



EUROPEAN PATENT SPECIFICATION

Date of publication of patent specification :
25.01.95 Bulletin 95/04

Int. Cl.⁶ : **H01H 33/91**

Application number : **91114964.9**

Date of filing : **05.09.91**

High-voltage circuit breaker of self-blasting type.

Priority : **11.09.90 SE 9002885**

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Date of publication of application :
18.03.92 Bulletin 92/12

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Publication of the grant of the patent :
25.01.95 Bulletin 95/04

Designated Contracting States :
CH DE FR GB IT LI

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Description

The invention relates to a high-voltage circuit breaker of self-blasting type according to the precharacterising part of claim 1.

The invention is primarily intended for circuit breakers with rated operating voltages of the order of magnitude of 100-300 kV, but it may, in principle, be used also for circuit breakers for voltages both above and below this range, for example for medium-voltage circuit breakers.

Circuit breakers of the above-mentioned kind are previously known, for example from US-A-4 658 108. In such a puffer type self-blasting circuit breaker, the reservoir for gas intended for arc extinction consists of two parts, namely, a pressure storage chamber, also referred to below as the pressure storage volume, and a compression chamber, also referred to below as the puffer volume. The two volumes are separated by a non-return valve which is closed when the pressure in the pressure storage volume is higher than in the puffer volume.

In this kind of circuit breaker, problems may arise if the breaker after a short-circuit breaking operation performs a normal rapid reclosing and the short circuit then remains, so that the breaker immediately has to perform a renewed short-circuit breaking. During the short period between the breakings (about 300 ms), it may be difficult to have time to ventilate the pressure storage volume sufficiently, which entails a risk of this volume still containing hot gas of low density when the second short-circuit breaking is to be carried out. This may cause the deionization of the arc to become insufficient, so that the renewed breaking attempt will fail.

In DE-C-3 843 405, it has been proposed to solve the above problem by sucking gas, during the closing of the circuit breaker, into the pressure storage volume from the region which surrounds the arcing contacts, with the aid of a special valve arranged between the pressure storage volume and the puffer volume. However, this is a less satisfactory solution since the gas in the mentioned region is still relatively hot at the time in question.

The invention aims at providing a high-voltage circuit breaker of self-blasting type of the above-mentioned kind which exhibits an improved breaking capacity for the second opening operation in an open-close-open operation sequence.

To achieve this aim the invention suggests a high-voltage circuit breaker of self-blasting type according to the introductory part of claim 1, which is characterized by the features of the characterizing part of claim 1.

Further developments of the invention are characterized by the features of the additional claims.

In a circuit breaker according to the invention, the blast piston of the puffer volume rests on one or more

springs which will be compressed when an overpressure builds up in the compression chamber. These springs may be adapted in strength and prestress in such a way that, at a certain overpressure in the compression chamber, the blast piston will start moving and further compressing the springs. The distance the blast piston is free to travel may be limited to a predetermined value. At the end of the opening operation, when the non-return valve located between the puffer volume and the pressure storage volume opens and the over-pressure in the puffer volume falls, the piston will make a return movement whereby a puff of gas is pressed into the pressure storage volume. This extra gas puff, which is thus accomplished with the aid of the movable piston, is an important addition to the gas mass in the pressure storage volume, in which the temperature is considerably reduced, thus greatly improving the breaking capacity in the second opening operation in an open-close-open operation.

In puffer-type circuit breakers which are not provided with a pressure storage volume it is known, per se, to arrange the blast piston axially displaceable against the action of a spring (see, e.g. DE-A-2 363 171 and US-A-4 322 591). However, the resilient piston in the known design has quite a different function compared with the present invention. In the known design, the aim of the resilient piston is partly to achieve a faster pressure increase in the puffer cylinder, partly to reduce the maximum pressure in the cylinder and provide a more uniform pressure distribution for a longer period of time.

By way of example, the invention will now be described in greater detail with reference to the accompanying drawing, the single figure of which shows, in axial section, the central part of a high-voltage circuit breaker according to the invention. The part of the figure to the left of the centre line shows the circuit breaker in the closed position, and the part of the figure to the right of the centre line shows the circuit breaker in the open position.

The circuit breaker shown in the drawing has a gas-tight casing 1 which at least partly consists of insulating material and which contains a fixed, plug-shaped arcing contact 2 and an axially movable sleeve-shaped arcing contact 3a. The arcing contact 3a forms part of a movable contact unit 3 which includes a tubular contact rod 4 and an insulating operating rod (not shown). The movable contact unit 3 is connected to an operating device of, for example, the design described in SE-A-9001116-4. With the aid of the operating device, the movable contact unit may be displaced between the closed position shown to the left in the figure and the open position shown to the right in the figure.

