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(54) **Adaptable arc chute for circuitbreaker**

Anpassbare Lichtbogenlöschkammer für Leistungsschalter

Chambre de soufflage d'arc adaptable pour disjoncteur

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## Description

**[0001]** The present invention pertains to an arc extinguishing chamber or "arc chute".

**[0002]** Arc chutes are used in circuit interrupting devices such as circuit breakers and contactors, and particularly in DC (direct current) circuit interrupting devices.

**[0003]** DC circuit interrupting devices generally comprise a stationary contact and a movable contact. Under normal conditions, these contacts touch each other and electric current is conducted through them. To interrupt the circuit, the movable contact is moved away from the stationary contact by some type of electromechanical actuator, which will create an electric arc between the two contacts. The electric arc is forced into an arc chute by the magnetic field generated by the circuit. Inside this arc chute the arc is split up in a multitude of smaller arcs which will ultimately lead to the final breakdown of the conduction between the separated contacts, see for example document DE 197 15 116 A<sub>1</sub>.

**[0004]** Arc chutes produce an arcing voltage that is significantly higher than the rated voltage of the circuit, typically 1.5 to 3 times the rated voltage. However, international standards require that the arcing voltage be limited to a maximum value equal to three times the rated insulation voltage. The rated insulation voltage is in keeping with the rated voltage of the circuit. Thus, an arc chute designed for a given rated voltage generally cannot be used for another rated voltage.

**[0005]** The present invention aims at providing an arc chute that can be adapted to different rated voltages. To this end there is provided an arc chute as defined in appended claim 1, particular embodiments thereof being defined in dependent claims 2 to 4. The present invention provides also a circuit interrupting device, in particular a DC circuit breaker, incorporating the said arc chute.

**[0006]** Other features and advantages of the present invention will be apparent upon reading the following detailed description made with reference to the appended drawings in which:

- Figure 1 is an electric diagram of a circuit interrupting device, such as a circuit breaker or a contactor, incorporating the arc chute according to the invention, this diagram showing a bypass switch of the arc chute in its open position; and
- Figure 2 is an electric diagram of the same circuit interrupting device, showing the bypass switch in its closed position.

**[0007]** In the Figures, reference numeral 1 designates a circuit power line, reference numeral 2 designates a switch consisting of conventional stationary and movable contacts and reference numeral 3 designates the arc chute according to the invention. The arc chute 3 comprises, in a known manner, a plurality of arc chute units 4 connected in series by means of conductive members 5. Each arc chute unit 4 comprises a plurality of separate

metal baffles 6. In the example shown, four identical arc chute units 4 are provided.

**[0008]** Referring to Figure 1, when the switch 2 is opened, i.e. when the movable contact is moved away from the stationary contact, while current is flowing in the power line 1, an electric arc is formed between the contacts. The arc is forced into the arc chute 3, where it breaks down into a multitude of smaller arcs in each arc chute unit 4 and into currents flowing through the conductive members 5, as diagrammatically shown by the arrows.

**[0009]** Each arc chute unit 4 produces an arcing voltage that depends on the number of baffles 6 provided in the arc chute unit 4. The arcing voltage produced by the arc chute 3 is the sum of the different arcing voltages produced by the arc chute units 4. Thus, in the example shown, if each arc chute unit 4 produces an arcing voltage of about 1 kV, the total arcing voltage produced by the arc chute 3 will be about 4 kV.

**[0010]** According to the invention, a switch 7 is connected in parallel with part of the arc chute units 4, i.e. in the example shown with one arc chute unit referenced 4a, between two conductive members 5. The switch 7 bypasses (shunts) the said part of the arc chute units 4 when in its closed position (Figure 2), and does not bypass the said part of the arc chute units 4 when in its open position (Figure 1). Thus, when the switch 7 is in its open position (Figure 1), all arc chute units 4 will be operative to extinguish an electric arc created by the opening of the switch 2, and when the switch 7 is in its closed position (Figure 2), only the arc chute units 4 other than that or those connected in parallel with the switch 7 will be operative to extinguish an arc. Different arcing voltages are therefore produced by the arc chute 3 depending on the position of the switch 7. In the example shown, in which only the arc chute unit 4a is connected in parallel with the switch 7, the arcing voltage of the arc chute 3 will be four times the arcing voltage corresponding to one arc chute unit 4 when the switch 7 is open (Figure 1) and three times the arcing voltage corresponding to one arc chute unit 4 when the switch 7 is closed (Figure 2).

