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(54) **Vacuum interrupter with integrated double gap and single drive**

(57) Vacuum interrupter (100) for medium and high voltage applications, in particular ranging from a 24 kV to a 145 kV level or above, the vacuum interrupter comprising a drive rod (101) with a first drive contact (102) and a second drive contact (103). For closing, the vacuum interrupter (100) is adapted to contact a first contact (104) with the first drive contact (102) and to contact a

second contact (105) with the second drive contact (103) by moving the drive rod (101) from an opened position to a closed position in a closing direction (140). In the opened position, a first distance (144) of a first gap (106) between the first drive contact (102) and the first contact (104) is smaller than a second distance (146) of a second gap (107) between the second drive contact (103) and the second contact (105).

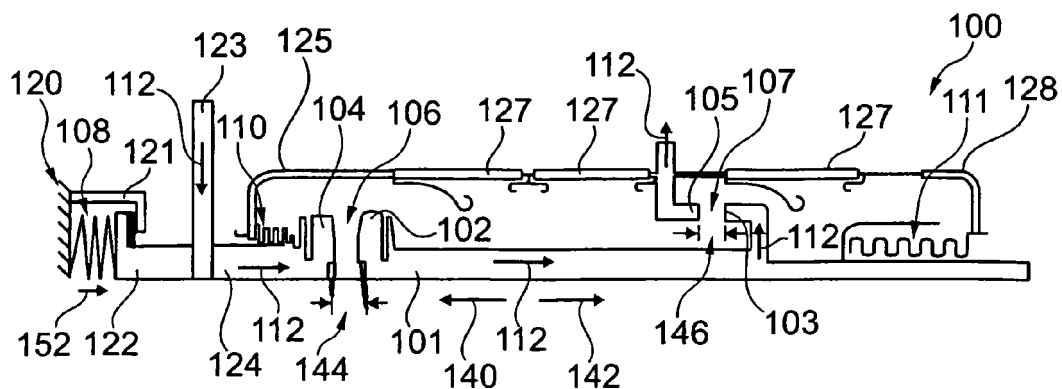


Fig. 1

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Description

Field of the invention

[0001] The invention relates to a vacuum interrupter for medium and high voltage applications and to a circuit breaker arrangement comprising the vacuum interrupter.

Background of the invention

[0002] For capacitive switching and high voltage applications a performance is influenced by factors such as a contact distance, a contact material, a contact geometry, and drive properties of a vacuum interrupter. A vacuum interrupter with a one gap system generally faces the uncertainty for the vacuum interrupter gap to withstand a voltage without any discharge. Two gaps in series provide for a better performance of interruption of a capacitive current.

[0003] US 6,498,315 depicts the use of two vacuum interrupters in series to improve the performance, wherein one vacuum interrupter functions as an interrupter and the other vacuum interrupter functions as an interrupter and as an insulator. The two interrupters are driven by a rather complicated drive system which may be costly.

[0004] DE 3 344 376 A1, DE 3 811 833, and DE 3 318 226 show vacuum interrupters with a double- or multi-gap, wherein the gaps are driven from two different directions. Driving multiple gaps from two different directions may result in high costs for the drive.

[0005] There are also solutions which use at least two gaps and a drive from one side which have, however, a rather large contact stroke for moving the contacts, and therefore a large amount of mechanical stress applied on a bellow of the vacuum interrupter. A large amount of mechanical energy may be needed to drive the large stroke.

[0006] DE 3 344 376 A1 uses a spring element inside the vacuum to support the drive of vacuum interrupter contacts, which may be difficult to realize, such as using T-form or Zig-Zag form constructions.

[0007] DE 1 975 630 uses a vacuum break interrupter with a slight contact inside a vacuum interrupter. Multiple gaps of the vacuum interrupter are driven in one direction. Due to the high temperature process during manufacturing, the sliding contact may lose its spring force.

[0008] All above described examples for a vacuum interrupter with multiple gaps or the usage of vacuum interrupters in series may result in extra costs for the drive, or multiple costs for multiple vacuum interrupters.

Summary of the invention

[0009] It is an object of the invention to provide an alternative efficient vacuum interrupter with two contact gaps inside the vacuum interrupter.

[0010] This object is achieved by the subject matter of the independent claims. Further exemplary embodi-

ments are evident from the dependent claims.

[0011] An aspect of the invention relates to a vacuum interrupter for medium and high voltage applications having a drive rod with a first drive contact and a second drive contact. The vacuum interrupter further comprises a first contact and a second contact. For closing, the vacuum interrupter is adapted to contact the first contact with the first drive contact and to contact the second contact with the second drive contact by moving the drive rod from an opened position to a closed position in a closing direction. In the opened position, a first distance of a first gap between the first drive contact and the first contact is smaller than the second distance of a second gap between the second drive contact and the second contact.

