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## (54) Switch for solid cut-off

(57) The present invention relates to a current breaker switch which allows quickly, effectively and completely extinguishing electric arcs occurring in an electric circuit during the circuit cut-off and closing operations, which makes it particularly applicable to cutting off direct current. The switch comprises a rotor (2) made of an insulating material that is rotational and incorporates a moving contact (9), at least one pair of fixed contacts (4,4'), such that the rotor (2) is configured such that in the open position of the switch, the rotor is in direct contact with the fixed contacts and covers most of the contact surface of the fixed contacts for cutting off current by the interposition of a solid means.

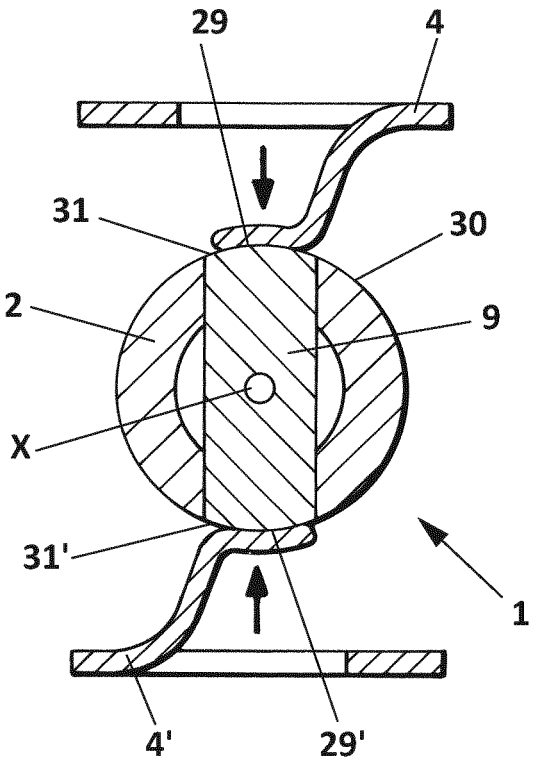



FIG. 1a

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## Description

Object of the Invention

**[0001]** The present invention belongs to the field of electric switches and/or circuit breakers, particularly suitable for extinguishing the electric arc occurring when opening and closing the contacts thereof.

**[0002]** More specifically, an object of the present invention is to provide a current breaker switch, which allows quickly and effectively extinguishing electric arcs occurring in an electric circuit during the cutting off and closing operations thereof, all in a smaller volume.

**[0003]** The switch of the invention is particularly applicable to cutting off high power direct current, where it is more difficult to extinguish the electric arc than in alternating current.

Background of the Invention

**[0004]** Today it is known that electric arcs occurring in electric circuits can cause many problems because the heat energy produced during an electric arc is highly destructive. Some of these problems are: deterioration of the material of the switch, malfunctions and/or total or partial destruction of electric installations, including damage to people due to burns or another type of injuries.

**[0005]** The problems with extinguishing the electric arc is particularly noticeable in direct current cut-off where, unlike alternating current, there is no zero-crossing, so an arc occurred which must be eliminated as quickly as possible by means of deionizing the medium and increasing dielectric strength.

**[0006]** Several techniques are known today for extinguishing the electric arc occurring when opening and closing the contacts of a current switch or circuit breaker. The common objective of all these techniques is to achieve that the energy dissipated in heat of the electric arc is the smallest amount possible, with the objective of this being nil. To that end, the critical variable on which to act is time control, trying to get the speed in putting out the electric arc to be the quickest possible.

**[0007]** To achieve said objective, various techniques are known, among which the following must be pointed out:

a) increase in the separation distance between the fixed and moving contacts of the electrical switch, which entails a larger volume of air between them, and therefore, a larger switch size.

- Speed increase in trip devices
- Radial cut-off
- Serially connecting simultaneous contacts

b) increase in the length or "lengthening" of the electric arc for one and the same time instant

- Arcing chambers
- Magnetic and pneumatic blow-out

c) cooling the electric arc using auxiliary means to reduce harmful heat effects, such as for example using sulfur hexafluoride $SF_6$ under pressure.

d) acting on the dielectric strength of the medium to prevent re-igniting the arc by the influence of the electric field due to potential differences.

**[0008]** However, even though there are electric breaker switches today that combine some of the techniques discussed above: arcing chamber with magnetic or pneumatic blow-out, radial instead of linear separation of contacts, etc., said switches today still have not satisfactorily solved their primary task of extinguishing the electric arc because the extinguishing time is still too high and the material still deteriorates, especially in very demanding applications such as high-power direct current cut-off.

**[0009]** Furthermore, the techniques known for extinguishing the arc generally entail an increase in the volume of switches due to the necessary volume of air between the contacts.

**[0010]** The operation of switch cut-off mechanisms usually entails some type of impact between parts which, in the long-term, cause the material to deteriorate by wear which can lead to destruction of the switch.

Description of the Invention

**[0011]** The present invention solves the drawbacks discussed above, providing a current breaker switch that can simultaneously and synergistically integrate several arc extinguishing techniques, quickly and effectively breaking the electric arc in a smaller space and in one and the same time instant.

**[0012]** Therefore, a first aspect of the invention relates to an electric current breaker switch, comprising:

a rotor made of an insulating material which is rotational with respect to an axis,
at least one moving contact assembled in the rotor and integrally movable with the rotor,
at least one pair of fixed contacts having a contact surface arranged for being contacted by the moving contact in the electrically closed position of the switch, and
where the rotor is movable between a closed position of the switch in which the moving contact establishes electrical continuity with the fixed contacts, and an open position in which current circulation is prevented.

**[0013]** The rotor is configured, i.e., it has a shape and size such that in the open position of the switch, the insulating material of the rotor is in direct contact with the fixed contacts and covers most, preferably all, of the contact surface of the fixed contacts, such that the electrical

cut-off operation (i.e., going from switch conduction to the power being cut off) is performed by means of the instantaneous interposition (in the same instant the power is cut off) of a solid material, such as the insulating material of the rotor, instead of the insulating means being air, oil or another insulating liquid, like what occurs in switches of the state of the art.

**[0014]** Therefore, the occurrence of the electric arc in the current cut-off process of the switch is eliminated or at least significantly reduced, achieving the electric insulation of the cut-off points instantaneously in the very moment the power is cut off by the interposition of a solid insulating medium or material between the fixed and moving contacts, with greater insulating capacity than air, oil, etc.

