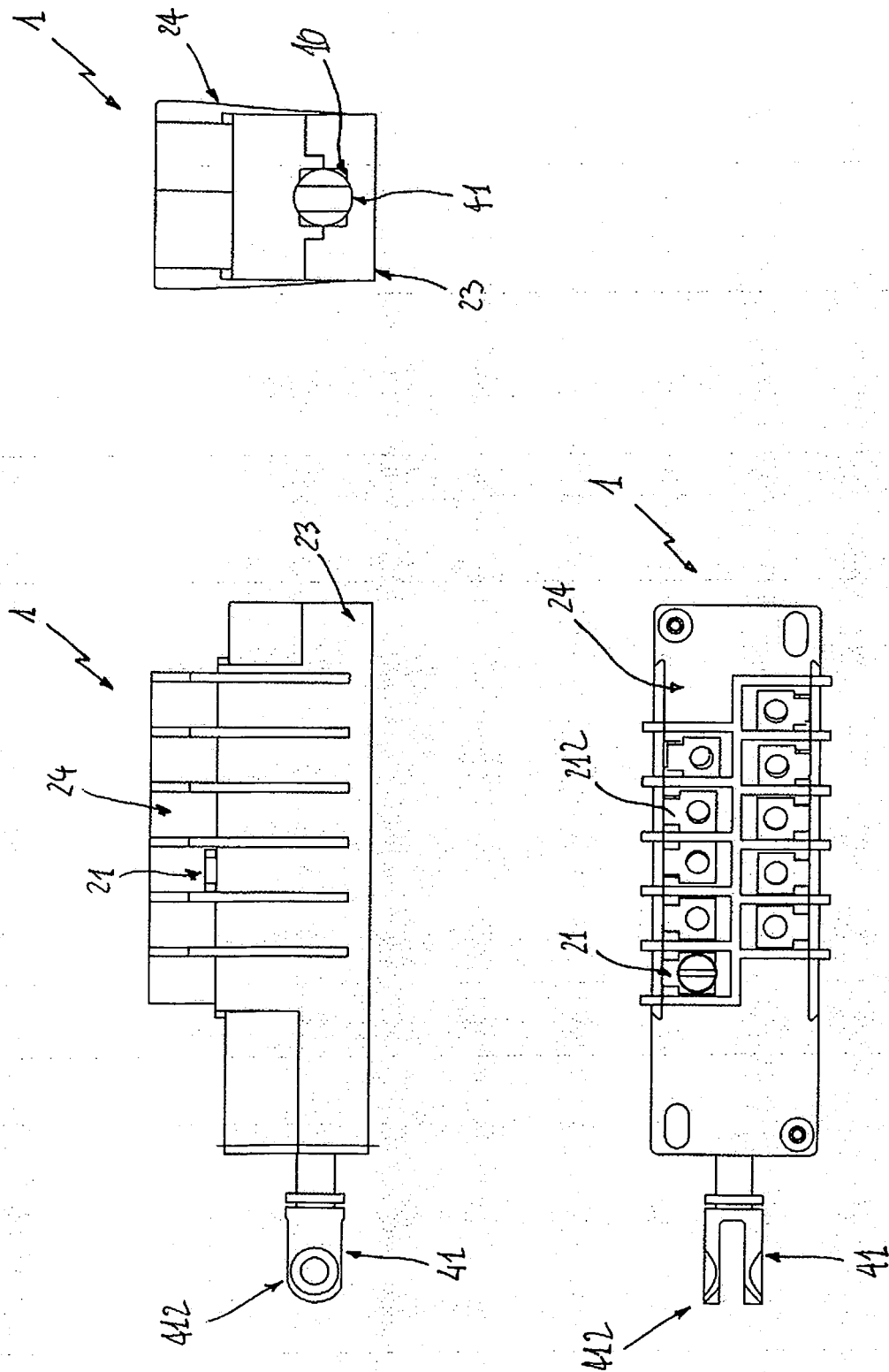


Fig. 2

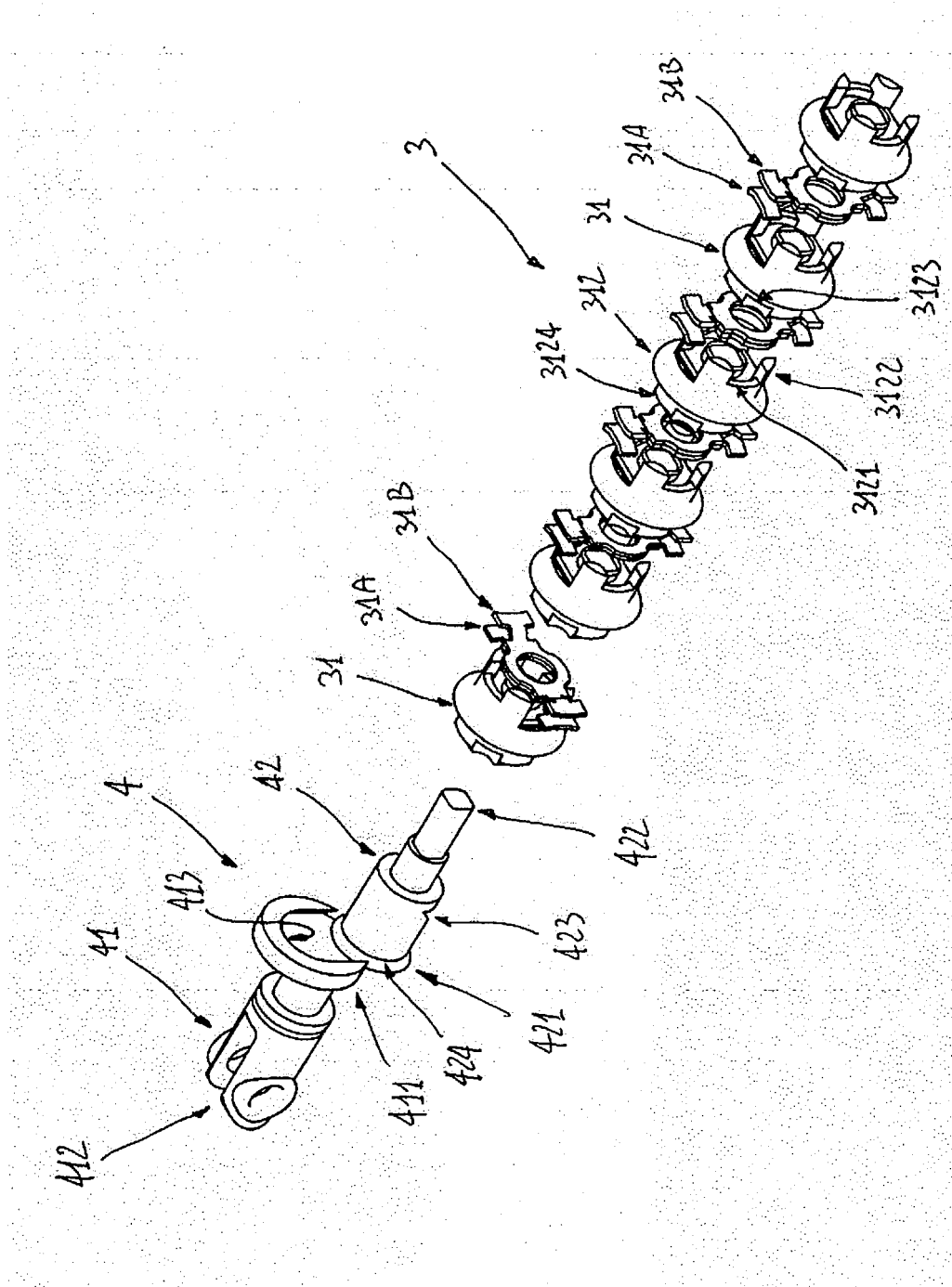


