

(19)



(11)

EP 2 876 657 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
07.07.2021 Bulletin 2021/27

(51) Int Cl.:
H01H 1/50 (2006.01) H01H 33/64 (2006.01)

(21) Application number: **14189463.4**

(22) Date of filing: **20.10.2014**

(54) Contact elements for medium to high voltage switches

Kontaktelemente für Mittel- bis Hochspannungsschalter

Éléments de contact pour commutateurs de moyenne à haute tension

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

(30) Priority: **26.11.2013 EP 13194428**

(43) Date of publication of application:
27.05.2015 Bulletin 2015/22

(73) Proprietor: **ABB Power Grids Switzerland AG
5400 Baden (CH)**

(72) Inventors:
• **Skarby, Per
CH-5436 Würenlos (CH)**

• **Steiger, Ueli
8038 Zürich (CH)**

(74) Representative: **Michalski Hüttermann & Partner
Patentanwälte mbB
Speditionstraße 21
40221 Düsseldorf (DE)**

(56) References cited:
US-A- 3 310 640 US-A1- 2012 256 711

• **None**

EP 2 876 657 B1

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

Technical Field

[0001] The invention relates to a high or medium voltage switch, particularly a DC switch, comprising a first and a second set of contact elements that are mutually displaceable. The invention also relates to a current breaker comprising such a switch.

Background Art

[0002] A switch of this type is disclosed for example in the co-owned United States patents and published patent application US7235751, US2012/0256711, and US2013/0098874. It has a first and a second set of contact elements and a drive adapted to mutually displace the contact elements along a displacement direction. Each contact element carries at least one conducting element. In a first mutual position of the contact elements, their conducting elements combine to form at least one conducting path between the first and second terminals of the switch, in a direction transversally to the displacement direction. In a second position of the contact elements, the conducting elements are mutually displaced into staggered positions and therefore the above conducting path is interrupted.

[0003] The switches described in US2012/0256711, and US2013/0098874 have contact elements with an insulating carrier carrying conducting elements. In the closed state of the switch, the conducting elements align to form one or more current paths between the terminals of the switch along an axial direction. For opening the switch, the contact elements are mutually displaced by means of two drives along a direction perpendicular to the axial direction. The switching arrangement is arranged in a fluid-tight housing in a gas of elevated pressure or in a liquid. The switch has a high voltage withstand capability and fast switching times. The conducting element project over the two opposite surfaces of the carrier that carries it and are slightly movable in axial direction in respect to the carrier that carries it and/or it is slightly tiltable around a tilt axis, wherein said tilt axis is perpendicular to the axial direction and to the direction of displacement. Each terminal forms a contact surface for contacting the conducting elements, wherein at least one of the terminals comprises a spring member that elastically urges the contact surface of the terminal against the conducting elements. This ensures a proper contacting force between the conducting elements themselves and between the conducting elements and the contact surfaces and, with conducting elements being movable in axial direction the forces between all the conducting elements in a current path are substantially equal.

[0004] While generally satisfactory it is seen as an object of the present invention to simplify the assembly of conducting elements onto their respective carriers and to improve the carrier itself.

Summary of the Invention

[0005] Hence, according to a first aspect of the invention, the switch has at least a first terminal and a second terminal for applying the current to be switched and at least a first set of contact elements and a second set of contact elements and a drive adapted to mutually displace the sets of contact elements relatively to each other along a displacement direction with each contact element including an insulating carrier part that carries at least one conducting element with the positions of the conducting elements being such that in a first mutual position of the contact elements the conducting elements form at least one conducting path between the first terminal and the second terminal, i.e. the switch is in the closed, conducting position; and in a second mutual position of the contact elements the conducting elements are mutually displaced such that there is no conducting path formed by the conducting elements between the first terminal and the second terminal, i.e. the switch is in its opened, non-conducting position, with the conducting elements mounted onto the carrier part are locked into their operating position by one or more spring-loaded pins.

[0006] The pin or pins are best rounded to allow for a small limited rotation movement of a main body of the conducting element around the central axis of the pin. Thus the main body of the conducting element is slightly tiltable around a tilting axis, wherein said tilt axis is perpendicular to the axial direction and to the direction of displacement. This allows the conducting element to axially position itself accurately when the switch is in its first, closed position, thereby improving current conduction.

[0007] The invention allows for a connection between the carrier and the conducting elements which is essentially free of hetero-material, in particular gluefree (free from glue).

[0008] The main body is an elongated rectangular cuboid with two long flattened contact faces oriented parallel to the plane of the contact element or its carrier part for contacting in operation the flattened contact face of a conducting element of an adjacent contact element. The cuboid main body has two further long faces and two small faces with such faces oriented in position perpendicular to the plane of the contact element. The small faces can have blind holes to mount the pins. Preferably an elastic element such as a spring is mounted behind the pins in the blind hole to facilitate the assembly and offer a latching action to lock the conducting element in its place on the contact element or carrier part. In a preferred embodiment the conducting elements are mounted within openings of the carrier part with the pin or pins having a forked tip to latch onto a side wall of the opening. The openings are made preferably slightly wider than the distance between the second long faces or sides of the main body of the conducting elements, thus providing a small gap for a limited movement of the main body of the conducting elements within the opening of the carrier part in its mounted position.

[0009] The pins are best made of a harder material than the main body, which in turn are typically manufactured using a material of high electrical conductivity such as silver, copper or aluminium. The pins themselves can be made of steel, preferably hardened steel or plastic material with a comparable hardness to steel. The term 'harder' is understood as a comparison of the hardness degree of different materials.

[0010] Further, the conducting element should advantageously project over the two opposite surfaces of the carrier that carries it. When a conducting element projects above the surface of the surrounding carrier, it can be shown that the electrical field at the intersection between the surface and the conducting element is smaller than for a device where the surface of the conducting element is substantially flush with the surface of the carrier.

