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

(11) EP 3 588 528 A1

(12) # EUROPEAN PATENT APPLICATION

(43) Date of publication:
01.01.2020 Bulletin 2020/01

(51) Int Cl.:
H01H 33/70 *(2006.01)* ***H01H 71/16*** *(2006.01)*

(21) Application number: **19182780.7**

(22) Date of filing: **27.06.2019**

(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

(30) Priority: **29.06.2018 EP 18180897**

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

(72) Inventors:
- **Gotti, Manuel**
  5300 Turgi (CH)
- **Costyson, Johan Karl Filip**
  5430 Wettingen (CH)
- **Florez, Javier Mantilla**
  5400 Baden (CH)
- **Grob, Stephan**
  5400 Baden (CH)

(74) Representative: **Zimmermann & Partner Patentanwälte mbB**
Postfach 330 920
80069 München (DE)

(54) ## GAS-INSULATED HIGH OR MEDIUM VOLTAGE CIRCUIT BREAKER WITH RING-LIKE ELEMENT

(57) A gas-insulated high or medium voltage circuit breaker (100) comprising a first arcing contact (101) and a second arcing contact (103), wherein at least one of the two arcing contacts (101, 103) is axially movable along a switching axis (140), wherein during a breaking operation, an arc (130) between the first arcing contact (101) and the second arcing contact (103) is formed in an arcing region. An electrically conductive armature (120) radially surrounds at least part of a diffuser portion (114) of the nozzle (110); an electrically conductive ring-like element (116) is mounted to the diffuser portion (114) and is slideable relative to the armature (120), and the ring-like element (116) is radially outwardly biased such that an outer side of the ring-like element (116) is pressed against the armature (120).

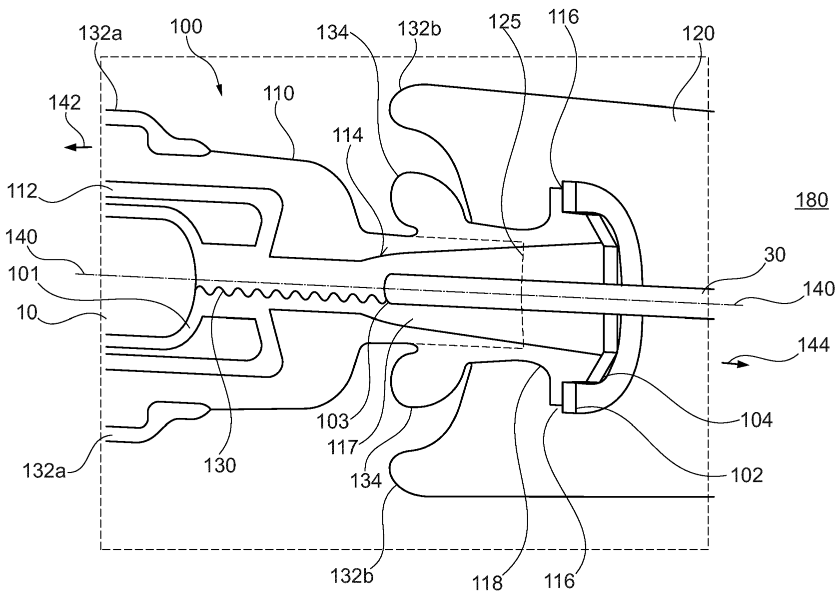

Fig. 1

Printed by Jouve, 75001 PARIS (FR)

Description

FIELD

[0001] Embodiments of the present disclosure relate generally to a gas-insulated circuit breaker for breaking high or medium voltages comprising a first arcing contact and a second arcing contact, wherein at least one of the two arcing contacts is axially movable along a switching axis, wherein during a breaking operation, an arc between the first arcing contact and the second arcing contact is formed in an arcing region. The circuit breaker further comprises a nozzle system including a channel directed to the arcing region, for blowing an arc-extinguishing gas to the arcing region during the breaking operation.

BACKGROUND

[0002] Circuit breakers are well known in the field of medium and high voltage breaking applications. They are capable of being used for interrupting a current, when an electrical fault occurs. As an example, circuit breakers have the task of opening contacts and keeping them apart from one another in order to avoid a current flow even in case of high fault current and/or electrical potential originating from the electrical fault itself.

[0003] When interrupting the current flowing in the electrical circuit, an arc is generally generated. This arc is extinguished by quenching gas, such that the gap between the contacts can repeatedly withstand the voltage in the electrical circuit and in the shields. During the interruption of the current flow the shields sometimes do not operate properly. For example, dielectric issues can occur, which can further lead to punctures in case of fast transients.

[0004] Thus, there is a need for solutions to improve the operation of the circuit breaker, in particular of the shields, and/or to reduce the above mentioned drawbacks.

SUMMARY OF THE INVENTION

[0005] An object of the invention can be considered to provide an improved gas-insulated high or medium voltage circuit breaker, which reduces the above mentioned problems occurring during power interruption.

[0006] In light of the above, a gas-insulated high or medium voltage circuit breaker according to claim 1 is provided. Aspects, benefits, and features of the present disclosure are apparent from the claims, the description, and the accompanying drawings.