Fig. 3

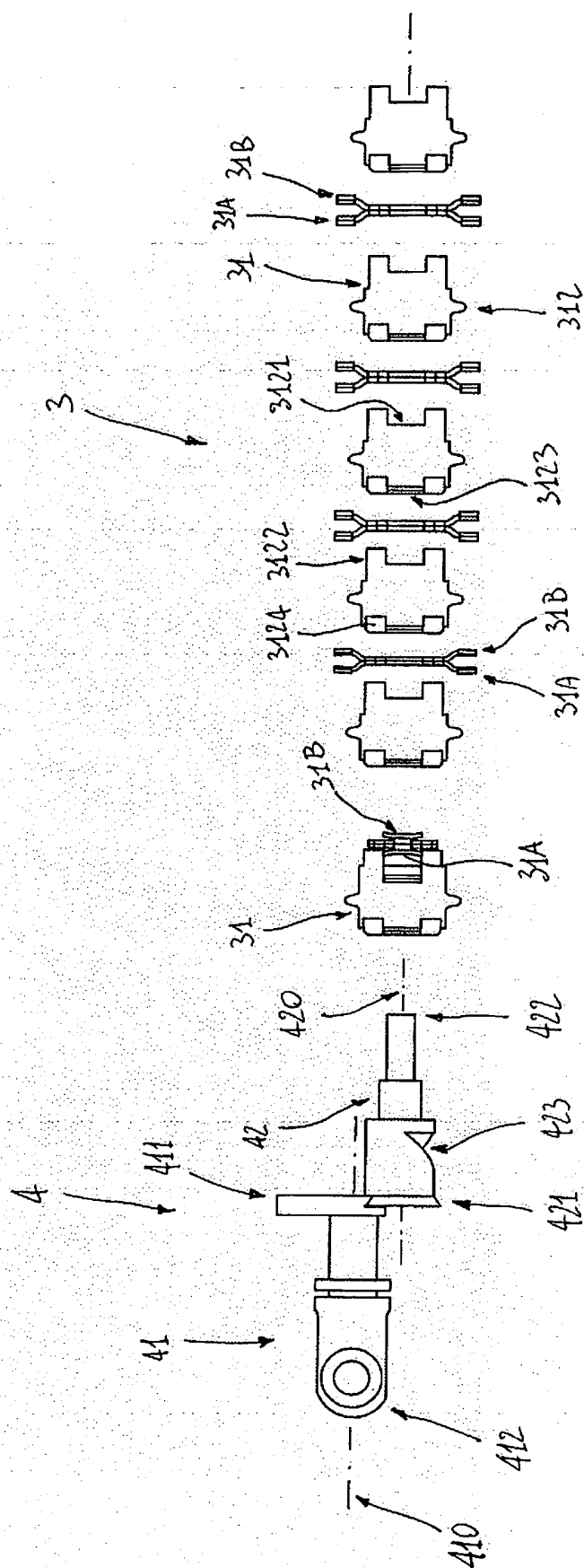


Fig. 4

