May 10, 1949. E. EICHENBERGER 2,469,459

GAS BLAST CIRCUIT BREAKER

Filed May 13, 1947

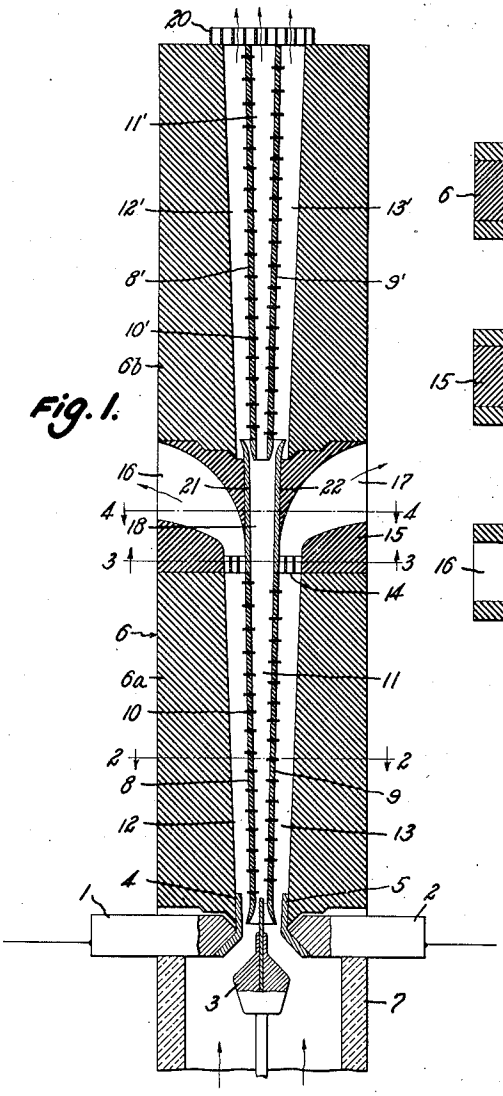

Fig. 1.

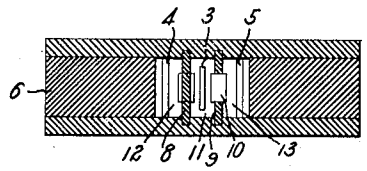

Fig. 2.

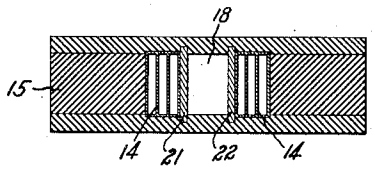

Fig. 3.

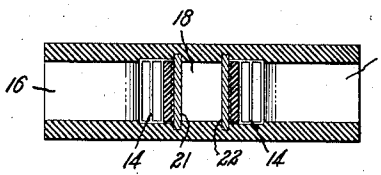

Fig. 4.

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Patented May 10, 1949

2,469,459

UNITED STATES PATENT OFFICE

2,469,459

GAS BLAST CIRCUIT BREAKER

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Application May 13, 1947, Serial No. 747,703
In Switzerland April 23, 1946

3 Claims. (Cl. 200—148)

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This invention relates to gas blast circuit breakers particularly for use in interrupting direct current loads and is an improvement over the construction disclosed and claimed in my co-pending United States application Serial No. 585,031, filed March 27, 1945, now Patent No. 2,451,669, granted October 19, 1948.

In the application referred to, a circuit breaker construction is there shown that provides an arc blowing chamber adjacent the circuit breaker contacts and which chamber is divided into at least three compartments traversed lengthwise by blast gas, such as compressed air. A plurality of electrodes spaced from each other in the direction of flow of the compressed gas are located at corresponding positions in each compartment of the blowing chamber, and electrodes at like levels in adjacent compartments are electrically connected to form electrode pairs which serve as points of attachment for intermediate portions of the arc loop formed upon separation of the breaker contacts and thereby enable the intermediate portions of the arc loop to climb upward in stages through the blowing chamber. The roots of the arc loop are retained at the base of the blowing chamber and hence the arc loop is lengthened by its climbing action until the voltage required to maintain it exceeds the voltage of the circuit across the breaker contacts whereupon the arc is extinguished.