[0007] According to one aspect a gas-insulated high or medium voltage circuit breaker is provided. The gas-insulated high or medium voltage circuit breaker includes a first arcing contact and a second arcing contact, wherein at least one of the two arcing contacts is axially movable along a switching axis, wherein during a breaking operation, an arc between the first arcing contact and the second arcing contact is formed in an arcing region. The circuit breaker further includes a nozzle system including a channel directed to the arcing region, for blowing an arc-extinguishing gas to the arcing region during the breaking operation. The circuit breaker further includes a diffuser portion adjacent to the nozzle, for transporting the arc-extinguishing gas from the arcing region to a region downstream of the diffuser portion. The circuit breaker further includes an electrically conductive armature radially surrounding at least part of the diffuser portion and an electrically conductive ring-like element mounted to the diffuser portion, wherein the ring-like element is slideable relative to the armature, wherein the ring-like element is radially outwardly biased such that an outer side of the ring-like element is pressed against the armature.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] So that the manner in which the above recited features of the present disclosure can be understood in detail, a more particular description of the disclosure, briefly summarized above, is given with reference to embodiments. The accompanying drawings relate to embodiments of the disclosure and are described in the following:

Fig. 1 schematically shows a cross-sectional view of a gas-insulated high or medium circuit breaker according to a first embodiment described herein;

Fig. 2 schematically shows a cross sectional side view of a gas-insulated high or medium voltage circuit having a ring-like element and a biasing element according to an embodiment described herein;

Fig. 3 schematically shows a diffusor portion having a groove according to an embodiment as described herein.

DETAILED DESCRIPTION OF EMBODIMENTS

[0009] Reference will now be made in detail to the various embodiments of the disclosure, one or more examples of which are illustrated in the figures. Within the following description of the drawings, the same reference numbers refer to same components. Generally, only the differences with respect to individual embodiments are described. Each example is provided by way of explanation of the disclosure and is not meant as a limitation of the disclosure. Further, features illustrated or described as part of one embodiment can be used on or in conjunction with other embodiments to yield yet a further embodiment. It is intended that the description includes such modifications and variations.

[0010] The term circuit breaker generally refers to a gas-insulated high or medium voltage circuit breaker.

The circuit breaker may be a puffer type circuit breaker or a self-blast circuit breaker or a combination thereof.

[0011] With exemplary reference to FIGs 1 to 3, embodiments of a gas-insulated high or medium voltage circuit breaker according to the present disclosure is described. According to embodiments, which can be combined with other embodiments described herein, the circuit breaker includes a first arcing contact 101 and a second arcing contact 103, wherein at least one of the two arcing contacts is axially movable along a switching axis 140, wherein during a breaking operation, an arc 130 between the first arcing contact 101 and the second arcing contact 103 is formed in an arcing region. The circuit breaker further includes a nozzle system 110 including a channel 112 directed to the arcing region, for blowing an arc-extinguishing gas to the arcing region during the breaking operation. The circuit breaker further provides a diffuser portion 114 adjacent to the nozzle system 110, for transporting the arc-extinguishing gas from the arcing region to a region downstream of the diffuser portion 114, and an electrically conductive armature 120 radially surrounding at least part of the diffusor portion 114. The circuit breaker further includes an electrically conductive ring-like element 116 mounted to the diffuser portion 114, wherein the ring-like element 116 is slideable relative to the armature 120, wherein the ring-like element 116 is radially outwardly biased such that an outer side of the ring-like element 116 is pressed against the armature 120.

[0012] Fig.1 shows a schematic sectional view of an exemplary embodiment of circuit breaker as described above. Herein, the first arcing contact 101 is in the form of a tulip, e. g. a contact tulip. The second arcing contact 103 is in the form of a rod, e. g. a contact rod. The two arcing contacts 101 and 103 cooperate with each other between an open end-position, in which the two arcing contacts 101 and 103 are completely electrically separated from each other, and a closed end-position, in which an electric current can pass between them.

[0013] The first arcing contact 101 is part of a first breaking contact 10 and has a first nominal contact. The second arcing contact 103 is part of a second breaking contact 30 with a second nominal contact. The first and the second arcing contacts 101, 103 are constituted in a manner such that they can conveniently carry an interruption current, so that the arcing contacts do not generate excessive heating and withstand the heat of an arc generated during a current interruption operation of the circuit breaker 100.

[0014] As indicated by the arrows 142, 144, at least one of the first and the second arcing contact 101, 103, e.g. as part of the first breaking contact 10 and of the second breaking contact 30, respectively, is movable relatively to the other one along the switching axis 140 to bring the arcing contacts 101, 103 in the open end-position or in the closed end-position. During the breaking operation an arc 130 develops in the arcing region between portions of the first and second arcing contact 101, 103.

[0015] The circuit breaker (in particular its interrupter part 100) is arranged in a gas-tight housing (not shown) filled with dielectric gas. The volume between the housing and the components of the circuit breaker 100 is indicated by reference numeral 180. This will also be referred to as an "outer volume" 180, which is a volume inside the gas-tight housing. The circuit breaker 100 further includes the nozzle system 110 having a channel 112 directed to the arcing region. In other words, the channel 112 is directed to the arc 130, and the outlet of the channel 112 serves as a blowhole for blowing the arc-extinguishing gas to the arcing region during the breaking operation. Thereby, the arc 130 can be extinguished or quenched by the arc-extinguishing gas provided in the circuit breaker.

[0016] Accordingly, the arc-extinguishing gas is transported from the arcing region of the diffusor portion to a region downstream of the diffusor portion.

[0017] The diffusor portion 114 is arranged at the nozzle 110. In particular, the diffusor portion 114 is rigidly connected to the nozzle 110. The cross-sectional area of a diffusor volume of the diffusor potion 114 increases in the axial direction away from the nozzle 110. The diffusor portion 114 forms a diverging duct for the flow of the arc-extinguishing gas. The diffusor portion 114 includes a first diffusor portion 117 and a second diffusor portion 118. The second diffusor portion 118 has a higher electrical conductivity than the first diffusor portion 117. The transition between the first diffusor portion 117 and the second diffusor portion 118 is represented by the dashed line with the reference numeral 125. The second diffusor portion 118 includes a shield 134, which partially encloses the first diffusor portion 117 (in other words axially extends over or overlaps and radially surrounds or (at least partially) encloses the first diffusor portion 117).