**[0015]** The rotor can be configured for rotating on the same plane, i.e., without axial movement, so the fixed contacts and the moving contact can be coplanar, such that the moving contact is movable on said plane to perform the operations of closing and opening the switch.

**[0016]** Alternatively, in another preferred embodiment of the invention the rotor is movable following a helicoidal movement about an axis, such that the moving contact assembled in the rotor also moves with that helicoidal movement. The helicoidal movement of the moving contact with respect to the fixed contacts is a combination of rotational movement together with longitudinal movement of the moving contact with respect to one and the same axis, which has the effect of achieving a longer separation length between contacts (lengthening the electric arc) for extinguishing the arc quickly and in a smaller space.

**[0017]** The invention thereby successfully lengthens the electric arc in helicoidal form without requiring a larger volume of air, which means that for one and the same rated cut-off current, the switch can be smaller compared to a switch of the state of the art.

**[0018]** As a result of the helicoidal movement, the tangential speed of the cut-off point increases depending on the turning radius, thus increasing the cut-off speed in a simple manner, without the need for complex mechanisms and with a smaller number of parts, so manufacturing the switch is very simple.

Description of the Drawings

**[0019]** To complement the description being made and for the purpose of aiding to better understand the features of the invention according to a preferred practical embodiment thereof, a set of drawings is attached as an integral part of said description in which the following has been depicted with an illustrative and nonlimiting character:

Figure 1 shows a sequence of drawings showing the movement of the rotor rotating clockwise. The drawings are a front elevational and cross-section view of a switch according to one embodiment of the invention, where Figure (a) corresponds to the electrically closed position of the switch (current circulation), Figure (b) corresponds to a transition position in which current is still circulating, and Figure (c) corresponds to the open position of the switch (current circulation is prevented).

Figure 2 shows an exploded view of an embodiment of a helicoidal movement current switch according to the invention.

Figure 3 shows the embodiment of Figure 2 in the initial position of 0° of rotation of the rotor, corresponding to the electrically closed position of the switch (the passage of current is allowed), where Figure 3a is a front elevational view without the stator, Figure 3b is a profile view, Figure 3c is a perspective view, and Figure 3d is another perspective view with the stator coupled and partially sectioned.

Figure 4 shows a depiction similar to that of Figure 3, when the rotation of the rotor is about 45° with the rotation direction clockwise, corresponding to an electrical cut-off position.

Figure 5 shows a depiction similar to that of Figure 3, when the rotor has rotated 90° with respect to a vertical axis, and the separation between the moving contact and the fixed contacts is maximum.

Preferred Embodiment of the Invention

**[0020]** Figure 1 shows an embodiment of a switch for solid cut-off according to the invention, comprising: a rotor (2) made of an insulating material that is rotational with respect to an axis (X), at least one moving contact (9) assembled in the rotor (2), and at least one pair of fixed contacts (4,4') respectively having a contact surface (29,29') arranged for being contacted by the moving contact (9) in the electrically closed position of the switch. The rotor (2) is movable between a closed position of the switch (Figure 1a) in which the moving contact (9) establishes electrical continuity with the fixed contacts (4,4'), and an open position (Figure 1c) in which the moving contact (9) is not in contact with the fixed contacts (4,4') and current circulation is prevented.

**[0021]** The rotor (2) is configured such that in the open position (Figure 1 c) of the switch, the rotor is in direct contact with the fixed contacts (4,4') and covers the entire contact surface (29,29') of the fixed contacts (4,4') to electrically insulate them. It can be seen in Figure 1c that the rotor is interposed between the fixed contacts (4,4'), and the moving contact (9), preventing or at least complicating the occurrence of the electric arc.

**[0022]** The rotor (2) has a side contact surface (30) arranged for sliding over the fixed contacts (4,4'), specifically over the respective contact surfaces (29,29'), such that that contact surface (30) is formed to an extent by an end of the moving contact (9) and to a larger extent by rotor (2) itself. In Figure 1, the rotor (2) is a circular disc or a cylinder, so the contact surface (30) has the curvature of an arc of circumference of center the axis

of rotation (X) of the rotor (2). Nevertheless, other different configurations of the rotor (2) are possible provided it has a shape and size suitable for being superimposed on the contact surface (29,29') of the fixed contacts (4,4') in the open position (Figure 1c) of the switch.

**[0023]** It can be seen in Figure 1 that the fixed contacts (4,4') are equidistant with respect to the axis (X) and are preferably arranged in a diametrically opposed manner with respect to the axis of rotation (X) of the rotor. On the other hand, the moving contact (9) is housed in the rotor (2) and is configured such that it has ends (31,31') projecting in diametrically opposed sides of the rotor (2). The rotor (2) has a circular section having a diameter coinciding with the separation distance between the fixed contacts (4'4') so with the rotation of rotor (2) the contact surface (30) slides in permanent contact with the fixed contacts (4'4') by means of the contact surfaces (29,29').

**[0024]** One of the effects or advantages that is obtained with those features of the invention is that as the fixed contacts (4,4') and the moving contact (9) begin to move further from or closer to one another in the switch transition process, the insulating material itself of the rotor (2) gradually comes into direct contact with the two fixed contacts (4,4') at the same time it slides over them, so the power is cut off by means of the instantaneous interposition of a solid medium or material instead of air, as conventionally occurs in the state of the art.

**[0025]** As can particularly be observed in Figure 1b, as the moving contact (9) rotates, the contact surface between the surfaces (29,29') and the ends (31,31') is reduced, and at the same time the insulating material of the rotor (2) gradually comes into contact with the surfaces (29,29'), so no air chamber in which the arc can be propagated is created at any instant. As soon as the moving contact (9) is no longer in contact with the fixed contacts (4,4') and current circulation is cut off, the rotor (2) will have completely covered the surfaces (29,29'). This effect is achieved because part of the outer surface (30) of the rotor is adjacent to the two ends (31,31') of the moving contact, i.e., those ends of the moving contact and part of the insulating material of the rotor form a continuous surface.

**[0026]** That interposition of a solid medium occurs at the same time in the two fixed contacts (4,4'), i.e., double insulation at two different points.