[0012] In other words, a vacuum interrupter is provided, wherein two different gaps, such as a first and a second gap, each one with corresponding first drive contact and first contact, and second drive contact and second contact, may be driven at the same time and from the same direction by actuating a drive rod or a drive in one closing direction. Such a vacuum interrupter with two gaps driven by moving the drive rod in one direction may enable to reduce the costs for the vacuum interrupter and the drive by increasing the performance of the vacuum interrupter compared to a vacuum interrupter with one gap or a vacuum interrupter with two gaps and drives moving in different directions to close the vacuum interrupter.

[0013] Such a vacuum interrupter may enable a short drive distance for the drive and the use of one drive for double gaps.

[0014] For the insulation of the vacuum interrupters, one or more insulators may be used for both sides of the second contacts, which may be ring contacts.

[0015] The vacuum interrupter according to the above and below mentioned embodiments and aspects may be used to secure capacitive switchings for levels above or below 40,5 kV, in particular for capacitive switchings above 17,5 kV.

[0016] The vacuum interrupter according to the above and below mentioned embodiments and aspects may be used to secure the performance for high voltage applications, for example above a voltage level of 40,5 kV and in particular at a voltage level ranging from 72,5 kV to 145 kV.

[0017] The vacuum interrupter according to the above and below mentioned embodiments and aspects may be used to secure the performance of a basic impulse level (BIL) the lightning impulse voltage, particularly for special applications or requirements such as 200 kV BIL and railway applications with 250 kV BIL vacuum interrupters.

[0018] The vacuum interrupter according to the above and below mentioned embodiments and aspects may provide short drive distances for the drive and a single drive to actuate or drive double gaps, at the same time and same direction.

[0019] The vacuum interrupters of hybrid solutions for ultra high voltage applications as depicted in DE 10 157

140 A1 may be replaced by the vacuum interrupter according to the above and below mentioned embodiments and aspects.

[0020] According to another embodiment of the invention, the above and below described embodiments and aspects of the vacuum interrupter may be applied to a switching module as described in DE 10 238 950 A1 to replace a flexible current path by the second gap of the vacuum interrupter in a vacuum, since flexible current connecting paths may be difficult to realize in the vacuum.

[0021] According to another aspect of the invention, for closing, the vacuum interrupter is adapted to contact the first contact with the first drive contact before contacting the second contact with second drive contact. During a closing of the vacuum interrupter, the first gap is closed first and the second gap is closed second, wherein the vacuum interrupter is adapted to contact both, the first contact with the first drive contact and the second contact with the second drive contact concurrently or at the same time, according to another embodiment of the invention.

[0022] According to another aspect of the invention, the vacuum interrupter further comprises a first bellows in cooperation with a first contact pen of the first contact. The first bellows may control a movement of the second contact relative to the second drive contact during opening and closing of the vacuum interrupter, such that the first gap is closed before the second gap is closed, and such that the second gap is opened before the first gap is opened. The first bellow may balance the contact between the first drive contact and the first contact, the contact between the second drive contact and the second contact, and an opening and closing of the drive rod.

[0023] The vacuum interrupter may further comprise a second bellow, which may be in cooperation with the drive rod. The second bellow may be adapted to control a movement of the drive rod relative to the second contact and the first contact. The second bellow may balance the contact between the first drive contact and the first contact, the contact between the second drive contact and the second contact, and an opening and closing of the drive rod.

[0024] According to another aspect of the invention, the first drive contact and the first contact of the first gap are selected from the group consisting of axial magnetic fields (AMF) contacts or radial magnetic fields (RMF) contacts. The AMF contacts may for example be unipolar quadruple contacts, or bipolar contacts and the RMF contacts may for example have contacts with a spiral or cup form with a slot cut.

[0025] By using RMF contacts such as spiral contacts in the vacuum interrupter which generate a radial magnetic field causing an azimuthal electromagnetic force to act on a contracted vacuum arc, the vacuum interrupter may be more efficient since the contracted arc may move over the contract surface at a speed of 50 to 350 m per second, the high velocity ensuring, that there is less contact erosion. Thus, the current interrupting capability may

be significantly improved as compared to flat contact.

[0026] The switching capacity of the vacuum interrupter may be increased even more by using axial magnetic field contacts which enable, that the vacuum arc burn in diffused mode, and that the supply of energy to the electrodes is reduced, such that an arc voltage may be achieved that is lower than the arc voltage when using RMF contacts.