[0011] While having a cuboid main body it is preferred to have all contour lines or edges which are visible after mounting in the carrier rounded, including the exposed contour lines of the pins.

[0012] Another aspect of the invention relates to the material used to manufacture the carrier part and/or a frame structure for the contact elements onto which frame the conducting elements can be mounted. It has been found that manufacturing the frame of the contact elements from an epoxy material reinforced by aramid fibers offers a superior performance in a DC switch as described above compared for example to the same structure manufactured from an epoxy material reinforced by glass fibers.

[0013] The switch is advantageously used in high voltage applications (i.e. for voltages above 72 kV), but it can also be used for medium voltage applications (between some kV and 72 kV), particularly DC voltages.

[0014] Other advantageous embodiments are listed in the dependent claims as well as in the description below.

Brief Description of the Drawings

[0015] The invention will be better understood and objects other than those set forth above will become apparent from the following detailed description thereof. Such description makes reference to the annexed drawings, wherein:

FIG. 1 shows a cross-sectional view of a known switch;

FIG. 2 shows an enlarged cross-sectional view of the contact elements of FIG. 1;

FIG. 3A shows a schematic perspective view of a contact element with carrier part and acceleration rod but without conducting elements;

FIGs. 3B and 3C show an enlarged section of FIG. 3A with a conducting element inserted into the carrier

part;

FIGs. 4A and 4B shows a schematic view of a main body of a conducting element at two different stages in the manufacturing process, respectively, in accordance with an example of the invention; and

FIG. 4C shows a schematic view of a pin of a conducting element in accordance with an example of the invention.

Modes of Carrying Out the Invention

[0016] An example of the present invention is now described in further detail using the switch design as described in the above cited applications US2012/0256711, and US2013/0098874. Accordingly, the switch of Fig. 1 includes a fluid-tight housing 1 enclosing a space 2 filled with an insulating fluid, in particular SF₆ or air at elevated pressure or an oil.

[0017] Housing 1 forms a GIS-type metallic enclosure of manifold type and comprises two tube sections. A first tube section 3 extends along an axial direction A, and a second tube section 4 extends along a direction D, which is called the displacement direction for reasons that will become apparent below. Axial direction A is perpendicular or nearly perpendicular to displacement direction D. The tube sections are formed by a substantially cross-shaped housing section 5.

[0018] First tube section 3 ends in first and second support insulators 6 and 7, respectively. First support insulator 6 carries a first terminal 8 and second support insulator 7 carries a second terminal 9 of the switch. The two terminals 8, 9 extending through the support insulators 6, 7 carry the current through the switch, substantially along axial direction A.

[0019] Second tube section 4 ends in a first and a second cap 10 and 11, respectively.

[0020] First terminal 8 and second terminal 9 extend towards a center of space 2 and end at a distance from each other, with a switching arrangement 12 located between them, at the intersection region of first tube section 3 with second tube section 4.

[0021] As can best be seen from Fig. 2, switching arrangement 12 comprises a first set of contact elements 13a, 13b, 13c and a second set of contact elements 14a, 14b, 14c. In the embodiment shown here, each set comprises three contact elements, but that number may vary, and, for example, be two or more than three. The first and second set may also have different numbers of contact elements, e.g. two and three, respectively. Advantageously, the number is at least two contact elements per set. The contact elements of the two sets are stacked alternately, i.e. each contact element of one set is adjacent to two contact elements of the other set unless it is located at the end of switching arrangement 12, in which case it is located between one contact element of the other set and one of the terminals 8, 9.

[0022] Each contact element comprises a plate-shaped insulating carrier 15, one or more conducting elements 16 and an actuator rod 17. In the embodiment shown here, each carrier 15 carries two conducting elements 16.

[0023] Figs. 1 and 2 show the switch in the closed state with the contact elements 13a, 13b, 13c, 14a, 14b, 14c in a first mutual position, where the conducting elements 16 align to form two conducting paths 34 along axial direction A between the first and the second terminals 8, 9. The conducting paths 34 carry the current between the terminals 8, 9. Their number can be greater than one in order to increase continuous current carrying capability.

[0024] For example an arrangement with three conducting elements 16 in each insulating carrier 15 leads to three conducting paths 34 when the switch is closed. A non-inline arrangement with four contact elements 16 in each insulating carrier 15 results in four conducting paths 34 when the switch is closed and so forth.

[0025] The contact elements 13a, 13b, 13c, 14a, 14b, 14c are moved in operation along the displacement direction D into a second position, where the conducting elements 16 are staggered in respect to each other and do not form a conducting path. In Fig. 2, the position of the conducting elements in this second position is shown in dotted lines under reference number 16'. As can be seen, the conducting elements 16' are now separated from each other along direction D, thereby creating several contact gaps, thereby quickly providing a high dielectric withstand level.

[0026] To achieve such a displacement, and as best can be seen in Fig. 1, the actuator rods 17 are connected to two drives 18, 19. A first drive 18 is connected to the actuator rods 17 of the first set of contact elements 13a, 13b, 13c, and a second drive 19 is connected to the actuator rods 17 of the second set of contact elements 14a, 14b, 14c.

[0027] In the embodiment shown in Figs. 1 and 2, the switch is opened by pulling the actuator rods 17 away from the center of the switch, thereby bringing the conducting elements into their second, staggered position. Alternatively, the rods 17 can be pushed towards the center of the switch, which also allows to bring the conducting elements into a staggered position.

[0028] The drives 18, 19 can e.g. operate on the repulsive Lorentz-force principle and be of the type disclosed in US 7 235 751, and they are therefore not described in detail herein. Each drive is able to displace one set of contact elements along the displacement direction D. They are adapted and controlled to move the first and second sets in opposite directions at the same time in order to increase the travelling length as well as acceleration and speed of displacement.

[0029] The drives 18, 19 are arranged in opposite end regions of second tube section 4.

