(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 561 844 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
30.10.2019 Bulletin 2019/44

(51) Int Cl.:
H01H 33/66 *(2006.01)* *H01H 33/662* *(2006.01)*

(21) Application number: **18169626.1**

(22) Date of filing: **26.04.2018**

(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
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **ABB Schweiz AG**
5400 Baden (CH)

(72) Inventors:
- **Gentsch, Dietmar**
  40882 Ratingen (DE)
- **Reuber, Christian**
  47877 Willich (DE)

(74) Representative: **Schmidt, Karl Michael**
ABB AG
GF-IP
Oberhausener Strasse 33
40472 Ratingen (DE)

(54) **A SPACER FOR A VACUUM INTERRUPTER**

(57) The present invention relates to a spacer (100) for a vacuum interrupter. The spacer has a first part (102), and a second part (104). The first part of the spacer is permanently connected to the second part of the spacer. The first part of the spacer is configured to push against a lid of a vacuum interrupter at a side of the vacuum interrupter having a movable contact. The second part of the spacer is configured to connect to a mating part of the movable contact. The spacer is configured such that connection of the second part of the spacer to the mating part of the movable contact leads to the first part of the spacer becoming pushed against the lid of the vacuum interrupter at the side of the vacuum interrupter having the movable contact to force the movable contact away from the fixed contact.

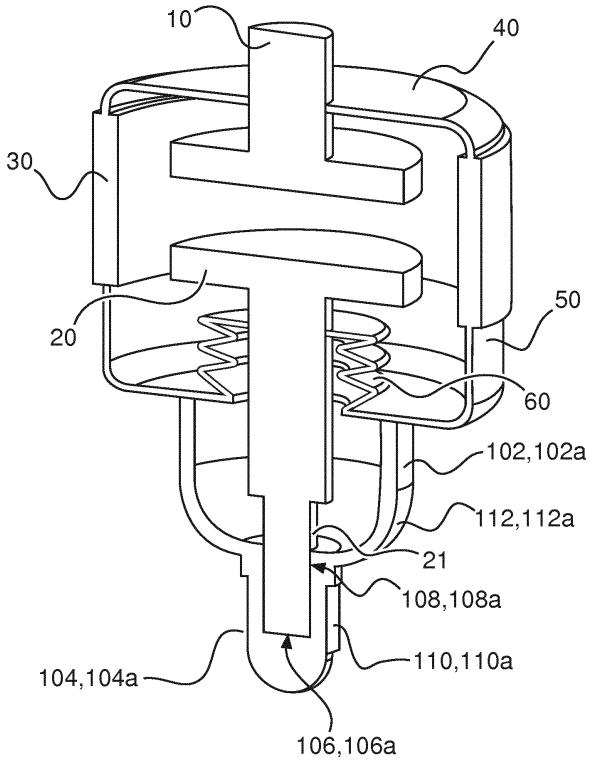

Fig. 7

EP 3 561 844 A1

Description

FIELD OF THE INVENTION

[0001] The present invention relates to spacers for a vacuum interrupter, to vacuum interrupters with spacers, and to methods of separating a movable contact of a vacuum interrupter from a fixed contact of the vacuum interrupter.

BACKGROUND OF THE INVENTION

[0002] Medium voltage (MV) vacuum interrupters (VI) usually have a fixed electrical contact and a movable electrical contact. In this situation the VI has not yet been connected to a drive, in other words it is loose, the pressure of the surrounding air pushes the movable contact onto the fixed contact, so that both contacts touch with a certain force. In this situation, the contacts can become stuck to another due to the cold welding effect. The cold welding effect can be amplified by vibrations, that can occur for example during transportation of the loose VI. There is a need to address this situation. So the movable contact normally is pressed to the fixed contact, by the external pressure. To prevent this, it is well known, to secure the movable contact in a distance to the fixed contact, by the use of bolts and washers and nuts. This is time comsuming and expensive.

SUMMARY OF THE INVENTION

[0003] Therefore, it would be advantageous to have an improved technology that mitigates a movable contact of a loose VI becoming stuck to a fixed contact of the loose VI.

[0004] The object of the present invention is solved with the subject matter of the independent claims, wherein further embodiments are incorporated in the dependent claims. It should be noted that the following described aspects of the invention apply also for the spacers for a vacuum interrupter, for the vacuum interrupters with spacers, and for the methods of separating a movable contact of a vacuum interrupter from a fixed contact of the vacuum interrupter.

In a first aspect, there is provided a spacer for a vacuum interrupter, the spacer comprising:

- a first part; and
- a second part.

[0005] The first part of the spacer is permanently connected to the second part of the spacer. The first part of the spacer is configured to push against a lid of a vacuum interrupter at a side of the vacuum interrupter having a movable contact. The second part of the spacer is configured to connect to a mating part of the movable contact. The spacer is configured such that connection of the second part of the spacer to the mating part of the movable contact leads to the first part of the spacer becoming pushed against the lid of the vacuum interrupter at the side of the vacuum interrupter having the movable contact to force the movable contact away from the fixed contact.

[0006] In other words, a spacer in the form of a single piece, which is simple and cost effective to manufacture, is connected to a vacuum interrupter that is loose and that has not yet been connected to a drive. By connecting the spacer to the vacuum interrupter the movable contact of the vacuum interrupter is moved (forced) away from the fixed contact of the vacuum interrupter and the spacer maintains a separation between these contacts of the vacuum interrupter. In this manner, the contacts do not come into contact with each other when the vacuum interrupter is loose, and consequently the contacts do not become damaged or even cold welded to each other during for example transportation of the vacuum interrupter. The spacer being in a single piece, in addition to being simple and easy to manufacture, means that the spacer is easy to fit to the vacuum interrupter, and different parts do not get lost or mislaid.

[0007] To put this another way, only a single part is required to keep the movable contact of a vacuum interrupter away from the fixed contact of a vacuum interrupter.

[0008] In an example, the spacer is configured to maintain a fixed separation between the movable contact of the vacuum interrupter and the fixed contact of the vacuum interrupter when the second part of the spacer has been connected to the mating part of the moveable contact.

[0009] In this manner, the correct separation between contacts can be maintained that mitigates damage to the contacts due to example from cold welding, and also means that the contacts of the vacuum interrupter are not separated by a distance that could damage the vacuum interrupter.

[0010] In an example, the mating part of the movable contact of the vacuum interrupter has an end that is distal from a part of the movable contact of the vacuum interrupter that can come into contact with the fixed contact of the vacuum interrupter. An internal part of the second part of the spacer forms an end stop; and the fixed separation between the movable contact of the vacuum interrupter and the fixed contact of the vacuum interrupter is maintained through the end of the mating part of the movable contact of the vacuum interrupter coming into contact with the end stop.

[0011] In this way, when the spacer is connected to the vacuum interrupter not only is the movable contact moved away from the fixed contact, but the distance between the contacts is always and automatically set at a correct distance when the second part of the spacer is tightened onto the mating part of the movable contact of the vacuum interrupter.

[0012] In an example, an internal part of the second part of the spacer has an internal screw thread configured

to screw onto an external screw thread of the mating part of the movable contact of the vacuum interrupter. Connection of the second part of the spacer to the mating part of the movable contact of the vacuum interrupter comprises the second part of the spacer being screwed onto the mating part of the movable contact of the vacuum interrupter.

[0013] In an example, a first outer surface of the spacer is substantially flat and is positioned opposite to and substantially parallel to a second outer surface of the spacer that is substantially flat.

[0014] In an example, the first outer surface and the second outer surface form two faces of a hexagonal outer structure of the spacer.

In an example, the second part of the spacer comprises the first outer surface and the second outer surface of the spacer.

[0015] Thus, the spacer has an outer structure that facilitates tightening, through for example a spanner or wrench.

