May 28, 1963 W. M. LEEDS 3,091,678

CIRCUIT INTERRUPTER STRUCTURE OF THE FLUID BLAST TYPE

Filed Feb. 17, 1961 2 Sheets-Sheet 1

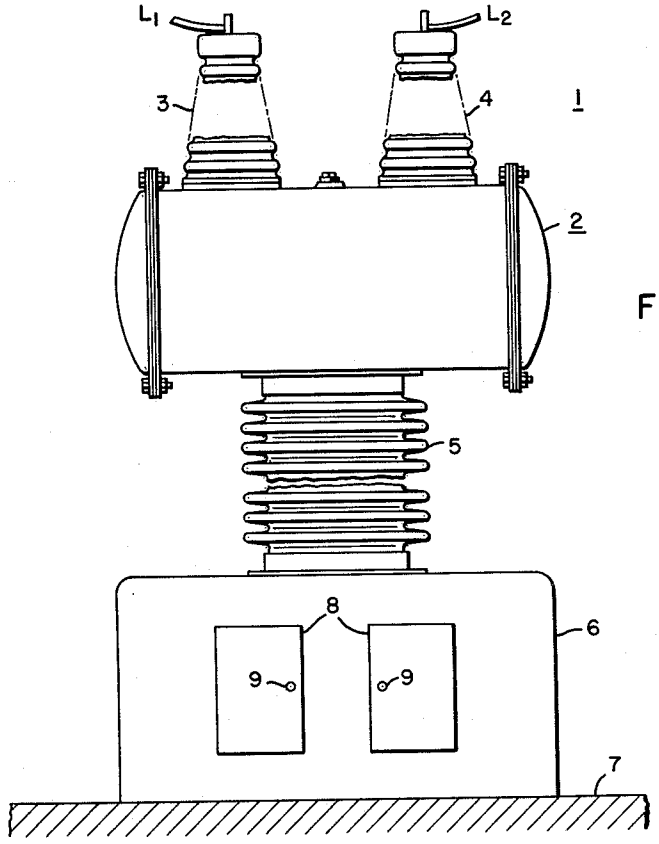


Fig. 1

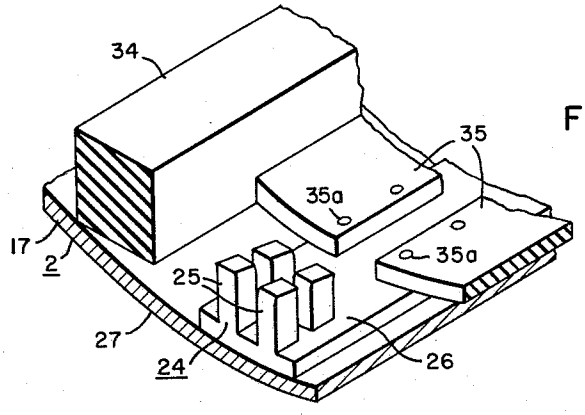


Fig. 4

WITNESSES

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Fig. 2

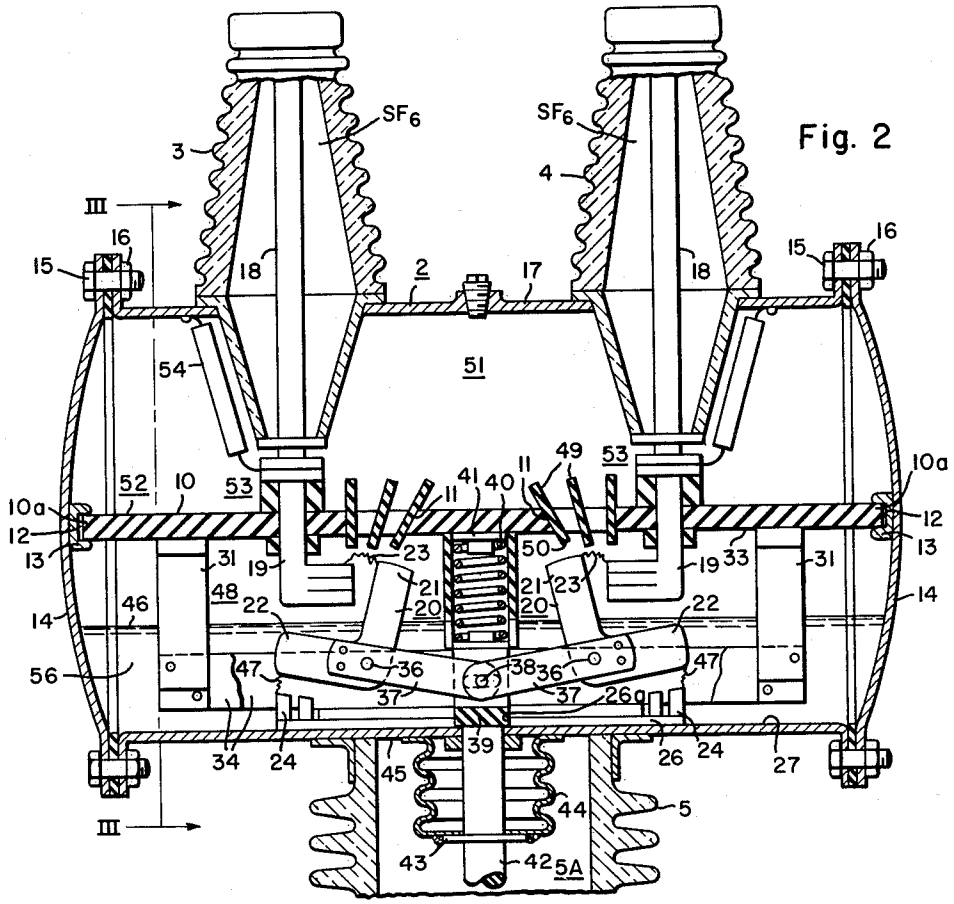
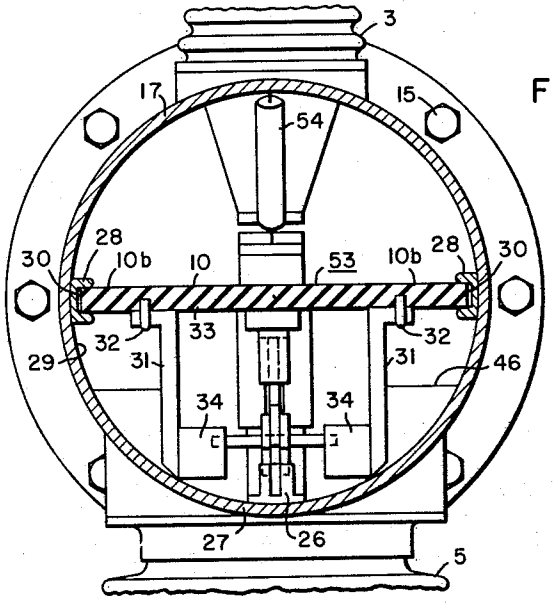


Fig. 3



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CIRCUIT INTERRUPTER STRUCTURE OF THE FLUID BLAST TYPE

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6 Claims. (Cl. 200—150)

This invention relates to circuit interrupters in general and, more particularly, to circuit-interrupting structures of the fluid-blast type.

A general object of the present invention is to provide an improved circuit-interrupting structure adaptable for withstanding high rates of rise of recovery voltage.

A more specific object of the present invention is to provide an improved high-voltage circuit interrupter of simplified construction, in which circuits, involving high rates of rse of recovery voltage, may readily be interrupted without the employement of shunting resistance means.

Still a further object of the present invention is to provide an improved circuit-interrupting structure involving a live metallic tank disposed at the upper end of an upstanding hollow insulating column, in which a baffle-plate structure is employed to sub-divide the metallic tank into a pressure-generating chamber and an exhaust chamber.

Circuit interruption research studies have indicated that a high arc voltage just before current zero at which arc interruption is to take place will enable a circuit interrupter to withstand high rates of rise of recovery voltage. This high extinction voltage is more readily obtained with a cross-blast and splitter arrangement than with a conventional orifice, since the arc lengthens by being forced around the splitters as the current falls in value toward a current zero. One particular structure for accomplishing this result has been set forth and claimed in U.S. patent application filed July 22, 1959, Serial No. 828,861, now U.S. Patent 3,071,671, issued January 1, 1963, to Winthrop M. Leeds and assigned to the assignee of the instant application. The circuit-interrupting structure set forth in the aforesaid patent application utilized metallic tanks at high potential containing liquefied sulfur hexafluoride (SF_6) gas.

It is a further object of the present invention to provide a simplified interrupting structure and of compact dimensions, which will be considerably less complex in construction that the interrupter set forth in the aforesaid Leeds application.

