May 23, 1944. J. SLEPIAN 2,349,681

CIRCUIT INTERRUPTER

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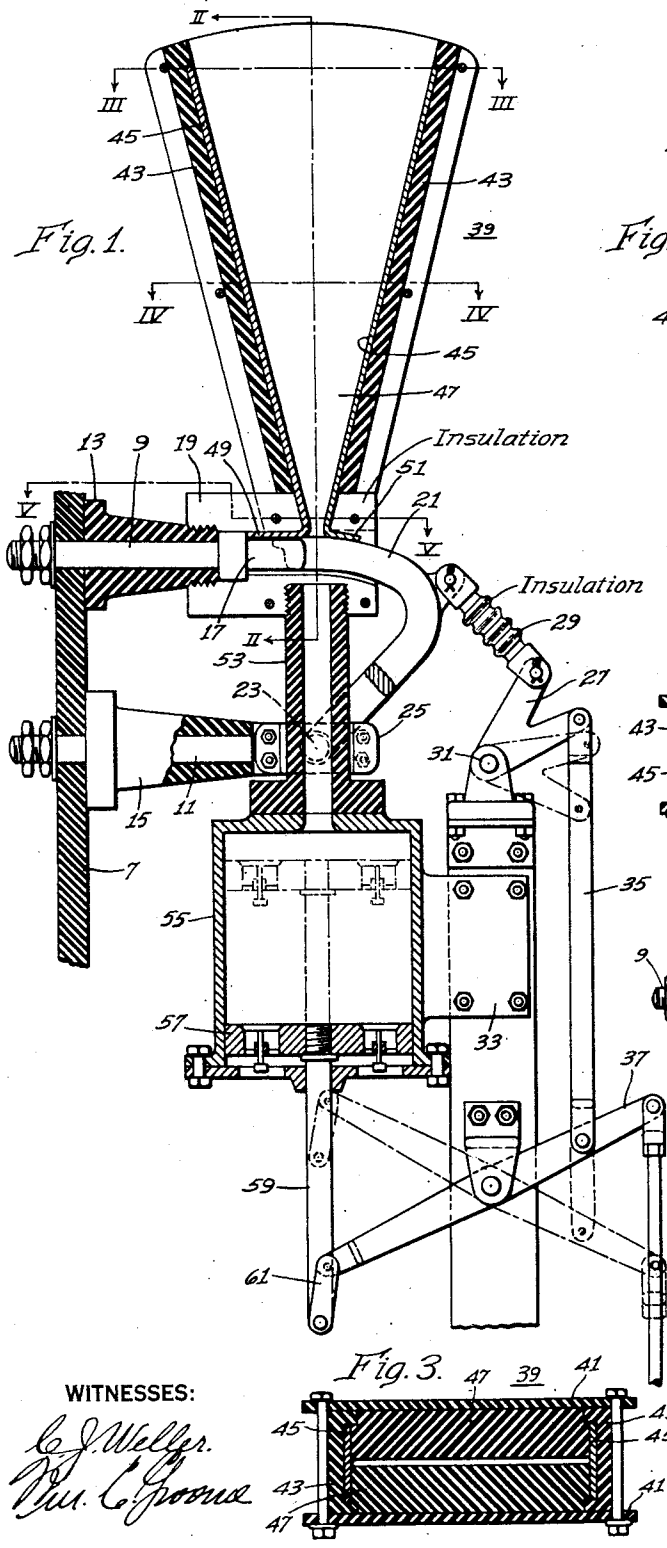


Fig. 1.

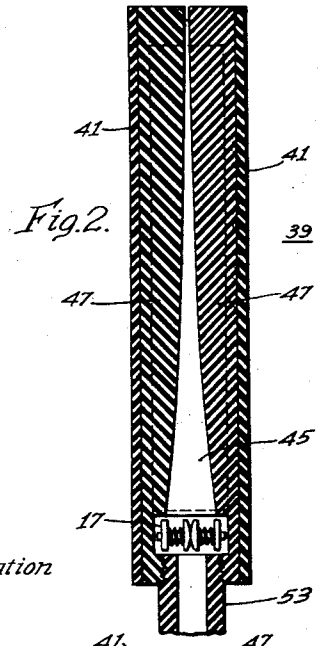


Fig. 2.

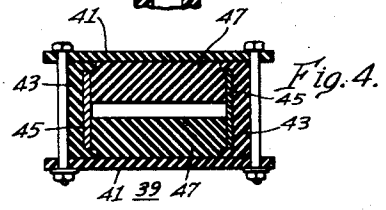


Fig. 4.

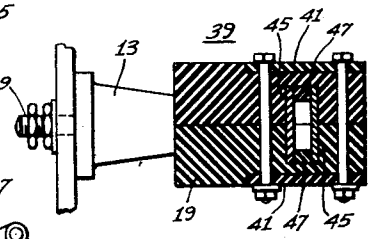


Fig. 5.

Fig. 3.

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CIRCUIT INTERRUPTER

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6 Claims. (Cl. 200—148)

This invention relates to circuit interrupters, and more particularly to circuit interrupters of the air break type utilizing a blast of gas to assist arc extinction.