[0016] In an example, the spacer has an axis that is substantially parallel to an axis of the movable contact of the vacuum interrupter when the second part of the spacer is connected to the mating part of the movable contact of the vacuum interrupter. A width of the first part of the spacer extending perpendicularly to the axis of the spacer is larger than a width of the second part of the spacer extending perpendicularly to the axis of the spacer.

[0017] In an example, the spacer is rotationally symmetric about the axis of the spacer.

[0018] In an example, the first part of the spacer is connected via a rounded shoulder to the second part of the spacer.

[0019] In this way, the mechanical load from the second part to the first part is distributed via the rounded shoulder.

[0020] In an example, the spacer is made from plastic.

[0021] In a second aspect, there is provided a spacer for a vacuum interrupter, the spacer comprising:

- a first part; and
- a second part.

[0022] The first part of the spacer is configured to push against a lid of a vacuum interrupter at a side of the vacuum interrupter having a movable contact. The second part of the spacer is configured to connect to a mating part of the movable contact. The spacer is configured such that connection of the second part of the spacer to the mating part of the movable contact leads to the first part of the spacer becoming pushed against the lid of the vacuum interrupter at the side of the vacuum interrupter having the movable contact to force the movable contact away from the fixed contact. The mating part of the movable contact of the vacuum interrupter has an end that is distal from a part of the movable contact of the vacuum interrupter that can come into contact with the fixed contact of the vacuum interrupter. An internal part of the second part of the spacer forms an end stop. A fixed separation between the movable contact of the vacuum interrupter and the fixed contact of the vacuum interrupter is maintained through the end of the mating part of the movable contact of the vacuum interrupter coming into contact with the end stop.

[0023] Thus, a spacer that is simple and cost effective to manufacture, is connected to a vacuum interrupter that is loose and that has not yet been connected to a drive. By connecting the spacer to the vacuum interrupter the movable contact of the vacuum interrupter is moved (forced) away from the fixed contact of the vacuum interrupter and the spacer maintains a separation between these contacts of the vacuum interrupter. In this manner, the contacts do not come into contact with each other when the vacuum interrupter is loose, and consequently the contacts do not become damaged or even cold welded to each other during for example transportation of the vacuum interrupter. The correct separation between the contacts can be maintained that mitigates damage to the contacts, and also means that the contacts of the vacuum interrupter are not separated by a distance that could damage the vacuum interrupter. Furthermore, when the spacer is connected to the vacuum interrupter not only is the movable contact moved away from the fixed contact as the spacer is connected, but the distance between the contacts is always and automatically set at a correct distance when the second part of the spacer is tightened onto the mating part of the movable contact of the vacuum interrupter.

[0024] In an example, an internal part of the second part of spacer has an internal screw thread configured to screw onto an external screw thread of the mating part of the movable contact of the vacuum interrupter, and wherein connection of the second part of the spacer to the mating part of the movable contact of the vacuum interrupter comprises the second part of the spacer being screwed onto the mating part of the movable contact.

[0025] In an example, a first outer surface of the spacer is substantially flat and is positioned opposite to and substantially parallel to a second outer surface of the spacer that is substantially flat.

In an example, the first outer surface and the second outer surface form two faces of a hexagonal outer structure of the spacer.

[0026] In an example, the second part of the spacer comprises the first outer surface and the second outer surface of the spacer.

[0027] In an example, the spacer has an axis that is substantially parallel to an axis of the movable contact of the vacuum interrupter when the second part of the spacer is connected to the mating part of the movable contact of the vacuum interrupter. A width of the first part of the spacer extending perpendicularly to the axis of the spacer is larger than a width of the second part of the spacer extending perpendicularly to the axis of the spacer.

[0028] In an example, the spacer is rotationally symmetric about the axis of the spacer.

[0029] In an example, the first part of the spacer is configured to connect to the second part of the spacer via a rounded shoulder.

[0030] In an example, the parts of the spacer are made from plastic.

[0031] In an example, the first part of the spacer is permanently connected to the second part of the spacer.

[0032] In a third aspect, there is provided a vacuum interrupter with spacer. The spacer comprises a first part, and comprises a second part. The first part of the spacer is permanently connected to the second part of the spacer. The second part of the spacer is connected to a mating part of a movable contact of the vacuum interrupter such that the first part of the spacer is pushed against a lid of the vacuum interrupter at a side of the vacuum interrupter having the movable contact to separate the movable contact of the vacuum interrupter from a fixed contact of the vacuum interrupter.

[0033] In a fourth aspect, there is provided a vacuum interrupter with spacer. The spacer comprises a first part, and comprises a second part. The second part of the spacer is connected to a mating part of a movable contact of the vacuum interrupter such that the first part of the spacer is pushed against a lid of the vacuum interrupter at a side of the vacuum interrupter having the movable contact to separate the movable contact of the vacuum interrupter from a fixed contact of the vacuum interrupter. The mating part of the movable contact of the vacuum interrupter has an end that is distal from a part of the movable contact of the vacuum interrupter that can come into contact with the fixed contact of the vacuum interrupter. An internal part of the second part of the spacer forms an end stop. A fixed separation between the movable contact of the vacuum interrupter and the fixed contact of the vacuum interrupter is maintained through the end of the mating part of the movable contact of the vacuum interrupter coming into contact with the end stop.

[0034] In a fifth aspect, there is provided a method of separating a movable contact of a vacuum interrupter from a fixed contact of the vacuum interrupter, comprising:

connecting a spacer to a vacuum interrupter, wherein the spacer comprises a first part and a second part, and wherein, the first part of the spacer is permanently connected to the second part of the spacer;

wherein, connecting the spacer to the vacuum interrupter comprises connecting the second part of the spacer to a mating part of a movable contact of the vacuum interrupter, such that the first part of the spacer pushes against a lid of the vacuum interrupter at a side of the vacuum interrupter having the movable contact to force the movable contact away from the fixed contact.

[0035] In a sixth aspect, there is provided a method of separating a movable contact of a vacuum interrupter from a fixed contact of the vacuum interrupter, comprising:

connecting a spacer to a vacuum interrupter, wherein the spacer comprises a first part and a second part;

wherein, connecting the spacer to the vacuum interrupter comprises connecting the second part of the spacer to a mating part of a movable contact of the vacuum interrupter, such that the first part of the spacer pushes against a lid of the vacuum interrupter at a side of the vacuum interrupter having the movable contact to force the movable contact away from the fixed contact;

wherein, the mating part of the movable contact of the vacuum interrupter has an end that is distal from a part of the movable contact of the vacuum interrupter that can come into contact with the fixed contact of the vacuum interrupter, and wherein an internal part of the second part of the spacer forms an end stop; and

wherein a fixed separation between the movable contact of the vacuum interrupter and the fixed contact of the vacuum interrupter is provided through the end of the mating part of the movable contact of the vacuum interrupter coming into contact with the end stop through connecting the second part of the spacer to the mating part of the movable contact of the vacuum interrupter.

[0036] The above aspects and examples will become apparent from and be elucidated with reference to the embodiments described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0037] Exemplary embodiments will be described in the following with reference to the following drawings:

Fig. 1 shows a schematic representation of an example of a spacer for a vacuum interrupter;

Fig. 2 shows a schematic representation of an example of a spacer for a vacuum interrupter;

Fig. 3 shows a schematic representation of an example of a vacuum interrupter with a spacer;

Fig. 4 shows a schematic representation of an example of a vacuum interrupter with a spacer;

Fig. 5 shows a method of separating a movable contact of a vacuum interrupter from a fixed contact of the vacuum interrupter;

Fig. 6 shows a method of separating a movable contact of a vacuum interrupter from a fixed contact of the vacuum interrupter; and

Fig. 7 shows a schematic representation of a detailed example of a vacuum interrupter with a spacer.