**[0027]** Additionally, contact between the rotor (2) and the fixed contacts (4'4') can be done under pressure, for example by means of springs pressing the fixed contacts (4,4') against the rotor (2) (as indicated by the arrows in Figure 1a), such that since the fixed contacts (4,4') are in the form of a flat bar, they have certain bending capacity. The electric insulation between the two fixed terminals (4,4') is thus significantly enhanced, so it is even more difficult for an arc to be generated.

**[0028]** In the embodiment of Figure 1, the fixed contacts (4,4') and the moving contact (9) are coplanar, and the moving contact (9) is rotational on said plane, i.e., there is no axial movement of the rotor.

**[0029]** Alternatively, the rotor (2) is movable defining a helicoidal movement about the axis of rotation (X), and reciprocally between a closed position and an electrical cut-off position of the switch, as shown in Figures 2 to 5.

**[0030]** Specifically, Figure 2 shows a helicoidal switch (1) for solid cut-off comprising a stator (11) including a casing (7,7') made of an insulating material intended for being assembled in a fixed position of an electric installation, for example in a switchboard, and can be formed by two halves (7,7') coupled to one another. The stator (11) internally forms a generally cylindrically-shaped chamber (3) in which a rotor (2) is housed, and such that the rotor (2) is suitable for moving, defining a helicoidal movement inside said chamber and with respect to its axis of revolution (X).

**[0031]** A pair of fixed contacts (4,4') are assembled in said casing (7,7'), forming contact terminals (6,6') projecting in said chamber (3) and curved in correspondence with the curvature of the outer surface of the rotor (2). The rotor (2) in turn incorporates at least one moving contact (9) which rotates integrally with the rotor and therefore also defines a helicoidal movement about the axis "X".

**[0032]** The rotor (2) is preferably hollow and has two transverse holes (8) located at diametrically opposed points thereof. To improve conduction, in this embodiment the moving contact (9) consists of one or more superimposed metal plates (5,5') in direct contact and housed in the rotor, such that the two ends (31,31') of the metal plates (5,5') project diametrically through said holes (8) of the rotor, being flush with its outer surface, for which purpose said ends are curved according to the curvature of the outer surface of the rotor.

**[0033]** The outer surface of the rotor (2) slides in permanent contact with the contact terminals (6,6') of the fixed contacts. The fixed contacts (4,4') and the moving contact (9) are arranged for coming into contact in the closed position of the switch (1) (Figure 3), whereas in the electrical cut-off position of the switch (Figures 4 and 5), the fixed contacts (4,4') are in contact with the insulating material of the rotor (2). The fixed contacts (4,4') are arranged in a diametrically opposed manner with respect to the axis of revolution (X) of the rotor (2).

**[0034]** Preferably, the switch further comprises at least one ring (10) made of an insulating material, assembled with rotational capacity inside the cylindrical chamber (3) of the stator (11), for which purpose the casing (7) has seatings (12) in the chamber (3) in which said rings are housed, and such that the inner surface of the rings is flush with the surface of the chamber (3). The diameter of the cylindrical chamber (3) coincides with or is slightly larger than the outer diameter of the rotor (2) to allow its sliding therein in a tight manner. The rotor (2) slides over said rings (10), which in turn are rotational with respect to the casing (7,7') such that the rings (10) act as bearings that facilitate the rotation of the rotor (2). For that purpose, the rings (10) can be made from an insulating material having low friction.

**[0035]** The insulating rings (10) perimetrically surrounding the rotor (2) furthermore serve to guide the rotor (2) in its helicoidal movement and to electrically insulate the moving contacts (9).

**[0036]** The stator (11) and the rotor (2) have ventilation windows, specifically the windows (13) of the rotor and the windows (14) of the stator, which are placed such that they are superimposed in the electrically closed position of the switch (as shown in Figure 3d), thus forming a ventilation channel communicating the inside of the rotor (2) with the outside of the stator (11), allowing ventilation of the switch and the exit of gases generated during current cut-off operations.

**[0037]** To cause the helicoidal movement of the rotor (2) with respect to its axis of revolution (X) inside the chamber (3), the stator and the rotor are configured forming a threaded coupling therebetween in a complementary manner. Specifically, in the case of Figure 2, the rotor has on its outer surface one or more channels (15) with a helicoidal trajectory, cooperating with ribs (16) with a similar shape that are inserted in said channels.

**[0038]** The rotor (2) is driven by conventional external means, for example a connecting rod (17) coupled with a lug (18) projecting from the rotor, which is in turn operated by any suitable mechanism. Said operating means cause the helicoidal movement of the rotor in one direction or the other, i.e., reciprocally, along the axis (X) between a closed position and an electrical cut-off position of the switch. The person skilled in the art will understand that other configurations are possible for obtaining said threaded or screw configuration between rotor and stator for the purpose of causing the helicoidal movement of the rotor.

**[0039]** To enhance the arc extinguishing effect, the switch of the invention can incorporate the electric arc breaking by means of the serial connection of contacts, together with the increase in the length of the arc at each cut-off point. To that end, as shown in Figure 2, the switch includes two or more moving contacts (9) assembled in the rotor in the same position but at a different axial position. One or more plates (19,19') made of a conductive material are assembled in the stator (11) outside the rotor, which respectively incorporate footings (20,20') and are arranged such that in the electrically closed position of the switch, they connect the moving contacts (9) between the fixed contacts (4,4') in series as is shown more clearly in Figure 3b, in which the arrows indicate the electric current circulation direction. The arc is thus split at several cut-off points, so it is easier to extinguish.

**[0040]** The plates (19,19') are permanently pressed against the fixed contacts (9) by elastic means, in this case by means of formed flat bars (21,21') placed between the plates (19,19') and the fixed terminals (4,4').

**[0041]** A pair of metal connection terminals (22,22') in the form of a plate serve to electrically connect the switch with an external circuit. Said terminals (22,22') are plate-shaped and are arranged in opposite portions of the casing (7,7') and electrically connected with the fixed contacts (4,4') with which they are in contact.

**[0042]** On the other hand, the rotor (2) is open in at least one of its ends, i.e., it is a tubular body, and the switch has a rear closure valve (24) assembled in a fixed position in the rear portion of the casing (7,7,), for example by means of a support (26) attached to the casing. The rear valve (24) is configured to be inserted and slid inside the rotor in a tight manner by its rear portion when the rotor moves towards said valve in its end position in the movement to cut off power. In the electrically closed position of the switch, the rear closure valve (24) does not seal the rotor, as seen in Figure 3b, so it allows air to circulate towards the inside thereof.