[0027] According to another embodiment of the invention, the second drive contact and the second contact of the second gap are RMF contacts, in particular RMF cup form contacts with a driving force of a second drive contact having an angle of about 10 to 80 degrees to a tangential direction of a RMF ring. The two cup form contacts may be provided with a drive force for the vacuum arc which may rotate around the ring of the RMF contacts.

[0028] According to a further aspect of the intervention, the vacuum interrupter further comprises a first spring which is adapted to generate a force acting against the movement of the first contact in the closing direction and generate enough contact force. The first contact may move in the closing direction such that by moving the drive rod in the closing direction to contact the first contact with the first drive contact while closing the first gap, the first contact and the first drive contact may move a first over-travel distance in the closing direction, the first drive contact in addition to the first distance. During closing, the first interruption gap may thus be closed, still providing a defined first over-travel distance due to a (elastic) force of the first spring, and a fixation of the first spring at the vacuum interrupter. After the first contact is moved along the over-travel distance, the second gap may be closed, wherein the drive rod may move a second over-travel distance in the closing direction due to a force generated by a second spring at the drive rod. The second over-travel distance may be larger than the first over-travel distance.

[0029] According to another aspect of the invention, a first over travel distance, which is the distance the first contact has to travel for moving from the opened position to the closed position, together with the first distance equals essentially the second distance.

[0030] According to another embodiment of the invention, the vacuum interrupter further comprises a second spring which is adapted to generate a force acting against the movement of the drive rod in an opening direction, which is opposite to the closing direction. During a movement of the drive rod in the closing direction to contact the second contact with the second drive contact while closing the second gap, the drive rod is enabled to move a second over-travel distance in the closing direction.

[0031] The first contact spring force of the first spring may be smaller than the second contact spring force of the second spring in a closed position of the first gap and the second gap.

[0032] According to another embodiment of the invention, the vacuum interrupter is adapted to disconnect the first contact from the first drive contact and to disconnect

the second contact from the second drive contact by moving the drive rod in an opening direction. The vacuum interrupter is adapted to first disconnect the second contact from a second drive contact before disconnecting the first contact from the first drive contact.

[0033] The vacuum interrupter may be adapted to disconnect the first contact from the first drive contact, when the first contact has moved the first over-travel distance to the limitation of the first spring.

[0034] According to another embodiment of the invention, the vacuum interrupter comprises an embedded pole part and the vacuum interrupter is imbedded in solid insulation or assembled inside insulator tube with extra gas or liquid insulation.

[0035] According to another aspect of the invention, a total voltage applied to the vacuum interrupter is distributed between the first and the second gap, such that a voltage in a range of 5% to 50% of the total voltage is distributed to the second gap. In particular, a voltage of 40% of the total voltage is distributed to the second gap.

[0036] A further aspect of the invention relates to a circuit breaker arrangement, comprising at least one vacuum interrupter according to the above-mentioned embodiments or aspects.

[0037] According to another embodiment of the invention, a use of a vacuum interrupter according to anyone of the above-mentioned embodiments or aspects in one of a capacitive switching, a medium or high voltage application, and a circuit breaker arrangement is provided, e.g. in series or parallel.

[0038] These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

Brief description of the drawings

[0039] Belows, embodiments of the present invention are described in more detail with reference to the attached drawings.

Fig. 1 schematically shows a cross sectional view of part of a vacuum interrupter according to an embodiment of the invention.

Fig. 2 schematically shows a cross sectional view of another vacuum interrupter according to an embodiment of the invention.

Fig. 3 schematically shows a cross sectional view of another vacuum interrupter according to an embodiment of the invention.

Fig. 4 schematically shows a cross sectional view of another vacuum interrupter according to an embodiment of the invention.

Fig. 5 schematically shows a cross sectional view of another vacuum interrupter according to an embod-

iment of the invention.

[0040] The reference symbols used in the drawings, and their meanings, are listed in summary form in the list of reference symbols. In principle, identical parts are provided with the same reference symbols in the figures.

Detailed description of embodiments

[0041] Fig. 1 shows a cross sectional view of a vacuum interrupter 100 cut along a longitudinal axis. The vacuum interrupter 100 is adapted for medium and high voltage applications and capacitive switching, in particular for securing capacitive switching for a 24 kV and a 36 kV level and levels above or below 36 kV, and for securing the performance of high voltage applications, for example, at a voltage level ranging from 72.5 kV to 145 kV. The drive rod 101 comprises a first drive contact 102 and a second drive contact 103. For closing, the vacuum interrupter 100 is adapted to contact a first contact 104 with the first drive contact 102 and to contact a second contact 105 with the second drive contact 103 by moving the drive rod 101 from an opened position to a closed position in a closing direction 140. In the opened position, the first distance 144 of a first gap 106 between the first drive contact 102 and the first contact 104 is smaller than a second distance 146 of a second gap 107 between the second drive contact 103 and a second contact 105. For closing, the vacuum interrupter 100 is adapted to first contact the first contact 104 with the first drive contact 102 before contacting the second contact 105 with the second drive contact 103.