DETAILED DESCRIPTION OF EMBODIMENTS

[0038] Fig. 1 shows an example of a spacer 100 for a vacuum interrupter, where dashed lines show optional features. The spacer 100 comprises a first part 102, and a second part 104. The first part 102 of the spacer 100 is permanently connected to the second part 104 of the spacer 100. The first part 102 of the spacer 100 is configured to push against a lid of a vacuum interrupter at a side of the vacuum interrupter having a movable contact. The second part 104 of the spacer 100 is configured to connect to a mating part of the movable contact of the vacuum interrupter. The spacer 100 is configured such that connection of the second part 104 of the spacer 100 to the mating part of the movable contact of the vacuum interrupter leads to the first part 102 of the spacer 100 becoming pushed against the lid of the vacuum interrupter at the side of the vacuum interrupter having the movable contact. In this way the movable contact of the vacuum interrupter is forced (moved) away from the fixed contact of the vacuum interrupter.

[0039] According to an example, the spacer is configured to maintain a fixed separation between the movable contact of the vacuum interrupter and the fixed contact of the vacuum interrupter when the second part of the spacer has been connected to the mating part of the moveable contact of the vacuum interrupter.

[0040] According to an example, the mating part of the movable contact of the vacuum interrupter has an end that is distal from a part of the movable contact of the vacuum interrupter that can come into contact with the fixed contact of the vacuum interrupter.

[0041] An internal part of the second part of the spacer forms an end stop 106. The fixed separation between the movable contact of the vacuum interrupter and the fixed contact of the vacuum interrupter is maintained through the end of the mating part of the movable contact of the vacuum interrupter coming into contact with the end stop 106 of the second part of the spacer.

[0042] According to an example, an internal part 108 of the second part of spacer has an internal screw thread configured to screw onto an external screw thread of the mating part of the movable contact of the vacuum interrupter. Connection of the second part of the spacer to the mating part of the movable contact of the vacuum interrupter comprises the second part of the spacer being screwed onto the mating part of the movable contact of the vacuum interrupter.

[0043] According to an example, a first outer surface 110 of the spacer is substantially flat and is positioned opposite to and substantially parallel to a second outer surface 110 of the spacer that is substantially flat.

[0044] According to an example, the first outer surface and the second outer surface form two faces of a hexagonal outer structure 110 of the spacer.

[0045] According to an example, the second part of the spacer comprises the first outer surface and the second outer surface of the spacer.

[0046] According to an example, the spacer has an axis that is substantially parallel to an axis of the movable contact of the vacuum interrupter when the second part of the spacer is connected to the mating part of the movable contact of the vacuum interrupter. A width of the first part of the spacer extending perpendicularly to the axis of the spacer is larger than a width of the second part of the spacer extending perpendicularly to the axis of the spacer.

[0047] According to an example, the spacer is rotationally symmetric about the axis of the spacer.

[0048] According to an example, the first part of the spacer is connected via a rounded shoulder 112 to the second part of the spacer.

[0049] According to an example, the spacer is made from plastic.

[0050] Fig. 2 shows an example of a spacer 100a for a vacuum interrupter, where dashed lines show optional features. The spacer 100a comprises a first part 102a, and a second part 104a. The first part 102a of the spacer 100a is configured to push against a lid of a vacuum interrupter at a side of the vacuum interrupter having a movable contact. The second part 104a of the spacer 100a is configured to connect to a mating part of the movable contact of the vacuum interrupter. The spacer 100a is configured such that connection of the second part 104a of the spacer 100a to the mating part of the movable contact of the vacuum interrupter leads to the first part 102a of the spacer 100a becoming pushed against the lid of the vacuum interrupter at the side of the vacuum interrupter having the movable contact to force the movable contact of the vacuum interrupter away from the fixed contact of the vacuum interrupter. The mating part of the movable contact of the vacuum interrupter has an end that is distal from a part of the movable contact of the vacuum interrupter that can come into contact with the fixed contact of the vacuum interrupter. An internal part of the second part 104a of the spacer 100a forms an end stop 106a. A fixed separation between the movable contact of the vacuum interrupter and the fixed contact of the vacuum interrupter is maintained through the end of the mating part of the movable contact of the vacuum interrupter coming into contact with the end stop 106a of the second part 104a of the spacer 100a.

[0051] According to an example, an internal part 108a of the second part 104a of spacer 100a has an internal screw thread configured to screw onto an external screw thread of the mating part of the movable contact of the vacuum interrupter. Connection of the second part 104a of the spacer 100a to the mating part of the movable contact of the vacuum interrupter comprises the second

part 104a of the spacer 100a being screwed onto the mating part of the movable contact of the vacuum interrupter.

[0052] According to an example, a first outer surface 110a of the spacer is substantially flat and is positioned opposite to and substantially parallel to a second outer surface 110a of the spacer that is substantially flat.

[0053] According to an example, the first outer surface and the second outer surface form two faces of a hexagonal outer structure 110a of the spacer.

[0054] According to an example, the second part of the spacer comprises the first outer surface and the second outer surface of the spacer.

[0055] According to an example, the spacer has an axis that is substantially parallel to an axis of the movable contact of the vacuum interrupter when the second part of the spacer is connected to the mating part of the movable contact of the vacuum interrupter. A width of the first part of the spacer extending perpendicularly to the axis of the spacer is larger than a width of the second part of the spacer extending perpendicularly to the axis of the spacer.

[0056] According to an example, the spacer is rotationally symmetric about the axis of the spacer.

[0057] According to an example, the first part of the spacer is configured to connect to the second part of the spacer via a rounded shoulder 112a.

[0058] According to an example, the parts of the spacer are made from plastic.

[0059] According to an example, the first part of the spacer is permanently connected to the second part of the spacer.

[0060] Fig. 3 shows an example of a vacuum interrupter 1 with spacer 100. The spacer 100 comprises a first part 102, and a second part 104. The first part 102 of the spacer 100 is permanently connected to the second part 104 of the spacer 100. The second part 104 of the spacer 100 is connected to a mating part 21 of a movable contact 20 of the vacuum interrupter 1. This connection has pushed the first part 102 of the spacer 100 against a lid 50 of the vacuum interrupter 1 at a side of the vacuum interrupter 1 having the movable contact 20 to separate the movable contact 20 of the vacuum interrupter 1 from a fixed contact 10 of the vacuum interrupter 1.

[0061] In an example, the spacer is configured to maintain a fixed separation between the movable contact of the vacuum interrupter and the fixed contact of the vacuum interrupter.

[0062] In an example, the mating part of the movable contact of the vacuum interrupter has an end that is distal from a part of the movable contact of the vacuum interrupter that can come into contact with the fixed contact of the vacuum interrupter. An internal part of the second part of the spacer forms an end stop 106. The fixed separation between the movable contact of the vacuum interrupter and the fixed contact of the vacuum interrupter is maintained through the end of the mating part of the movable contact of the vacuum interrupter coming into contact with the end stop of the second part of the spacer.

[0063] In an example, an internal part 108 of the second part of spacer has an internal screw thread configured to screw onto an external screw thread of the mating part of the movable contact of the vacuum interrupter. Connection of the second part of the spacer to the mating part of the movable contact of the vacuum interrupter comprises the second part of the spacer being screwed onto the mating part of the movable contact of the vacuum interrupter.

[0064] In an example, a first outer surface 110 of the spacer is substantially flat and is positioned opposite to and substantially parallel to a second outer surface 110 of the spacer that is substantially flat.

[0065] In an example, the first outer surface and the second outer surface form two faces of a hexagonal outer structure 110 of the spacer.

[0066] In an example, the second part of the spacer comprises the first outer surface and the second outer surface of the spacer.

[0067] In an example, the spacer has an axis that is substantially parallel to an axis of the movable contact of the vacuum interrupter. A width of the first part of the spacer extending perpendicularly to the axis of the spacer is larger than a width of the second part of the spacer extending perpendicularly to the axis of the spacer.
In an example, the spacer is rotationally symmetric about the axis of the spacer.

