May 16, 1944. J. A. HENLEY 2,349,095

ELECTRIC CIRCUIT BREAKER

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Fig. 1.

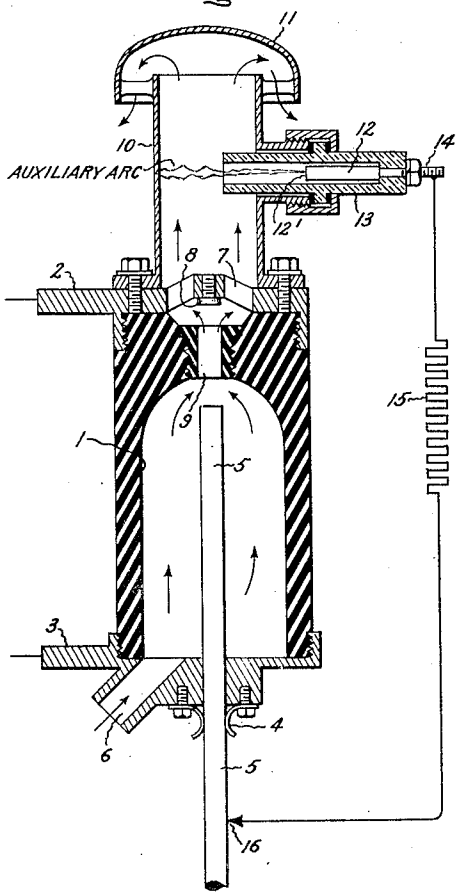


Fig. 2.

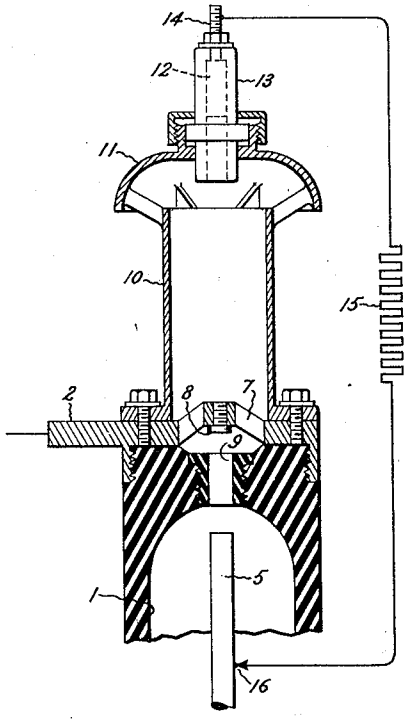
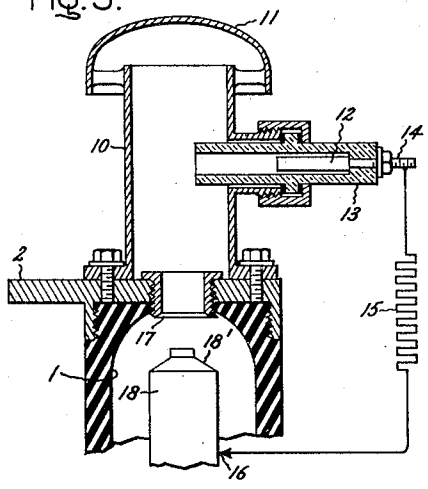


Fig. 3.



Inventor:
John A. Henley,
by Harry E. Dunham
His Attorney.

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ELECTRIC CIRCUIT BREAKER

John A. Henley, Sale, England, assignor to Metropolitan-Vickers Electrical Company Limited, a company of Great Britain

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6 Claims. (Cl. 200—148)

My invention relates to electric circuit breakers, more particularly to those of the air or gas blast type wherein an auxiliary electrode is provided for connecting a resistance across the main circuit breaker terminals when the circuit is being opened, and has for its principal object the provision of an improved gas blast circuit breaker of the aforesaid type that is more efficient and effective in completely opening the circuit.

My invention will be more fully set forth in the following description referring to the accompanying drawing, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Referring to the drawing, Fig. 1 is an elevational view in section showing a gas blast circuit breaker embodying the present invention in an intermediate stage of the circuit opening operation, Fig. 2 is a similar view showing a modified form of my invention, and Fig. 3 is a view generally similar to Fig. 1 showing another modification of my invention.

In accordance with the broader aspects of my invention, an air or gas blast circuit breaker is provided with a main pressure chamber to which the interrupting gas under pressure is directly admitted and a nozzle or the like at one end of the chamber from or through which an arc may be drawn upon separation of the main contacts. Means are provided whereby air or gas under pressure is directed from said chamber through the nozzle into a discharge passage having internal walls of electrically conducting material connected to one terminal of the breaker. An auxiliary electrode is disposed in a recess or side chamber of the discharge passage, said recess or side chamber being formed by or connecting with the discharge passage through a tubular member of insulating material. The auxiliary electrode is also electrically connected to the other terminal of the breaker through a suitable resistance. Accordingly, the resistance can be inserted in a circuit across the main terminals of the breaker of a so-called secondary or auxiliary arc striking between the conducting inner wall of the discharge passage and said auxiliary electrode. Preferably the tubular insulating member in which the auxiliary electrode is disposed projects into the discharge passage and has a bore of comparatively small cross section so as to have a quenching effect on the aforesaid auxiliary or secondary arc.