**[0043]** Similarly, in the front portion of the rotor (2) the switch has a front closure valve (25) assembled in a fixed position in the front portion of the casing (7,7,), for example by means of a support (27) attached to the casing. The front valve (25) is housed at all times inside the rotor, specifically in its front portion, and is configured to slide inside the rotor in a tight manner, hermetically sealing it.

**[0044]** The front and rear valves (25,24) are cylindrical-shaped and made of an insulating material, for example a rigid or flexible plastic material.

**[0045]** On the other hand, the rotor (2) has a through conduit (28) in at least one of the holes (8), preferably located in a corner of the holes, which communicates the inside of the rotor with the outside, and is intended for allowing suctioning the electric arc towards the inside of the rotor, as will be described below.

**[0046]** The operation of the switch for closing and cutting off the electric current is illustrated in Figures 3 to 4.

**[0047]** In the situation of Figure 3, the switch is in the electrically closed position, so the three moving contacts (9) are connected in series by means of the plates (19,19'), and a moving contact (9) is in turn connected with the fixed contact (4), and another moving contact (9") is connected with the fixed contact (4'), establishing electrical continuity and therefore allowing current circulation, as indicated by the arrows of Figure 3b.

**[0048]** In this same situation, the ventilation windows (13,14) of the rotor and stator, respectively, coincide, i.e., they are superimposed as seen in Figure 3d, so the inside of the rotor is communicated with the outside of the stator, allowing the natural ventilation thereof by air circulation, as indicated by the arrows of Figure 3d. Furthermore, as a result of the windows (13,14) coinciding in this position, the moving contacts (9,9',9") inside the rotor can be seen from outside the switch, which provides the additional advantage that the state of the switch can be visually inspected, which can be useful, for example, for an operator performing maintenance tasks.

**[0049]** To cut off power, the rotor (2) is rotated clockwise seen in Figure 3a, with which the rotor moves axially and defines a helicoidal trajectory in the direction of arrow "A" of Figure 4b, while at the same time the rear closure valve (24) seals the rear opening of the rotor when reaching a rotation of about 40° before cutting off current circulation. The moving contacts (9,9',9") move in a helicoi-

dal manner in the same direction until they are no longer connected with the plates (19,19') and with the fixed contacts (4,4'), so current circulation is cut off, as seen in Figure 4c.

**[0050]** At the same time the rotor (2) starts to rotate, the ventilation windows of the rotor (13) start to be concealed below the rings (10), which are suitably located for such function, and the rotor itself in turn closes the ventilation windows (14) of the stator. The rotor (2) approaches the rear closure valve (24) sealing the rear opening of the rotor. When the rotor has rotated 45° it is in the position of Figure 4, where the inside of the rotor is completely sealed because the ventilation windows are closed, and the front and rear openings of the rotor are sealed by the valves (24,25).

**[0051]** In such situation, air can only circulate through the conduits (28), such that the relative movement between the rotor and the front and rear valves (25,24), generates a suction similar to that produced by a plunger in a syringe, which suctions the electric arc towards the inside of the rotor, which in turn entails stretching the arc and cooling the cut-off area due to the suction current.

**[0052]** To go from the electrical cut-off position to the electrically closed or electrical continuity position, the rotor is rotated counter-clockwise, as seen in Figure 5c, whereby the rotor moves in the direction opposite that indicated by the arrow of Figure 4b, until the rotor again reaches the position of Figure 3.

**[0053]** One of the advantages of the invention is that as a result of the current cut-off being performed without having any impact between parts, materials different from those used today can be used. Therefore in a preferred embodiment of the invention, the rotor (2) is made of glass, which provides the additional advantage of that material being an excellent insulating material with high dielectric strength, and it is highly resistant to deterioration caused by the electric arc, compared with plastic insulating materials conventionally used in the state of the art, which in turn significantly prolongs the service life of the switch. Alternatively, the rotor can also be made of porcelain, obtaining the same advantages discussed above with respect to glass.

**[0054]** In view of these figures it can be seen that the switch developed in this invention is capable of achieving in one and the same instant and with a single movement the following effects:

- current cut-off with the instantaneous interposition (in the very moment of the cut-off) of an insulating solid material,
- optionally, greater separation between contacts in the cut-off process as a result of the sum of the radial and axial movement of the helicoidal movement of the moving contacts,
- and optionally, the possibility of producing the suction of the arc towards the inside of the rotor.

**[0055]** The particular structure of the switch allows it to be smaller because it is not necessary to have air chambers between contacts, being able to reach a size reduction of about 50% with respect to a conventional switch for the same cut-off power.

**[0056]** The operation of the switch does not entail the abrupt impact between any of its parts, which increases the service life of the switch and increases its reliability.

**[0057]** The embodiment depicted in the drawings corresponds to a one-pole, i.e., single-pole, switch. However, for the person skilled in the art it is clear that the same depicted structure can easily be adapted to implement a multiple pole switch.

**[0058]** The various embodiments and alternatives described herein can be combined with one another, giving rise to other embodiments, such as those obtained with the multiple combinations of the attached claims, for example.

## Claims

**1.** Switch for solid cut-off comprising:

a rotor made of an insulating material that is rotational with respect to an axis,
at least one moving contact assembled in the rotor,
at least one pair of fixed contacts, having a contact surface arranged for being contacted by the moving contact,
where the rotor is movable between a closed position of the switch in which the moving contact establishes electrical continuity with the fixed contacts, and an open position in which current circulation is prevented,
**characterized in that** the rotor is configured such that in the open position of the switch, the rotor is in direct contact with the fixed contacts and covers a major part of the contact surface of the fixed contacts.

**2.** Switch according to claim 1, where the rotor has a side contact surface arranged for sliding over at least one of the fixed contacts, and in that part of the side contact surface of the rotor and the ends of the moving contact form a continuous surface arranged for sliding over the fixed contacts.

**3.** Switch according to claim 1 or 2, where said side contact surface has the curvature of an arc of circumference of center the axis of rotation of the rotor, and where the fixed contacts are equidistant with respect to said axis.

**4.** Switch according to any of the preceding claims, where the fixed contacts are arranged in a diametrically opposed manner with respect to the axis of rotation of the rotor, and in that the moving contact

is housed in the rotor and is configured such that it has ends projecting on diametrically opposed sides of the rotor.