[0068] In an example, the first part of the spacer is connected via a rounded shoulder 112 to the second part of the spacer.

[0069] In an example, the spacer is made from plastic.

[0070] Fig. 4 shows an example of a vacuum interrupter 1 with spacer 100a. The spacer 100a comprises a first part 102a, and a second part 104a. The second part 104a of the spacer 100a is connected to a mating part 21 of a movable contact 20 of the vacuum interrupter 1. This connection has pushed the first part 102a of the spacer 100a against a lid 50 of the vacuum interrupter 1 at a side of the vacuum interrupter1 having the movable contact 20 to separate the movable contact 20 of the vacuum interrupter 1 from a fixed contact 10 of the vacuum interrupter 1. The mating part 21 of the movable contact 20 of the vacuum interrupter 1 has an end that is distal from a part of the movable contact 20 of the vacuum interrupter 1 that can come into contact with the fixed contact 10 of the vacuum interrupter 1. An internal part of the second part 104a of the spacer 100a forms an end stop 106a. A fixed separation between the movable contact 20 of the vacuum interrupter 1 and the fixed contact 10 of the vacuum interrupter 1 is maintained through the end of the mating part 21 of the movable contact 20 of the vacuum interrupter 1 coming into contact with the end stop 106a of the second part 104a of the spacer 100a.

[0071] In an example, an internal part 108a of the second part of spacer has an internal screw thread configured to screw onto an external screw thread of the mating part of the movable contact of the vacuum interrupter.

Connection of the second part of the spacer to the mating part of the movable contact of the vacuum interrupter comprises the second part of the spacer being screwed onto the mating part of the movable contact of the vacuum interrupter.

[0072] In an example, a first outer surface 110a of the spacer is substantially flat and is positioned opposite to and substantially parallel to a second outer surface 110a of the spacer that is substantially flat.

[0073] In an example, the first outer surface and the second outer surface form two faces of a hexagonal outer structure 110a of the spacer.

[0074] In an example, the second part of the spacer comprises the first outer surface and the second outer surface of the spacer.

[0075] In an example, the spacer has an axis that is substantially parallel to an axis of the movable contact of the vacuum interrupter. A width of the first part of the spacer extending perpendicularly to the axis of the spacer is larger than a width of the second part of the spacer extending perpendicularly to the axis of the spacer.

[0076] In an example, the spacer is rotationally symmetric about the axis of the spacer.

[0077] In an example, the first part of the spacer is configured to connect to the second part of the spacer via a rounded shoulder 112a.

[0078] In an example, the parts of the spacer are made from plastic.

[0079] In an example, the first part of the spacer is permanently connected to the second part of the spacer.

[0080] Fig. 5 shows a method 200 of separating a movable contact of a vacuum interrupter from a fixed contact of the vacuum interrupter in its basis steps. The method 200 comprises connecting 300 a spacer to a vacuum interrupter. The spacer comprises a first part and a second part. The first part of the spacer is permanently connected to the second part of the spacer. The connecting 300 the spacer to the vacuum interrupter comprises connecting 310 the second part of the spacer to a mating part of a movable contact of the vacuum interrupter, such that the first part of the spacer pushes 320 against a lid of the vacuum interrupter at a side of the vacuum interrupter having the movable contact to force 330 the movable contact away from the fixed contact.

[0081] In an example, the spacer is configured to maintain a fixed separation between the movable contact of the vacuum interrupter and the fixed contact of the vacuum interrupter.

[0082] In an example, the mating part of the movable contact of the vacuum interrupter has an end that is distal from a part of the movable contact of the vacuum interrupter that can come into contact with the fixed contact of the vacuum interrupter. An internal part of the second part of the spacer forms an end stop. The fixed separation between the movable contact of the vacuum interrupter and the fixed contact of the vacuum interrupter is maintained through the end of the mating part of the movable contact of the vacuum interrupter coming into contact with the end stop.

[0083] In an example, an internal part of the second part of spacer has an internal screw thread configured to screw onto an external screw thread of the mating part of the movable contact of the vacuum interrupter. Connection of the second part of the spacer to the mating part of the movable contact of the vacuum interrupter comprises the second part of the spacer being screwed onto the mating part of the movable contact of the vacuum interrupter.

[0084] In an example, a first outer surface of the spacer is substantially flat and is positioned opposite to and substantially parallel to a second outer surface of the spacer that is substantially flat.

[0085] In an example, the first outer surface and the second outer surface form two faces of a hexagonal outer structure of the spacer.

[0086] In an example, the second part of the spacer comprises the first outer surface and the second outer surface of the spacer.

[0087] In an example, the spacer has an axis that is substantially parallel to an axis of the movable contact of the vacuum interrupter. A width of the first part of the spacer extending perpendicularly to the axis of the spacer is larger than a width of the second part of the spacer extending perpendicularly to the axis of the spacer.

In an example, the spacer is rotationally symmetric about the axis of the spacer.

In an example, the first part of the spacer is connected via a rounded shoulder to the second part of the spacer.

[0088] In an example, the spacer is made from plastic.

[0089] Fig. 6 shows a method 400 of separating a movable contact of a vacuum interrupter from a fixed contact of the vacuum interrupter in its basic steps. The method 400 comprises connecting 500 a spacer to a vacuum interrupter. The spacer comprises a first part and a second part. The connecting 500 the spacer to the vacuum interrupter comprises connecting 510 the second part of the spacer to a mating part of a movable contact of the vacuum interrupter, such that the first part of the spacer pushes 520 against a lid of the vacuum interrupter at a side of the vacuum interrupter having the movable contact to force 530 the movable contact away from the fixed contact. The mating part of the movable contact of the vacuum interrupter has an end that is distal from a part of the movable contact of the vacuum interrupter that can come into contact with the fixed contact of the vacuum interrupter. An internal part of the second part of the spacer forms an end stop. A fixed separation between the movable contact of the vacuum interrupter and the fixed contact of the vacuum interrupter is provided through the end of the mating part of the movable contact of the vacuum interrupter coming into contact with the end stop through connecting the second part of the spacer to the mating part of the movable contact of the vacuum interrupter.

[0090] In an example, an internal part of the second part of spacer has an internal screw thread configured

to screw onto an external screw thread of the mating part of the movable contact of the vacuum interrupter. Connection of the second part of the spacer to the mating part of the movable contact of the vacuum interrupter comprises the second part of the spacer being screwed onto the mating part of the movable contact of the vacuum interrupter.

[0091] In an example, a first outer surface of the spacer is substantially flat and is positioned opposite to and substantially parallel to a second outer surface of the spacer that is substantially flat.

[0092] In an example, the first outer surface and the second outer surface form two faces of a hexagonal outer structure of the spacer.

[0093] In an example, the second part of the spacer comprises the first outer surface and the second outer surface of the spacer.

[0094] In an example, the spacer has an axis that is substantially parallel to an axis of the movable contact of the vacuum interrupter. A width of the first part of the spacer extending perpendicularly to the axis of the spacer is larger than a width of the second part of the spacer extending perpendicularly to the axis of the spacer.

[0095] In an example, the spacer is rotationally symmetric about the axis of the spacer.

[0096] In an example, the first part of the spacer is connected via a rounded shoulder to the second part of the spacer.

[0097] In an example, the spacer is made from plastic.

[0098] In an example, the first part of the spacer is permanently connected to the second part of the spacer.

