

March 13, 1951

C. J. BALENTINE

2,545,334

ELECTRIC CIRCUIT INTERRUPTER

Filed June 23, 1950

2 Sheets-Sheet 1

FIG. 1.

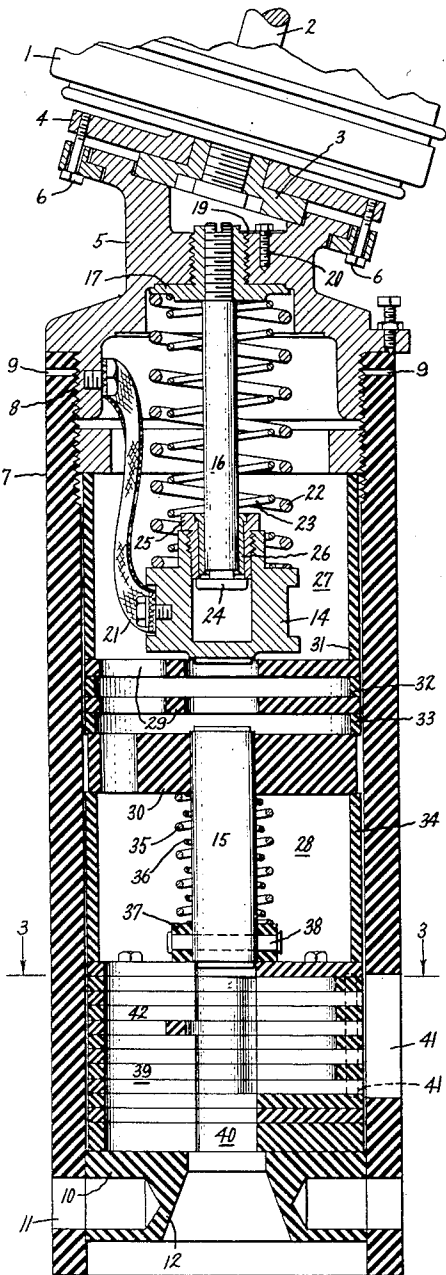


FIG. 2.

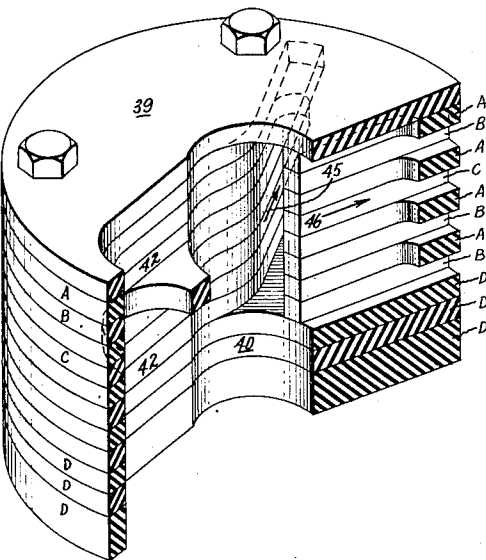
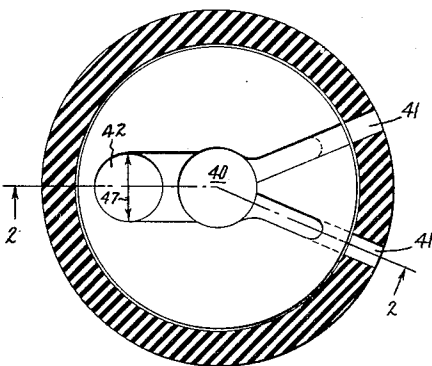


FIG. 3.