[0042] During closing, when the drive rod 101 is moving in the closing direction 140, the first interruption gap 106 is closed a first contact drive rod 122 may travel a first over-travel distance (not shown) in the closing direction 140 due to an opposing force generated by a first spring 108 fixed at the fixation 120 of the vacuum interrupter 100. The first spring 108 is adapted to generate a force acting against the movement of the first contact 104 in the closing direction 140. By moving the drive rod 101 in the closing direction 140 to contact the first contact 104 with the first drive contact 102 while closing the first gap 106, first contact drive rod 122, the first contact 104 and the first drive contact 102 are enabled to move a first over-travel distance (see fig. 5) in the closing direction 140. The first drive contact 102 may move the first over-travel distance in addition to the first distance 144. The first over-travel distance, which is the distance the first contact 104 has to travel from the opened position to the closed position, together with the first distance 144 equals essentially the second distance 146. The first spring 108 may be a contact spring and is housed in a (contact) spring holder 121. The first contact drive rod 122 is attached to a current receiver element 123 which is attached to a first contact pen 124 of the first contact 104.

[0043] A first bellow 110 is provided at the first contact

pen 124 of the first contact 104. The first bellow 110 may balance the contact between the first drive contact 102 and the first contact 104, the contact between the second drive contact 103 and the second contact 105, and an opening and closing of the drive rod 101 in an opening direction 142 and in a closing direction 140. A second bellow 111 is provided at a region of the drive rod 101 or in cooperation with the drive rod 101, and may be adapted to control a movement of the drive rod 101 relative to the second contact 105 and the first contact 104. The second bellow 111 may balance the contact between the first drive contact 102 and the first contact 104, the contact between the second drive contact 103 and the second contact 105, and an opening and closing of the drive rod 101 in an opening direction 142 and in a closing direction 140.

[0044] A second spring (see fig. 5) may be provided at the drive rod 101. The second spring may be adapted to generate a force acting against the movement of the drive rod 101 in an opening direction 142, which is opposite to the closing direction 140. During a movement of the drive rod 101 in the closing direction 140 to contact the second contact 105 with the second drive contact 103 while closing the second gap 107, the drive rod 101 is kept in closed position with a second over-travel distance in the closing direction 140 (see Fig. 5), by using second contact spring. A first contact spring force 152 of the first spring 108 may be smaller than a second contact spring force of the second spring in a closed position of the first gap 106 and the second gap 107 (see Fig. 5).

[0045] During closing, after the first gap 106 is closed, and the first contact 104, and the first drive contact 102, respectively, have travelled the first over-travel distance (see Fig. 5), the second gap 107 is closed, and the drive rod 101 is kept in closed position by a second over-travel distance larger than the first over-travel distance (see fig. 5).

[0046] When the vacuum interrupter 100 is closed, a current may move following a current path 112 through the current receiver 123, the first contact 104, the first drive contact 102, the drive rod 101, the second drive contact 103 and the second contact 105. By separating the contacts 102; 104; 103, 105 during opening and thus separating the current flow 112, the explosion of the last "metallic bridge" causes a metal vapor arc to form. This arc which consists exclusively of the vaporizing contact material is sustained by the external supply of energy until the next time the current passes through zero. At the instant of the current zero-crossing, the arc is finally extinguished and the vacuum interrupter 100 regains its insulating capability, i.e. it is able to withstand the transient recovery voltage. The size of the vacuum gaps 106, 107 and the geometry of the contacts 102, 104; 103, 105 determine the capacity of the vacuum interrupter 100 to extinguish the arc after the current zero-crossing.

[0047] The first drive contact 102 and the first contact 104 of the first gap 106 may be selected from the group consisting of axial magnetic fields (AMF) contacts such

as unipolar quadruple contacts and bipolar contacts, and radial magnetic fields (RMF) contacts, such as spiral or cup form contacts with slot cuts.

[0048] The second drive contact 103 and the second contact 105 of the second gap 107 are RMF contacts, in particular RMF cup form contacts with a driving force of the second drive contact 103 possibly having an angle of about 40 - 80 degrees to a tangential direction of a RMF ring. The two cup form contacts may be provided with the drive force for the vacuum arc which may rotate around the ring of the RMF.