[0099] Fig. 7 shows a detailed example of a vacuum interrupter 1 having had a spacer 100, 110a connected to it. The vacuum interrupter has a fixed contact 10, a movable contact 20. The movable contact 20 has a threaded section 21 at its outer end. The vacuum interrupter 1 has an insulator 30, and a lid 40 on the side of the fixed contact 10 and a lid 50 on the side of the movable contact 20. The vacuum interrupter has a bellows 60. When the vacuum interrupter is loose and has not been connected to a drive and has not yet had the spacer 100, 100a connected to it the surrounding air pushes the movable contact 20 onto the fixed contact 10. However, connection of the spacer 100, 100a to the vacuum interrupter 1 has moved the movable contact 20 away from the fixed contact 10 by a set distance that is maintained, as discussed in more detail. The spacer 100, 100a has a first part 102, 102a and a second part 104, 104a. The first part 102, 102a of the spacer 100, 100a is joined to the second part 104, 104a of the spacer 100, 100a by a rounded shoulder 112, 112a. The first part 102, 102a, second part 104, 104a and rounder shoulder 112, 112a are all permanently fixed together to form a single part. However, the parts need not be permanently fixed together. An internal part 108, 108a of the second part 104, 104a of the spacer 100, 100a is threaded that can be screwed onto the threaded section 21 of the movable contact 20 of the vacuum interrupter 1. The second part 104, 104a of the spacer 100, 100a also has an end stop 106, 106a. In Fig. 7, the spacer 100, 100a has been placed around the end of the movable contact 20 and the internal screw threaded part 108, 108a of the second part 104, 104a of the spacer 100, 100a has been screwed onto the threaded section 21 of the movable contact 20. As the spacer is screwed onto the movable contact, the first part 102, 102a becomes pushed up against the lid 50 of the vacuum interrupter 1 that is on the side of the vacuum interrupter 1 that has the movable contact 20. The movable contact 20 of the vacuum interrupter 1 is then forced away from the fixed contact 10 of the vacuum interrupter 1 until the end of the movable contact 20 of the vacuum interrupter 1 reaches the end stop 106, 106a. The spacer can be appropriately designed to separate the movable 20 and fixed contacts 10 of the vacuum interrupter by a set designed amount, and connection of the spacer 100, 100a to the vacuum interrupter automatically moves the movable contact 20 away from the fixed contact until the designed separation is provided, and which is then maintained until the spacer is unscrewed from the vacuum interrupter 1.

So the spacer is screwed on the stem of the movable contact, until first part 102 is pressed in end position to the lid. Then the defined space will be hold during transportation.

[0100] It has to be noted that embodiments of the invention are described with reference to different subject matters. In particular, some embodiments are described with reference to method type claims whereas other embodiments are described with reference to the device type claims. However, a person skilled in the art will gather from the above and the following description that, unless otherwise notified, in addition to any combination of features belonging to one type of subject matter also any combination between features relating to different subject matters is considered to be disclosed with this application. However, all features can be combined providing synergetic effects that are more than the simple summation of the features.

[0101] While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive. The invention is not limited to the disclosed embodiments. Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing a claimed invention, from a study of the drawings, the disclosure, and the dependent claims.

[0102] In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. A single processor or other unit may fulfill the functions of several items recited in the claims. The mere fact that certain measures are re-cited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope.

Claims

1. A spacer (100) for a vacuum interrupter for transportation of the Vacuum interrupter, the spacer comprising:

    - a first part (102); and
    - a second part (104);

    wherein, the first part of the spacer is permanently connected to the second part of the spacer;
    wherein, the first part of the spacer is configured to push against a lid of a vacuum interrupter at a side of the vacuum interrupter having a movable contact;
    wherein, the second part of the spacer is configured to connect to a mating part of the movable contact;
    wherein, the spacer is configured such that connection of the second part of the spacer to the mating part of the movable contact leads to the first part of the spacer becoming pushed against the lid of the vacuum interrupter at the side of the vacuum interrupter having the movable contact to force the movable contact away from the fixed contact.

2. Spacer according to claim 1, wherein the spacer is configured to maintain a fixed separation between the movable contact of the vacuum interrupter and the fixed contact of the vacuum interrupter when the second part of the spacer has been connected to the mating part of the moveable contact.

3. Spacer according to claim 2, wherein the mating part of the movable contact of the vacuum interrupter has an end that is distal from a part of the movable contact of the vacuum interrupter that can come into contact with the fixed contact of the vacuum interrupter; wherein an internal part of the second part of the spacer forms an end stop (106); and wherein the fixed separation between the movable contact of the vacuum interrupter and the fixed contact of the vacuum interrupter is maintained through the end of the mating part of the movable contact of the vacuum interrupter coming into contact with the end stop.

4. Spacer according to any of claims 1-3, wherein an internal part (108) of the second part of spacer has an internal screw thread configured to screw onto an external screw thread of the mating part of the movable contact of the vacuum interrupter, and wherein connection of the second part of the spacer to the mating part of the movable contact of the vacuum interrupter comprises the second part of the spacer being screwed onto the mating part of the movable contact of the vacuum interrupter.

5. Spacer according to claim 4, wherein a first outer surface (110) of the spacer is substantially flat and is positioned opposite to and substantially parallel to a second outer surface (110) of the spacer that is substantially flat.

6. Spacer according to claim 5, wherein the first outer surface and the second outer surface form two faces of a hexagonal outer structure (110) of the spacer.

7. Spacer according to any of claims 5-6, wherein the second part of the spacer comprises the first outer surface and the second outer surface of the spacer.

8. Spacer according to any of claims 1-7, wherein the spacer has an axis that is substantially parallel to an axis of the movable contact of the vacuum interrupter when the second part of the spacer is connected to the mating part of the movable contact of the vacuum interrupter; and wherein a width of the first part of the spacer extending perpendicularly to the axis of the spacer is larger than a width of the second part of the spacer extending perpendicularly to the axis of the spacer.

9. Spacer according to claim 8, wherein the spacer is rotationally symmetric about the axis of the spacer.

10. Spacer according to any of claims 1-9, wherein the first part of the spacer is connected via a rounded shoulder (112) to the second part of the spacer.

11. Spacer according to any of claims 1-10, wherein the spacer is made from plastic.

12. A spacer (100a) for a vacuum interrupter, the spacer comprising:

    - a first part (102a); and
    - a second part (104a);

    wherein, the first part of the spacer is configured to push against a lid of a vacuum interrupter at a side of the vacuum interrupter having a movable contact;
    wherein, the second part of the spacer is configured to connect to a mating part of the movable contact;
    wherein, the spacer is configured such that connection of the second part of the spacer to the mating part of the movable contact leads to the first part of the spacer becoming pushed against the lid of the vacuum interrupter at the side of the vacuum interrupter having the movable contact to force the movable contact away from the fixed contact;
    wherein the mating part of the movable contact of the vacuum interrupter has an end that is distal from a part of the movable contact of the vacuum interrupter that can come into contact with the fixed contact of the vacuum interrupter;
    wherein an internal part of the second part of the spacer forms an end stop (106a); and
    wherein a fixed separation between the movable

contact of the vacuum interrupter and the fixed contact of the vacuum interrupter is maintained through the end of the mating part of the movable contact of the vacuum interrupter coming into contact with the end stop.

13. Spacer according to claim 12, wherein an internal part (108a) of the second part of the spacer has an internal screw thread configured to screw onto an external screw thread of the mating part of the movable contact of the vacuum interrupter, and wherein connection of the second part of the spacer to the mating part of the movable contact of the vacuum interrupter comprises the second part of the spacer being screwed onto the mating part of the movable contact.

14. Spacer according to claim 13, wherein a first outer surface (110a) of the spacer is substantially flat and is positioned opposite to and substantially parallel to a second outer surface (110a) of the spacer that is substantially flat.

15. Spacer according to claim 14, wherein the first outer surface and the second outer surface form two faces of a hexagonal outer structure (110a) of the spacer.

16. Spacer according to any of claims 14-15, wherein the second part of the spacer comprises the first outer surface and the second outer surface of the spacer.

17. Spacer according to any of claims 12-16, wherein the spacer has an axis that is substantially parallel to an axis of the movable contact of the vacuum interrupter when the second part of the spacer is connected to the mating part of the movable contact of the vacuum interrupter; and wherein a width of the first part of the spacer extending perpendicularly to the axis of the spacer is larger than a width of the second part of the spacer extending perpendicularly to the axis of the spacer.