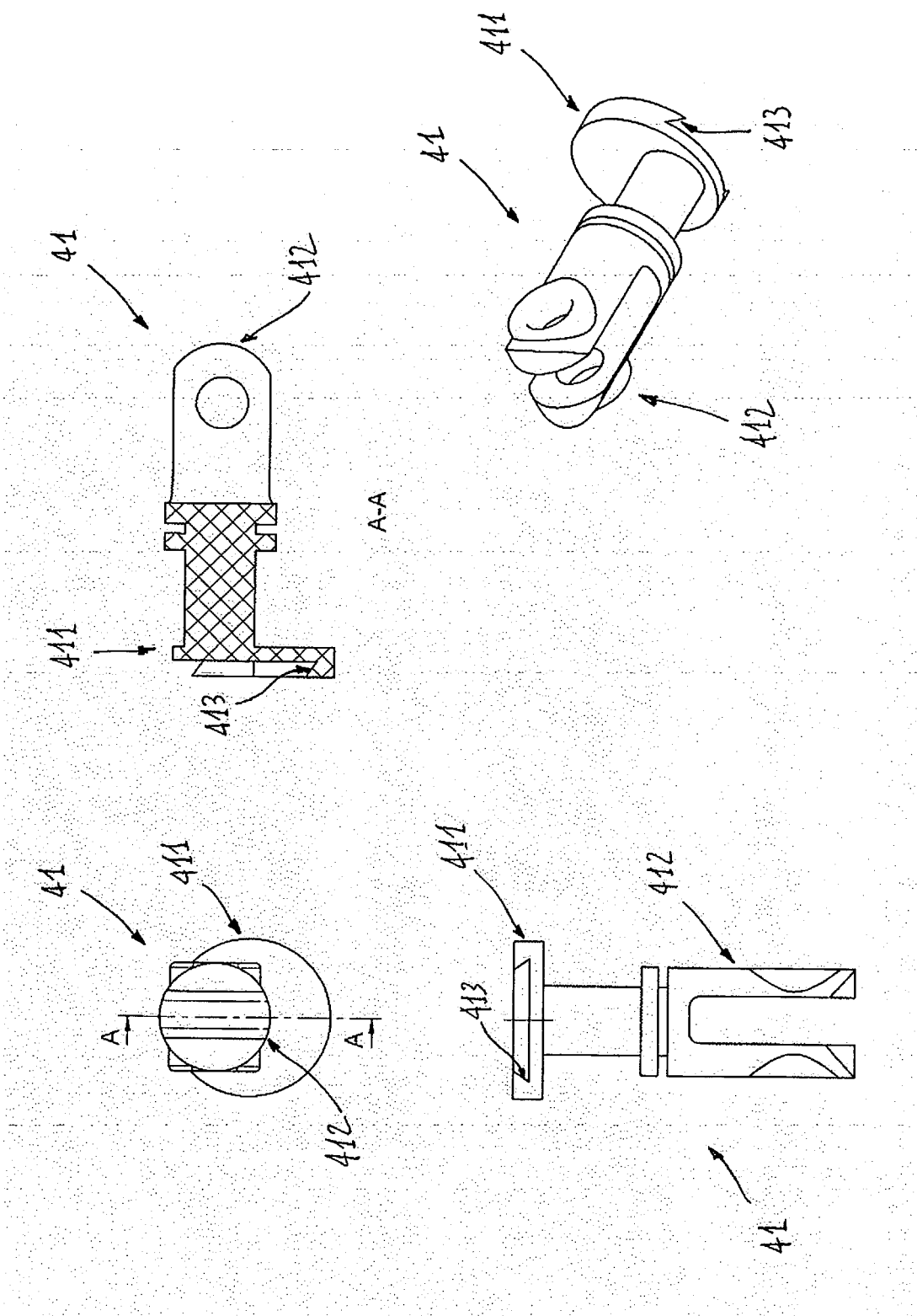


Fig. 5

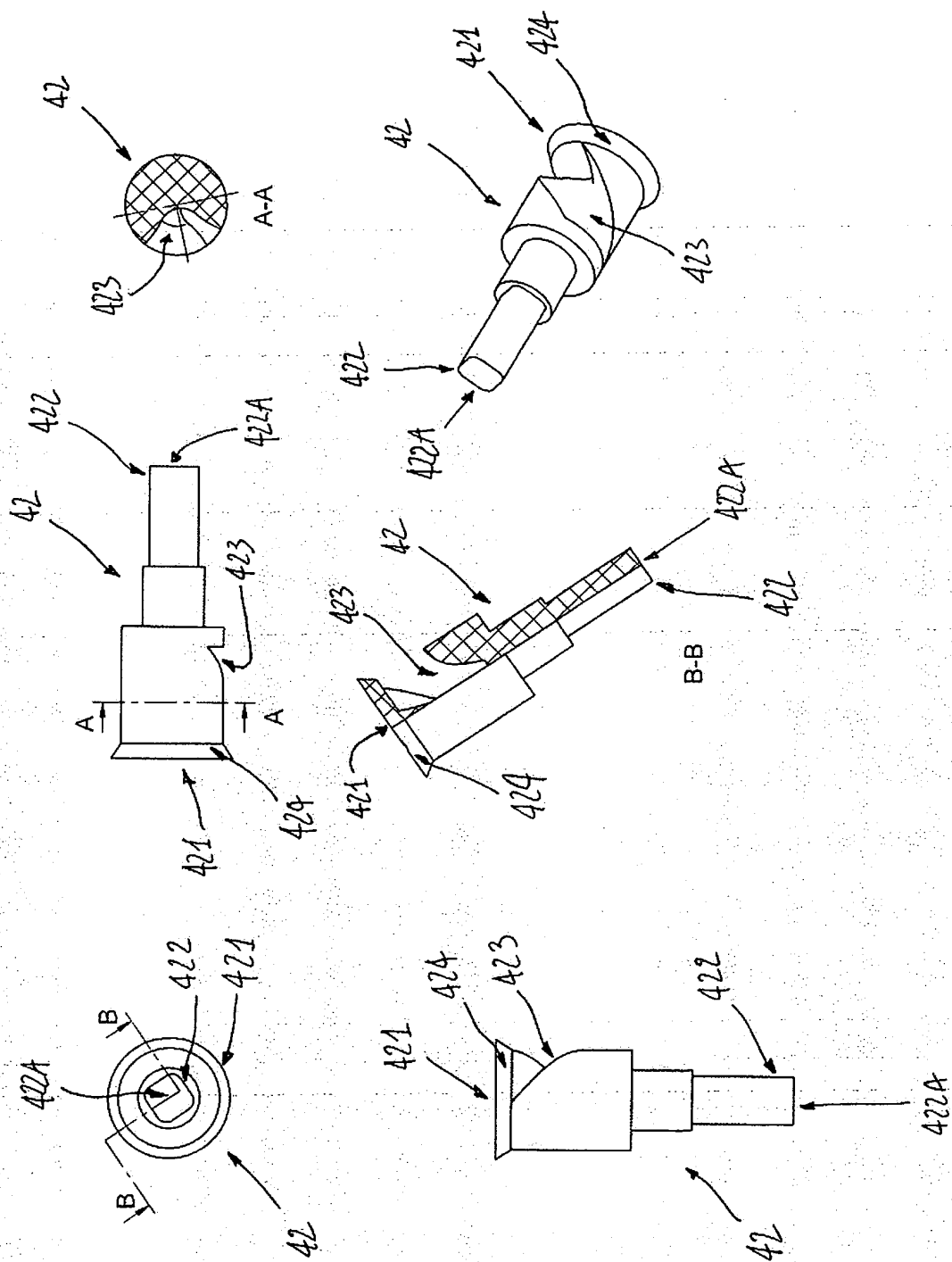


