

June 17, 1958

W. H. EDMUNDS

2,839,641

ARC SHIELD FOR CIRCUIT BREAKER ARC QUENCHER

Filed Sept. 30, 1954

2 Sheets-Sheet 1

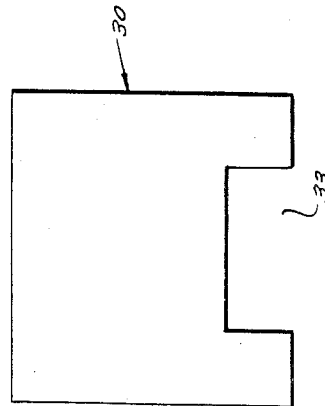
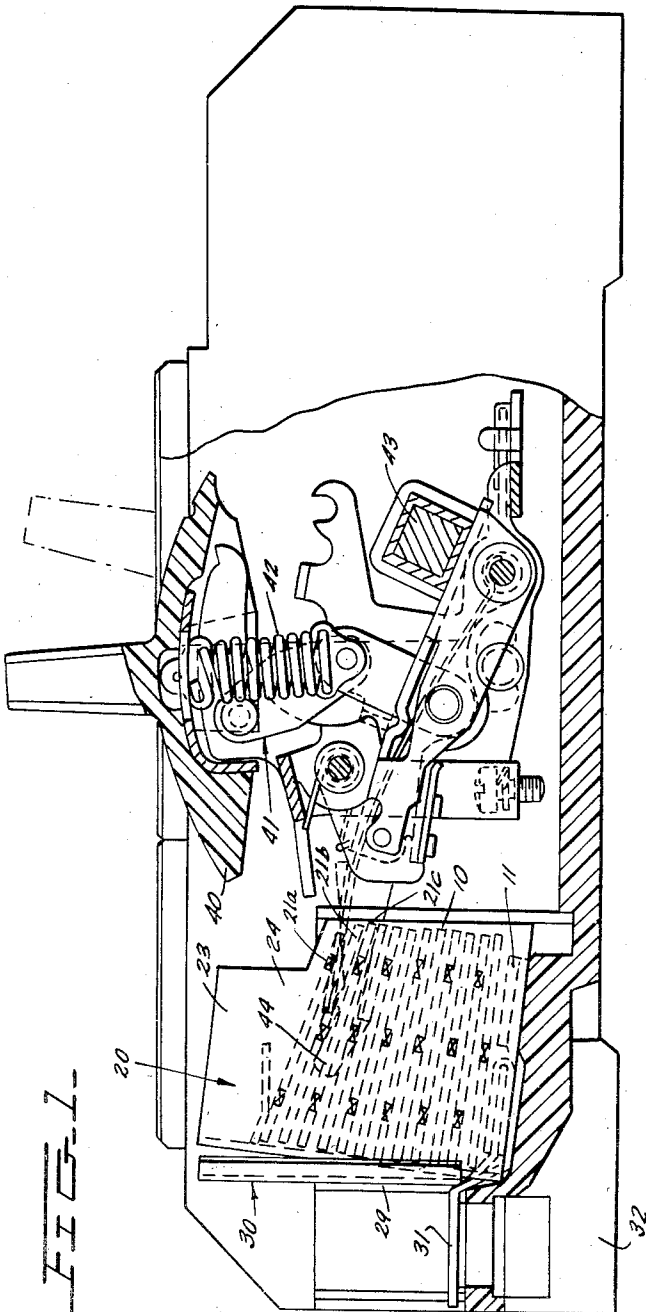


FIG. 1.

FIG. 5.