[0030] It should be noted that the full stroke (e.g. 20 mm per drive) of the drives may not be necessary to travel

in order for the contact system to provide the dielectric strength required, but a distance much shorter (e.g. 10 mm per drive), which can be reached in an even shorter time, suffices. This also provides certain safety in case of backtravel upon reaching the end-of-stroke position and damping phase of the actuators. A sufficient separation of the conducting elements 16 can be reached within 1 or 2 ms (milliseconds).

[0031] As shown in Fig. 2, each terminal 8, 9 carries a contact plate 32 forming a contact surface 33 contacting the conducting elements 16 when the switch is in its first position. The contact plates 32 are mounted to the terminals 8, 9 in axially displaceable manner, with springs 20 elastically urging the contact surface 33 against the conducting elements, thereby compressing the conducting elements 16 in their aligned state for better conduction. In the embodiment of Fig. 2, helical compression springs 20 are used for this purpose, but other types of spring members can be used as well. Also, even though it is advantageous, if there is at least one spring member 20 in each terminal 8, 9, a compression force for the aligned conducting elements 16 can also be generated by means of a spring member (s) in only one of the terminals 8, 9 to reduce the contact resistance between the elements 16 in the closed position of the switch.

[0032] A perspective schematic view of a single contact element 13a prior to its full assembly is shown in FIG. 3A. The contact element includes a carrier part 15 and the actuator rod 17. In the example shown both parts are made together as a single part from the same material. The carrier part 15 has a frame structure with cut-out sections or holes 151, 152 to mount further conducting elements 16 and/or other elements. The carrier part 15 has a central opening 153 and further cut-out sections at one end to reduce the mass which has to be accelerated at each operation of the switch without reducing the mechanical stability unduly.

[0033] The material used to make the frame structure of the contact element 13a of FIG. 3A is an epoxy resin reinforced with aramid fibers. Glass fiber reinforced epoxy materials have been found to be prone to electrically induced erosion processes and to lower insulation breakdown strength, which can be avoided with the epoxy resin reinforced with aramid fibers. The later material is still capable of withstanding the high acceleration forces during switching.

[0034] An enlarged section of the carrier part 15 is referred to below in figures 3B and 3C. This section includes a hole or opening 151 for the insertion of a conducting element 16 as described in the following.

[0035] FIG. 4A is a cross-section of a main body 160 for use to manufacture a conducting element 16 for insertion into the carrier part 15 of a contact element such as the frame shown in FIG. 3A above. The main body 160 of conducting element 16 has essentially a rectangular cuboid shape with an aspect ratio of approximately 5:1. It is made of aluminium coated with a silver layer. Both ends or small faces of the main body 160 are ma-

chined into semi-spherical shape. All edges of the main body 160 are rounded.

[0036] The shape of the main body 160 is chosen such that the width in direction of the displacement is small to ensure that conducting elements 16 can be separated with a correspondingly small displacement of the contact elements 13a -14c. The length in a direction perpendicular to both, the direction of displacement and the axial direction of the switch, i.e. in direction of the tilting axis as defined above, however is chosen to ensure a large contact area between two neighbouring conducting elements (16) in the closed state.

[0037] In Fig. 4B a cross-section of the main body 160 of a conducting element 16 is shown with a blind bore or hole 163 drilled into each of the rounded ends or small faces. The bore 163 is used to accommodate a spring 161 and a pin 162.

[0038] A cross-section of such a pin 162 is shown in FIG. 4C. It has an essentially cylindrical shape with one rounded end. A central cut 164 is machined into the rounded end rendering this end of the pin into a two pronged fork. The in radial direction outer corners of each prong are again all rounded.

[0039] A fully mounted conducting element 16 within the frame structure of a contact element 13a (as shown in FIG. 3A) is illustrated in figures 3B and 3C, with FIG. 3B showing a perspective view on an enlarged section of FIG. 3A with a conducting element 16 inserted into the pre-cut hole 151 of the carrier 15 of the contact element 13a. Due the manufacturing steps as described above, all external exposed edges and corners are rounded, thus providing a better protection against discharges and/or arc-forming in a medium and high voltage environment.

[0040] The cross-section along the dash-dotted line X-X in FIG. 3B and perpendicular to the plane of the opening 151 within the frame structure of the contact element 13a (as shown in FIG. 3A) and with an conducting element 16 inserted is shown in FIG. 3C.

[0041] The conducting element 16 is shown in its assembled and mounted state. The conducting element 16 includes the main body 160 and two pins each inserted into one of the blind holes 163 at either end of the main body. Also located within the blind hole 163 is a springy or an elastic element 161. In the absence of forces the springy element 161 pushes the upper, forked part of the pin 162 in direction out of its blind hole.

[0042] A conducting element 16 as described can be mounted into an opening 151 and thus onto the carrier 15 of a contact element by exerting a force on the pin or pins 162 and by releasing this force, after the conducting element is in its desired position. After the release of the force, the pins lock against the walls of the opening 151. The width of the cut 164 in each pin is matched by the thickness of carrier wall at this location. Thus a secure fastening is achieved without any further fastening means such as screws or glues. At the same time, each contact element can be easily assembled and conducting

elements can be easily mounted or replaced.

[0043] Instead of or in addition to the two-pronged fork, the pin can be designed, for example with a smaller pin at the top, to be inserted into holes within the side wall of the openings 151. However this alternative is considered inferior to the example presented above as it further weakens the structural integrity of the carrier part 15 or requires at least a local increase in its thickness.

[0044] It is also possible, for example with a further cut perpendicular to the first cut 164 to structure the tip of the pin as four-pronged fork with each prong at the corner of a rectangular. Again, this alternative is considered inferior as it weakens the prongs and generates more edges and small features on the surfaces of the carrier. The latter can again be the location of discharges and/or arc-forming in a medium and high voltage environment.