Still a further object of the present invention is to provide an improved circuit-interrupting structure involving a pair of pressure-generating breaks and a pair of interrupting breaks in which the interrupting structure is rendered exceedingly simple by involving an insulating baffle plate having exhaust openings therein. Preferably, the interrupting baffle plate is employed in a single steel tank at high potential disposed at the upper end of a porcelain insulating column.

Still a further object of the present invention is to provide an improved circuit-interrupting structure in which removal of the arc-extinguishing assembly is facilitated by a novel supporting arrangement.

Further objects and advantages will readily become apparent upon reading the following specification, taken in conjunction with the drawings, in which:

FIGURE 1 is a fragmentary side elevational view of a circuit interrupter embodying features of the present invention;

FIG. 2 is a longitudinal vertical sectional view taken through the upper portion of the circuit interrupter of FIG. 1, illustrating the contact structure in the partially open-circuit position;

FIG. 3 is a vertical sectional view taken substantially along the line III—III of FIG. 2; and,

FIG. 4 is a fragmentary perspective view illustrating the manner of supporting the bridging contact structure of the circuit interrupter of FIG. 1.

Referring to the drawings, and more particularly to FIG. 1 thereof, the reference numeral 1 generally designates a circuit interrupter of the high-voltage type including a live metallic tank, 2 a pair of terminal bushings 3, 4 and a supporting insulating column 5. The insulating column 5 is surmounted upon a lower mechanism housing 6, which rests upon a suitable concrete base 7. The mechanism housing 6 preferably has access doors 8 opened by handles 9.

FIG. 2 more clearly illustrates the internal construction of the tank structure 2 and the arc-extinguishing assemblage of the present invention. With reference to FIG. 2, which illustrates the contact structure in the partially open-circuit position, it will be observed that extending substantially horizontally across the tank structure 2 is an insulating baffle plate 10, having exhaust openings 11 provided therein. The opposite ends 10*a* of the insulating baffle plate 10 are preferably supported within recesses 12 provided in boss supports 13 welded to the inner sides of end cover plates 14. Bolts 15 and cooperating nuts 16 fixedly secure the end covers 14 to the outer open ends of the cylindrical central portion 17 of the tank structure 2.

Extending substantially centrally through each terminal bushing 3, 4 is a conductor stud 18, which is insulated by the employment of a suitable arc-extinguishing gas, such as sulfur-hexafluoride (SF_6) gas. Reference may be had to United States patent application filed December 2, 1959, Serial No. 856,775, now U.S. Patent 3,059,044, issued October 16, 1962, to Robert E. Friedrich and James H. Frakes, illustrating and describing such a sulfur-hexafluoride-insulated terminal-bushing construction.

A relatively stationary interrupting contact structure 19 is secured to the lower end of each conductor stud 18 by suitable means, such as bolts (not shown). Cooperating with each relatively stationary interrupting contact 19 is a bell-crank-shaped movable bridging contact, generally designated by the reference numeral 20. It will be noted that the rotatable movable bridging contact 20 has two end portions 21, 22. The end portion 21 constitutes a movable interrupting contact, which cooperates with the relatively stationary interrupting contact 19 to establish an interrupting arc 23, as illustrated in FIG. 2.

The end portion 22 of the bridging contact 20 constitutes a movable pressure-generating contact, which cooperates with a relatively stationary pressure-generating contact structure, generally designated by the reference numeral 24, and shown more in detail in FIG. 4 of the drawings. As shown in FIG. 4, the relatively stationary pressure-generating contact 24 preferably has resilient upstanding finger portions 25 which laterally engage the blade portion 22 with slight flexibility for proper contact pressure. The relatively stationary pressure-generating contacts 24 are disposed at the outer extremities of a relatively stationary bridging contact plate 26, which extends along the lower wall 27 of the cylindrical portion 17 of the tank structure 2.

With reference to FIG. 3 of the drawings, it will be noted that extending longitudinally along the outer sides 10*b* of the baffle plate 10 are recessed boss portions 28 fixedly secured, as by welding, to the interior sides 29 of the central cylindrical portion 17 of the tank structure 2. The recesses 30, provided by the supporting bosses 28, assist the end recessed boss portions 13 in fixedly main-

taining the baffle plate 10 in a fixed operative horizontal position, as shown.