INVENTOR.  
WILLIAM HAROLD EDMUNDS

BY

*Oetzel & Faber*  
ATTORNEYS

June 17, 1958

W. H. EDMUNDS

2,839,641

ARC SHIELD FOR CIRCUIT BREAKER ARC QUENCHER

Filed Sept. 30, 1954

2 Sheets-Sheet 2

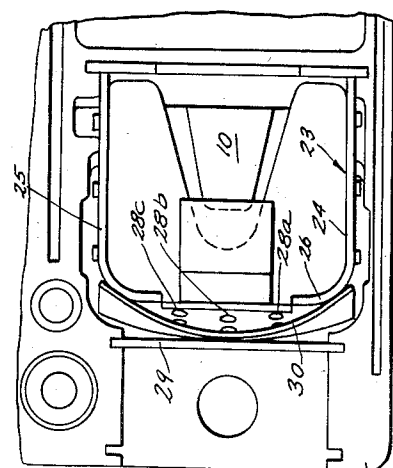


FIG. 2a-

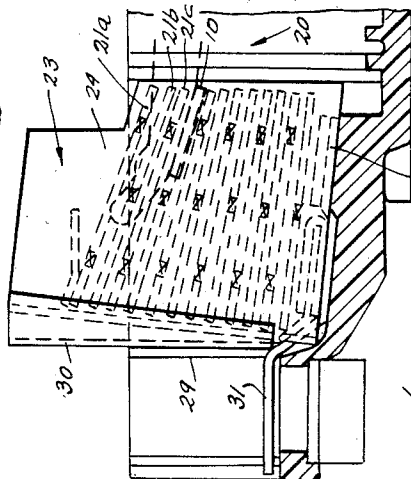


FIG. 3-

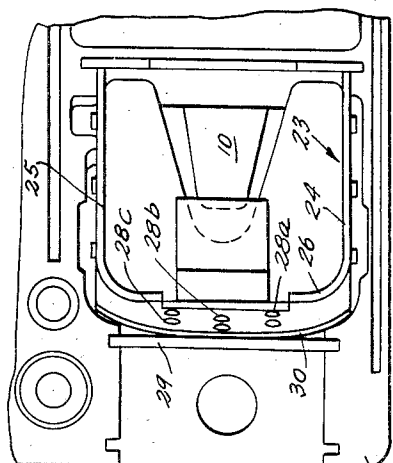


FIG. 2b-

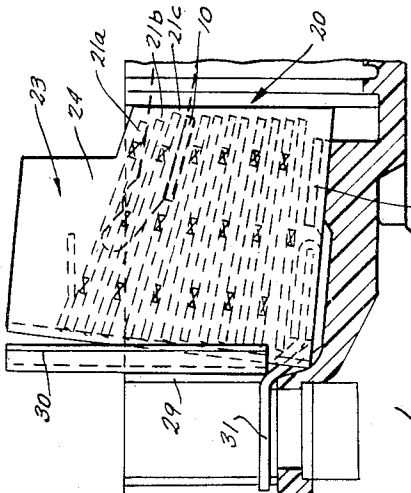


FIG. 3a-

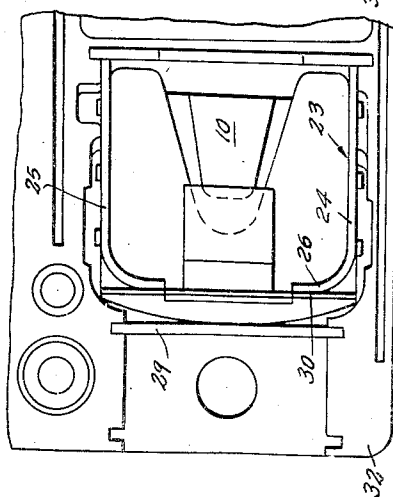


FIG. 2c-

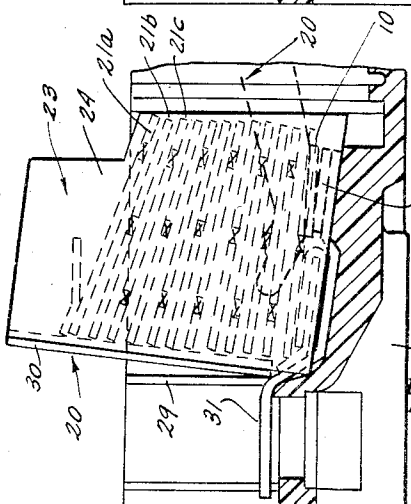


FIG. 3b-

INVENTOR.  
WILLIAM HAROLD  
EDMUNDS

By *Detweiler & Faber*  
ATTORNEYS

1

2,839,641

## ARC SHIELD FOR CIRCUIT BREAKER ARC QUENCHER

William Harold Edmunds, Havertown, Pa., assignor to I-T-E Circuit Breaker Company, Philadelphia, Pa., a corporation of Pennsylvania

Application September 30, 1954, Serial No. 459,250

4 Claims. (Cl. 200—144)

My invention relates to circuit breakers and more particularly is directed to a novel arc chute wherein an arc shield is positioned behind the housing of the arc chute to increase the interrupting capacity of the circuit breaker.

In the circuit interrupter art, it is well known that it is necessary to provide a plurality of magnetic or non-magnetic plates to form an arc chute in order to extinguish the arc created by the main cooperating contacts when the circuit breaker is opened as a result of the occurrence of a fault current condition.

The plurality of slotted arc plates serve to elongate the arc with minimum space requirement. In many circuit breaker constructions, the insulated housing for the plurality of openings in the back of the housings in order to provide a sufficient venting for the hot gases and ionized air existing within the arc chute when an arc is drawn between the cooperating contacts.