[0049] During opening, the second gap 107 is opened first and after release of the first spring 108, there may be a move of the first contact 104 of the first over-travel distance till the limitation of the first spring 108, until the first gap 106 is opened. Thus, the vacuum interrupter 100 is adapted to disconnect the first contact 104 from the first drive contact 102 and to disconnect the second contact 105 from the second drive contact 103 by moving the drive rod 101 in the opening direction 142, wherein the vacuum interrupter 100 is adapted to first disconnect the second contact 105 from the second drive contact 103 before disconnecting the first contact 104 from the first drive contact.

[0050] The vacuum interrupter 100 may comprise an embedded pole part, and may be imbedded in solid insulation, or could be assembled inside insulation or metal housing provided with gas or liquid insulation.

[0051] The total voltage applied to the vacuum interrupter 100 is distributed between the first and second gaps 106 and 107, such that a voltage in a range of 5% to 50 % of the total voltage is distributed to the second gap 107, in particular a voltage of 40 % of the total voltage.

[0052] The vacuum interrupter 100 further comprises a cover and shielding element 125 in a region of the first gap 106 as well as ceramic elements 127 in a region of the drive rod 101 and a region of the second gap 107, and a cover and shielding element 128 at a region of the drive rod 101 below the second gap 107 at an end of the drive rod 101 connected to the drive rod actuating mechanism.

[0053] Fig. 2 schematically shows a cross sectional view of a vacuum interrupter 100 according to Fig. 1 with the difference, that there are only two ceramic elements 127 instead of the three ceramic elements 127 of Fig. 1. A middle axis A is depicted separating the vacuum interrupter in an upper and a lower half. Furthermore, in addition to the vacuum interrupter of Fig. 1, four shielding elements 126 are shown.

[0054] Fig. 3 schematically shows a cross sectional view of the vacuum interrupter of Fig. 2, with the difference, that six shielding elements 126 are shown, wherein all shielding elements are attached to the ceramic elements 127, as shown in fig. 2.

[0055] Fig. 4 schematically shows the vacuum interrupter 100 of Fig. 2, with the difference, that the ceramic elements 127 extend from the second gap 107 region over the first gap region 106 and over the first bellow 110.

The ceramic element 127 also extends over the larger part of the second bellow 111. One shielding element 126 extends over the larger part of the second bellow 111 and another shielding element 126 extends over the first gap 106. Furthermore, the first spring 108 is shown in the vacuum interrupter 101 similar to the embodiment of Fig. 1.

[0056] Fig. 5 schematically shows a cross sectional view of a vacuum interrupter 101 according to Fig. 5, with the difference, that the vacuum interrupter 101 is shown in a closed position with the first and the second gaps closed, and with a second contact drive rod 130 attached to the drive rod 101, and attached to a second spring 109. The second spring 109 is adapted to generate a force acting against the movement of the drive rod 101 in an opening direction 142, which is opposite to the closing direction 140. During a movement of the drive rod 101 in the closing direction 140 to contact the second contact 105 with the second drive contact 103 while closing the second gap, the drive rod 101 kept in closed position by a second over-travel distance 150 in the closing direction 140. A first contact spring force 152 of the first spring 108 may be smaller than a second contact spring force 154 of the second spring 109 in a closed position of the first gap and the second gap as shown in Fig. 5. The second (contact) spring 109 is housed in a (contact) spring holder 131.

[0057] 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 the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the independent article "a" or "an" does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. Any reference symbols in the claims should not be construed as limiting the scope.

List of reference symbols

[0058]

100 vacuum interrupter
101 drive rod
102 first drive contact
103 second drive contact
104 first contact

105 second contact
106 first gap
107 second gap
108 first spring
109 second spring
110 first bellow
111 second bellow
120 fixation
121 (contact) spring holder
122 first contact drive rod
123 current conducting element
124 first contact pen
125 cover and shielding element
126 shielding element
127 ceramic element
128 cover element
130 second contact drive rod
131 (contact) second spring holder
140 closing direction
142 opening direction
144 first distance
146 second distance
148 first over-travel distance
150 second over-travel distance
152 first contact spring force
154 second contact spring force
A longitudinal axis

Claims

1. A vacuum interrupter (100) for medium and high volt-

age applications, the vacuum interrupter (100) comprising:

a drive rod (101) with a first drive contact (102) and a second drive contact (103);
a first contact (104); and
a second contact (105);

characterized in that, for closing, the vacuum interrupter (100) is adapted to contact the first contact (104) with the first drive contact (102) and to contact the second contact (105) with the second drive contact (103) by moving the drive rod (101) from an opened position to a closed position in a closing direction (140).

wherein, in the opened position, a first distance (144) of a first gap (106) between the first drive contact (102) and the first contact (104) is smaller or equal than a second distance (146) of a second gap (107) between the second drive contact (103) and the second contact (105).