Referring in particular to a specific embodiment of my invention, Fig. 1 shows a gas blast breaker having a main interrupting chamber 1 at the opposite ends of which are located the main breaker terminals 2 and 3. The lower terminal 3 is in sliding electrical contact at 4 with the movable rod contact 5 and is provided with an inlet port 6 for admiting gas under pressure from a suitable supply source to the main chamber 1.

The upper terminal 2 is provided with a spider 7 having a centrally located fixed contact 8 which the rod contact 5 can engage in the closed circuit position of the breaker. The rod contact 5 in engaging the fixed contact moves through an insulating nozzle 9 which is designed to direct the interrupting blast from the main chamber through the arc upon separation of the contacts as indicated by the flow direction arrows.

There is also mounted on the terminal structure 2 in electrical contact therewith a metallic cylinder 10 constituting a discharge passage for the interrupting blast. The discharge passage terminates in a dome shaped cover 11 arranged to deflect and dissipate the heated arc gases and to provide weather protection in certain cases.

The auxiliary electrode 12 is disposed laterally of the discharge passage and is positioned well within an insulating tube or bushing 13 of arc resisting material that is mounted in the side wall of the cylinder 10 as indicated, so as to project a material distance into the passage. The arcing end 12' of the auxiliary electrode is in direct communication with the interior of the passage 10 as the insulating tube 13 opens into the passage through a bore of limited cross sectional area and is closed at its outer end. The auxiliary electrode is electrically connected at 14 to a resistance 15 of suitable value that is in turn electrically connected as indicated at 16 to the movable contact 5, and hence to the lower terminal 3.

In the operation of the circuit breaker above described the arc drawn upon separation of the main contacts 5 and 8 will be extinguished by the blast of air or gas under pressure directed through the nozzle 9. It should be noted, however, that this interruption, which takes place at a current zero, may be but temporary due to recurrence of high voltage across the interrupting gap. The function of the auxiliary electrode 12 and the resistance 15 is to prevent high rates of increase of recovery voltage, or high peak voltages, subsequent to interruption of the arc between the main contacts at a current zero, thereby to prevent restriking of the arc. This is accomplished since during the circuit interrupt-

ing operation the gas in the discharge passage is highly heated and ionized due to the main arc and as a result a secondary or auxiliary arc restrikes between the conducting inner wall of the discharge passage and the auxiliary electrode. There is thereby provided a current path which includes the auxiliary arc and said resistance and which shunts the main contacts. The striking of such an auxiliary arc is indicated in Fig. 1.

Immediately upon interruption of the arc at the main contacts, the ionized gas in the discharge passage is swept out of the passage by the blast and the greatly reduced current flowing through the auxiliary arc and resistance circuit will in turn be interrupted by the cross blast action of the air or gas flowing through the discharge passage across the open end of the insulating tube 13. By restricting the bore of the tubular member 13 to a cross section not materially in excess of that of the auxiliary electrode, the expansion of the auxiliary arc is restricted and the extinguishing effect on said arc will be increased.

Upon interruption of the auxiliary arc the circuit is completely opened and cleared so that the movable contact 5 can safely be operated to the fully open circuit position for increasing the isolating distance between the breaker terminals. Closing the breaker is accomplished simply by moving the rod contact 5 upward through the nozzle 9 into engagement with the fixed contact 8. Suitable valve structure (not shown) may be used for controlling admission of the interrupting gas to the chamber 1 in a manner well known in the art.

In the modification shown by Fig. 2 the contact arrangement of the breaker is essentially the same as that of Fig. 1 and the auxiliary electrode 12 and its insulating tube 13 are disposed coaxially of the passage 10 at the upper end thereof. In this arrangement the auxiliary electrode is suitably mounted in the dome-like cover structure 11 of the passage. The operation is essentially the same as that described in connection with Fig. 1 since after the main current interruption the auxiliary arc strikes through the ionized gas in the discharge passage from the conducting wall structure of the passage to the electrode and is then quickly extinguished. The circuit breakers shown by Figs. 1 and 2 are particularly designed for high voltage operation.

The modified circuit breaker shown in Fig. 3 is generally suitable for lower voltages than the breakers above described. The fixed main contact 17 forms the nozzle for the gas blast. The contact comprises a conducting member of cylindrical form carried in the top of the main chamber 1 and forming a part of the terminal structure 2. The cooperating movable contact 18, instead of extending through the nozzle, is provided at its upper end with a conical shaped surface 18' adapted to engage the lower internal edge of the fixed contact 17. It will be noted that with this arrangement the auxiliary electrode in its insulating tube or sleeve may extend either laterally of the discharge passage, as in Fig. 1, or coaxially of the discharge passage, as in Fig. 2 so as to function in the manner above described.