The movable contact unit 3 supports a hollow cylinder 5 of metal, which contributes in forming a pressure storage chamber 6, the volume of which is con-

stant, and a compression chamber 7. The movable contact unit 3 further supports an electrically insulating blast nozzle 8 with an annular channel 9, which connects the pressure storage chamber 6 to the region where the arc is burning during an opening operation. The hollow cylinder 5 constitutes the movable operating current contact of the circuit breaker, which cooperates with a fixed operating current contact 10.

The pressure storage chamber 6 and the compression chamber 7 are coaxially arranged around the movable contact rod 4 and are separated by a wall 11 provided with openings 12. These openings function as a non-return valve with the help of an adjacent annular plate 13, which is arranged axially displaceable between the wall 11 and a limiting stop 14 fixed to the movable contact rod 4. The non-return valve 12 to 14 allows flow only in a direction from the compression chamber 7 to the pressure storage volume 6.

The compression chamber 7 is delimited by a puffer cylinder 15, a blast piston 16, the movable contact rod 4 and the wall 11, which constitutes the bottom in the pressure storage chamber. The puffer cylinder 15 in its turn is formed by the hollow cylinder 5.

The blast piston 16 consists of an annular plate resting on a number of springs 17, which support against a fixed counter support 18.

Upon a breaking operation, the contact rod 4 is pulled downwards with the aid of the operating device, the operating current contacts 5 and 10 being first separated. The current then commutates over to the arcing contacts 2, 3a which become separated with an arc being created between them. The arc heats the gas in the arc region, which results in increased gas pressure and starts a gas flow through the channel 9 into the pressure storage chamber 6. As a result of this flow, the pressure in the pressure storage chamber 6 increases. The arc current follows the power system frequency sine curve, and when the current value approaches the zero crossing, the pressure in the arc region starts decreasing. The contact movement has now proceeded so far that the plug contact 2 has released the nozzle outlet, where the pressure is now lower than in the pressure storage chamber 6. This gives rise to a gas flow from the pressure storage chamber 6 through the channel 9 and the nozzle 8 to a surrounding expansion chamber 19. The arc is cooled by this flow and is extinguished at the following current zero crossing.

During the opening operation the gas in the compression chamber 7 is compressed because the distance between the wall 11 and the blast piston 16 then decreases. This causes an increase of pressure in the compression chamber which in turn moves the blast piston downwards against the resistance of the springs 17. Since in the embodiment shown the springs are prestressed by means of a rod 20, which is secured to the blast piston 16 and bears with an end

stop 20a against the counter support 18, the downward movement of the blast piston 16 does not start until the overpressure in the compression chamber exceeds a certain level. This prestressing of the springs ensures that also in cases of small operating currents to be broken by the circuit breaker a sufficient increase of pressure will occur in the compression chamber. A second end stop 21 may be provided that limits the distance the blast piston 16 can travel.

Towards the end of the opening operation, the pressure in the pressure storage chamber 6 is decreased, as described above, and the non-return valve 13 opens. This leads to a reduction of the pressure in the compression chamber 7, which causes the blast piston 16 to make a return movement and an extra puff of gas to be pressed into the pressure storage chamber 6, where hot gas of low density in this way is replaced by cold gas of high density. This additional gas entails a considerable reduction of the temperature in the pressure storage chamber 6, the breaking capacity of an immediately following opening operation thus being greatly improved.

When breaking relatively small currents, the pressure increase in the pressure storage chamber 6, generated by the arc, is insufficient to achieve an effective flow of arc extinguishing gas. In such cases the arc extinction is performed with the aid of the compression chamber 7, in which a pressure build-up takes place during the opening operation because of the downward movement of the wall 11. The pressure in the compression chamber 7 then becomes higher than in the pressure storage chamber 6, which causes the non-return valve 13 to open and cold arc-extinguishing gas to flow from the compression chamber 7 via the pressure storage chamber 6 and the channel 9 to the blast nozzle 8, where the arc is cooled and extinguished.

The invention is not limited to the embodiment shown, but several variants are feasible within the scope of the claims. For example, the blast piston 16 may be provided with an overpressure valve for discharge of gas from the compression chamber 7 to the expansion chamber 19 if the pressure in the compression chamber should exceed a certain level. In addition, the blast piston may be provided with a non-return valve to refill the compression chamber with gas from the expansion chamber upon closing of the circuit breaker.