[0045] It should be noted that the springy element 161 together with the cylindrical shape of each pin 162 enable small tilting movements of the main body 161 out of the plane of the carrier part 15. This aspect becomes important when the conducting elements 16 of two adjacent contact elements, e.g. contact element 13a and 14a of FIG. 1 come into contact during the closing or opening of the switch. The tilting ensures that in the final closed position the flattened long sides of the main body 160 are fully in contact with each other and thus reduce the contact resistance and limit the heat generated at the interface between the neighbouring conducting elements (16).

[0046] A switch with spacer elements as described above has applications for example in a high voltage circuit breaker as illustrated in the FIG. 5 and described in the accompanying text of US 2013/0098874. In such arrangement the switch is connected in series with solid state breakers and in parallel with a second set of solid state breakers.

Reference numerals

[0047]

1:	housing
2:	space
3, 4:	tube sections
5:	housing section
6, 7:	support insulators
8, 9:	terminals
10, 11:	caps
12:	switching arrangement
13a, 13b, 13c:	first set of contact elements
14a, 14b, 14c:	second set of contact elements
15:	insulating carrier part
151, 152, 153:	recesses, openings of the carrier
16, 16':	conducting elements
160:	main body of conducting element
161:	springy element
162:	pin
163:	blind hole

164: cut through pin
 17: actuator rods
 18: drive
 19: drive
 20: springs
 32: contact plate
 33: contact surface
 34: conducting path

Claims

1. A high or medium voltage switch comprising a first and a second terminal (8, 9), a first and a second set of contact elements (13a, 13b, 13c; 14a, 14b, 14c) arranged between the first and the second terminal (8, 9), at least a first drive (18) for mutually displacing the sets of contact elements (13a, 13b, 13c; 14a, 14b, 14c) along a displacement direction (D), wherein each contact element (13a, 13b, 13c; 14a, 14b, 14c) comprises an insulating carrier part (15) carrying at least one conducting element (16), and wherein in a first mutual position of said contact elements (13a, 13b, 13c; 14a, 14b, 14c) the conducting elements (16) of said contact elements (13a, 13b, 13c; 14a, 14b, 14c) form at least one conducting path (34) in an axial direction (A) between said first and said second terminals (8, 9) in a direction transversally to said displacement direction (D), and wherein in a second mutual position of said contact elements (13a, 13b, 13c; 14a, 14b, 14c) the conducting elements (16) are mutually displaced and do not form said conducting path, **characterized in that** the conducting elements (16) are fastened to the contact elements (13a, 13b, 13c; 14a, 14b, 14c) with at least one spring-loaded pin (161,162) allowing for a limited amount of rotation or tilting of each conducting element (16) around its respective at least one pin (161,162), and wherein the conducting element (16) comprises an elongated rectangular cuboid as main body (160) with two flattened long contact faces for contacting in operation the flattened contact side of the conducting element (16) of an adjacent contact element (13a, 13b, 13c; 14a, 14b, 14c) and further comprises at least one spring-loaded pin (161,162) partially inserted into a blind hole (163) at at least one of the small faces of the main body (160).
2. The switch of claim 1 with the conducting element (16) having spring-loaded pins (161,162) partially inserted into blind holes (163) at both small faces of the main body (160).
3. The switch of claim 1 or 2, wherein the main body (160) of the conducting element (16) is located within a hole (151) in the carrier part (15) such that the

flattened contact faces of the main body are parallel to the plane of the carrier and the one or more pins (161,162) lock with the side walls of the hole (151).