**5.** Switch according to any of the preceding claims, where the rotor has a circular section having a diameter coinciding with the separation distance between the fixed contacts.

**6.** Switch according to any of the preceding claims, where the fixed contacts and the moving contact are coplanar, and the moving contact is movable on said plane.

**7.** Switch according to any of claims 1 to 5, where the rotor is movable defining a helicoidal movement about an axis of rotation, and reciprocally between a closed position and an electrical cut-off position of the switch.

**8.** Switch according to any of the preceding claims, where the rotor is cylindrical and is rotational with respect to its axis of revolution.

**9.** Switch according to any of the preceding claims, further comprising a stator including a casing made of an insulating material, where said fixed contacts are assembled in said stator, and where the rotor is housed inside the stator.

**10.** Switch according to any of claims 7 to 9, where the stator and the rotor are configured forming a complementary threaded coupling therebetween to cause the helicoidal movement of the rotor.

**11.** Switch according to any of the preceding claims, where the stator has a cylindrical chamber in which the rotor is housed, where the rotor is at least partially hollow, and where the stator and the rotor have ventilation windows placed such that they are superimposed in the electrically closed position of the switch, defining a ventilation channel communicating the inside of the rotor with the outside of the stator.

**12.** Switch according to any of the preceding claims, where the rotor has at least two holes located at diametrically opposed points thereof, and where the fixed contact is one or more superimposed metal plates housed in the rotor such that the two ends of the fixed contact project from said holes of the rotor and are arranged for contacting with the corresponding fixed contacts in the closed position of the switch.

**13.** Switch according to any of the preceding claims, further comprising at least one ring made of an insulating material, assembled integrally in the cylindrical chamber of the stator, such that the rotor slides over said rings, and in that the moving contacts are arranged such that in the electrical cut-off position, their free ends are facing an insulating ring.

**14.** Switch according to any of the preceding claims, further comprising two or more moving contacts assembled in the rotor, and one or more footings made of a conductive material outside the rotor, the footings being arranged such that in the electrically closed position of the switch they connect the moving contacts between the fixed contacts in series.