[0018] A ring-like element 116 is mounted on the diffusor portion 114, in particular on the second diffusor portion 118, within a groove 102. The ring-like element 116 is biased by a biasing element 104, which presses the ring-like element 116 radially outwardly against an armature 120. The armature 120 has the shape of a hollow cylinder which surrounds the second diffusor portion 118. The biasing element 104 can be a polygon-shaped tensioned band, which is arranged within the groove 102 between the second diffusor portion 118 and the ring-like element 116. Due to its tension the biasing element 104 exerts a radially outward force on the ring-like element 116 by which an outer side of the ring-like element 116 is pressed against the armature 120. The diffusor portion 114 is movable with respect to the armature 120 along the axis 140, in particular the switching axis 140, whereby the ring-like element 116 slides axially relative to the armature 120.

[0019] By biasing the ring-like element 116 against the armature 120, the electrical conductivity between the shield 134 and the armature 120 via the ring-like element 116 can be improved, which can prevent issues linked to the shield 134 in the sensitive interruption regions. In particular, due to the improved electrical conductivity the potential of the shield 134 can adapt to the potential of the arcing contact 103 via the biased ring-like element 116 and the armature 120. Thereby, a higher safety against dielectric issues in case of fast transients can be provided, when the power is interrupted between the nominal contacts 132a and 132b.

[0020] The circuit breaker can include also other parts such as a drive, a controller, and the like, which have been omitted in the Figures. These parts are provided in analogy to a conventional high or medium voltage gas-insulated circuit breaker.

[0021] Fig. 2 shows a schematic cross sectional view of the diffusor portion of the circuit breaker 100 of Fig. 1 across the ring-like element. The diffusor portion 114 surrounds the second breaking contact 30. The circuit breaker 100 includes a biasing element 104, which is arranged between the ring-like element 116 and the diffusor portion 114. The biasing element 104 has the shape of a polygonal band including edge portions 106 and corner portions 107. The biasing element 104 is under tension, wherein the corner portions 107 are pressed against the inner side 215 of the ring-like element 116. Likewise the edge portions 106 are pressed against the diffusor potion 114 due to the tension of the biasing element 104. Thus, the edge portions 106 form contact areas 214 with the diffusor portion 114 and the corner portions 107 form contact areas 216 with the ring-like element 116, in particular with the inner side 215 of the ring-like element 116. Thereby, the ring-like element 116 is biased radially outwardly against the armature (not shown) as described herein.

[0022] With respect to Fig. 2, the electrical connection between the diffusor portion 114 and the ring-like element 116 can be formed by a biasing element 104 according to embodiment described herein. Thereby, the diffusor portion 114 is electrically connected to the ring-like element 116 via the contact areas 214 formed between the edge portions 106 of the biasing element 104 and the contact areas 216 formed between the corner portion 107 and the ring-like element 116, in particular the inner side 215 of the ring-like element 116. The ring-like element 116 is in contact, in particular is pressed with its radially outer side to the armature (not shown in Fig. 2). The ring-like element 116 is pressed, in particular is pushed, in the direction of the armature by the biasing element 104. The ring-like element 116 is not unitary with a closed form, but has a gap 236 to facilitate the mounting of ring-like element 116 on the diffusor portion 114.

[0023] A schematic cross-sectional side view of an embodiment of the diffusor portion depicted in Fig. 1 and Fig. 2 is given in Fig. 3. The groove 302 is formed within the diffusor portion 114 by a first bulge 305 and a second bulge 306, in which the ring-like element 116 and the biasing element 104 are arranged. The ring-like element 116 and the biasing element 104 are mounted within the groove 302, wherein the first bulge 305 and the second bulge 306 can stabilize the position of the ring-like element 116 when the diffusor portion 114 is moved in a sliding movement along the armature 120.

[0024] The term "ring-like element" can be understood as a tape-like or a ribbon like element configured to provide a connection between the diffusor portion and the armature. The ring-like element can include different materials, such as metal, plastic, rubber, Teflon or the like. The ring-like element can be composed of several superposed layers of the same or of different materials as described herein. The ring-like element can be mounted to the diffusor portion within a groove or a recess of the diffusor portion, in particular of the circumferential surface of the diffusor portion, wherein the ring-like element protrudes from the circumferential surface of the diffusor portion to provide a contact surface for the armature. Furthermore, the term "ring-like" can be understood such that the ring-like element has the shape of a closed ring or a unitary ring with a closed surface. Furthermore, the ring-like element can include one gap, wherein the gap portion covers an at least five times smaller angle than the portion covered by the ring-like element. The term can also be understood as a half ring or a three quarter ring. Moreover, the ring-like element can for example be divided into one or more ring parts, wherein a gap is provided between two consecutive ring parts. The total angle covered by the ring parts is at least 50 %, in particular at least 75 %, or more particularly over 90% of the full circumference (of 360°).

[0025] Term "electrically conductive" can be understood that the ring-like element is electrical conductive at least in sections to provide a galvanic electrical connection between the diffusor portion and the armature. The electrical conductivity can be provided by electrical conductive elements within the ring-like element such like metals, metallic alloys, graphite, carbon or the like. The conductivity can also be provided by electrically conductive coatings on the surface of the ring-like element. The electrical conductivity can be improved and amplified by the degree of the biasing of the ring-like. The electrical connection can also be maintained when moving, in particular sliding the diffusor portion relative to armature. The sliding movement can be supported by arranging a low friction material, such as Teflon on the outer side of the ring like element.