2. The vacuum interrupter (100) according to claim 1, wherein, for closing, the vacuum interrupter (100) is adapted to first contact the first contact (104) with the first drive contact (102) before contacting the second contact (105) with the second drive contact (103).

3. The vacuum interrupter (100) according to claim 1 or 2, further comprising:

a first bellow (110) in cooperation with a first contact pen (124) of the first contact (104).

4. The vacuum interrupter (100) according to claim 3, further comprising:

a second bellow (111) in cooperation with the drive rod (101).

5. The vacuum interrupter (100) according to anyone of the preceding claims, wherein the first drive contact (102) and the first contact (104) of the first gap (106) are selected from the group consisting of Axial Magnetic Field (AMF) contacts or Radial Magnetic Field (RMF) contacts.

6. The vacuum interrupter (100) according to anyone of the preceding claims, wherein the second drive contact (103) and the second contact (105) of the second gap (107) are RMF contacts.

7. The vacuum interrupter (100) according to anyone of the preceding claims, further comprising:

a first spring (108);

wherein the first spring (108) is adapted to generate a force acting against the movement of the first contact (104) in the closing direction (140).

8. The vacuum interrupter (100) according to anyone of the preceding claims, wherein a first over-travel distance (148), which is the distance the first contact (104) has to travel from the opened position to the closed position of the vacuum interrupter (100), together with the first distance (144) equals essentially the second distance (146).

9. The vacuum interrupter (100) according to anyone of the preceding claims, further comprising:

a second spring (109);

wherein the second spring (109) is adapted to generate a force acting against a movement of the drive rod (101) in an opening direction (142).

10. The vacuum interrupter (100) according to anyone of the preceding claims, wherein the vacuum interrupter (100) is adapted to disconnect the first contact (104) from the first drive contact (102) and to disconnect the second contact (105) from the second drive contact (103) by moving the drive rod (101) in an opening direction (142); wherein the vacuum interrupter (100) is adapted to first disconnect the second contact (105) from the second drive contact (103) before disconnecting the first contact (104) from the first drive contact (102).

11. The vacuum interrupter (100) according to anyone of the preceding claims, further comprising:

an embedded pole part;

wherein the vacuum interrupter (100) is imbedded in solid insulation materials provided with mechanical compensation layers.

12. The vacuum interrupter (100) according to anyone of the preceding claims, wherein a total voltage applied to the vacuum interrupter (100) is distributed between the first and the second gap (106, 107) such that a voltage in a range of 5% to 50% of the total voltage is distributed to the second gap (107).

13. A circuit breaker arrangement comprising at least one vacuum interrupter (100) according to anyone of claims 1 to 12.

14. A circuit breaker system comprising a multiple of aforesaid vacuum interrupters in series and/or in parallel, according to anyone of claims 1 to 12.