18. Spacer according to claim 17, wherein the spacer is rotationally symmetric about the axis of the spacer.

19. Spacer according to any of claims 12-18, wherein the first part of the spacer is configured to connect to the second part of the spacer via a rounded shoulder (112a).

20. Spacer according to any of claims 12-19, wherein the parts of the spacer are made from plastic.

21. Spacer according to any of claims 12-20, wherein the first part of the spacer is permanently connected to the second part of the spacer.

22. A vacuum interrupter (1) with spacer (100):

wherein, the spacer comprises a first part (102), and comprises a second part (104);
wherein, the first part of the spacer is permanently connected to the second part of the spacer; and
wherein, the second part of the spacer is connected to a mating part (21) of a movable contact (20) of the vacuum interrupter such that the first part of the spacer is pushed against a lid (50) of the vacuum interrupter at a side of the vacuum interrupter having the movable contact to separate the movable contact of the vacuum interrupter from a fixed contact (10) of the vacuum interrupter.

23. A vacuum interrupter (1a) with spacer (100a):

wherein, the spacer comprises a first part (102a), and comprises a second part (104a);
wherein, the second part of the spacer is connected to a mating part (21a) of a movable contact (20a) of the vacuum interrupter such that the first part of the spacer is pushed against a lid (50a) of the vacuum interrupter at a side of the vacuum interrupter having the movable contact to separate the movable contact of the vacuum interrupter from a fixed contact (10a) of the vacuum interrupter;
wherein, the mating part of the movable contact of the vacuum interrupter has an end that is distal from a part of the movable contact of the vacuum interrupter that can come into contact with the fixed contact of the vacuum interrupter;
wherein an internal part of the second part of the spacer forms an end stop (106a); and
wherein a fixed separation between the movable contact of the vacuum interrupter and the fixed contact of the vacuum interrupter is maintained through the end of the mating part of the movable contact of the vacuum interrupter coming into contact with the end stop.

24. A method (200) of separating a movable contact of a vacuum interrupter from a fixed contact of the vacuum interrupter, comprising:

connecting (300) a spacer to a vacuum interrupter, wherein the spacer comprises a first part and a second part, and wherein, the first part of the spacer is permanently connected to the second part of the spacer;
wherein, connecting the spacer to the vacuum interrupter comprises connecting (310) the second part of the spacer to a mating part of a movable contact of the vacuum interrupter, such that the first part of the spacer pushes (320) against

a lid of the vacuum interrupter at a side of the vacuum interrupter having the movable contact to force (330) the movable contact away from the fixed contact.

25. A method (400) of separating a movable contact of a vacuum interrupter from a fixed contact of the vacuum interrupter, comprising:

connecting (500) a spacer to a vacuum interrupter, wherein the spacer comprises a first part and a second part;
wherein, connecting the spacer to the vacuum interrupter comprises connecting (510) the second part of the spacer to a mating part of a movable contact of the vacuum interrupter, such that the first part of the spacer pushes (520) against a lid of the vacuum interrupter at a side of the vacuum interrupter having the movable contact to force (530) the movable contact away from the fixed contact;
wherein, the mating part of the movable contact of the vacuum interrupter has an end that is distal from a part of the movable contact of the vacuum interrupter that can come into contact with the fixed contact of the vacuum interrupter, and wherein an internal part of the second part of the spacer forms an end stop; and
wherein a fixed separation between the movable contact of the vacuum interrupter and the fixed contact of the vacuum interrupter is provided through the end of the mating part of the movable contact of the vacuum interrupter coming into contact with the end stop through connecting the second part of the spacer to the mating part of the movable contact of the vacuum interrupter.