Further, the invention is not limited to be used in connection with circuit breakers in which the breaker casing 1 is made of electrically insulating material, but the invention may also be used with metal-enclosed gas insulated circuit breakers.

Claims

1. High-voltage circuit breaker of self-blasting type

comprising

- a casing (1), surrounding an expansion chamber (19) and filled with a gaseous arc-extinguishing medium,
- two cooperating contacts (2, 3a), at least one (3a) of which being part of a movable contact unit (3) connected to an operating device and being adapted, while being influenced by the operating device, to be displaced in the casing between a closed and an open position,
- a pressure storage chamber (6) with a constant volume, which via a channel (9) communicates with that region where the arc is burning upon an opening operation,
- a compression chamber (7), delimited by a blast piston (16) and a puffer cylinder (15), which is connected to the movable contact unit (3), and
- a non-return valve (12,13,14), arranged between the compression chamber (7) and the pressure storage chamber (6), which valve only allows flow in the direction from the compression chamber (7) to the pressure storage chamber (6),

characterized in that the blast piston (16) is arranged axially displaceable against the action of one or more springs (17).

2. Circuit breaker according to claim 1, **characterized** in that the springs (7) are prestressed by blocking the movability of the blast piston (16) in the direction of expansion of the springs (7) by means of one or more end stops (20,20a).
3. Circuit breaker according to claim 1 or 2, **characterized** in that a second end stop (21) is provided to limit the movement of the blast piston (16) in the compression direction of the springs (7).
4. Circuit breaker according to any of the preceding claims, **characterized** in that the pressure storage chamber (6) and the compression chamber (7) are arranged coaxially around the contact rod (4) of the movable contact unit (3) and separated by a wall (11) which forms the bottom in the pressure storage chamber (6) and exhibits an opening (12) designed as said non-return valve (12,13,14).
5. Circuit breaker according to any of the preceding claims, **characterized** in that the movable contact unit (3) supports a blast nozzle (8) in which said channel (9) between the pressure storage chamber (6) and the arc region is arranged.
6. Circuit breaker according to any of the preceding claims, **characterized** in that an overpressure

valve is arranged between the compression chamber (7) and the expansion chamber (19).

7. Circuit breaker according to any of the preceding claims, **characterized** in that a non-return valve is arranged in the blast piston (16) for refilling of arc-extinguishing gas from the expansion chamber (19) to the compression chamber (7).

Patentansprüche

1. Selbstblasender Hochspannungs-Leistungsschalter mit

- einem Gehäuse (1), welches eine Ausdehnungskammer (19) umgibt und mit einem gasförmigen Lichtbogen-Löschmedium gefüllt ist,
- zwei zusammenarbeitenden Kontakten (2, 3a), von denen zumindest einer (3a) Teil einer beweglichen Kontakteinheit (3) ist, die an eine Betätigungsvorrichtung angeschlossen ist und die bei Betätigung durch die Betätigungsvorrichtung in dem Gehäuse zwischen einer geschlossenen und einer offenen Position bewegt werden kann,
- einer Druckspeicherkammer (6) mit konstantem Volumen, welches über einen Kanal (9) mit dem Bereich in Verbindung steht, in welchem der Lichtbogen bei einem Öffnungsvorgang brennt,
- einer Druckerzeugungskammer (7), die abgegrenzt wird von einem Blaskolben (16) und einem Pufferzylinder (15), der mit der beweglichen Kontakteinheit (3) verbunden ist, und
- einem Rückschlagventil (12, 13, 14), welches zwischen der Druckerzeugungskammer (7) und der Druckspeicherkammer (6) angeordnet ist und welches nur einen Strom in Richtung von der Druckerzeugungskammer (7) zu der Druckspeicherkammer (6) erlaubt,

dadurch gekennzeichnet, daß der Blaskolben (16) gegen die Wirkung einer oder mehrerer Federn (17) axial verschiebbar angeordnet ist.

2. Leistungsschalter nach Anspruch 1, **dadurch gekennzeichnet**, daß die Federn (7) durch Blockierung der Beweglichkeit des Blaskolbens (16) in Richtung einer Entspannung der Federn (7) mittels eines oder mehrerer Endanschläge (20, 20a) vorgespannt sind.
3. Leistungsschalter nach Anspruch 1 oder 2, **dadurch gekennzeichnet**, daß ein zweiter Endanschlag (21) vorhanden ist zur Begrenzung der Bewegung des Blaskolbens (16) in Kompressi-

onsrichtung der Federn (7).