Extending downwardly adjacent the ends of the baffle plate 10 are two pairs of insulating brackets 31. Preferably the insulating brackets 31 are secured, as by bolts 32, to the lower side 33 of the baffle plate 10. The lower ends of the four insulating brackets 31 support a pair of longitudinally-extending insulating support bars or rods 34. The insulating support rods 34 preferably have inwardly extending ears 35 (FIG. 4), which are secured, by bolts 35*a*, to the ends of the relatively stationary bridging contact plate 26. Consequently, when it is desired to remove the movable contact assemblage 52 through one end of the tank structure 2, it is merely necessary to remove the bolts 15, one end plate 14, reach in and dismantle the bolts (not shown) connecting the upper ends of the stationary contacts 19 to the lower ends of the conductor studs 18, and pull the entire baffle-plate 10, together with its brackets 31 and bridging contact plate 26 laterally out of the open end of the tank structure 2.

The bell-crank-shaped bridging contacts 20 are preferably pivotally mounted by pivot pins 36, which extend through the supporting rods 34 and are journaled therein. Fastened laterally to the side of each bridging contact 20 is an actuating link 37, as more clearly shown in FIG. 2 of the drawings.

The inner ends of the two actuating links 37 are slotted, and are interconnected by a drive pin 38, which, in turn, extends laterally through an insulating driving block 39. The driving block 39 is biased in a downward opening direction by an accelerating compression spring 40, which is seated upon a spring plate 41, which rests against the lower side 33 of the baffle plate 10. The bridging contact plate 26 has an opening 26*a* provided therein, as indicated in FIG. 2, to accommodate the driving block 39.

To effect closing motion of the bridging contacts 20 an upwardly-extending insulating push rod 42 is provided. The upper end of the push rod 42 is provided with a metallic plate 43, which has fixedly secured thereto, as by soldering, a metallic bellows 44. The upper end of the metallic bellows 44, as viewed in FIG. 2, is fixedly secured, as by a soldered connection, to the lower side 45 of the tank structure 2. The tank 2 is, therefore, sealed with respect to the interior 5A of column 5. The upper end of the push rod 42 makes an abutting engagement with the driving block 39, this separable connection being desired to permit lateral removal of the arc-extinguishing assemblage 52, as previously described.

To effect a closing operation of the circuit interrupter 1, suitable mechanism, not shown, and disposed interiorly within mechanism housing 6, is operative to effect upward closing motion of the insulating push rod 42. The upper end of the push rod 42 forcibly moves the driving block 39 upwardly against the opposition afforded by the accelerating spring 40. In addition, the drive pin 38, being movable with the block 39, effects closing rotative movement of the two bridging contacts 20, and thereby effects simultaneous engagement of the several contact pairs 19—21, 22—24, 24—22 and 21—19. The circuit through the circuit interrupter 1 extends in a somewhat obvious manner, that is, downwardly through the terminal bushings 3, 4 and generally horizontally through the bridging plate 26 and through the several contact structures detailed above.

To assist in the effective extinguishing action exerted upon the arcs 23, 47, preferably a suitable arc-extinguishing fluid under pressure is disposed within the tank structure 2. Preferably the pressurized arc-extinguishing fluid is liquefied sulfur-hexafluoride (SF_6) gas, such as set forth in U.S. patent application filed September 13, 1957, by Winthrop M. Leeds and Benjamin P. Baker, Serial No. 683,760, and assigned to the assignee of the instant application. Any of the liquefied

gases set forth in this patent application may be employed. However, the present invention is not necessarily confined merely to the use of liquefied gases, but, may advantageously be employed with more conventional arc-extinguishing fluids, such as, for instance, oil, or even with an arc-extinguishing gas, such as air. Higher interrupting ability is achieved, of course, by the employment of a liquefied gas, such as sulfur-hexafluoride (SF_6) gas. The level of the liquid sulfur-hexafluoride (SF_6) gas in indicated by the reference numeral 46 in FIG. 2.

The opening operation of the circuit interrupter 1 will now be described. When it is desired to effect an opening operation of the circuit interrupter 1, suitable means, not shown, are effective to unlatch the mechanism disposed within the mechanism housing 6. This will permit the accelerating compression spring 40 to cause downward opening movement of the supporting block 39, and consequent downward opening movement of the push rod 42. The downward opening movement of the supporting block 39, in turn, effects downward motion of the drive pin 38, and hence simultaneous opening rotative motion of the two bell-crank-shaped movable bridging contact members 20. This will be effective to simultaneously draw two interruptering arcs 23 and two pressure-generating arcs 47. The pressure generated within the pressure-generating chamber, or region 48, is effective to drive fluid under pressure out through the openings 11 provided in the baffle plate 10 and to carry the interrupting arcs 23 around the lower ends of the splitter portions 49. The interrupting arcs 23 loop about the lower edges 50 of the splitter portions 49, and are quickly extinguished by the fluid blast. To resist the action of the arcs 23 upon the insulating splitter 49, preferably they are formed of a suitable arc-resisting material, such as polytetrafluoroethylene, such as set forth and claimed in United States Patent 2,757,261, Lingal et al.