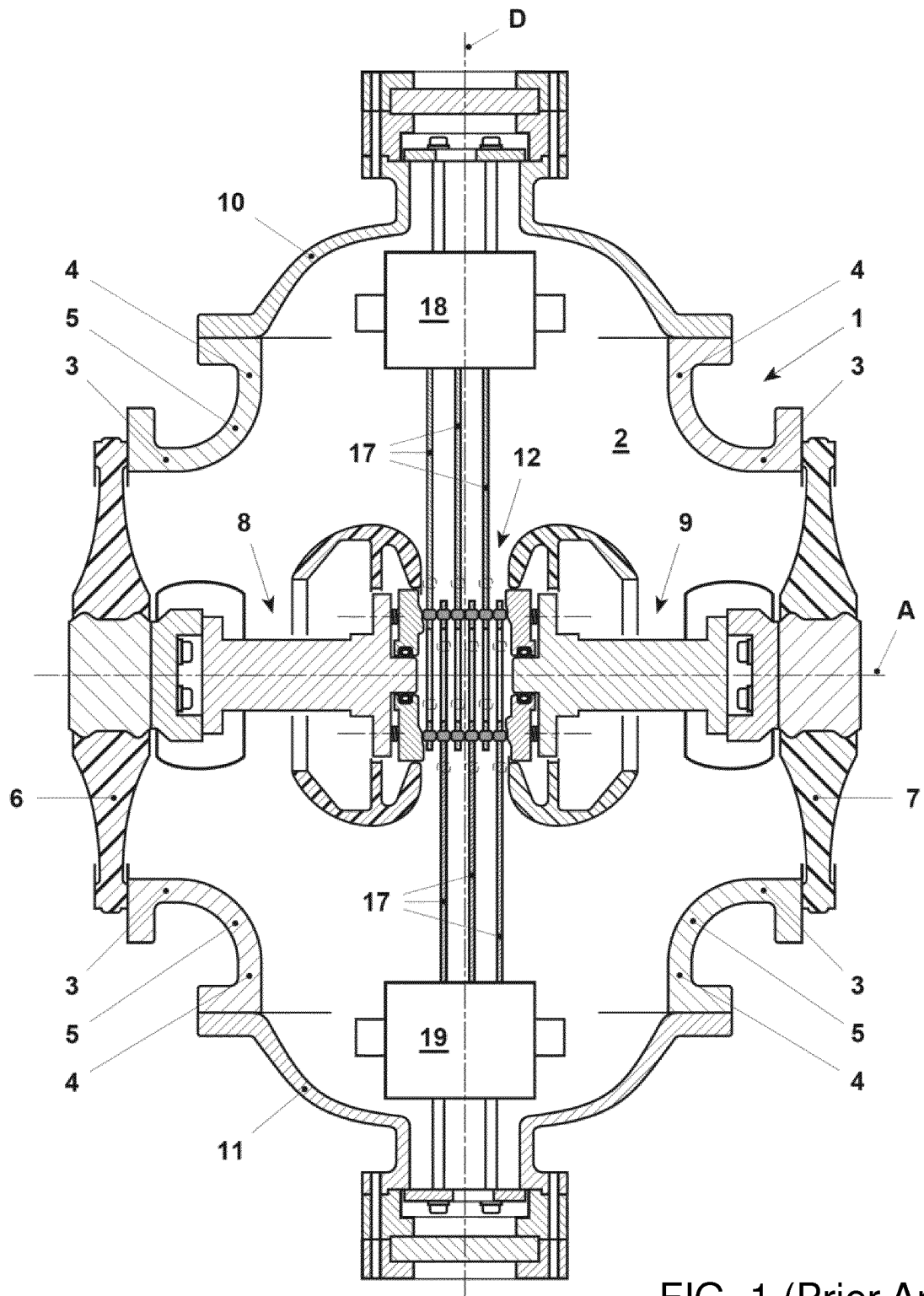
4. The switch of claim 3, wherein the tip of the one or more pins (161,162) includes a recess (164) with a width matching the thickness of the carrier part (15) such that the pin can latch onto the carrier (15).
5. The switch of claim 3 or 4, wherein the width of the hole (151) is slightly larger than the width of the main body (160) of the contacting element (16) such that a rotational movement around the at least one pin (161,162) is limited to less than 5° in each rotational direction about a tilt axis defined by the at least one pin (161,162).
6. The switch of any of the preceding claims, wherein the at least one pin (161,162) is made of a harder material than the main body (160).
7. The switch of any of the preceding claims, wherein all exposed contours of the conducting element (16) including all exposed contours of the at least one pin (161,162) are rounded.
8. The switch of any of the preceding claims, wherein the connection between the carrier (15) and the conducting element (16) mounted on it is free of hetero-material, in particular gluefree.
9. The switch of any of the preceding claims, wherein at least a carrier part (15) for mounting conducting elements (16) is made of a material comprising a composite of epoxy resin reinforced with aramid fibers.
10. The switch of claim 9, wherein at least the carrier part (15) and an actuator rod (17) connecting the carrier part (15) with a drive (18,18) for opening and closing the switch are essentially made of a single sheet of material comprising a composite of epoxy resin reinforced with aramid fibers providing a frame with recesses and/or holes (151) for mounting conducting elements (16).

Patentansprüche

1. Hoch- oder Mittelspannungsschalter, umfassend:
 einen ersten und einen zweiten Anschluss (8,9),
 einen ersten und einen zweiten Satz von Kontaktelementen (13a, 13b, 13c; 14a, 14b, 14c),
 die zwischen dem ersten und dem zweiten Anschluss (8, 9) angeordnet sind,
 mindestens einen ersten Antrieb (18) zum gegenseitigen Verschieben der Sätze von Kontak-