[0026] The term "radially outwardly biased" can be understood such that the ring-like element is, for example, pre-tensioned or pre-stressed or preloaded, wherein the ring-like element is pressed outwardly perpendicularly to the circumferential surface of the diffusor portion by a biasing force. The biasing force can for example be exerted or applied by external forces and/or by internal forces based on restoring forces or deformation forces of the ring-like element itself. According to embodiments, the biasing force can be applied uniformly to the ring-like element, wherein each angular portion of the ring-like element is biased by a force substantially equal in strength.

[0027] An outer side of the ring-like element can include one or more contact areas, which are pressed against the armature. The outer side of the ring-like element can be formed as a single common contact area or can consist of a plurality of separated contact sections, for example surfaces or projections arranged at a distance from each other at the outer side of the ring-like element. According to embodiments, the outer side is pressed against the armature.

[0028] According to embodiments which can be combined with other embodiments described herein, the diffusor portion includes a first diffusor portion and a second diffusor portion. The second diffusor portion can have a higher electrical conductivity than the first diffusor portion. The ring like element is arranged on the second diffusor portion. The second diffusor portion can include a shield. The shield can be integrally formed as integral part of the second diffusor portion. The shield can partially enclose the first diffusor portion. The term "enclose" can be understood that the shield axially extends over or overlaps the first diffusor portion. The shield can also at least partially surround the first diffusor portion. The diffusor portion can be metallic or can include metallic material.

[0029] According to some embodiments which can be combined with other embodiments described herein, the shield can face the nozzle system. The shield is arranged between the first diffusor portion and the armature. The shield can extend radially outwards at a distal portion of the second diffusor portion.. The term "distal portion of the second diffusor portion" can be understood as the portion of the second diffusor portion which is close to the first arcing contact.

[0030] Further, the shield can have a convex shaped front portion. The shield can have a diameter along the radial direction which is similar in size of a diameter along the radial direction of the ring like element. In particular, the diameter along the radial direction of the upper part of the shield can be +/- 50 %, in particular +/- 30%, or more particularly +/- 10 % of the length of the diameter of the ring like element along the radial direction. Moreover, the distance between the axial position of the convex shaped front portion of the shield on the switching axis and the axial position of the tip of the second arcing contact can be less than the diameter of the second arcing contact, in particular less than 50%, in particular less than 25%, or more particularly less than 10% of the diameter of the second arcing contact. The shield according to embodiments described herein can have improved electrostatic by which the generation of sparks during the switching operation can be reduced.

[0031] The circuit breaker according to the present disclosure can improve the contact, in particular the electrical contact between the diffusor portion and the armature by pressing the outer side of the electrically conductive ring-like element against the armature. In particular, the ohmic resistance is reduced between the diffusor portion and the armature. Furthermore, the sliding of the ring-like element along the armature can be improved by pressing the ring-like element against the armature, which facilitates the guiding of the diffusor portion along the armature. Due to the improved contact also an improved centering and positioning of the diffusor portion with respect to the armature can be achieved. Additionally, the ring-like element can improve or enhance the gas-tight function of the ring.

[0032] Next general aspect of the invention are described, which can be combined with other aspects or embodiments described thereof. The term high or medium voltage relates to voltages that exceeds 1 kV. According to embodiments described herein, the circuit breaker is a gas-insulated circuit breaker adapted to interrupt medium to high-voltages of 12 kV or more, 52 kV or more, or 145 kV or more.

[0033] A high voltage preferably concerns nominal voltages in the range from 72 kV to 550 kV, like 145 kV, 245 kV or 420 kV. Nominal currents of the circuit breaker can be preferably in the range from 1 kA to 5 kA. The current which flows during the abnormal conditions in which the circuit breaker performs its duty may be interchangeably referred to as the breaking current or the short circuit current. The short circuit current may be in the range from 31.5 kA to 80 kA, which is termed high short-circuit current duty. In low short-circuit current duties, the breaking current is typically larger than the nominal current and smaller than 0.3 times the rated short-circuit current, e.g. at most 24 kA. During a breaking operation, breaking voltages may be very high, e.g. in the range from 110 kV to 1200 kV.

[0034] In a gas-insulated circuit breaker, the arc-extinguishing medium comprises a gas. In embodiments, the circuit breaker includes an encapsulating housing which defines a volume for the gas. According to some embodiments, the circuit breaker can include a gas blowing system configured to extinguish an arc formed between a first arcing contact and a second arcing contact of the circuit breaker during a stage of the current interruption operation.

[0035] According to embodiments, which can be combined with other embodiments described herein, the circuit breaker comprises a biasing element configured to apply a force to the ring-like element for pressing the outer side of the ring-like element against the armature. The biasing element can, for example, be arranged between the diffusor portion and the ring-like element. At this position, the biasing element can apply a force on the ring-like element, which pushes the ring-like element away from the diffusor portion to press the ring-like element against the armature. Furthermore, the biasing element can be arranged within a gap of the ring-like element, wherein the circumference of the ring-like element is enhanced by an extension of the biasing element, which results to a force pushing the ring-like element outwards. Providing a biasing element is an uncomplicated way to provide the required pressing force. Moreover, the biasing element can easily improve the function of the ring-like element.

[0036] According to embodiments, which can be combined with other embodiments described herein, the biasing element is deformable and arranged between the ring-like element and the diffusor portion in a compressed manner. The biasing element can, for example, include materials such like rubber, vulcanized rubber, elastics, or intelligent materials which can adapt their shape by external pressure. The characteristic of the deformability can also be provided by design, shape or construction of the biasing element. By arranging a deformable biasing element in a compressed manner between the ring like element and the diffusor portion a steady and homogenous contact force can be applied on the ring-like element which can further improve the operation of the ring-like element.