4. Leistungsschalter nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet**, daß die Druckspeicherkammer (6) und die Druckerzeugungskammer (7) koaxial um einen Kontaktstab (4) der beweglichen Kontakteinheit (3) angeordnet sind und voneinander durch eine Wand (11) getrennt sind, die den Boden der Druckspeicherkammer (6) bildet und eine Öffnung (12) hat, die als Rückschlagventil (12, 13, 14) ausgebildet ist. 5
5. Leistungsschalter nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet**, daß die bewegliche Kontakteinheit (3) eine Blasdüse (8) trägt, durch welche der genannte Kanal (9) zwischen der Druckspeicherkammer (6) und dem Lichtbogenbereich verläuft. 10
6. Leistungsschalter nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet**, daß ein Überdruckventil zwischen der Druckerzeugungskammer (7) und der Expansionskammer (19) vorhanden ist. 15
7. Leistungsschalter nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet**, daß ein Rückschlagventil in dem Blaskolben (16) angeordnet ist zum Nachfüllen von Lichtbogen-Löschgas aus der Ausdehnungskammer (19) in die Druckerzeugungskammer (7). 20

Revendications

1. Un disjoncteur à haute tension du type à auto-soufflage, comprenant :
 - un carter (1), entourant une chambre d'expansion (19) et rempli avec un mélange gazeux d'extinction d'arc, 40
 - deux contacts (2, 3a) qui coopèrent, l'un au moins (3a) d'entre eux faisant partie d'une structure de contact mobile (3) qui est connectée à un dispositif de manoeuvre, et étant conçu pour être déplacé dans le carter entre une position fermée et une position ouverte, sous l'action du dispositif de manoeuvre, 45
 - une chambre de stockage de pression (6) avec un volume constant, qui communique par l'intermédiaire d'un canal (9) avec la région dans laquelle l'arc brûle au moment d'une opération d'ouverture, 50
 - une chambre de compression (7), délimitée par un piston de soufflage (16) et un cylindre d'émission de bouffée (15), qui est reliée à la structure de contact mobile (3), et 55

- un clapet de non-retour (12, 13, 14), disposé entre la chambre de compression (7) et la chambre de stockage de pression (6), ce clapet permettant seulement l'écoulement dans la direction allant de la chambre de compression (7) vers la chambre de stockage de pression (6),

caractérisé en ce que le piston de soufflage (16) est monté de façon à pouvoir être déplacé axialement contre l'action d'un ou de plusieurs ressorts (17).

2. Disjoncteur selon la revendication 1, **caractérisé** en ce que les ressorts (17) sont préchargés par le blocage de la mobilité du piston de soufflage (16) dans la direction d'expansion des ressorts (7) au moyen d'une ou de plusieurs butées d'extrémité (20, 20a).
3. Disjoncteur selon la revendication 1 ou 2, **caractérisé** en ce qu'une seconde butée d'extrémité (21) est incorporée pour limiter le mouvement du piston de soufflage (16) dans la direction de compression des ressorts (7).
4. Disjoncteur selon l'une quelconque des revendications précédentes, **caractérisé** en ce que la chambre de stockage de pression (6) et la chambre de compression (7) sont disposées de façon coaxiale autour de la tige de contact (4) de la structure de contact mobile (3) et sont séparées par une paroi (11) qui forme le fond de la chambre de stockage de pression (6) et qui présente une ouverture (12) conçue pour constituer le clapet de non-retour (12, 13, 14).
5. Disjoncteur selon l'une quelconque des revendications précédentes, **caractérisé** en ce que la structure de contact mobile (3) supporte une buse de soufflage (8) dans laquelle est disposé le canal (9) entre la chambre de stockage de pression (6) et la région de l'arc.
6. Disjoncteur selon l'une quelconque des revendications précédentes, **caractérisé** en ce qu'une soupape de surpression est disposée entre la chambre de compression (7) et la chambre d'expansion (19).
7. Disjoncteur selon l'une quelconque des revendications précédentes, **caractérisé** en ce qu'un clapet de non-retour est disposé dans le piston de soufflage (16) pour remplir à nouveau la chambre de compression (7) avec du gaz d'extinction d'arc provenant de la chambre d'expansion (19).