The foregoing construction has been found most satisfactory for operation on circuits of a few kilo-volts since the blowing chamber can be maintained in a substantially completely unionized state throughout its length by the continuous charge of compressed gas flowing through it thereby making reignition of the arc well nigh impossible. However, as to high voltage applications in the range of 100 kilo-volts or more, which require a relatively long blowing chamber with a large number of interconnected electrode pairs for enabling the intermediate portion of the arc loop to climb to such a length that extinction takes place, it has been found that the arc voltage per centimeter of arc length, i. e. the arc gradient, diminishes appreciably at the upper end of the two outer compartments of the blowing chamber. Thus the arc extinguishing ability of the blowing chamber decreases with its length with the result that prohibitively long chambers must be used on the higher voltage lines. The reduction in arc voltage gradient at the upper end of the chamber is due to the fact that the continuous blast of compressed gas through the chamber is not able to maintain the gas in the

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outer two compartments in a completely unionized state throughout the chamber's length. In other words, as the gas passes upward through the two outer compartments of the chamber, it at first remains substantially completely unionized throughout about a half meter or so of its length, but above this point because of the increasing arc length in these compartments, the gas becomes increasingly more ionized with an attendant reduction in arc voltage gradient that reduces the arc extinguishing ability of the blowing chamber.

The object of this invention is therefore to provide a switch construction of the general type described in my aforesaid patent application but which will be capable of handling high voltage arcs without having to resort to the use of excessively long arc blowing chambers. In general, the desired result is obtained by introducing relatively fresh (substantially un-ionized) gas into the outer compartments of the arc blowing chamber where the length of arc is great at at least one point between the switch contact end of the chamber and the opposite chamber end, and at such point also removing the now ionized air initially introduced in a fresh state into the outer two compartments at the base of the chamber adjacent the circuit breaker contacts.

A preferred embodiment of a circuit breaker incorporating the invention is shown in Fig. 1 in central longitudinal section. Figs. 2, 3 and 4 are tranverse sections taken on lines 2—2, 3—3 and 4—4 of Fig. 1, respectively.

Referring now to the drawings, the stationary contact members of the circuit breaker are designated 1, 2 and these are bridged by a movable contact member 3. Auxiliary electrodes 4 and 5 conductively connected with stationary contacts 1 and 2, respectively, serve to catch the roots of the arc that forms between these contacts as contact member 3 moves downwardly to disconnect itself therefrom and thereby interrupt the line circuit that is closed through contacts 1 and 2 when the latter are bridged by contact member 3.

An arc blowing chamber 6 is placed transverse to the path of the arc and the auxiliary electrodes 4 and 5 extend into the chamber entrance. Intermediate portions of the arc are blown by blast gas such as compressed air directed upwardly through a hollow insulating support 7 disposed transversely of the spaced stationary contacts 1 and 2. The blowing chamber 6 which is of insulating material is divided longitudinally into two sections 6a, 6b, placed one above the other in the direction of flow of the blast gas. The lower

chamber section 6a is partitioned into three chambers or compartments by walls 8 and 9 of insulating material that extend generally longitudinally through chamber 6a. Walls 8 and 9 may be parallel to the chamber axis but are preferably placed so as to diverge slightly from such axis in the direction of flow of the blast gas. As in the construction shown in my co-pending application Ser. No. 585,031, electrodes are placed in vertically spaced relation in each of the three compartments and in accordance with the preferred construction consist of short rod inserts 10 of conductive material extending transversely through the walls 8, 9 into each compartment. The center compartment 11 receives the middle portion of the arc loop while the side or outer compartments 12, 13 receive the side portions of the loop.

The upper ends of the two side compartments 12, 13 of the lower blowing chamber 6a are each terminated by a metallic grid insert 14 through which the arc loop can close and which is carried by an insulating member 15 that also serves as a support for the upper blowing chamber 6b. Support 15 is provided with a passage 16 to atmosphere leading from grid 14 for the exhaust of compressed gas from the top of side compartment 12 and a similar passage 17 for exhausting compressed gas from side compartment 13.

The intermediate support 15 also contains an axial passageway 18 connected with the upper end of the center compartment 11 that serves to conduct compressed gas to the entrance point of the three compartments 11', 12', 13' formed in the upper blowing chamber 6b by the slightly divergent partitions 8', 9'. The upper ends of the latter three compartments are capped by a metallic grid insert 20 through which the arc loop can close.

A second set of auxiliary electrodes 21, 22 connected with the grid 14 of the lower chamber 6a extend upwardly through passageway 18 on opposite sides thereof and these terminate, respectively, in the gas entrance ends of the two outer compartments 12', 13', of the upper blowing chamber.

As in the lower chamber, conductive inserts 10' extend through the partitions 8' and 9' to serve as attaching points on which the arc can climb upwardly through the chamber compartments.