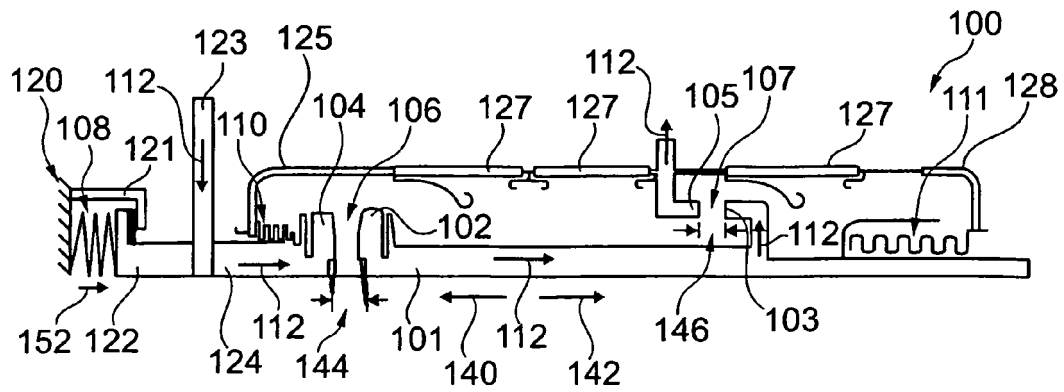


Fig. 1

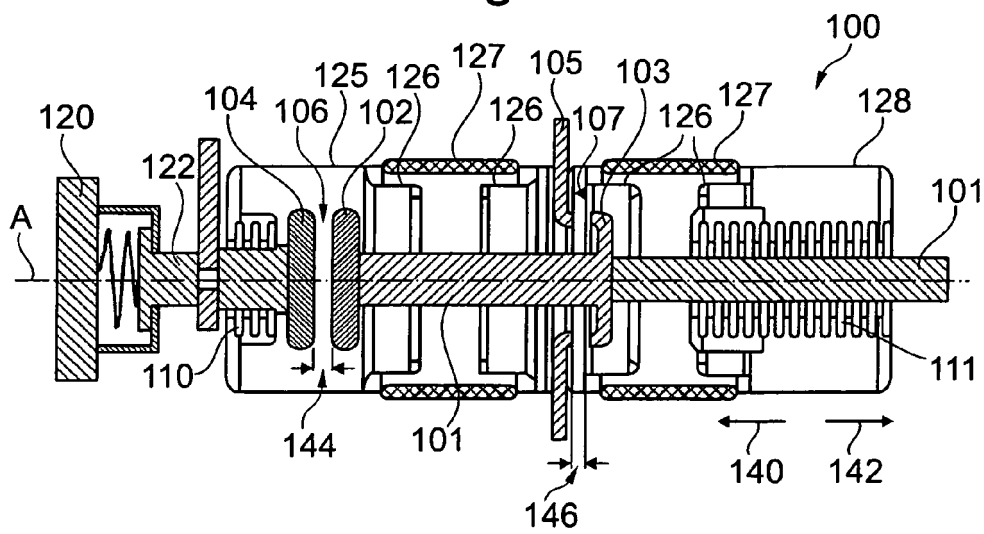


Fig. 2

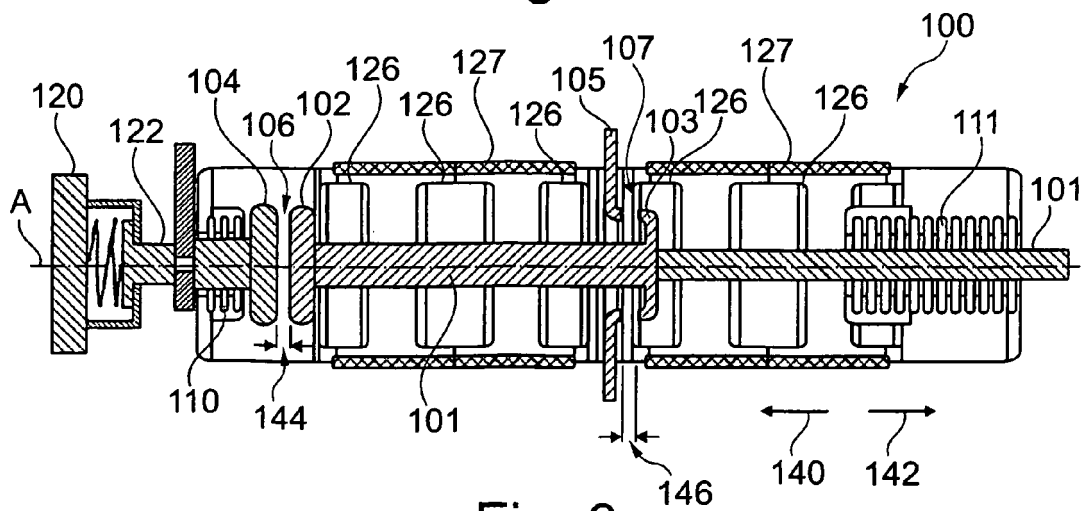


Fig. 3

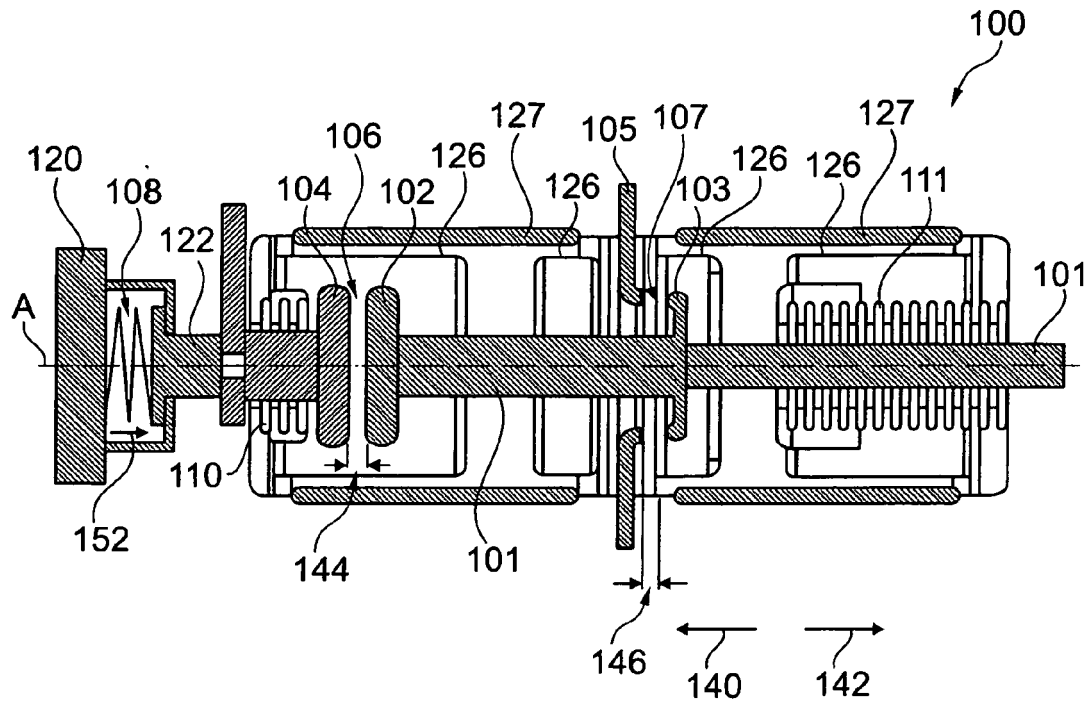


Fig. 4

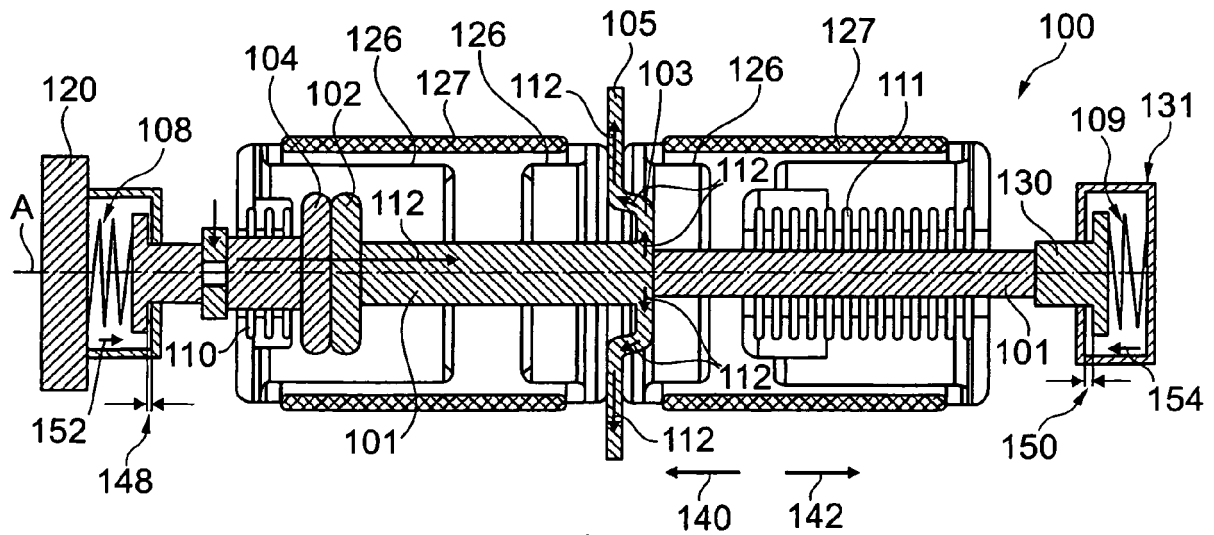


Fig. 5



EUROPEAN SEARCH REPORT

Application Number
EP 11 00 5888

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 2003 007179 A (MITSUBISHI ELECTRIC CORP) 10 January 2003 (2003-01-10)	1-5,7,8,10,12-14	INV. H01H33/14
Y	* abstract; figures *	6,9,11	H01H33/664
X	DE 197 56 308 C1 (SIEMENS AG [DE]) 25 March 1999 (1999-03-25) * column 4, line 33 - column 5, line 43; figures 1,2 *	1,2,4,8,10,12,13	
X	DE 102 38 950 A1 (ABB PATENT GMBH [DE]) 4 March 2004 (2004-03-04) * paragraphs [0030], [0046], [0056], [0058]; figures *	1,3,7,12,13	
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