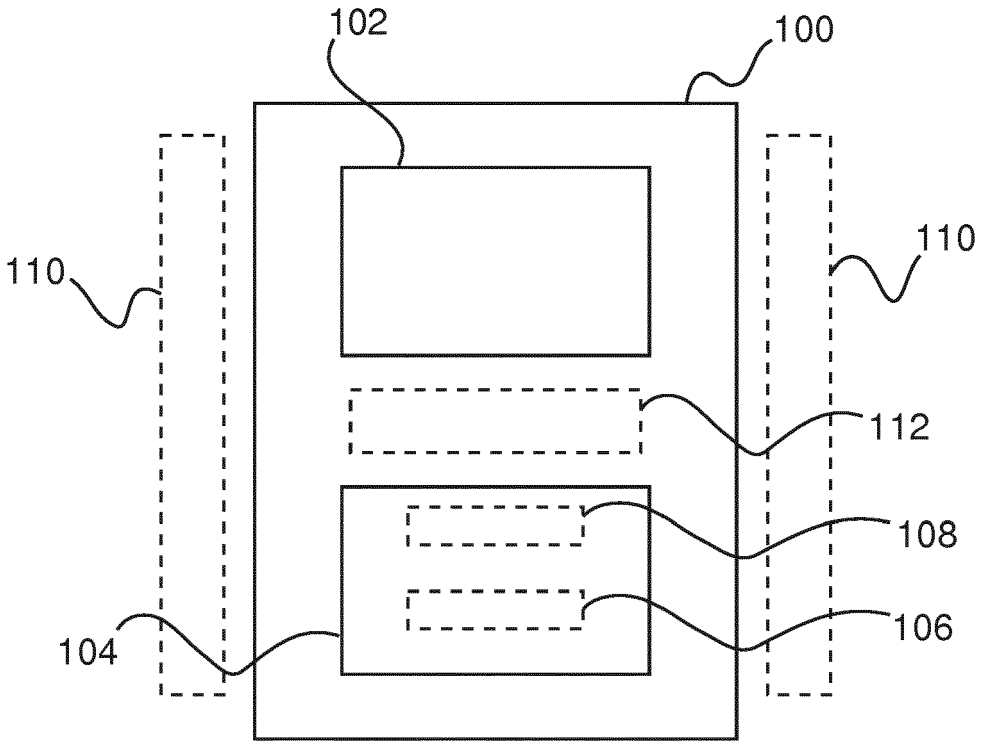
102
100
110
110
112
108
104
106

Fig. 1

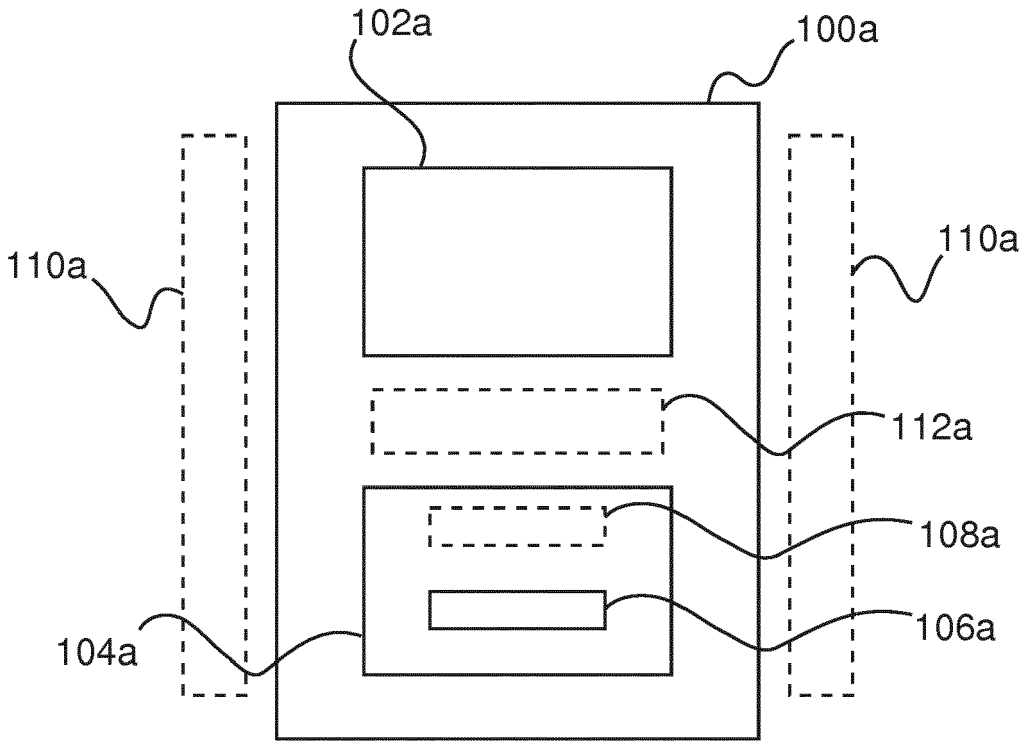
102a
100a
110a
110a
112a
108a
104a
106a

Fig. 2

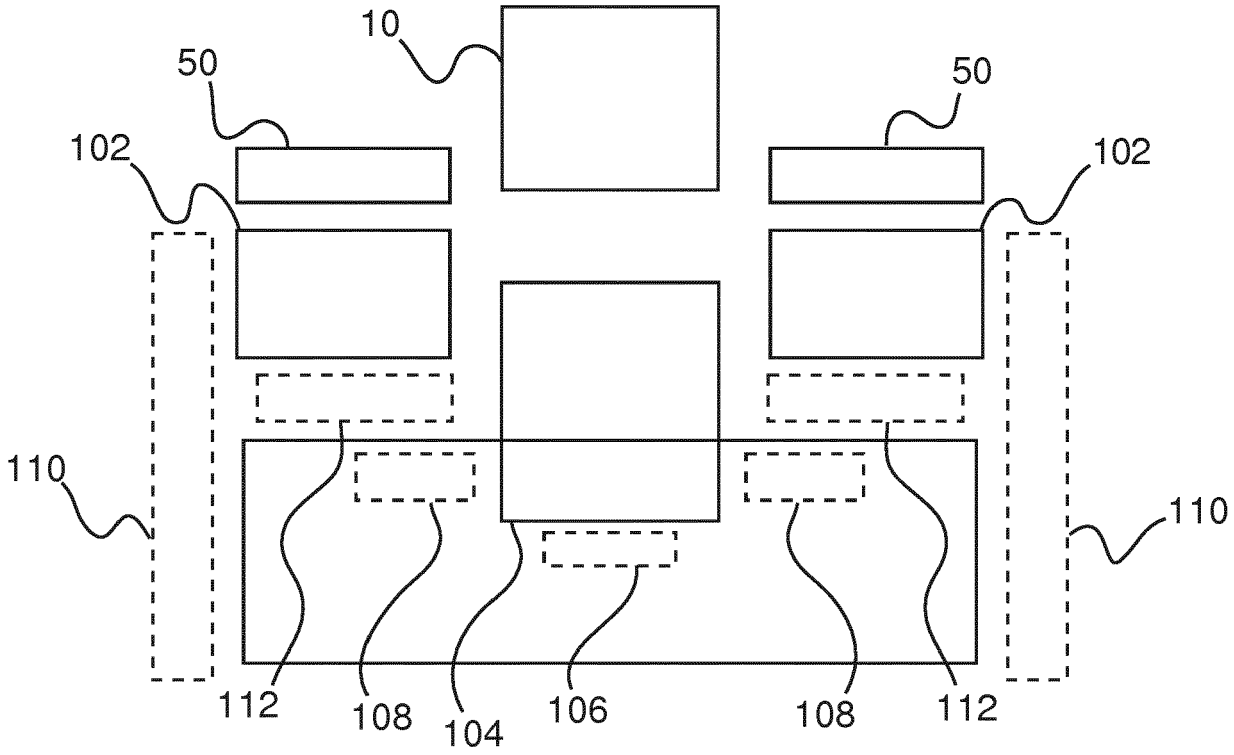
10
50
50
102
102
110
110
112
108
104
106
108
112

Fig. 3

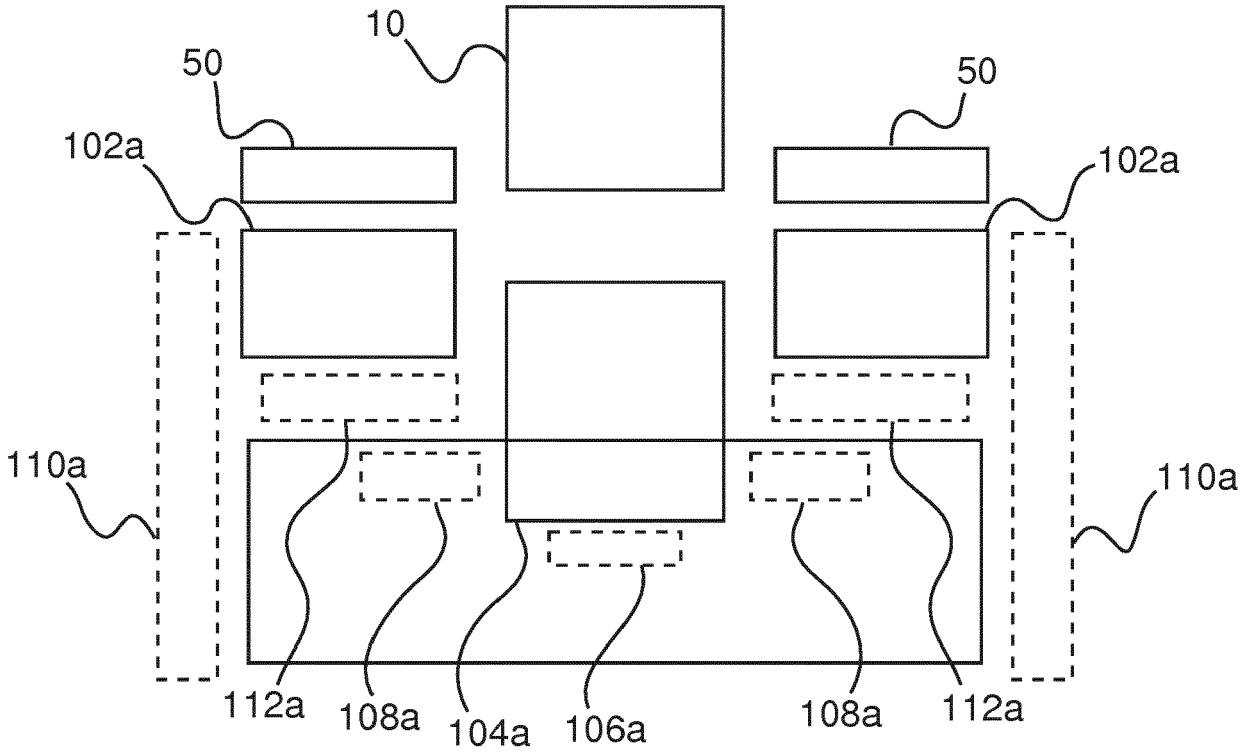
10
50
50
102a
102a
110a
110a
112a
108a
104a
106a
108a
112a