The improved blast gas switch operates in the following manner:

Upon actuating the movable contact member 3 to break the line circuit at the gap formed between stationary contacts members 1 and 2, a valve (not shown) at the lower end of insulator column 7 opens automatically to direct blast gas under pressure upwardly across the contact gap. The roots of the arc formed in the gap at the main stationary contacts 1 and 2 are transferred to the associated auxiliary contact electrodes 4, 5 and the portion of the arc intermediate the roots is blown by the gas blast transversely into the entrance of the three compartments 11, 12, 13 in the lower chamber 6a. Here under the continued action of the flowing gas, the intermediate portions of the arc loop are driven upwardly through the compartments, the loop climbing upwardly and across on the electrodes 10 stage by stage until it closes through the grid 14 and the electrodes 21, 22 at the top of the lower chamber 6a. The gases in the side compartments 12, 13 ionized by the presence of the relatively long side parts of the arc in these compartments pass into the atmosphere through the outlets 16 and 17.

The middle portion of the arc loop now at the top of the center compartment 11 and transferred to the auxiliary electrodes 21, 22 is blown upwardly through passageway 18 and soon reaches the lower end of the upper chamber 6b where the arc blowing process now virtually repeats itself. That is, the roots of the arc are now anchored respectively to the upper ends of the auxiliary electrodes 21, 22, the middle portion of the arc loop rises through the center compartment 11' and the side arc sides rise in the side compartments 12', 13', the arc loop closing through the conductive inserts 10' stage by stage until extinguished.

Due to the nature of the path taken by the arc loop as it climbs through the compartments in the lower chamber 6a, only a short portion of the entire length of the arc loop is present in the center compartment 11. Hence the compressed gas travelling through center compartment 11 remains substantially free from ionization and is thus most effective for use in extending the remaining central section of the arc loop further upwardly through the center and side compartments 11', 12' and 13' of the upper chamber with a good arc voltage characteristic at all stages.

The construction described enables the so-called arc gradient to be raised considerably and at the same time permits a substantial reduction in the length of the blowing chamber for a given circuit application. By shortening the various compartments in the chamber, the mean field strength of the arc is increased throughout the whole length of the chamber and in this way, with a given arc length, a greater arc voltage is produced.

In conclusion, it is to be understood that while I have described and illustrated a preferred embodiment of the invention, various changes in the construction and arrangement of parts of the circuit breaker and the associated arc blowing chambers may be made without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. Gas blast circuit breaker comprising a pair of arc blowing chambers mounted one above the other, each of said chambers including partitions dividing the chamber longitudinally into at least three side-by-side compartments through which blast gas is adapted to flow, a plurality of electrodes in each compartment spaced from each other in the direction of flow of the blast gas, correspondingly positioned electrodes in adjacent compartments being connected electrically in pairs to form successive climbing points of attachment for the center and two outer portions of the arc loop, switch contacts disposed adjacent the bottom open end of the lower chamber, a set of auxiliary electrodes connected to said switch contacts, said auxiliary electrodes extending respectively into the two outer compartments of the lower chamber to catch and hold the roots of the arc loop formed upon opening of said switch contacts, a gas exhaust outlet leading to atmosphere from the upper end of the outer two compartments of the lower chamber, a second set of auxiliary electrodes connected to conductive grids located respectively at the upper ends of the outer two compartments of the lower chamber and which extend into the bottom open ends of the two outer compartments of the upper chamber and a gas passageway placing the center compartment of the lower chamber in communication with the bottom open ends of the three compartments of the upper chamber.

2. Gas blast circuit breaker as defined in claim 1 wherein an insulating support atop the lower chamber carries the upper chamber and said gas outlets and gas passageway are constituted by passageways through said support.

3. Gas blast circuit breaker comprising a pair of arc blowing chambers mounted one above the other, each of said chambers including partitions dividing the chamber longitudinally into at least three side-by-side compartments through which blast gas is adapted to flow, a plurality of electrodes in each compartment spaced from each other in the direction of flow of the blast gas, correspondingly positioned electrodes in adjacent compartments being connected electrically in pairs to form successive climbing points of attachment for the arc loop, switch contacts disposed adjacent the bottom end of the lower chamber, auxilitary electrode means electrically connected to said switch contacts to catch and hold the roots of the arc loop formed upon opening of said contacts, a gas exhaust outlet leading to atmosphere from the upper end of the two outer compartments of the lower chamber, and a passageway placing the upper end of the center compartment of the lower chamber in communication with the bottom open ends of the three compartments of the upper chamber.

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No references cited.