During the interrupting operation the fluid under pressure, which is ejected out of the pressure-generating chamber 48 will be forced into the upper exhaust chamber 51. However, when the circuit is opened and static conditions again prevail, the fluid may leak back through the openings 11 in the baffle plate 10, and again be collected in the lower body of fluid 56 provided in the pressure-generating chamber 48.

From the foregoing description, it will be apparent that there is provided an improved fluid-blast circuit interrupter, in which interrupting action is obtained by the employment of splitter-type interrupters 53, which have been proven to be highly effective during the interruption of high rates of rise of recovery voltage associated with the current to be interrupted. In addition, it has been illustrated how upon removal of one of the end plates 14, the entire arc-extinguishing assembly 52, comprising the baffle plate 10 and supports 31 together with the bridging plate 26, may be laterally removed out of the tank structure 2 through one open end of the central cylindrical portion 17.

To assist in dividing the voltage equally between the interrupting units 53, voltage-dividing impedance means 54 may be provided. Preferably, such voltage-dividing means 54 may assume the form of a voltage-grading resistor.

From the foregoing description, it will be apparent that there is provided an improved interrupting arrangement, which is considerably simpler than the construction set forth in the aforesaid Leeds patent application Serial No. 828,861 in which two pressure breaks and two interrupting breaks are mounted beneath an insulating baffle plate 10 in a single steel tank 2 at high potential on top of a porcelain column 5. It will be noted that the pressure-generating breaks 47 are drawn under the liquid close to the bottom of the tank 2. The inter-

rupting breaks 23 are drawn horizontally just beneath the baffle plate 10, below the openings 11, in which the polytetrafluoroethylene splitter plates 49 are mounted.

The insulating contact operating rod 42, sealed with a metallic bellows 44, closes the contacts by applying upward pressure against an insulating block 39 and a pair of links 37, which compress the accelerating spring 40, as the contacts are moved to the closed-circuit position. When the end covers 14 are removed from the tank 2, and the connections taken apart at the lower ends 20 of the terminals 3, 4, the baffle plate 10, splitters 49 and contacts 20 can all be pulled out of one open end of the tank 2 as one complete unified assembly.

Although there has been illustrated and described a specified fluid-blast interrupting structure, it is to be clearly understood that the same was merely for the purpose of illustration, and that changes and modifications may readily be made therein by those skilled in the art, without departing from the spirit and scope of the invention.

I claim as my invention:

1. A circuit interrupter of the fluid-blast type including a tank containing a dielectric fluid, a baffle plate having a pair of exhaust openings disposed interiorly within the tank and dividing the tank into a pressure-generating chamber and an exhaust chamber, a pair of relatively stationary contacts supported by the baffle plate adjacent said pair of exhaust openings within the pressure-generating chamber, a relatively stationary bridging contact disposed within the pressure-generating chamber, said bridging contact forming a spaced pair of relatively stationary pressure-generating contacts, a pair of cooperable movable contact structures, each movable contact structure cooperating with one of said relatively stationary contacts and with one of said relatively stationary pressure-generating contacts to draw a pressure-generating arc and a serially related interrupting arc being drawn transversely across an exhaust opening, and the pressure generated within the pressure-generating chamber by the two pressure-generating arcs forcing fluid transversely across the interrupting arcs and through the pair of exhaust openings to thereby effect circuit interruption.

2. A circuit interrupter of the fluid-blast type including a tank containing a dielectric fluid, a baffle plate having a pair of exhaust openings disposed interiorly within the tank and dividing the tank into a pressure-generating chamber and an exhaust chamber, a pair of relatively stationary contacts supported by the baffle plate adjacent said pair of exhaust openings within the pressure-generating chamber, a relatively stationary bridging contact disposed within the pressure-generating chamber, said bridging contact forming a spaced pair of relatively stationary pressure-generating contacts, a pair of cooperable movable bridging contact structures, each movable contact structure cooperating with one of said relatively stationary contacts and with one of said relatively stationary pressure-generating contacts to draw a pressure-generating arc and a serially related interrupting arc, the interrupting arc being drawn tansversely across an exhaust opening, means for effecting the simultaneous opening and closing movement of the pair of movable bridging contact structures, and the pressure generated within the pressure-generating chamber by the two pressure-generating arcs forcing fluid transversely across the interrupting arcs and through the pair of exhaust openings to thereby effect circuit interruption.