Fig. 6

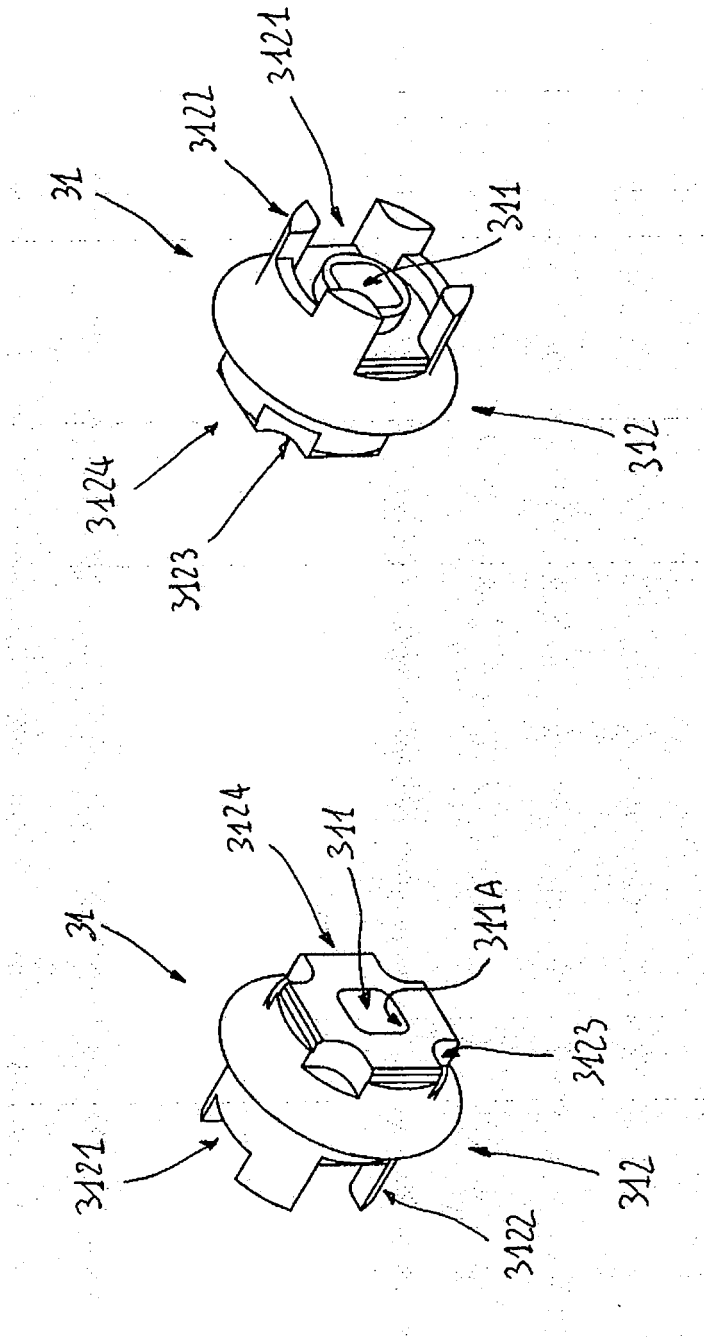


Fig. 7