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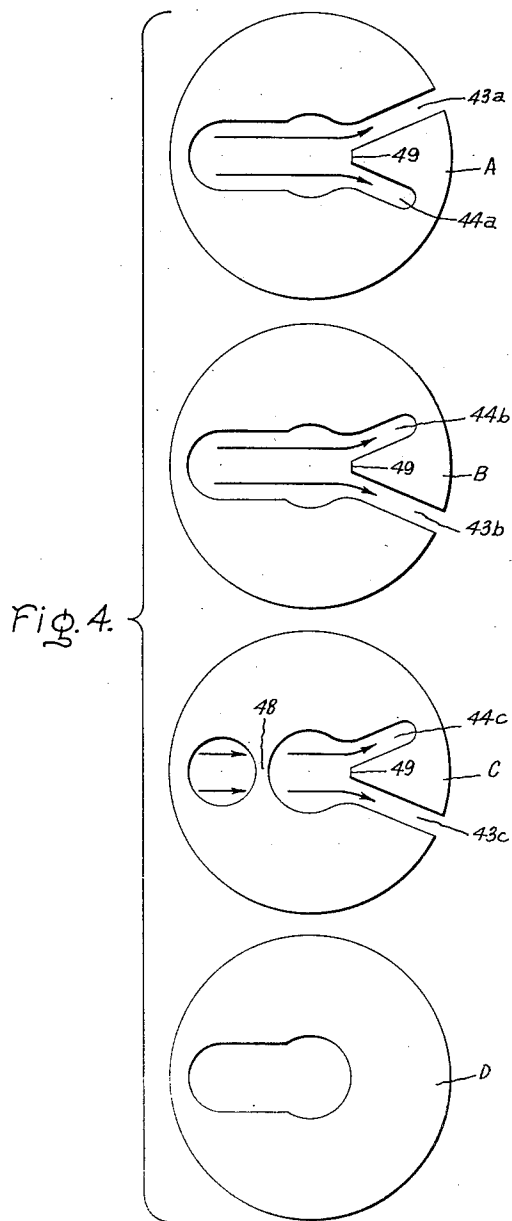
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,545,334

ELECTRIC CIRCUIT INTERRUPTER

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Application June 23, 1950, Serial No. 169,981

2 Claims. (Cl. 200—150)

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My invention relates to electric circuit interrupters for high voltage circuits, and particularly to high speed circuit breakers of the liquid blast type for opening high voltage alternating current power circuits within a few half cycles.

More specifically, my invention is a further development and an improvement upon the series-break type of interrupter disclosed in U. S. Patent 1,548,799 granted on an application filed by J. D. Hilliard, which is assigned to the same assignee as the present application.

Nowadays the principle upon which this type of interrupter operates is known as "oil blast action," this being the process whereby an arc that is drawn past an expulsion port within an oil confining structure is extinguished by displacement of the oil caused by a pressure established therein in the region adjacent the arc.

In the above-mentioned Hilliard patent, the pressure for blasting the arc to be interrupted is generated by means of a series so-called pressure-generating arc, although it is well understood that other means may be employed for establishing blast action such, for example, as an impulse piston. An example of a fluid blast breaker wherein the oil blast action is produced by means of an impulse piston is disclosed in U. S. Patent 2,147,497 to Prince et al., which is assigned to the same assignee as the present application.

Conventional forms that fluid blast action may assume are well known and may be defined as radial blast, axial blast, and cross blast. These three different forms are shown clearly in Figs. 1, 2 and 3 respectively of the above-mentioned Hilliard patent. Frequently, these several blast actions are combined. For example, it will be apparent that the oil blast produced in the case of Fig. 1 of the above Hilliard patent is an inward radial blast between the spaced superposed baffles, which blast continues as an axial blast down the bore of the throat insulator as the contact rod pulls downward from the interrupter into the tank. In other cases an axial blast is directed through, say, a hollow contact and then is caused to diverge radially outward as, for example, in U. S. Patent 2,434,506 to Buchwald et al., which is assigned to the same assignee as the present application.