3. A circuit interrupter of the fluid-blast type including a metallic tank containing a dielectric fluid, a pair of terminal bushings extending interiorly within said tank, a baffle plate having pair of exhaust openings disposed interiorly within the tank and dividing the tank into a pressure-generating chamber and an exhaust chamber, a pair of relatively stationary contacts connected to said pair of terminal bushings and disposed within the pressure-generating chamber adjacent said pair of exhaust openings, a relatively stationary bridging contact disposed within the pressure-generating chamber, said bridging contact forming spaced pair of relatively stationary pressure-generating contacts, a pair of cooperable movable contact structures, each movable contact structure cooperating with one of said relatively stationary contacts and with one of said relatively stationary pressure-generating contacts to draw a pressure-generating arc and a serially related interrupting arc, the interrupting arc being drawn transversely across an exhaust opening, and the pressure generated within the pressure-generating chamber by the two pressure-generating arcs forcing fluid transversely across the interrupting arcs and through the pair of exhaust openings to thereby effect circuit interruption.

4. A circuit interrupter of the fluid-blast type including a tank containing a dielectric fluid, a baffle plate having a pair of exhaust openings disposed interiorly within the tank and dividing the tank into a pressure-generating chamber and an exhaust chamber, a pair of relatively stationary contacts supported by the baffle plate adjacent said pair of exhaust openings within the pressure-generting chamber, a relatively stationary bridging contact disposed within the pressure-generating chamber, said bridging contact forming a spaced pair of relatively stationary pressure-generating contacts, a pair of cooperable pivotally movable contact blades, one end of each pivotally movable contact blade separating from a relatively stationary pressure-generating contact to establish a pressure-generating arc within the pressure-generating chamber, the other end of each pivotally movable contact blade separating from one of said first-mentioned relatively stationary contacts to establish an interrupting arc transversely across an exhaust opening and the pressure-generated within the pressure-generating chamber by the two pressure-generating arcs forcing fluid transversely across the interrupting arcs and through the pair of exhaust openings to thereby effect circuit interruption.

5. The combination in a high-voltage fluid-blast circuit interrupter of a live metallic tank, a pair of terminal bushing extending within said live metallic tank, insulating means for supporting said live tank an adequate distance from ground potential, a baffle plate having a pair of exhaust openings disposed interiorly within the tank and dividing the tank into a pressure-generating chamber and an exhaust chamber, a pair of relatively stationary contacts connected to said pair of terminal bushings and disposed within the pressure-generating chamber adjacent said pair of exhaust openings, a relatively stationary bridging contact disposed within the pressure-generating chamber, said bridging contact forming a spaced pair of relatively stationary pressure-generating contacts, a pair of cooperable movable contact structures, each movable contact structure cooperating with one of said relatively stationary contacts and with one of said relatively stationary pressure-generating contacts to draw a pressure-generating arc and a serially related interrupting arc, the interrupting arc being drawn transversely across an exhaust opening, and the pressure generated within the pressure-generating chamber by the two pressure-generating arcs forcing fluid transversely across the interrupting arcs and through the pair of exhaust openings to thereby effect circuit interruption.

6. A high-voltage fluid-blast circuit interrupter including a hollow insulating column extending up in the air above ground potential, a live metallic tank supported at the upper end of the hollow insulating column, a pair of terminal bushings extending within said tank, an interrupting baffle plate having a pair of exhaust openings disposed interiorly within the tank and dividing the tank into a pressure-generating chamber and an exhaust chamber, a pair of relatively stationary contacts supported by the baffle plate adjacent said pair of exhaust openings within the pressure-generating chamber and connected to said

pair of terminal bushings, a relatively stationary bridging contact disposed within the pressure-generating chamber, said bridging contact forming a spaced pair of relatively stationary pressure-generating contacts, a pair of cooperable movable contact structures, each movable contact structure cooperating with one of said relatively stationary contacts and with one of said relatively stationary pressure-generating contacts to draw a pressure-generating arc and a serially related interrupting arc, the interrupting arc being drawn transversely across an exhaust opening, and the pressure generated within the pressure-generating chamber by the two pressure-generating arcs forcing fluid transversely across the interrupting arcs and through the

pair of exhaust openings to thereby effect circuit interruption, and insulating operating rod means extending upwardly through said hollow insulating column to effect movement of the pair of movable contact structures.

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