**[0011]** Preferably, the bypass switch 7 is a disconnecter. A disconnecter differs from a circuit breaker or a contactor in that it can open a circuit only when no current is flowing therein. A disconnecter thus does not require an arc chute. Alternatively, the bypass switch 7 may consist of a semiconductor switch, such as an insulated gate bipolar transistor (IGBT) switch or an integrated gate commutated thyristor (IGCT) switch.

**[0012]** Thanks to its bypass switch 7, the arc chute 3 of the present invention can be used in circuits working at different voltages. When configured so that all arc chute units 4 are operative (Figure 1), the arc chute 3 may be used in a first circuit having a first rated voltage. When configured so that only part of the arc chute units 4 are operative (Figure 2), the arc chute 3 may be used in a second circuit having a second rated voltage, lower

than the first rated voltage, since the arcing voltage is lower than in the former configuration and, more particularly, can be made lower than the maximum value required by international standards for the second circuit.

[0013] In the example shown, only one bypass switch 7 is provided. In variants, however, several bypass switches could be provided so that more than two different arcing voltages may be produced. For example, in addition to the switch 7 connected in parallel with the arc chute unit 4a, another bypass switch could be connected in parallel with the arc chute unit referenced 4b. Depending on the position of each of these two bypass switches, either zero, one or two arc chute units 4 could thus be bypassed, and three different arcing voltages could thus be obtained.

[0014] Furthermore, the or each bypass switch provided in the arc chute of the invention may be connected in parallel with several adjacent arc chute units rather than only one of them as represented in the Figures.

[0015] A particular field of application of the present invention are railway networks and vehicles. Railway networks indeed work at voltages that vary from one country to the other. Interrupting devices incorporating the arc chute of the invention may, for example, be installed on locomotives to enable these latter to run over the railway networks of different countries. The present invention eliminates the need for providing such locomotives with one circuit interrupting device for each network voltage.

[0016] The present invention is not limited to direct current, but could also be applied in the same manner to alternate current (AC).

## Claims

1. Arc chute (3) for a circuit interrupting device, comprising a plurality of arc chute units (4) connected in series, **characterised by** further comprising switching means (7) which are connected in parallel with part (4a) of said arc chute units (4) to bypass said part (4a) of said arc chute units (4) when in a closed position.
2. Arc chute according to claim 1, **characterised in that** said switching means (7) consist of a disconnector.
3. Arc chute according to claim 1, **characterised in that** said switching means (7) consist of a semiconductor switch.
4. Arc chute according to any one of claims 1 to 3, **characterised in that** said arc chute units (4) are connected in series by conductive members (5), and **in that** said switching means (7) are connected between two of said conductive members (5).
5. Circuit interrupting device (2, 3) incorporating an arc

chute (3) according to any one of claims 1 to 4.

6. DC circuit interrupting device incorporating an arc chute according to any one of claims 1 to 4.

## Patentansprüche

1. Lichtbogenkammer (3) für eine Stromkreis-Unterbrechungsvorrichtung mit einer Mehrzahl von in Reihe geschalteten Lichtbogenkammereinheiten (4), **dadurch gekennzeichnet, dass** sie weiter Schaltmittel (7) umfasst, die parallel zu Teil (4a) dieser Lichtbogenkammereinheiten (4) geschaltet sind, um diesen Teil (4a) der Lichtbogenkammereinheiten (4) zu umgehen, wenn sie sich in einer geschlossenen Stellung befinden.
2. Lichtbogenkammer nach Anspruch 1, **dadurch gekennzeichnet, dass** die Schaltmittel (7) aus einem Trennschalter bestehen.
3. Lichtbogenkammer nach Anspruch 1, **dadurch gekennzeichnet, dass** die Schaltmittel (7) aus einem Halbleiterschalter bestehen.
4. Lichtbogenkammer nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** die Lichtbogenkammereinheiten (4) durch leitende Elemente (5) in Reihe geschaltet sind, und dadurch, dass die Schaltmittel (7) zwischen zwei der leitenden Elemente (5) geschaltet sind.
5. Stromkreis-Unterbrechungsvorrichtung (2, 3), die eine Lichtbogenkammer (3) nach einem der Ansprüche 1 bis 4 einbezieht.
6. Gleichstrom-Unterbrechungsvorrichtung, die eine Lichtbogenkammer nach einem der Ansprüche 1 bis 4 einbezieht.