While known interrupters of the type referred to above, generally provide for injecting at high velocity one or more blasts or jets of fluid toward the arc at predetermined relatively small localized points along the arc length, I have found that improved interruption is accomplished

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if a relatively large volume of oil is quickly moved laterally into the arc path so that a large portion of the length of the arc is simultaneously subjected to the influence of the displaced fluid and also if a plurality of exhaust passages are disposed at a small angle with respect to each other on the side of the interrupting unit which is opposite from the side of the unit from which the fresh fluid under pressure is directed into the arcing passage.

A principal object of my invention is to provide an improved circuit interrupter which is capable of performing a circuit interrupting operation in a more efficient manner than in prior arrangements and which, in addition, is simple and compact in construction.

Another object of the invention is to provide a circuit interrupter of the fluid blast type wherein a mass of fluid is moved under pressure into the arc from one side thereof so as to encounter and displace substantially the entire length of the arc from between the separating contacts and to vent the interrupting chamber in a manner which is adequate to scavenge the ionized gaseous products of arcing out into the enclosing tank but which at the same time does not allow the arc itself to be forced through the venting structure into the containing tank.

Further objects and advantages of my invention will become apparent as the following description proceeds 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.

In the drawings, Fig. 1 represents a sectional view of a circuit interrupting unit embodying my invention taken along the line 2—2 of Fig. 3; Fig. 2 is a perspective view partly in section of a baffle structure embodying my invention, which structure is disposed within the lower portion of the unit shown in Fig. 1; Fig. 3 is a cross sectional view along the line 3—3 of the interrupter shown in Fig. 1; and Fig. 4 is a view of the various baffle plates utilized in the assembly of the structure shown in Fig. 2.

The interrupting unit shown in Fig. 1 of the drawings is adapted to be mounted along with another similar unit inside a relatively large oil-filled enclosing metallic tank. These two interrupting units would cooperate with a reciprocating blade contact, such as is shown in Fig. 1 of the above-mentioned Hilliard Patent 1,548,799.

With reference to Fig. 1, the interrupting unit is shown secured to the electric bushing 1 constructed of insulating material through the bore

of which is disposed a conductor stud 2. As is well known in the art, the bushing 1, a part of which is shown, would contain a mounting flange which would cooperate with an opening in the cover of the large tank enclosing both the interrupting units. Threadedly engaging the lower portion of the conductor stud 2 is a flanged metallic nut 3 which secures the metallic flange 4 compressively with respect to the bushing. Adapter unit 5 in turn is secured to the flange 4 by means of bolts 6. The enclosing pressure confining casing 7 for the interrupter unit is threaded onto the lower portion of the adapter unit at 8. For the purpose of tightening of the casing 7, wrench holes 9 may be provided and a conventional set screw may be utilized for locking the tightened casing 7 with respect to the adapter unit 5, as shown. The lower portion of the enclosing casing 7 is partially enclosed by a throat member 10 constructed of insulating material, which throat is secured into the casing by means of dowel pins or screws 11. Throat member 10 is provided with a conical opening 12 through which the movable contact 13 vertically travels into or out of the interrupter during the opening or closing operation respectively of the circuit breaker.

The contact structure disposed within the enclosing casing 7 comprises a relatively fixed butt contact 14 and an intermediate "floating" contact 15. The relatively fixed contact 14 is mounted for limited resilient movement about a fixed guide rod 16 which is screwed into the flanged cylindrical spring retainer member 17.

It will be observed that the butt contact 14 and its associated parts which are mounted about the guide rod 16, together with the guide rod 16 and its spring retainer 17, constitute a complete sub-assembly which is screwed into the adapter 5. This easily renewable contact unit is prevented from slacking back by any conventional means, such as the locking plate 19, which may engage a suitable flat surface on the side of the spring retainer 17 and which is held fixedly by the screw 20.

Electrical contact is maintained between the butt contact 14 and the adapter 5 by means of conventional flexible connecting braids, such as is indicated at 21.