Fig. 4

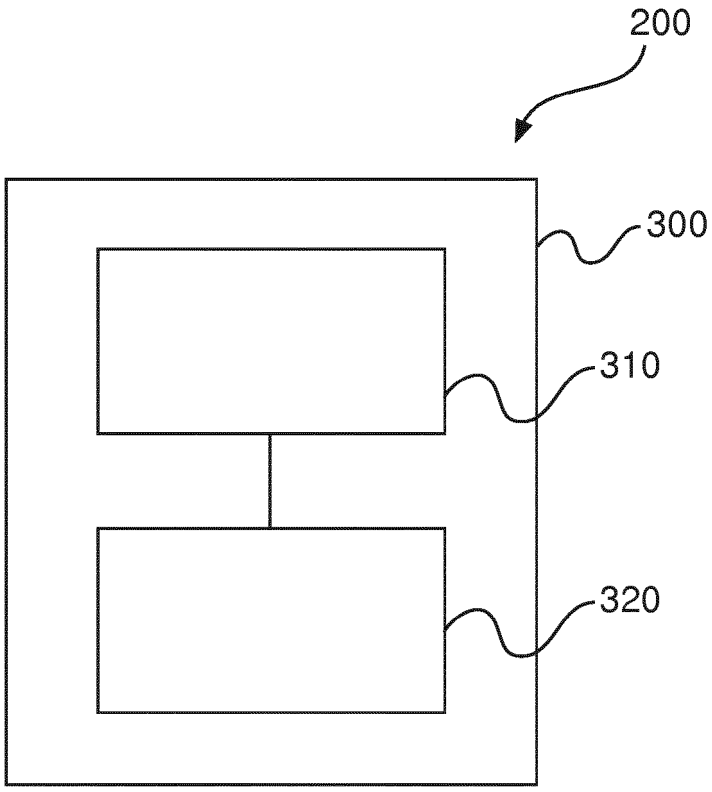

Fig. 5

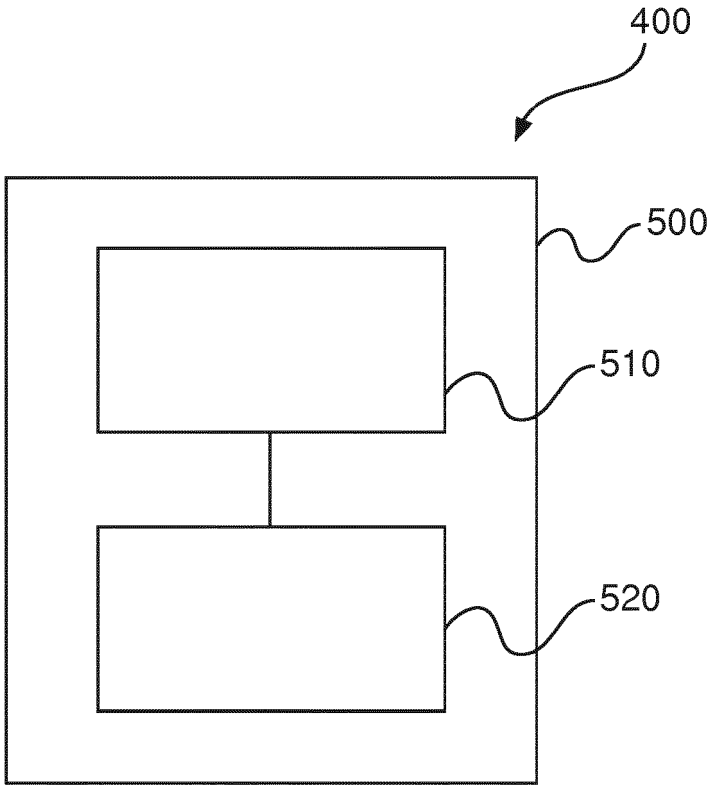

Fig. 6

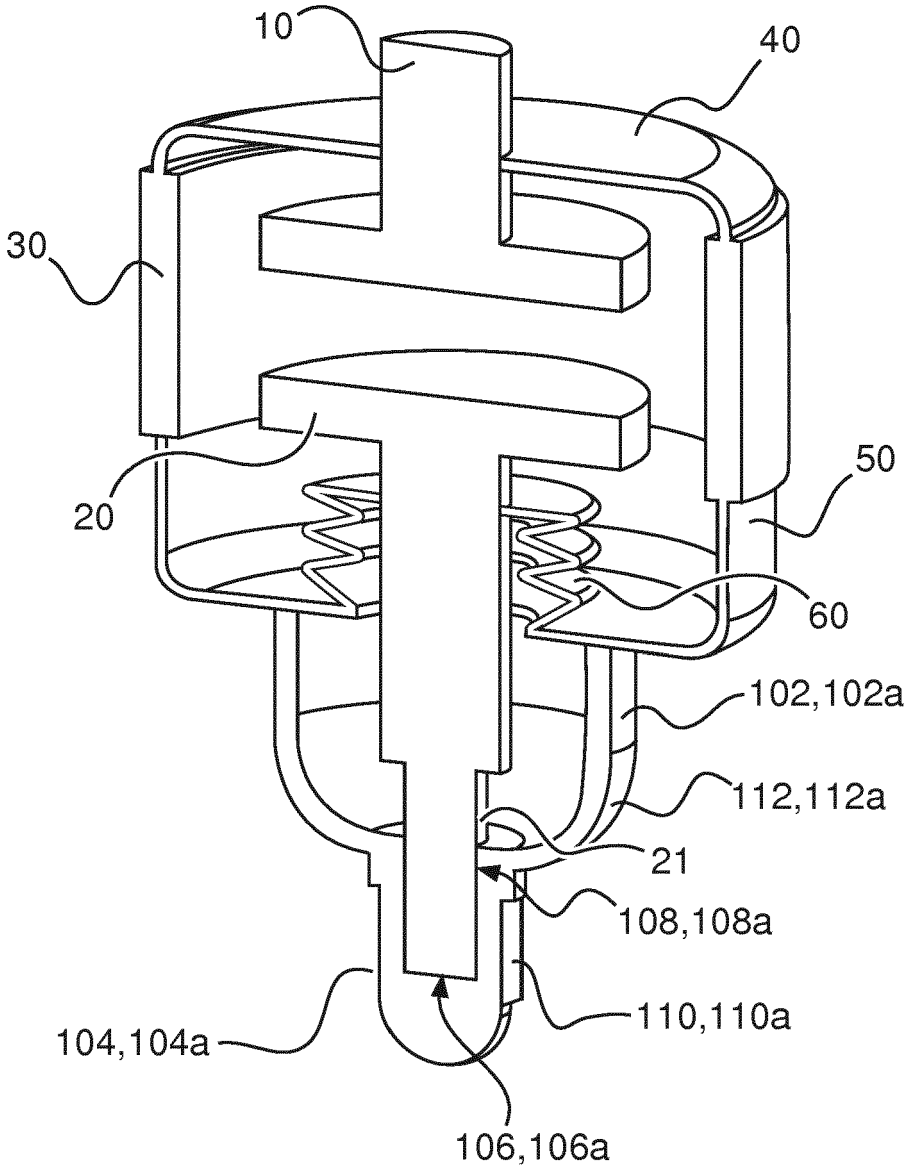
10
40
30
20
50
60
102,102a
112,112a
21
108,108a
110,110a
104,104a
106,106a

Fig. 7

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 18 16 9626

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	JP H10 340655 A (MITSUBISHI ELECTRIC CORP) 22 December 1998 (1998-12-22) * abstract; figures 1-10 *	1-25	INV. H01H33/66 ADD. H01H33/662
X	JP 2011 113666 A (TOSHIBA CORP) 9 June 2011 (2011-06-09) * abstract; figure 1 *	1-25	
A	GB 1 445 475 A (MEIDENSHA ELECTRIC MFG CO LTD) 11 August 1976 (1976-08-11) * page 4, line 9 - line 70; figures 1-5 *	1,12, 22-25	

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	15 August 2018	Ernst, Uwe

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 16 9626

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

15-08-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP H10340655 A	22-12-1998	NONE	
JP 2011113666 A	09-06-2011	JP 5367544 B2	11-12-2013
		JP 2011113666 A	09-06-2011
GB 1445475 A	11-08-1976	CA 996165 A	31-08-1976
		DE 2416038 A1	10-10-1974
		FR 2223812 A1	25-10-1974
		GB 1445475 A	11-08-1976
		JP S5637309 Y2	01-09-1981
		JP S49140654 U	04-12-1974
		US 3941960 A	02-03-1976

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82