[0037] According to embodiments, which can be combined with other embodiments described herein, the biasing element is a spring-loaded biasing element. The biasing element can include one or more spring elements or consist of one or more spring elements. A spring element can be understood as any kind of a spring, for example a coil spring, a helical spring, a compression spring or a volute spring and the like. The one or more spring elements can directly apply their spring forces between the diffusor portion and an inner portion of the ring-like element by being compressed in-between the diffusor portion and the inner portion of the ring-like element. Furthermore, the one or more spring elements can be components within the biasing element which give the biasing element the required deformation property.

[0038] According to embodiments, which can be combined with other embodiments described herein, the biasing element is a substantially band-shaped element surrounding an end portion of the diffusor portion. The band-shaped element can be for example a self-contained loop being under preload while being arranged within the diffusor portion and the ring-like element. The band-shaped element can also have, for example, a zigzag shape. Furthermore, the band-shaped element can be polygon shaped.

[0039] According to embodiments, which can be combined with other embodiments described herein, the diffusor portion comprises a groove for receiving the biasing element. The groove is arranged on the diffusor portion and can be formed as a channel-like recess within an outer surface of the diffusor portion. The term "groove" can be also understood as a notch or a deepening or the like, in which the biasing element can be arranged or put inside. The groove can also provide a space for the ring-like element wherein at least a part of the ring-like element is arranged within the groove. The groove can improve the position of the biasing element with respect to the diffusor. In particular, the groove can improve the effect of the biasing element by stabilizing the position of the biasing element, when the diffusor is moved with respect to the armature.

[0040] According to embodiments, which can be combined with other embodiments described herein, the biasing element is electrically conductive. The biasing element can act as electrical conductor that electrically connects the diffusor portion with the ring-like element. The biasing element can have properties of a conductor or a semi-conductor. The electrical conductivity can be provided by electrical conductive elements within the biasing element such like metals, metallic alloys, graphite, carbon or the like. The conductivity can also be provided by electrically conductive coatings on the surface of the biasing element. An electrically conductive biasing element can improve the potential definition between the diffusor portion and the armature by improving the conductivity between the diffusor and the ring-like element which is in contact with the armature.

[0041] According to embodiments, which can be combined with other embodiments described herein, the ring-like element is a self-biasing element structured in a manner such that the outer side of the ring-like element is pressed against the armature. The self-biasing element can be a preloaded or pre-stressed ring-like element which is arranged at the diffusor portion, with the tendency to radially expand outwards in the direction the armature. The self-biasing element can have sub-elements corresponding to the ring-like element and the biasing-element according to embodiments described herein. For example, a biasing element can be connected or fixed to the ring-like element according to embodiments described herein. In particular, the biasing element can be attached on an inner side of the ring-like element, which is opposite to the outer side of the ring-like element. Furthermore, the self-biasing element can also be in one piece.

[0042] The term "structured" can be understood such that a biasing-element is bordered, enclosed or integrated within an outer layer to form a self-biasing element. The term "structured" can also be understood as the self-biasing element consists of several layers, wherein one or more layers include biasing elements according to embodiments described herein. A self-biasing element combines the functions of a ring-like element together with a biasing element by which the functionality and the handling can be improved.

[0043] According to embodiments which can be combined with other embodiments described herein, the ring-like element includes PTFE (Polytetrafluoroethylene). The term "PTFE" can also be understood as Plastomere Polyolefin, Polychlorotrifluoroethylene, Teflon, and the like. The ring-like element can be made of PTFE or include PTFE as a surface coating to improve the surface characteristics of the ring-like element. PTFE can limit the contact friction between the ring-like element and the armature. Furthermore, metallic particle generation (e.g. by abrasion) can be prevented by using PTFE.

[0044] According to embodiments which can be combined with other embodiments described herein, the ring-like element includes an electrically conductive filler such as carbon. Carbon can be provided in different modifications within the ring-like element, for example as graphite, amorphous carbon, carbon fibers or can be added in powder form or the like within the ring-like element. The carbon can provide electrical conductivity to the ring-like element or further improves its conductivity. The ring-like element can include an electrically conductive filler concentration up to 50 %, in particular between 10% to 30%, or more particularly about 25% (+/- 2%) by mass. The electrically conductive filler mass concentration of the ring-like element can improve the transfer of the electrical potential between the ring-like element and the armature, in particular between the diffusor and the armature by means of the ring-like element. This allows to improve the potential adaptation between the shield connected to the diffusor portion and the nominal contacts.

[0045] According to embodiments, which can be combined with other embodiments described herein, the circuit breaker further includes a gear system operatively coupled to the nozzle and the second arcing contact for providing a relative movement between the nozzle and the second arcing contact along the switching axis, wherein the armature has a cylindrical shape and the nozzle system can be moved relative to the armature. In some embodiments, the circuit breaker is a single motion circuit breaker. That is to say, only one of the first and second arcing contact is movable along the switching axis. In other embodiments, the circuit breaker is a double motion circuit breaker. In other words, both the first and the second arcing contact can be movable along the switching axis.

[0046] According to embodiments, which can be combined with other embodiments described herein, the gas-insulated high or medium voltage circuit breaker is one of a puffer-type circuit breaker, a self-blast circuit breaker or a combination thereof. In embodiments, the gas blasted by the gas blast system is any suitable gas that enables to adequately extinguish the electric arc formed between the arcing contacts during current interruption operation, such as, but not limited, to an inert gas, for example, Sulphur hexafluoride SF_6. Thereby, the arc between the first and the second arcing contact develops in an arcing region.