The limited resilient vertical movement or "wipe" of the fixed contact 14 provides for slight variations in the closed position of the movable contact 13 and also for subsequent erosion of the arcing contact faces. Nested springs 22 and 23, of suitable strength for adequate contact pressure, bias the fixed contact 14 toward its lower extreme position as determined by the head 24 of the guide rod 16 which abuts the lower rim of the threaded sleeve member 25. This sleeve 25 is screwed fixedly into contact 14 and may be equipped with an anti-friction bushing 26.

As pointed out above, pressure could be established for causing the oil to blast and extinguish the interrupting arc in any suitable manner. I have chosen to illustrate my invention in conjunction with an interrupter wherein pressure is established by a pair of series contacts, such as 14 and 15, which draw a pressure generating arc just before the interrupting arc between the contacts 13 and 15 is drawn. Thus, the enclosing casing 7 is shown as including a pressure-generating chamber generally indicated by the numeral 27 and an interrupting chamber of which the upper portion is indicated by the

numeral 28. These two chambers are separated by a common wall 30 having a communicating aperture therein as shown. The arc confining baffles 29 in the pressure-generating chamber and the thick wall member 30 are secured within the casing 7 by means of suitable insulating spacer sleeves or rings 31, 32, 33 and 34, which are all maintained compressively in place by means of the threaded ring nut shown at the upper end of the casing.

The intermediate contact 15 is biased in the downward direction by means of springs, such as 35 and 36, which engage a ring 37 of insulating material which is secured to the lower portion of the contact 15 by means of a pin 38.

When the interrupter contacts are in the open position, as shown in Fig. 1, the intermediate contact 15 assumes its fully open position by engaging the lower baffle structure, generally designated by the numeral 39, which is held compressively in position between the lower throat member 10 and the insulating spacer sleeve 34. To close the interrupter contacts from the open position shown, the contact 13 first is elevated through the arcing chamber passage generally designated by the numeral 40 which passage is constituted by the generally hollow baffle structure 39. After the contact 13 closes the interrupting arc gap by engaging the lower end of the intermediate contact 15, both of these contacts rise in unison. Contact 15 now is elevated slidingly in the wall 30 against the bias of its springs 35 and 36 so that it eventually closes the pressure generating arc gap by engaging the lower surface of the relatively fixed contact member 14. Moving contact 13 is finally arrested by its operating mechanism (not shown) when the fixed contact 14 has been moved upward a short suitable "wipe" distance by the intermediate contact 15.

When the circuit breaker is tripped open, the movable contact 13 moves downwardly at high speed with the intermediate contact 15 in follow-up engagement due to its springs 35 and 36; as will be understood from Fig. 1, until the contact 15 is arrested by engagement of its ring 37 with the baffle structure. During this initial downward movement, the gap produced between contacts 14 and 15 establishes an initial arc which generates pressure within the upper chamber 27. This pressure will urge oil to move downwardly through the opening in both the baffle plates 29 and the wall 30 into the interrupting chamber 28. As soon as the moving contact 13 leaves the intermediate contact 15, a second or series arc is established within the arcing passage 40. Since the baffle structure is vented to the low pressure region in the enclosing tank (not shown) through suitable expulsion openings such as 41 provided in the walls of casing 7, and because of the high pressure generated in the upper chamber 27, the oil in the lower chamber 28 consequently is pressurized and caused to move through the baffle structure 39 whereby the series interrupting arc drawn in the passage 40 may be displaced laterally therefrom and is extinguished by the flow and pressure of the oil through the interrupting chamber 28.

In accordance with my invention, the baffle structure 39 is so constructed, as will be more clearly pointed out hereinafter, that arc extinguishing fluid under pressure is directed sideways into the arcing passage 40 so as to engage the arc along substantially its entire length while this fluid and the associated arc products

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exhaust from the passage 40 through restricted branch arcing passages within the baffle structure 39 which radiate outwardly therefrom. As will be more fully explained hereinafter, these exhaust passageways are arranged so that the extinguishing fluid proceeds laterally through the arcing passage 40 into the branch passages without substantial movement axially along the arc itself as it is drawn by the downwardly moving contact 13 in arcing passage 40 during the interrupting operation.