- telementen (13a, 13b, 13c; 14a, 14b, 14c) entlang einer Verschiebungsrichtung (D), wobei jedes Kontaktelement (13a, 13b, 13c; 14a, 14b, 14c) ein isolierendes Trägerteil (15) umfasst, das mindestens ein leitendes Element (16) trägt, und wobei in einer ersten gegenseitigen Position der Kontaktelemente (13a, 13b, 13c; 14a, 14b, 14c) die leitenden Elemente (16) der Kontaktelemente (13a, 13b, 13c; 14a, 14b, 14c) mindestens einen leitenden Pfad (34) in einer axialen Richtung (A) zwischen dem ersten und dem zweiten Anschluss (8, 9) in einer Richtung quer zur Verschiebungsrichtung (D) bilden, und wobei in einer zweiten gegenseitigen Position der Kontaktelemente (13a, 13b, 13c; 14a, 14b, 14c) die leitenden Elemente (16) gegeneinander verschoben sind und den leitenden Pfad nicht bilden, **dadurch gekennzeichnet, dass** die leitenden Elemente (16) an den Kontaktelementen (13a, 13b, 13c; 14a, 14b, 14c) mit mindestens einem federbelasteten Stift (161, 162) befestigt sind, der ein begrenztes Maß an Drehung oder Kippen jedes leitenden Elementes (16) um seinen jeweiligen mindestens einen Stift (161, 162) ermöglicht, und wobei das leitende Element (16) einen länglichen rechteckigen Quader als Hauptkörper (160) mit zwei abgeflachten langen Kontaktflächen zum Kontaktieren der abgeflachten Kontaktseite des leitenden Elementes (16) eines benachbarten Kontaktelementes (13a, 13b, 13c; 14a, 14b, 14c) im Betrieb umfasst und ferner mindestens einen federbelasteten Stift (161, 162) umfasst, der teilweise in ein Sackloch (163) an mindestens einer der kleinen Flächen des Hauptkörpers (160) eingesetzt ist.
2. Schalter nach Anspruch 1, wobei das leitende Element (16) federbelastete Stifte (161, 162) aufweist, die teilweise in Sacklöcher (163) an beiden kleinen Flächen des Hauptkörpers (160) eingesetzt sind.
 3. Schalter nach Anspruch 1 oder 2, wobei der Hauptkörper (160) des leitenden Elementes (16) innerhalb eines Lochs (151) im Trägerteil (15) angeordnet ist, derart, dass die abgeflachten Kontaktflächen des Hauptkörpers parallel zur Ebene des Trägers liegen und der eine oder die mehreren Stifte (161, 162) an den Seitenwänden des Lochs (151) verrasten.
 4. Schalter nach Anspruch 3, wobei die Spitze des einen oder der mehreren Stifte (161, 162) eine Aussparung (164) mit einer Breite beinhaltet, die der Dicke des Trägerteils (15) entspricht, derart, dass der Stift am Träger (15) einrasten kann.
 5. Schalter nach Anspruch 3 oder 4, wobei die Breite des Lochs (151) geringfügig größer ist als die Breite des Hauptkörpers (160) des Kontaktelementes (16), derart, dass eine Drehbewegung um den mindestens einen Stift (161, 162) auf weniger als 5° in jeder Drehrichtung um eine durch den mindestens einen Stift (161, 162) definierte Kippachse begrenzt ist.
 6. Schalter nach einem der vorhergehenden Ansprüche, wobei der mindestens eine Stift (161, 162) aus einem härteren Material als der Hauptkörper (160) hergestellt ist.
 7. Schalter nach einem der vorhergehenden Ansprüche, wobei alle freiliegenden Konturen des leitenden Elementes (16) einschließlich aller freiliegenden Konturen des mindestens einen Stiftes (161, 162) abgerundet sind.
 8. Schalter nach einem der vorhergehenden Ansprüche, wobei die Verbindung zwischen dem Träger (15) und dem darauf montierten leitenden Element (16) frei von Heteromaterial, insbesondere klebstofffrei, ist.
 9. Schalter nach einem der vorhergehenden Ansprüche, wobei mindestens ein Trägerteil (15) zum Montieren von leitenden Elementen (16) aus einem Material hergestellt ist, das einen Verbundwerkstoff aus mit Aramidfasern verstärktem Epoxidharz umfasst.
 10. Schalter nach Anspruch 9, wobei zumindest das Trägerteil (15) und eine Betätigungsstange (17), die das Trägerteil (15) mit einem Antrieb (18, 18) zum Öffnen und Schließen des Schalters verbindet, im Wesentlichen aus einer einzigen Materialplatte hergestellt sind, die einen Verbundwerkstoff aus mit Aramidfasern verstärktem Epoxidharz umfasst, die einen Rahmen mit Aussparungen und/oder Löchern (151) zum Montieren leitender Elemente (16) bereitstellt.
- Revendications**
1. Commutateur de haute ou moyenne tension, comprenant :
 - une première et une seconde borne (8, 9),
 - un premier et un second ensemble d'éléments de contact (13a, 13b, 13c ; 14a, 14b, 14c) agencés entre la première et la seconde borne (8, 9),
 - au moins un premier moyen d'entraînement (18) pour déplacer mutuellement les ensembles d'éléments de contact (13a, 13b, 13c ; 14a, 14b, 14c) suivant une direction de déplacement (D),
 - chaque élément de contact (13a, 13b, 13c ; 14a, 14b, 14c) comprenant une partie de support isolante (15) isolant au moins un élément conducteur (16), et

- dans une première position mutuelle desdits éléments de contact (13a, 13b, 13c ; 14a, 14b, 14c), les éléments conducteurs (16) desdits éléments de contact (13a, 13b, 13c ; 14a, 14b, 14c) formant au moins un chemin conducteur (34) dans une direction axiale (A) entre ladite première et ladite seconde borne (8, 9) dans une direction transversale à ladite direction de déplacement (D), et dans une seconde position mutuelle desdits éléments de contact (13a, 13b, 13c ; 14a, 14b, 14c), les éléments conducteurs (16) étant déplacés mutuellement et ne formant pas ledit chemin conducteur,
- le commutateur étant **caractérisé en ce que** les éléments conducteurs (16) sont fixés aux éléments de contact (13a, 13b, 13c ; 14a, 14b, 14c) avec au moins une cheville à ressort (161, 162) permettant une ampleur limitée de rotation ou de basculement de chaque élément conducteur (16) autour de son au moins une cheville (161, 162) respective, et
- l'élément conducteur (16) comprenant un cuboïde rectangulaire allongé en guise de corps principal (160) avec deux faces de contact planes longues pour entrer en contact, lors de l'utilisation, avec le côté de contact plat de l'élément conducteur (16) d'un élément de contact (13a, 13b, 13c ; 14a, 14b, 14c) adjacent, et comprenant en outre au moins une cheville à ressort (161, 162) partiellement insérée dans un trou borgne (163) au niveau d'au moins une des petites faces du corps principal (160).
2. Commutateur selon la revendication 1 avec l'élément conducteur (16) qui comporte des chevilles à ressort (161, 162) partiellement insérées dans des trous borgnes (163) au niveau des deux petites faces du corps principal (160).
 3. Commutateur selon la revendication 1 ou 2, dans lequel le corps principal (160) de l'élément conducteur (16) est situé dans un trou (151) dans la partie de support (15) de sorte que les faces de contact plates du corps principal soient parallèles au plan du support et que la ou les chevilles (161, 162) se bloquent avec les parois latérales du trou (151).
 4. Commutateur selon la revendication 3, dans lequel la pointe de la ou des chevilles (161, 162) inclut un évidement (164) avec une largeur qui concorde avec l'épaisseur de la partie de support (15) de sorte que la cheville puisse se verrouiller sur le support (15).
 5. Commutateur selon la revendication 3 ou 4, dans lequel la largeur du trou (151) est légèrement plus grande que la largeur du corps principal (160) de l'élément de contact (16) de sorte qu'un mouvement de rotation autour de l'au moins une cheville (161, 162) soit limité à moins de 5° dans chaque sens de rotation autour d'un axe de basculement défini par l'au moins une cheville (161, 162).
 6. Commutateur selon l'une quelconque des revendications précédentes, dans lequel l'au moins une cheville (161, 162) est fabriquée dans un matériau plus dur que celui du corps principal (160).
 7. Commutateur selon l'une quelconque des revendications précédentes, dans lequel tous les contours exposés de l'élément conducteur (16), y compris tous les contours exposés de l'au moins une cheville (161, 162), sont arrondis.
 8. Commutateur selon l'une quelconque des revendications précédentes, dans lequel la connexion entre le support (15) et l'élément conducteur (16) monté sur lui est exempte d'hétéro-matière, en particulier exemple de colle.
 9. Commutateur selon l'une quelconque des revendications précédentes, dans lequel au moins une partie de support (15) pour monter des éléments conducteurs (16) est fabriquée dans un matériau comprenant un composite de résine époxy renforcé de fibres aramides.
 10. Commutateur selon la revendication 9, dans lequel au moins la partie de support (15) et une bielle de commande (17), qui connecte la partie de support (15) à un moyen d'entraînement (18, 18) pour ouvrir et fermer le commutateur, sont essentiellement fabriquées d'une seule feuille de matériau qui comprend un composite de résine époxy renforcé de fibres aramides et qui sert de structure avec des évidements et/ou des trous (151) pour monter des éléments conducteurs (16).