**15.** Switch according to any of the preceding claims, where the rotor is made of porcelain or glass.

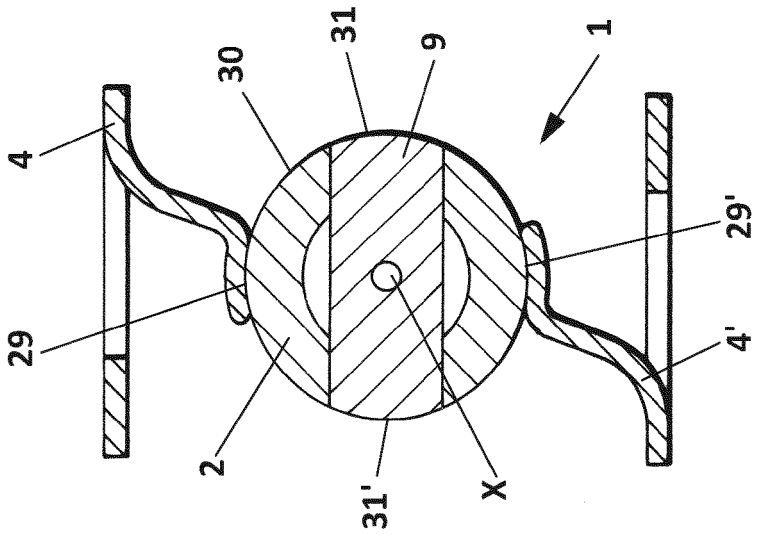



FIG. 1c

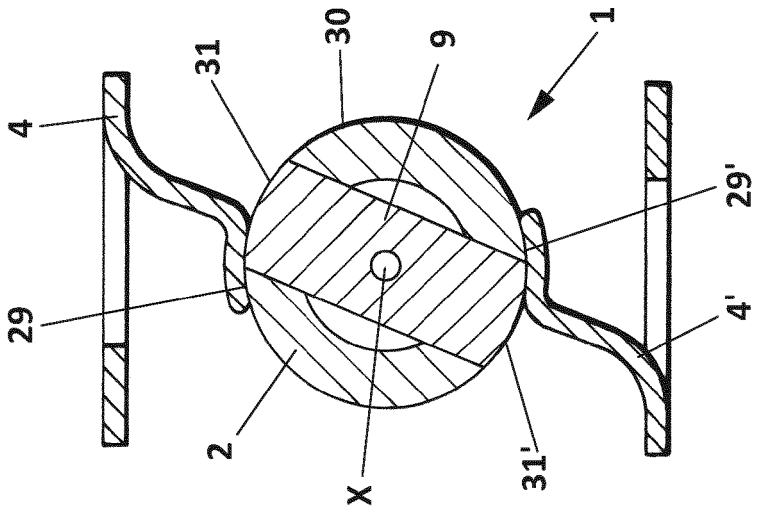



FIG. 1b

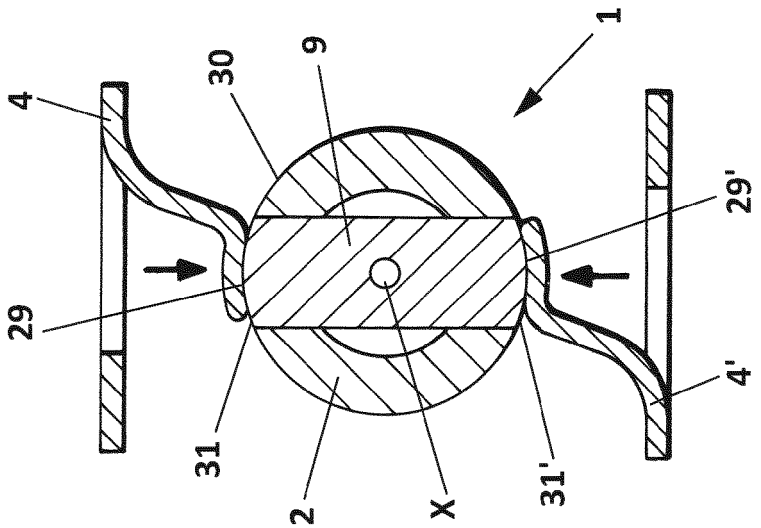



FIG. 1a

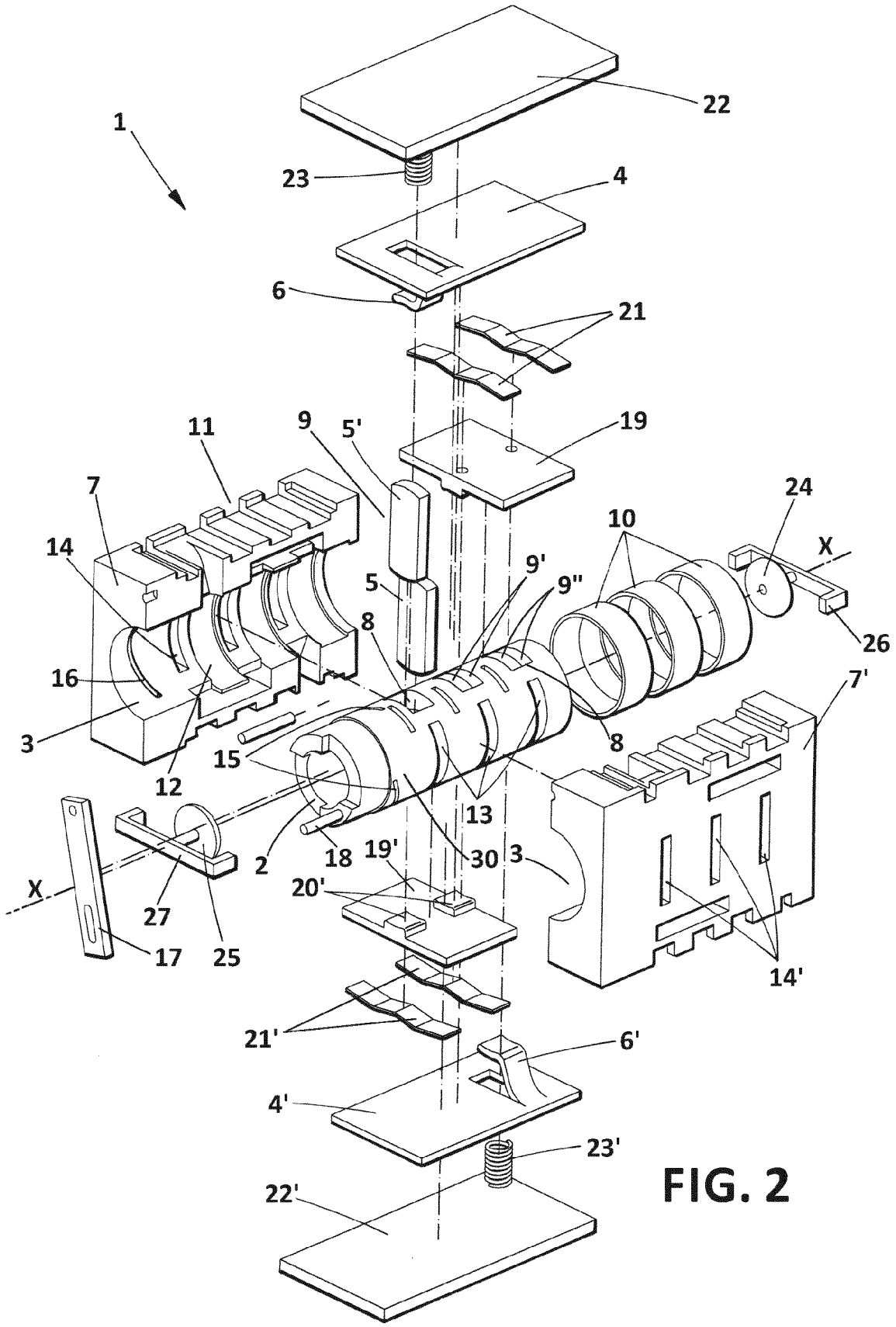

1
22
23
4
6
21
19
11
9
5'
7
24
10
14
X
9'
9"
5
8
26
16
7'
3
8
15
12
13
2
18
19'
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X
20'
27
17
25
14'
21'
6'
4'
23'
22'