The baffle members shown in Fig. 4 and designated by the letters A, B, C and D are assembled to form the bolted, stacked, baffle structure shown in Fig. 2. Obviously, baffle B is simply baffle A laid on its reverse face.

An arcing passage 40 is somewhat generally defined centrally within the baffle structure 39 by reason of the vertical alignment of the enlarged portion of each of the appropriately configured apertures in the several kinds of baffles which constitute the complete stack. Defined on one side of this central passage 40 is a vertical channel 42 down through which extinguishing fluid must flow in passing from the oil-containing reservoir chamber 28 toward the arcing passage 40. From vertical channel 42 the fluid is forcibly displaced laterally into the interrupting arc as it is drawn within the central passage 40.

For the purpose of discharging the ionized products of arcing from the interrupter structure while holding the arc itself entrapped therein for blasting by arc extinguishing fluid directed into the arcing passage, the baffles A, B and C are respectively provided with an open end slot 43a, 43b, and 43c and a closed slot 44a, 44b, and 44c associated in V relationship. With the baffles of Fig. 4 arranged as shown in Fig. 2 it will be obvious that the V-slots of the baffles form a pair of supplementary arc-confining passages 45 and 46 which diverge from each other and lead out from the arcing passage 40. Thus it will be clear that the closed ends of the slots 44a, 44b, and 44c constitute arc retaining barriers which however are not effective to prevent the flow of arc gases from within the arcing passage 40 so that the latter may be immediately filled with fresh dielectric liquid after the arcs extinguishment at a current zero. Preferably the combined widths of the restricted arcing passages 45 and 46 are substantially less than the width 47 of the channel 42 or of the arcing passage 40. The purpose of the barrier portion 48 of the C baffle is to insure that the arc will not wander or loop back into the channel 42. Thus, irrespective of whether the arc is squeezed into one or other (or both) of the divergent passages, ionized arc products may vent through the open ends of the V-slots so that flow of fresh dielectric liquid may proceed under pressure into the passage 40 throughout the interrupting operation.

While I have shown and described a particular embodiment of my invention, it will be obvious

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to those skilled in the art that various changes and modifications may be made without departing from my invention in its broader aspects and I, therefore, intend in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

I claim:

1. An interrupting unit for an electric circuit breaker of the fluid blast type comprising baffle structure including a plurality of stacked plates of insulating material provided with a substantially centrally disposed opening therein, the central openings in said plates defining a main arcing passage, the openings in some of said plates being elongated to one side to form a fluid channel in communication with said main arcing passage and being slotted in two divergent directions on the other side to form a pair of supplementary arcing passages, one slot in each slotted plate extending to the outer edge of the plate and one slot in each plate being closed at its outer end, said slotted plates being stacked so that the slots in alternate plates are coincidental, and means for establishing pressure within said unit.

2. An interrupting unit for an electric circuit breaker of the fluid blast type comprising baffle structure including a plurality of stacked plates of insulating material provided with a substantially centrally disposed opening therein, the central openings in said plates defining a main arcing passage, the openings in some of said plates being elongated to one side to form a fluid channel in communication with said main arcing passage and being slotted in two divergent directions on the other side to form a pair of supplementary arcing passages, one slot in each slotted plate extending to the outer edge of the plate and one slot in each plate being closed at its outer end, said slotted plates being stacked so that the slots in alternate plates are coincidental, the central opening in at least one of said plates being closed on the side thereof adjacent said fluid chamber to form an arc barrier, an opening in said one of said plates in registry with the elongated openings in the other of said plates for defining a portion of the walls of said fluid channel, and means for establishing pressure within each unit.

CONRAD J. BALENTINE.

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The following references are of record in the file of this patent:

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