[0047] For the purpose of this disclosure the dielectric medium used in the circuit breaker can be SF_6, or carbon or any other dielectric insulation medium, and in particular can be a dielectric insulation gas or arc quenching gas. Such dielectric insulation medium can for example encompass media comprising an organofluorine compound, such organofluorine compound being selected from the group consisting of: a fluoroether, an oxirane, a fluoroamine, a fluoroketone, a fluoroolefin, a fluoronitrile, and mixtures and/or decomposition products thereof.

[0048] This written description uses examples to disclose the invention, including the best mode, and also to enable the person skilled in the art to practice the invention, including making and using any devices or systems and performing any incorporated methods. While various specific embodiments have been disclosed in the foregoing, those skilled in the art will recognize that there are equally effective modifications. Especially, mutually non-exclusive features of the embodiments described above may be combined with each other. The patentable scope of the invention is defined by the claims and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims, if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal language of the claims.

Claims

1. A gas-insulated high or medium voltage circuit breaker (100) comprising:

    a first arcing contact (101) and a second arcing contact (103), wherein at least one of the two arcing contacts is axially movable along a switching axis (140), wherein during a breaking operation, an arc (130) between the first arcing contact and the second arcing contact is formed in an arcing region;
    a nozzle system (110) including a channel (112) directed to the arcing region, for blowing an arc-extinguishing gas to the arcing region during the breaking operation;
    a diffuser portion (114) adjacent to the nozzle, for transporting the arc-extinguishing gas from the arcing region to a region downstream of the diffuser portion (114);
    an electrically conductive armature (120) radially surrounding at least part of the diffuser portion (114); and
    an electrically conductive ring-like element (116) mounted to the diffuser portion (114), wherein the ring-like element (116) is slideable relative to the armature (120), wherein the ring-like element (116) is radially outwardly biased such that an outer side of the ring-like element (116) is pressed against the armature (120).

2. The gas-insulated high or medium voltage circuit breaker (100) according to claim 1, wherein the circuit breaker (100) comprises a biasing element (104) configured to apply a force to the ring-like element (116) for pressing the outer side of the ring-like element (116) against the armature (120).

3. The gas-insulated high or medium voltage circuit breaker (100) according to claim 2, wherein the biasing element (104) is deformable and arranged between the ring-like element (116) and the diffusor portion (114) in a compressed manner.

4. The gas-insulated high or medium voltage circuit breaker (100) according to any one of the preceding

claims 2 to 3, wherein the biasing element (104) is a spring-loaded biasing element.

5. The gas-insulated high or medium voltage circuit breaker (100) according to any of claims 2 to 4, wherein the biasing element (104) is a substantially band-shaped element surrounding an end portion of the diffuser portion (114).

6. The gas-insulated high or medium voltage circuit breaker (100) according to any one of the preceding claims 2 to 5, wherein the diffuser portion (114) comprises a groove (102) for receiving the biasing element (104).

7. The gas-insulated high or medium voltage circuit breaker (100) according to any one of the preceding claims 2 to 6, wherein the biasing element is electrically conductive.

8. The gas-insulated high or medium voltage circuit breaker (100) according to any one of the preceding claims 1 to 7, wherein the ring-like element is a self-biasing element structured in a manner such that the outer side of the ring-like element is pressed against the armature.

9. The gas-insulated high or medium voltage circuit breaker (100) according to any one of the preceding claims 1 to 8, wherein the ring-like element comprises PTFE.

10. The gas-insulated high or medium voltage circuit breaker (100) according to any one of the preceding claims 1 to 9, wherein the ring-like element comprises an electrically conductive filler.

11. The gas-insulated high or medium voltage circuit breaker (100) according to any one of the preceding claims, wherein the circuit breaker is a gas-insulated circuit breaker adapted to interrupt medium to high-voltages of 12 kV or more, 52 kV or more, or 145 kV or more.

12. The gas-insulated high or medium voltage circuit breaker (100) according to any one of the preceding claims, further comprising a gear system operatively coupled to the nozzle (110) and the second arcing contact (103) for providing a relative movement between the nozzle (110) and the second arcing contact (103) along the switching axis (140), wherein the armature (120) has a cylindrical shape and the nozzle (110) can be moved relative to the armature (120).

13. The gas-insulated high or medium voltage circuit breaker (100) according to any one of the preceding claims, wherein the gas-insulated high or medium voltage circuit breaker (100) is one of a puffer-type circuit breaker, a self-blast circuit breaker, or a combined puffer-type and self-blast circuit breaker.