## Revendications

1. Chambre de coupure (3) pour un dispositif d'interruption de circuit, comprenant une pluralité d'unités de chambre de coupure (4) connectées en série, **caractérisée en ce qu'elle** comprend en outre des moyens de commutation (7) qui sont connectés en parallèle avec une partie (4a) desdites unités de chambre de coupure (4) pour court-circuiter ladite partie (4a) desdites unités de chambre de coupure (4) lorsqu'ils sont dans une position fermée.
2. Chambre de coupure selon la revendication 1, **caractérisée en ce que** lesdits moyens de commutation (7) consistent en un sectionneur.

3. Chambre de coupure selon la revendication 1, **caractérisée en ce que** lesdits moyens de commutation (7) consistent en un commutateur à semiconducteur. 5
4. Chambre de coupure selon l'une quelconque des revendications 1 à 3, **caractérisée en ce que** lesdites unités de chambre de coupure (4) sont connectées en série par des éléments conducteurs (5), et **en ce que** lesdits moyens de commutation (7) 10 sont connectés entre deux desdits éléments conducteurs (5).
5. Dispositif d'interruption de circuit (2, 3) comprenant une chambre de coupure (3) selon l'une quelconque 15 des revendications 1 à 4.
6. Dispositif d'interruption de circuit à courant continu comprenant une chambre de coupure selon l'une 20 quelconque des revendications 1 à 4.