A study of the fundamental processes covering arc extinction in gas blast circuit interrupter indicates quite definitely that the function of the gas blast is to so place and so alter the configuration of a length of arc that the diffusive forces such as heat conduction and deionization are greatly enhanced. It has been determined that the most favorable arc configuration for diffusive effects is a relatively long arc of very small cross section. In addition, turbulence in the gas flow will increase the effective diffusion coefficient and also the thermal conductivity coefficient so as to improve the arc extinguishing action.

In the gas blast circuit interrupters of the prior art, both the nozzle and cross blast types, arc extinction is accomplished by reducing the cross section of a relatively short length of arc by the action of a blast of gas thereon. A large part of the gas blast, however, in these interrupters during the greater part of the circuit interrupting operation flows remotely from the reduced section of arc so that it is in a sense wasted. For this reason, very intense blasts of gas are necessary to bring about arc extinction.

The present invention has for its object the provision of a circuit interrupter of the gas blast type which, by a more effective utilization of the blast of gas, brings about arc extinction with a materially lower gas blast pressure and much smaller quantity of gas than heretofore required.

It is another object of my invention to provide arc extinguishing means for circuit interrupters of the gas blast type which when acting upon an arc produces a configuration of arc most favorable for arc extinction.

More specifically, my invention embraces an arc chute for circuit interrupters of the gas blast type of such design that even as the arc section is reduced, the full gas blast continues to act upon it so as to further reduce the section without any gas being able to pass around the reduced section. This may be accomplished by blowing the arc after it is drawn on to diverging arc horns within a chute having insulating walls which converge in proportion as the arc length from horn to horn increases.

Other objects and advantages will appear in the following description when read in connection with the accompanying drawing, in which:

Figure 1 is a side view partially in section showing a circuit interrupter embodying my invention,

Fig. 2 is a longitudinal sectional view of the arc chute of the interrupter shown in Fig. 1, taken along the line II—II thereof with the moving contact in open position,

Figs. 3, 4 and 5 are cross sectional views of the arc chute of the interrupter shown in Fig. 1, taken respectively along the lines III—III, IV—IV and V—V.

Referring to the drawing, the reference numeral 7 designates a panel preferably of insulating material upon which is mounted a pair of lead-in conductors 9 and 11. The lead-in conductors are preferably insulated in part by bushings 13 and 15. The right-hand end of lead-in conductor 9 carries a stationary contact assembly 17 which may be enclosed in a housing 19 of insulating material and secured to the end of bushing 13 for support. Coacting with the stationary contact assembly 17 is a movable contact member 21, the lower portion of which is bifurcated and pivotally joined at 23 to a conducting bracket 25 secured to the lower lead-in conductor 11.

The movable contact member 21 is operative about the pivotal support 23 into and out of engagement with the stationary contact 17 by an operating mechanism which may comprise a bell crank 27 connected through an insulating operating rod 29 to the contact member 21. The bell crank 27 which is pivoted at 31 to a suitable framework 33 may be actuated by a rod 35 connected to a rocker arm 37 also pivoted to the frame 33. The rocker arm 37 may be actuated by a suitable operating device, not shown, as for example a solenoid or motor driven mechanism or a pneumatic engine, all of which are well known in the art and need not be further described.

Supported upon the housing 19 is an arc chute generally designated at 39 comprising fan shaped side members 41 and a pair of diverging enclosing members 43. A pair of arc terminal members 45 are disposed along the inner surfaces of the side enclosure members 43 and extend from the lower end of the chute 39 upwardly to substantially the upper end thereof. The space between the diverging arc terminal members 45 is lined with a pair of wall members 47 preferably of insulating material, which is of a refractory nature and does not emit gas in an appreciable amount when subjected to the heat of the arc, and which also maintains a high resistance when subjected to the heat of the arc.

The wall members 47 are inclined with respect

to each other so as to form an arc passage which converges in a direction away from the lower or stationary contact end of the arc chute. The degree of convergence, as more clearly shown in Fig. 2, is proportional to the divergence of the arc terminal members 45 so as to provide a passage of substantially uniform cross sectional area throughout the length of the arc chute. The purpose of this particular configuration of arc passage in the arc chute will appear more fully hereinafter.

The lower end of the left-hand arc terminal member 45 makes contact with an arcing contact 49 connected to the lead-in conductor 9. The right-hand arc terminal member 45 is provided with a resilient arcing member 51 adapted to make sliding contact with the movable contact 21 during the opening movement of the latter. In operation, an arc established between the stationary contact 17 and the moving contact 21 is moved upwardly onto the arcing contacts 49 and 51 from whence it transfers to the arc terminal members 45.

Arc movement and arc extinction are preferably produced by a blast of arc extinguishing gas, such as compressed air. The requisite blast of compressed gas is preferably directed at right angles to the arc through a tube 53 of insulating material which joins the lower end of the casing 19 as more clearly shown in Fig. 1, and is held in position by the conducting bracket 25.