FIG. 2

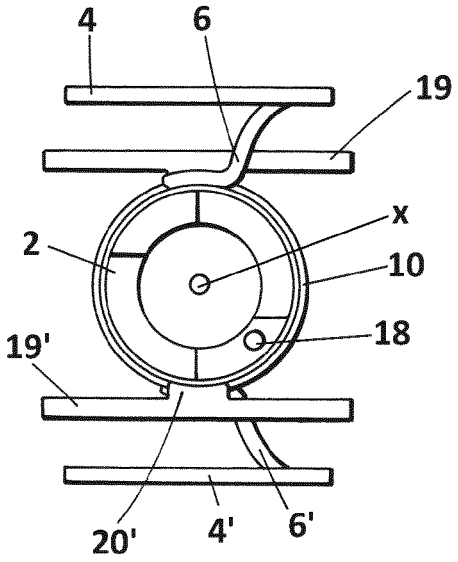



FIG. 3a

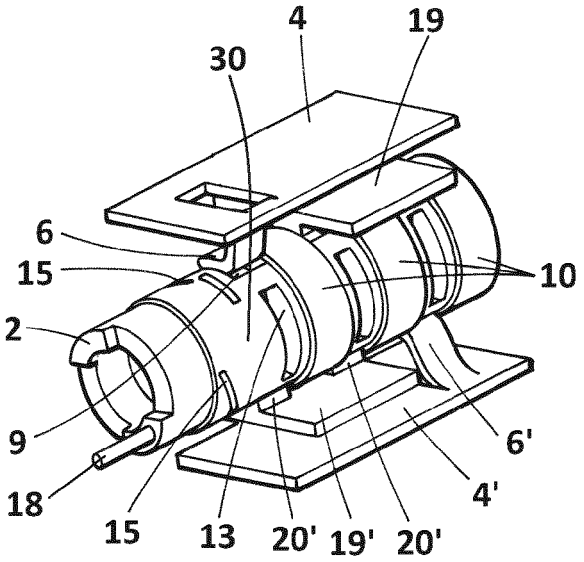



FIG. 3c

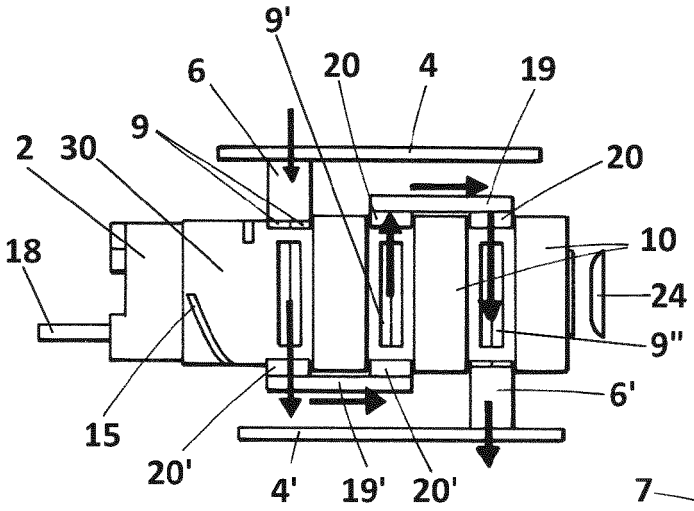



FIG. 3b

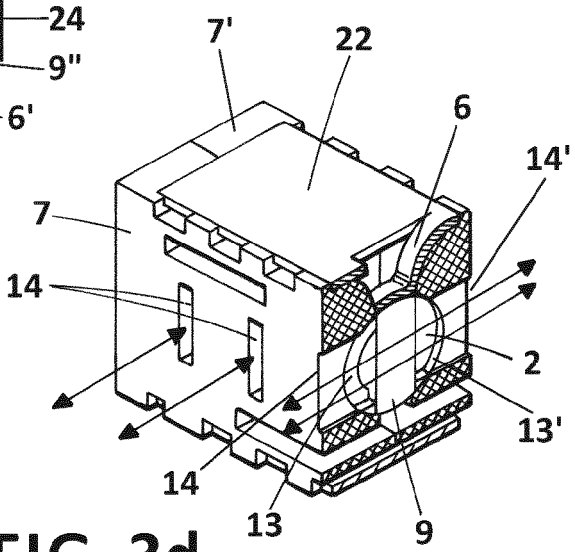



FIG. 3d

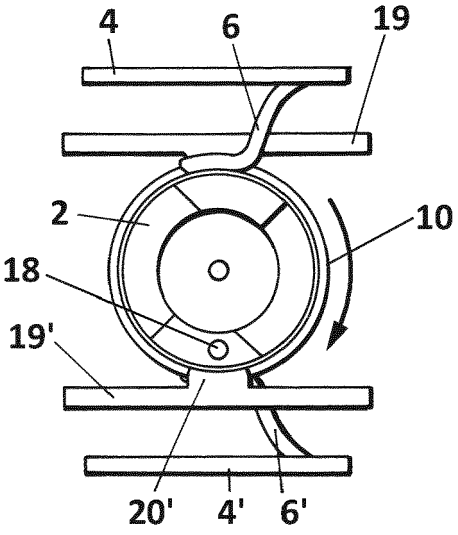



FIG. 4a

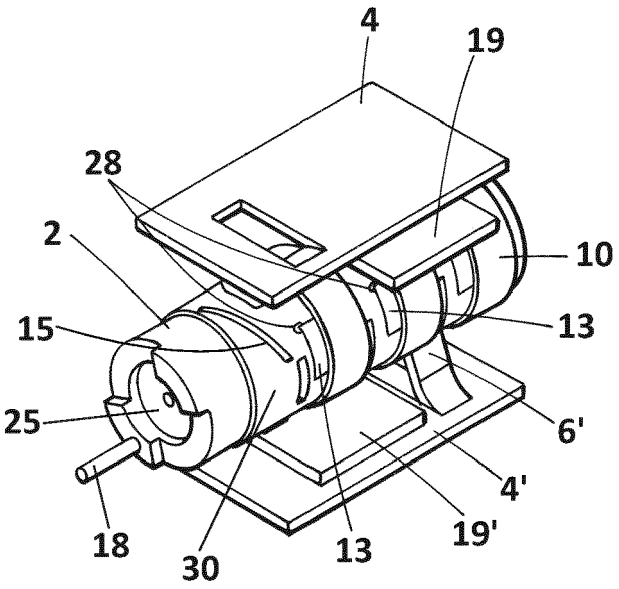



FIG. 4c

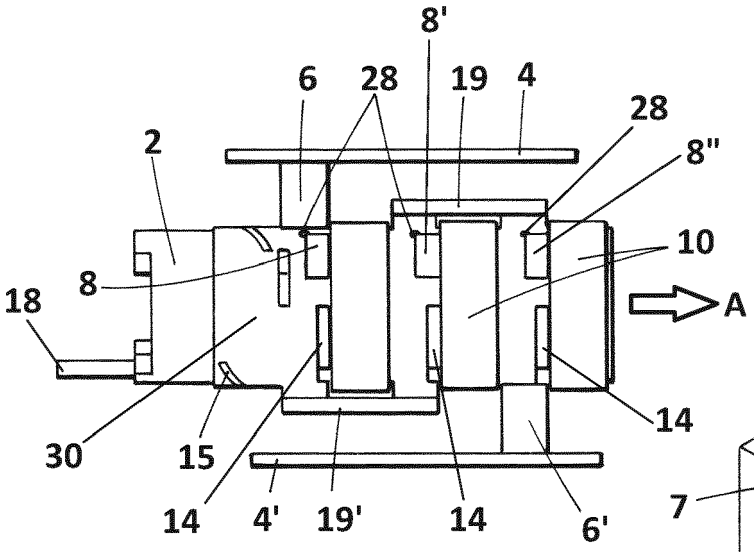



FIG. 4b

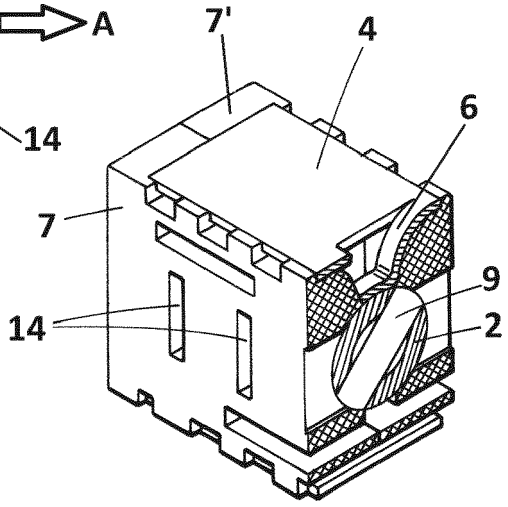



FIG. 4d

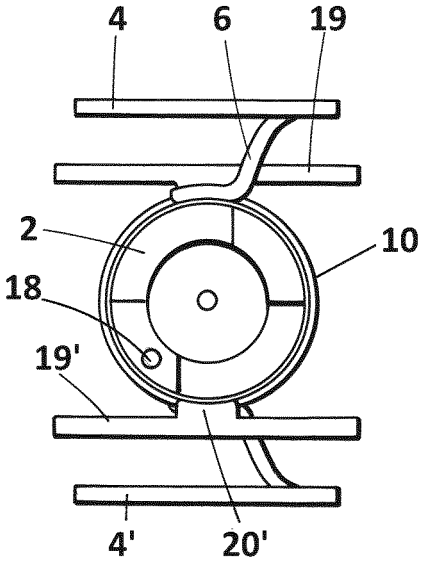



FIG. 5a

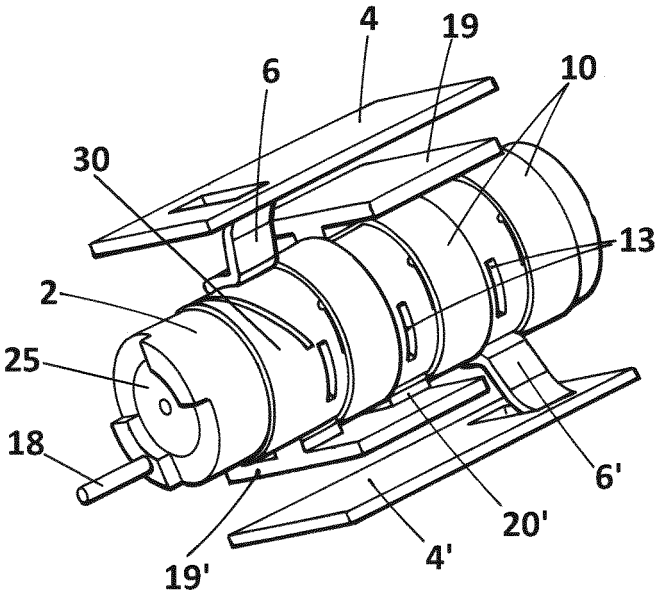



FIG. 5c

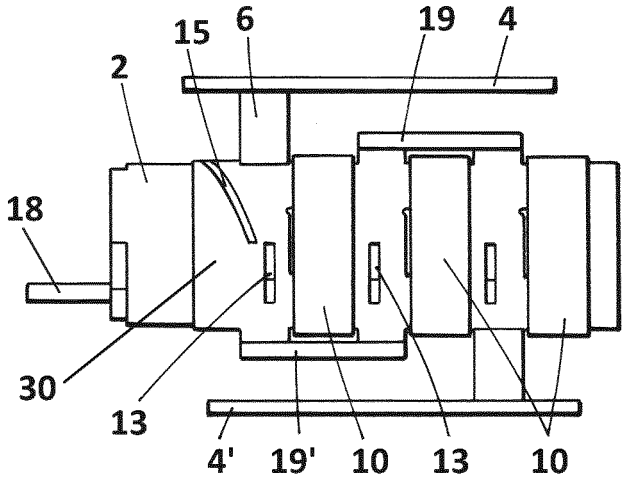



FIG. 5b

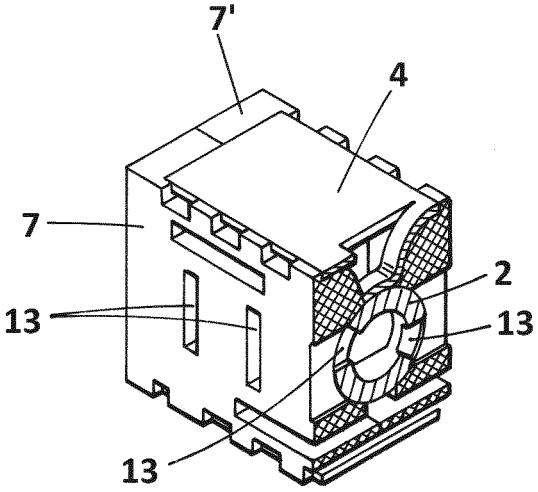



FIG. 5d

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# EUROPEAN SEARCH REPORT

Application Number
EP 13 38 2416

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
| X<br>Y | US 4 841 833 A (SCHERBARTH DAVID W [US] ET AL) 27 June 1989 (1989-06-27)<br>* column 4, line 7 - column 5, line 33; figures 2,3,7 * | 1-10,12, 15<br>11,13,14 | INV.<br>H01H19/56<br>H01H1/36<br>H01H9/32<br>H01H1/40 |