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**Fig.1**

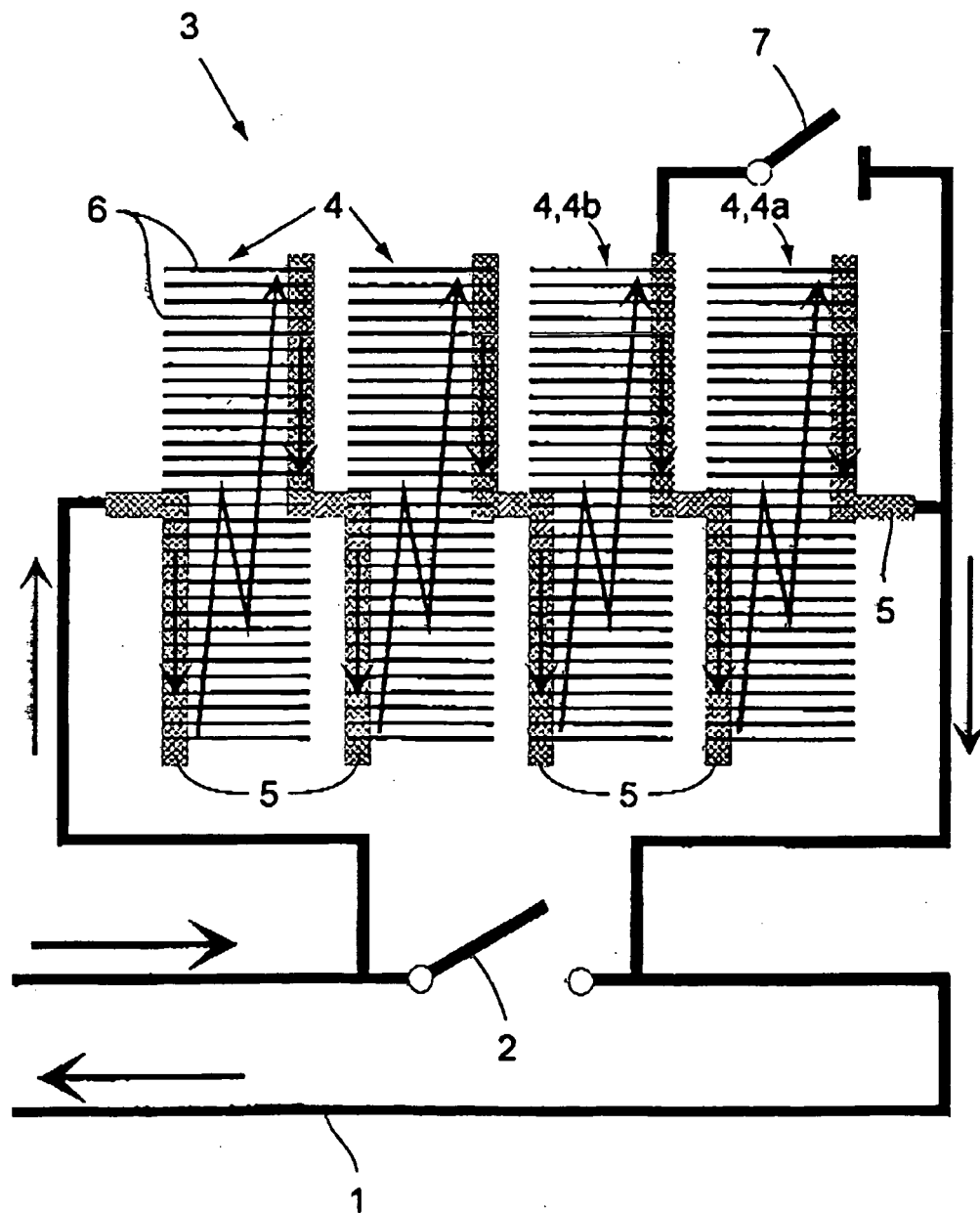
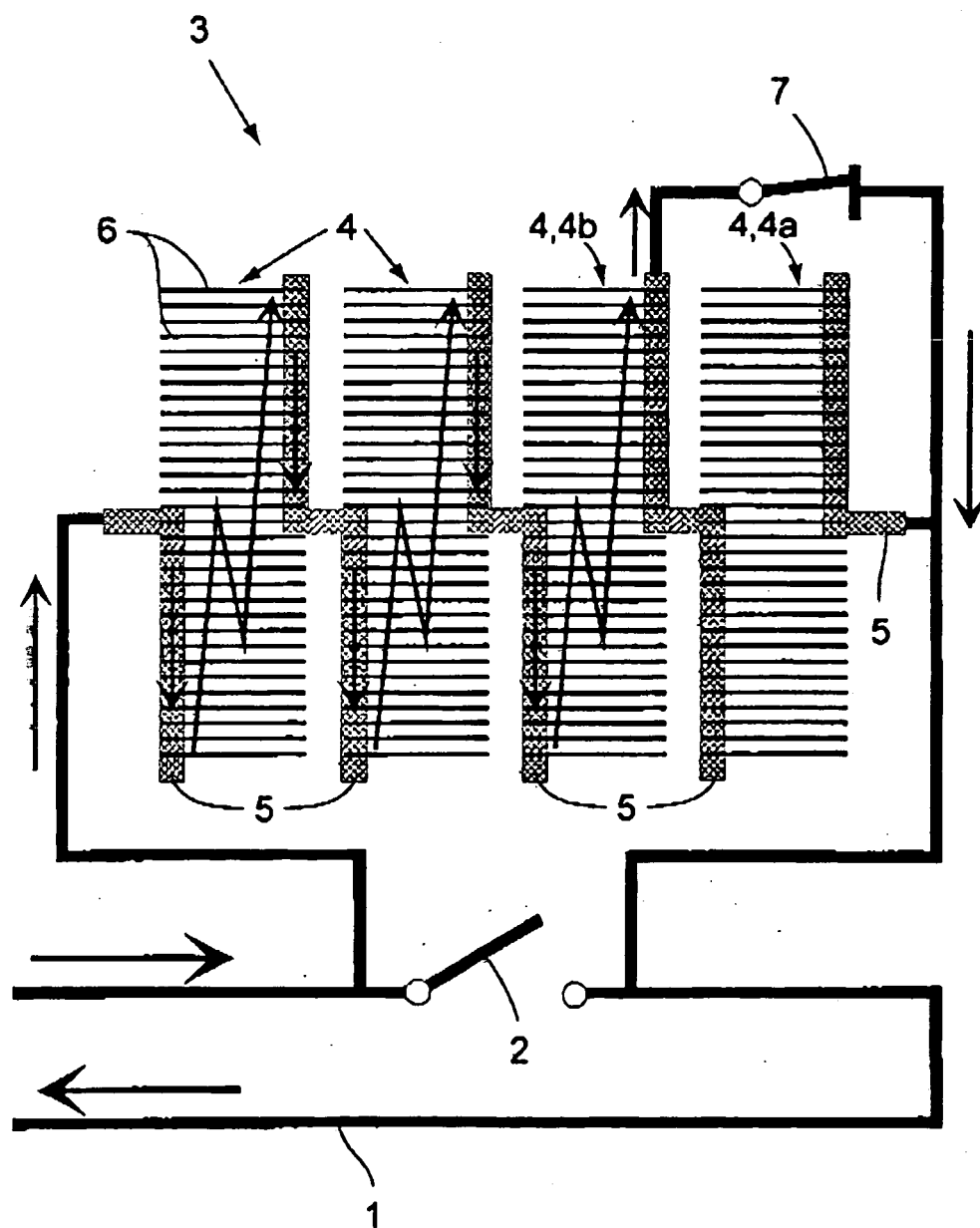


Fig.2



**REFERENCES CITED IN THE DESCRIPTION**

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