It should be understood that my invention is not limited to specific details of construction and arrangement thereof herein illustrated, and that changes and modifications may occur to one skilled in the art without departing from the spirit of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. An electric circuit breaker of the gas blast type comprising relatively movable interrupting contacts, means for directing a blast of interrupting gas through the arc formed upon separation of said contacts for interrupting the arc at a current zero, a resistance connected to one terminal of said breaker, an auxiliary electrode connected to said resistance and located in proximity to but spaced from conducting structure electrically connected to the opposite terminal of said breaker, and means forming a recess in communication only with the flow of exhaust gas from the interrupting arc, said auxiliary electrode being located a material distance within said recess so that an auxiliary arc can strike between said terminal conducting structure and said electrode for establishing a current shunt path through said resistance across said breaker terminals, said auxiliary arc in turn being interrupted and the circuit completely opened by said interrupting gas.

2. An electric circuit breaker of the gas blast type comprising relatively movable interrupting contacts, means for directing a blast of interrupting gas through the arc formed upon separation of said contacts for interrupting the arc at a current zero, a resistance associated with one terminal of said breaker, an auxiliary electrode connected to said resistance and located in proximity to conducting structure associated with the opposite terminal of said breaker, and means forming a recess in communication with the flow of exhaust gas from the interrupting arc, the arcing end of said auxiliary electrode being located a material distance within said recess, said recess being located with respect to said flow of exhaust gas so that an auxiliary arc can strike between said terminal conducting structure and into said recess to said electrode arcing end for establishing a current shunt path through said resistance across said breaker terminals, said auxiliary arc being thereupon quickly extinguished by the quenching action of said recess and said gas blast.

3. An electric circuit breaker of the gas blast type comprising relatively movable interrupting contacts, means for directing a blast of interrupting gas through the arc formed upon separation of said contacts for interrupting the arc at a current zero, a resistance connected to one terminal of said breaker, an auxiliary electrode connected to said resistance and located in proximity to but spaced from conducting structure connected to the opposite terminal of said breaker, and means forming an insulating recess of restricted cross sectional area in communication only with the flow of exhaust gas from the interrupting arc, said auxiliary electrode being located a material distance within said restricted recess and positioned so that an auxiliary reduced current arc can strike between said terminal conducting structure and said electrode for establishing a current shunt path through said resistance across said breaker terminals, said auxiliary arc being quickly extinguished by said gas blast and the quenching action of said restricted recess completely to open the circuit.

4. An electric circuit breaker of the gas blast type comprising relatively movable interrupting contacts, means for directing a blast of interrupting gas through the arc formed upon separation of said contacts for interrupting the arc at a current zero, a discharge passage for said

blast having at its inner wall conducting structure electrically connected to one terminal of said breaker, a resistance connected to the opposite terminal of said breaker, an auxiliary electrode connected to said resistance and located adjacent to said conducting structure, and an insulating tube mounted in a wall of said discharge passage having one closed end while the other end thereof is in communication with the flow of exhaust gas from the interrupting arc, said auxiliary electrode being located a material distance within said tube so that an auxiliary reduced current arc can strike between conducting structure in said passage and said electrode for establishing a current shunt path through said resistance across said breaker terminals, said auxiliary arc thereupon being subjected to the extinguishing action of the gas blast in said passage.

5. An electric circuit breaker of the gas blast type comprising relatively movable interrupting contacts, means for directing a blast of interrupting gas through the arc formed upon separation of said contacts for interrupting the arc at a current zero, a chimney forming a discharge passage for said blast having at its inner wall conducting structure electrically connected to one terminal of said breaker, a resistance connected to the opposite terminal of said breaker, an auxiliary electrode connected to said resistance and located adjacent to said conducting structure, and an insulating tube with a closed end having a restricted bore mounted in a side wall of said discharge passage and projecting laterally into said passage so as to be in communication with the flow of exhaust gas from the interrupting arc, said auxiliary electrode being located a material distance within said tube so that an auxiliary reduced current arc can strike between said passage conducting structure and said electrode for establishing a current shunt path through said resistance across said breaker terminals, said auxiliary arc thereupon being subjected to the cross blast extinguishing action of the gas flowing through said passage.

6. An electric circuit breaker of the gas blast type comprising relatively movable interrupting contacts, means for directing a blast of interrupting gas through the arc formed upon separation of said contacts for interrupting the arc at a current zero, a chimney forming a discharge passage for said blast having conducting structure at the inner wall thereof electrically connected to one terminal of said breaker, a resistance connected to the opposite terminal of said breaker, an auxiliary electrode connected to said resistance, and insulating structure forming a recess communicating with said passage mounted at the top of said discharge passage substantially coaxially thereof and projecting into said passage so as to be in communication with the flow of exhaust gas from the interrupting arc, said auxiliary electrode being located within said recess so that an auxiliary reduced current arc can strike between said passage conducting structure and said electrode for establishing a current shunt path through said resistance across said breaker terminals, said auxiliary arc thereupon being subjected to the blast extinguishing action of the gas flowing through said passage.

JOHN A. HENLEY.