| X<br>Y<br>A | DE 10 2011 118713 A1 (DEHN & SOEHNE [DE]) 27 September 2012 (2012-09-27)<br>* page 6, paragraph 0070 - page 7, paragraph 0080; figures 3-7 * | 1-6,8,9, 12,15<br>11,13,14<br>7,10 | ADD.<br>H01H9/52 |
| X<br>Y<br>A | EP 1 267 373 A1 (YAZAKI CORP [JP]) 18 December 2002 (2002-12-18)<br>* column 7, line 1 - column 9, line 24; figures 7-11 * | 1-6,8,9, 12,15<br>11,13,14<br>7,10 | |
| Y<br>A | US 4 426 562 A (KEMENY GEORGE A [US]) 17 January 1984 (1984-01-17)<br>* column 5, line 47 - column 11, line 25; figures 2-4 * | 11,13,14<br>1-10,12, 15 | |

TECHNICAL FIELDS SEARCHED (IPC)

H01H

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| Munich | 12 March 2014 | Pavlov, Valeri |

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12-03-2014

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| US 4841833 A | 27-06-1989 | NONE | |
| DE 102011118713 A1 | 27-09-2012 | DE 102011118713 A1 | 27-09-2012 |
| | | EP 2689445 A1 | 29-01-2014 |
| | | WO 2012126850 A1 | 27-09-2012 |
| EP 1267373 A1 | 18-12-2002 | DE 60208972 T2 | 03-08-2006 |
| | | EP 1267373 A1 | 18-12-2002 |
| | | US 2002187659 A1 | 12-12-2002 |
| US 4426562 A | 17-01-1984 | NONE | |

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