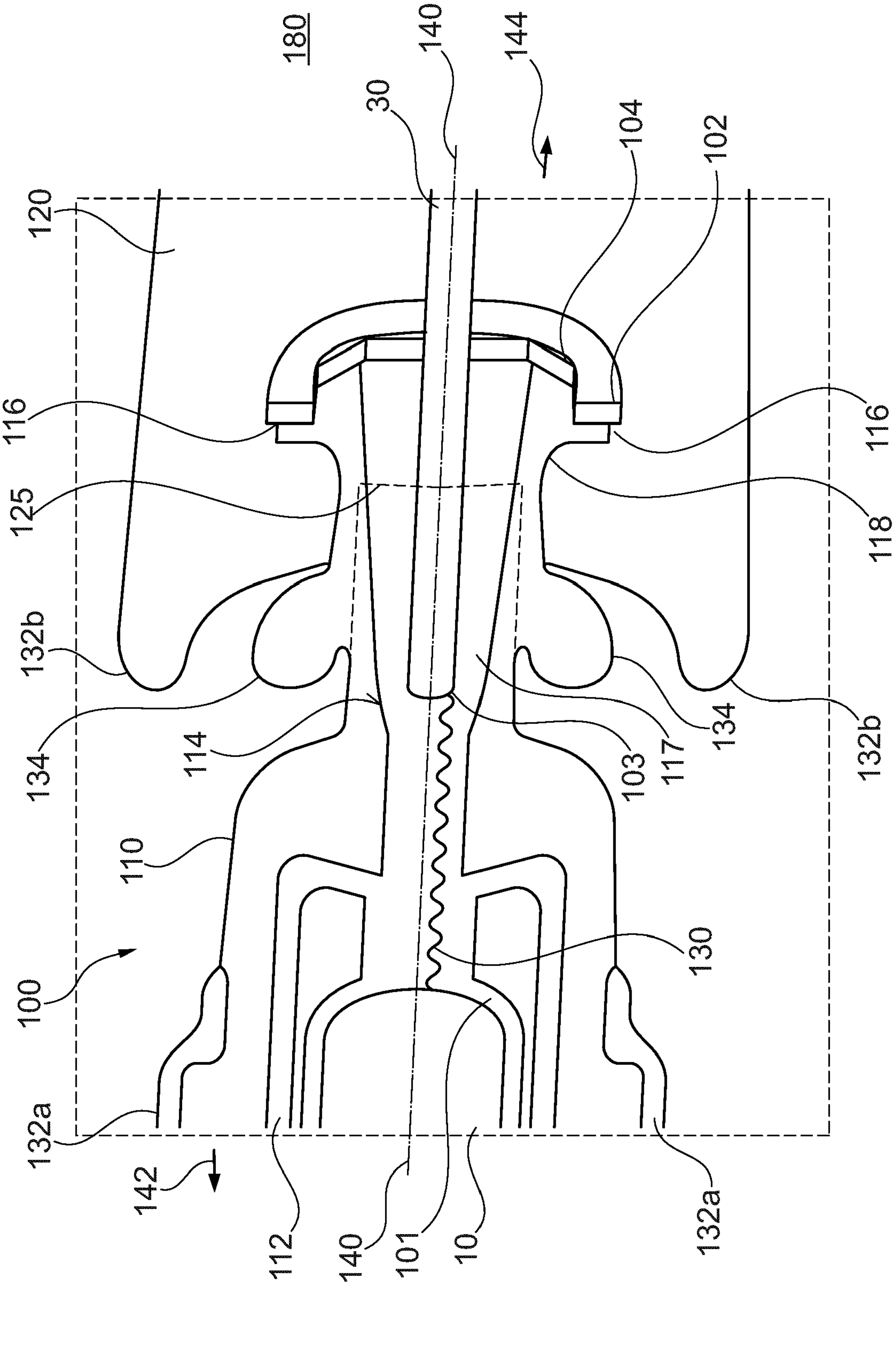
180
140
144
30
104
102
120
116
116
125
118
132b
132b
134
134
114
103
117
110
100
130
132a
132a
142
112
140
101
10

Fig. 1

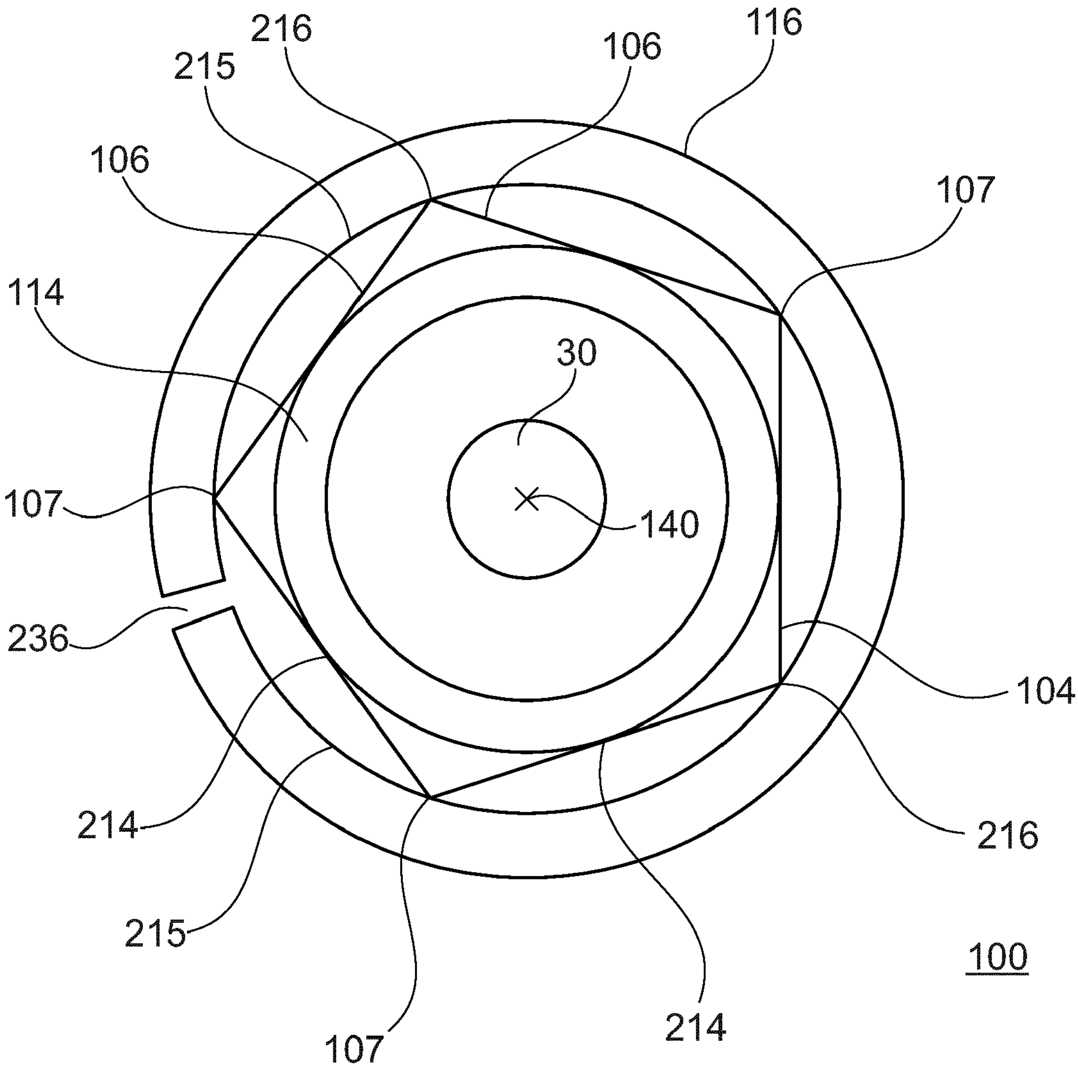
216
215
106
116
106
107
114
30
107
140
236
104
214
216
215
100
107
214