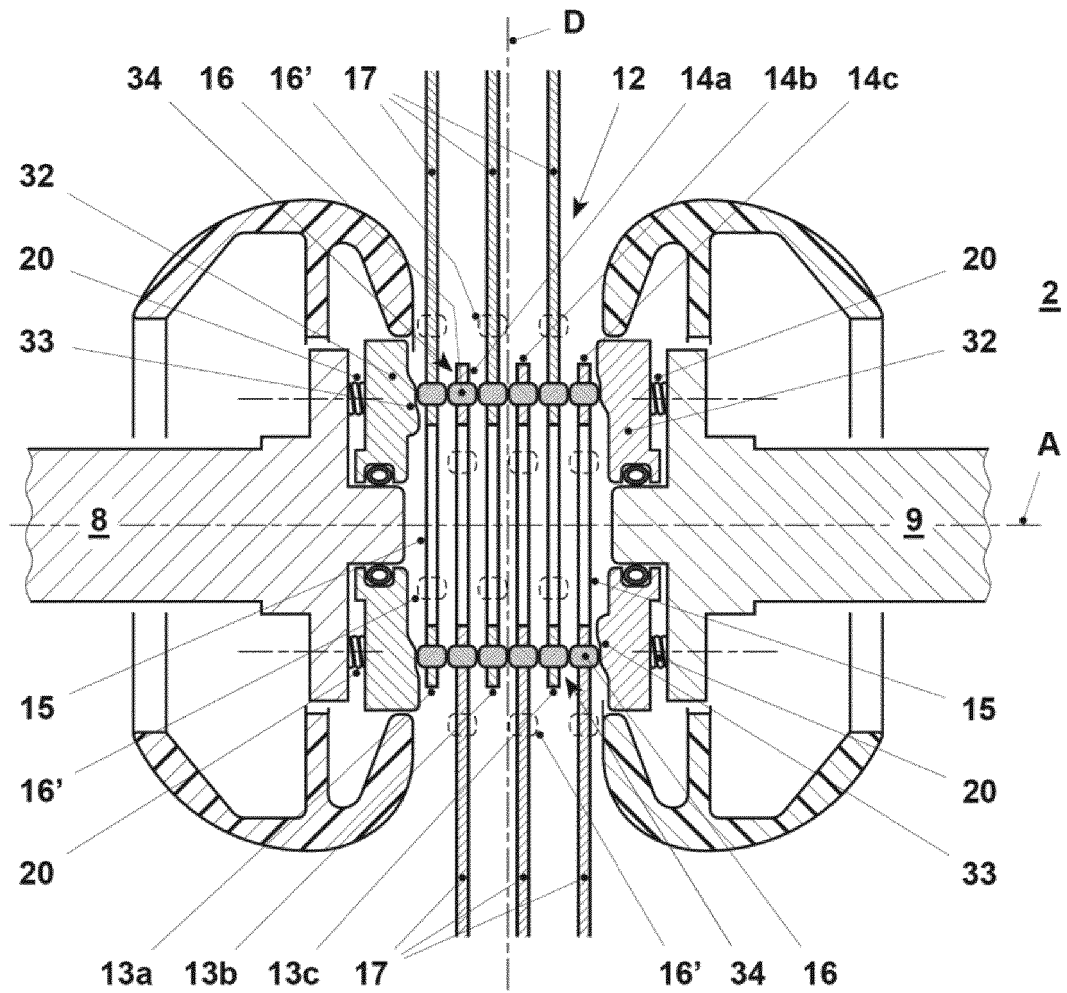
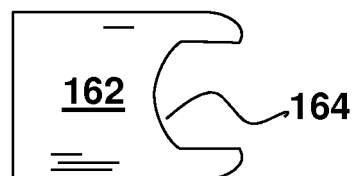
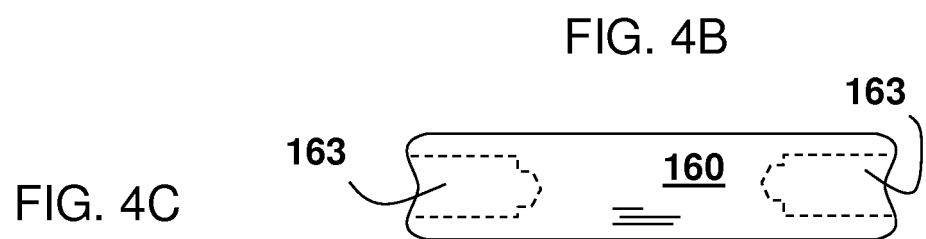
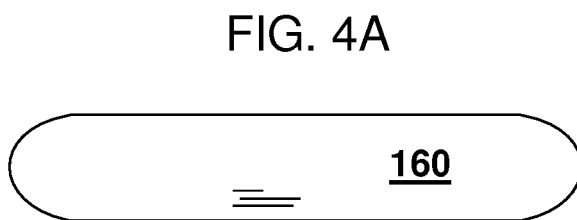
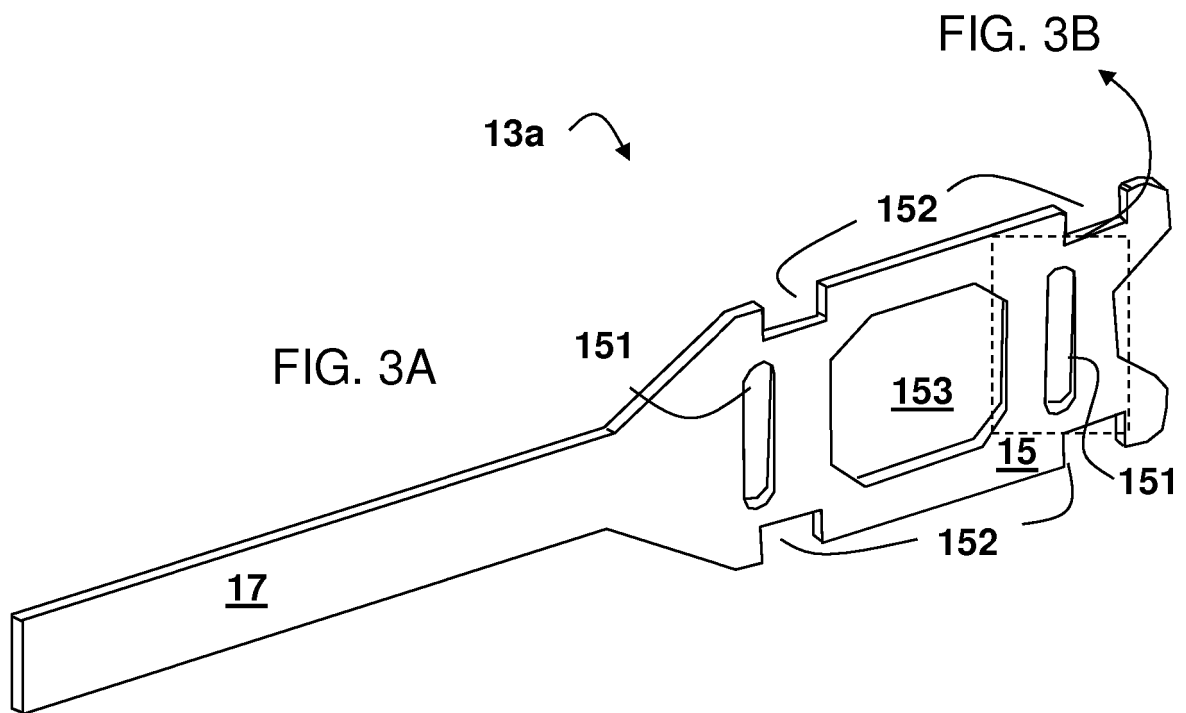
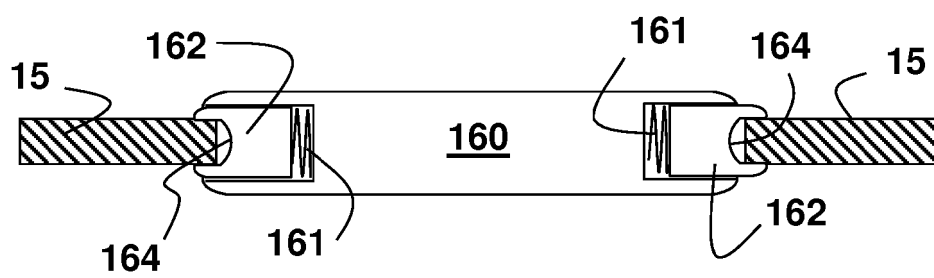