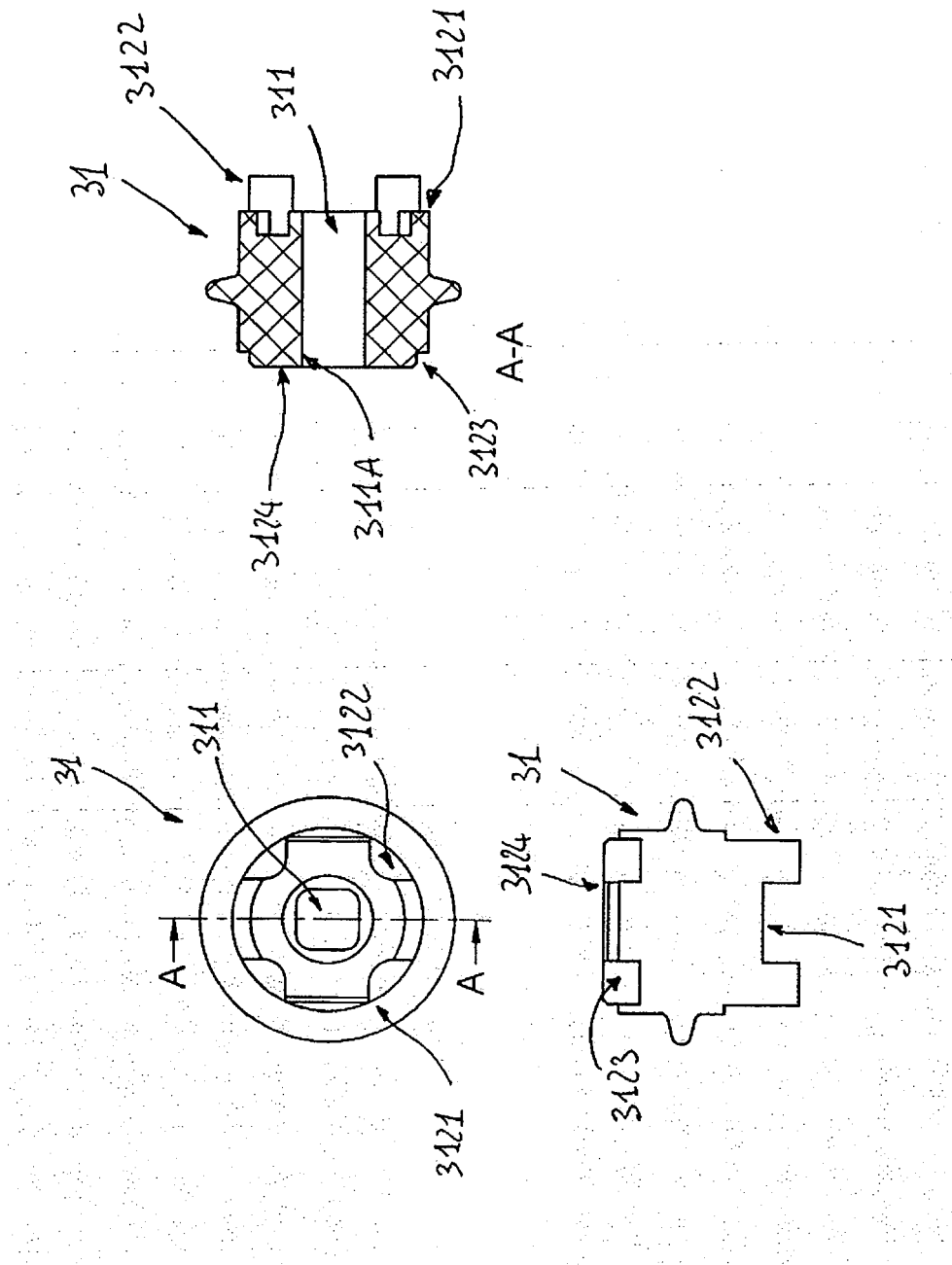


Fig. 8

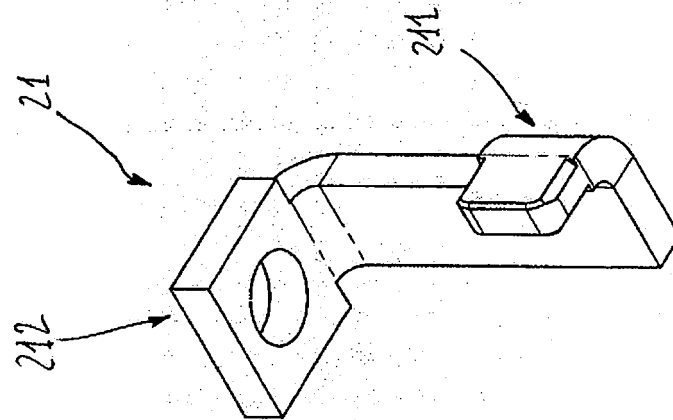