Fig. 2

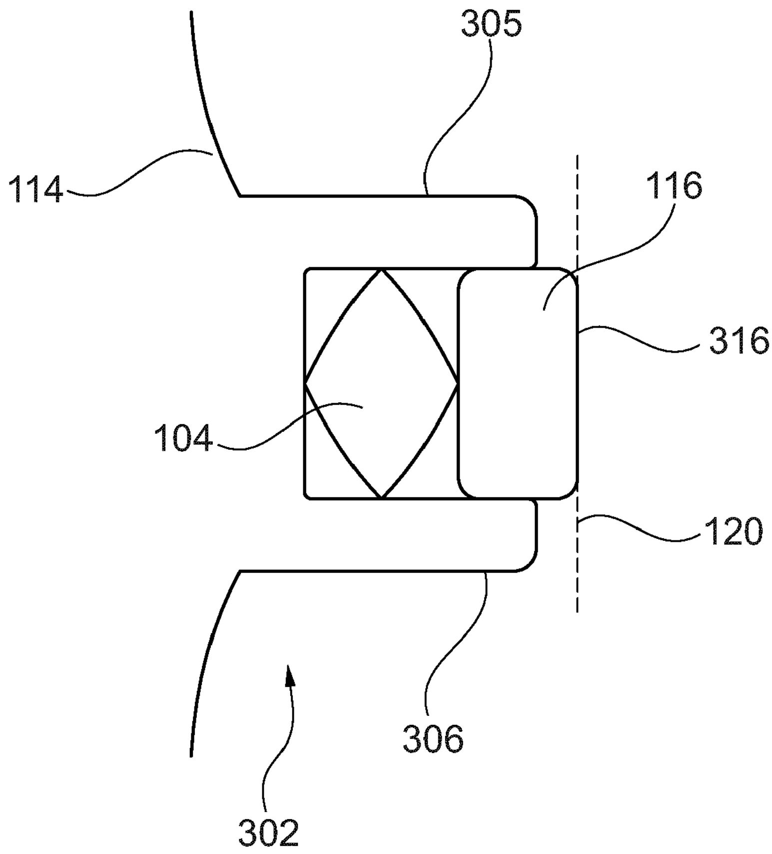

Fig. 3

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 19 18 2780

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 Y	JP 2004 119290 A (TOSHIBA CORP; MITSUBISHI ELECTRIC CORP) 15 April 2004 (2004-04-15) * paragraphs [0024], [0036] - [0054]; claim 1; figures 2-5 * -----	1-11,13 12	INV. H01H33/70 H01H71/16
X	US 5 585 610 A (MEYER JEFFRY R [US] ET AL) 17 December 1996 (1996-12-17) * column 5, line 24 - line 45; figure 7 * -----	1,8,13	
Y	EP 2 325 859 A1 (ABB TECHNOLOGY AG [CH]) 25 May 2011 (2011-05-25) * paragraph [0022]; figure 1 * -----	12	
A	US 3 639 712 A (BALMAT GEORGES ET AL) 1 February 1972 (1972-02-01) * column 3, line 50 - line 73; figure 3 * -----	1	
A	JP H11 162305 A (HITACHI LTD) 18 June 1999 (1999-06-18) * the whole document * -----	2-7	TECHNICAL FIELDS SEARCHED (IPC) H01H

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	29 July 2019	Ramírez Fueyo, M

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 19 18 2780

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.

29-07-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2004119290 A	15-04-2004	JP 4131926 B2	13-08-2008
		JP 2004119290 A	15-04-2004
US 5585610 A	17-12-1996	DE 69527950 D1	02-10-2002
		DE 69527950 T2	02-01-2003
		EP 0754345 A1	22-01-1997
		US 5585610 A	17-12-1996
		WO 9527299 A1	12-10-1995
EP 2325859 A1	25-05-2011	CN 102074406 A	25-05-2011
		EP 2325859 A1	25-05-2011
		US 2011120975 A1	26-05-2011
US 3639712 A	01-02-1972	CH 515602 A	15-11-1971
		DE 2039240 A1	08-04-1971
		FR 2057344 A5	21-05-1971
		GB 1272704 A	03-05-1972
		US 3639712 A	01-02-1972
JP H11162305 A	18-06-1999	JP H11162305 A	18-06-1999
		KR 19990045517 A	25-06-1999

EPO FORM P0459

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