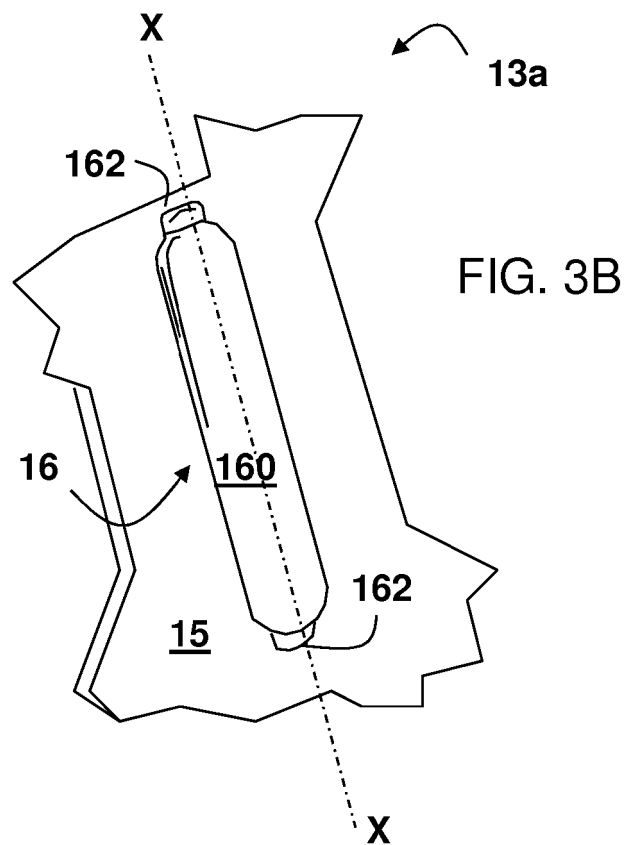


FIG. 2 (Prior Art)





REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 7235751 B [0002] [0028]
- US 20120256711 A [0002] [0003] [0016]
- US 20130098874 A [0002] [0003] [0016] [0046]