Fig. 9

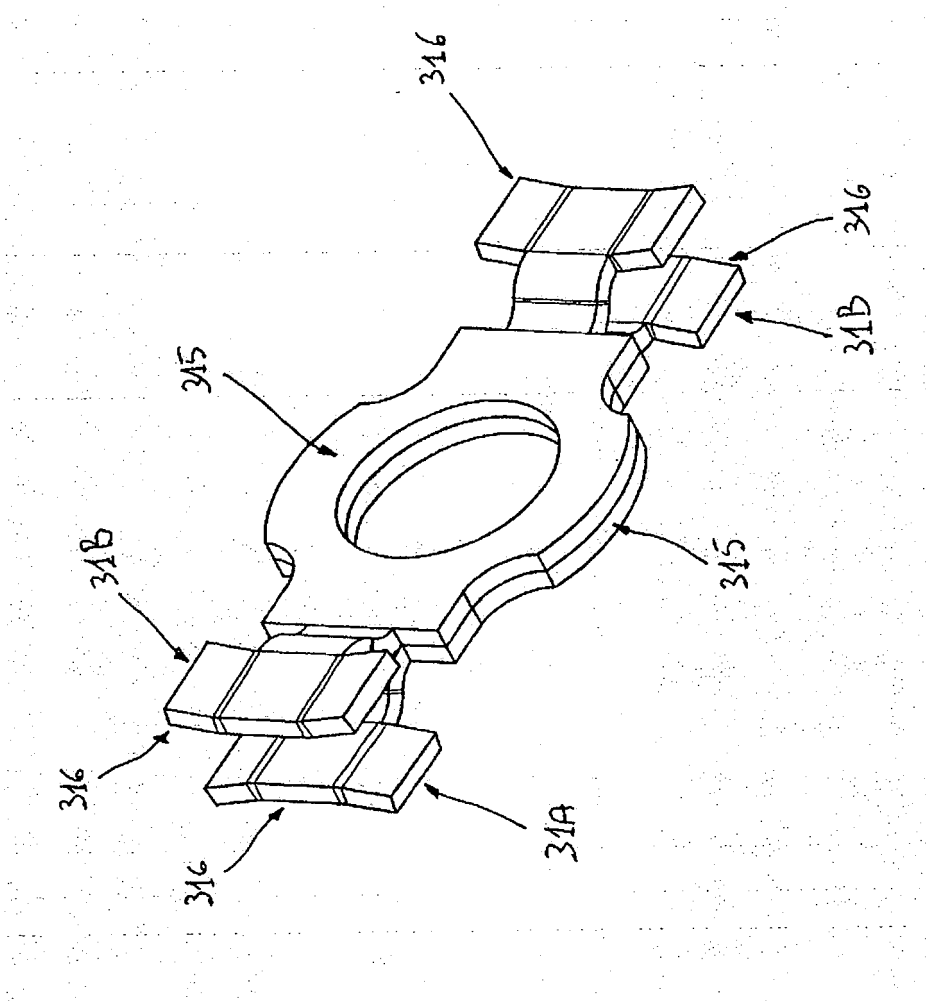


Fig. 10

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 2028674 A2 [0002]