I have discovered that effective operation of the interrupter may be obtained with only a relatively low pressure source of compressed gas. Compressed gas for circuit interruption may be obtained from any suitable source such as a storage reservoir or from a compressor secured to and operated by the contact operating mechanism. The fact that only a small quantity of compressed gas at a relatively low pressure is needed, makes the latter arrangement feasible. The form of compressor which may be used is shown in Fig. 1 and comprises a cylinder 55 secured to the lower end of the tubular insulator 53.

The cylinder 55 has a piston 57 operable therein by means of a connecting rod 59 extending through the lower end of the cylinder. The connecting rod 59, for example, may be coupled by a link 61 to the rocker arm 37 of the contact operating mechanism. Thus when the rocker arm 37 is rotated in a clockwise direction so as to actuate the moving contact 21 to the open circuit position, the piston 57 will be moved upwardly within the cylinder 55 to cause a blast of gas to flow through the tubular insulator 53 and into engagement with the arc drawn between the separating contacts to force the arc upwardly into the arc chute 39. As heretofore described, the walls 47 are spaced farther apart at the lower or contact end of the chute and narrow in proportion with the divergence of the arc terminal members 45.

The arc drawn between the arcing members 49 and 51 is moved upwardly and transverse to the diverging arc terminal members 45. As the arc moves upwardly, it is progressively lengthened but at the same time is moved into correspondingly narrower portions of the arc chute. The continually narrowing arc path, therefore, subjects the arc to a more effective gas flow. In fact, the dimensions of the chute are so proportioned that the arc substantially obstructs the gas flow and thereby prevents the wastage of gas which would otherwise flow around the arc. For some applications, it has been found desirable to maintain a substantially constant gas velocity with respect to the entire length of the arc. To do this, the walls of the arc chute may be so proportioned that the cross section of passage remains substantially constant along the entire length of the arc chute.

As the current reduces in intensity in approaching a current zero, the arc is carried by the gas blast to narrower and longer sections of the chute so that at current zero it has the long length and narrow section most favorable for arc extinction. For interrupting 50,000 amperes at 15 k. v. and at 60 cycles per second. I have found that satisfactory results can be obtained with an arc chute of approximately 50" in length and an arc passage therethrough of approximately 3 square inches in cross section. Furthermore, it has been determined that an arc passage of 1" x 3" at the section shown in Fig. 5, of ¼" x 12" at the section shown in Fig. 4 and of ⅛" x 24" at the section shown in Fig. 3 gives a desirable arc chute configuration. I also found that satisfactory results can be obtained when air pressures as low as 6 to 10 pounds per square inch were used. The efficiency of the foregoing structure is further exemplified in that only 450 cubic inches of compressed air at the above named pressures, is required to bring about complete circuit interruption.

Although I have shown and described a particular circuit interrupting structure and have given specific dimensions of certain parts thereof, it is to be understood that the same is for the purpose of illustration and that changes and modifications may be made by those skilled in the art without departing from the spirit and scope of the appended claims.

I claim as my invention:

1. In a circuit interrupter, means for establishing an arc, means for extinguishing said arc comprising means at least partially of insulating material defining a slot-like arc passage, and means for moving said arc laterally within said arc passage, said means of insulating material being so arranged that said passage decreases in width in the direction of arc movement and increases dimensionally generally longitudinally of the arc at a rate to maintain a substantially constant cross-sectional area of passage throughout the length of the arc passage.

2. In a circuit interrupter, means for establishing an arc, a pair of diverging arc terminal members for receiving said arc, means for moving the terminal ends of said arc along said arc terminal members, and means of insulating material enclosing at least the sides of the space between said arc terminal members, said means of insulating material being so arranged to provide an arc passage of substantially uniform cross-sectional area throughout its length.

3. In a circuit interrupter of the gas blast type, an arc chute including a pair of spaced walls of insulating material, diverging arc horns disposed between said walls and forming closures for the side edges of said chute, means for establishing an arc between the converged ends of said arc horns, and means for directing a blast of gas between said arc horns for moving said arc along said arc horns, the spacing of said walls between said arc horns narrowing in proportion to the increase in arc length as the arc is moved along said arc horns.

4. In a circuit interrupter, a substantially fan-shaped arc chute having a narrow passage there-

through, said passage having a substantially uniform cross-section throughout its length, means external to said arc chute for supplying a blast of gas, separable contact means for establishing an arc across the converged end of said chute, and means for subjecting said arc to a lateral blast of gas from said external means for moving said arc into said chute to lengthen the same within said chute to cause its interruption.

5. In a circuit interrupter, a substantially fan-shaped arc chute having a narrow passage therethrough, said passage having a substantially uniform cross-section throughout its length, separable contact means for establishing an arc across the converged end of said chute, operating means actuating said contact means, and means operative in response to movement of said operating means for causing a blast of gas to flow against said arc and move it laterally into said arc chute.

6. In a circuit interrupter, a substantially fan-shaped arc chute having a narrow passage therethrough, said passage having a substantially uniform cross-section throughout its length, separable contact means for establishing an arc across the converged end of said chute, operating means actuating said contact means, and means including a piston actuated by said operating means in response to an opening movement of said contact means for causing a blast of gas to flow against said arc and move it into said arc chute.

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