However, art constructions require sufficient spacing between the back terminal and arc quencher to prevent the arc from striking to the back terminal. Thus, whenever the pressure of the gases within the arc chute exceeds the atmospheric pressures, the gases will be exhausted through the openings within the housing and hence, removed from the area immediately surrounding the cooperating contacts to prevent restriking.

In addition to the above, means may be provided whereby the exhausted gases are directed away from the back terminal which may be adjacent to the back of the arc chute housing. That is, the hot gases are not permitted to exhaust into the area adjacent to the terminals thereby preventing the possibility of an arc between the movable contact and the back terminal of the circuit breaker.

In a typical structure of the prior art arrangement wherein a molded case circuit breaker is designed for rated current of 225 amperes at 600 volts A.-C. the above noted construction has provided the circuit breaker with an interrupting capacity of approximately 15,000 amperes.

Attempts have been made to make the housing of the circuit breaker arc chute of an insulated material without venting openings in the rear thereof, in order to prevent the possibility of an arc striking between the movable contact and the rear terminal stud. However, with this arrangement, it has been found that the hot gases within the arc chute will either prevent the arc created between the cooperating contacts from being extinguished for a relatively long period of time or permit a restriking of the arc between the cooperating contacts. Thus, by closing off the venting path, the interrupting capacity of the circuit breaker may be substantially reduced and in many instances reduces it to such a magnitude that the circuit interrupter is not capable of performing its function when used on a network for which it was originally designed.

2

My invention is directed to a circuit interrupter wherein venting openings in the rear of the arc chute housing are maintained even though the rear terminal is positioned in close proximity to the rear of the arc chute housing.

My invention provides an arrangement whereby an arc shield made of insulated material is positioned behind the housing of the arc chute and is urged thereagainst due to the flexible characteristics of the arc shield material. Thus, the arc shield normally covers up the escapement vents in the housing of the arc chute while the cooperating contacts of the circuit breaker are in the engaged position.

With my novel arrangement, the arc shield not only prevents possible striking of the arc between the movable cooperating contacts and the terminal stud (due to the fact that the insulated shield is not positioned between these two components) but also substantially increases the interrupting capacity rating of the circuit breaker.

Thus, for example, in tests which have been performed on molded case circuit breakers which are designed for 600 volts A.-C. and 225 amperes continuous current, it has been found that the interrupting capacity has been increased from 15,000 amperes to 30,000 amperes when my novel arc shield is resiliently positioned behind the arc chute. Thus, with my novel arrangement, it is possible to position the rear terminal stud in close proximity to the arc chute and still provide a venting path in the rear arc chute housing and still avoid the possibility of an arc striking between the movable contacts and the arc chute. Furthermore, it provides for an increased interrupting capacity rating of the circuit interrupter.

Accordingly, a primary object of my invention is the provision of a novel arrangement wherein an insulated arc shield is resiliently urged against an arc chute housing having venting openings therein so that the circuit interrupter will have a relatively high interrupting capacity and also wherein the rear terminal connections can be placed in close proximity to the rear of the arc chute housing.

Another object of my invention is to provide an arc chute housing with venting openings therein wherein an insulated arc shield is resiliently positioned against the arc housing to seal off the venting passages while the circuit breaker is in the latched closed position.

Another object of my invention is to provide a novel valve type control for an arc quencher structure wherein the hot gases within the arc chute are not permitted to escape until after they have reached a predetermined pressure.

These and other objects of my invention will be apparent from the following description when taken in connection with the drawings in which:

Figure 1 is a cross-sectional view of one pole of a typical circuit breaker which may utilize my novel arrangement. This figure illustrates the cooperating contacts in the engaged position and the relationship of the arc structure thereto.

Figure 2 is an enlarged cross-sectional view of the arc chute of Figure 1 and illustrates the position of the arc shield in relationship thereto.

Figure 2a is a top view of Figure 2.

Figure 3 is a side view similar to Figure 2 and illustrates the position of the arc shield during circuit interruption following the occurrence of a fault current.

Figure 3a is a top view of the arc chute of Figure 3.

Figure 4 is a side view similar to that of Figure 3 illustrating the configuration of the arc shield following a plurality of circuit interruptions.

Figure 4a is a top view of the view illustrated in Figure 4.

3

Figure 5 is an end view of the arc shield used in Figures 1, 2, 3 and 4.

In Figure 1, I have shown a cross-sectional view of a typical circuit breaker to which my invention may be applied. As seen at the extreme left hand end adjacent the cooperating contacts 10 and 11, there is positioned an arc chute 20 having a flexible shield 30 positioned adjacent thereto. The arc shield 30, to which my invention is particularly directed, will be described in detail following the primary description of the circuit breaker.

In Figure 1, I have shown one pole of a three pole circuit breaker. The operating mechanism of the circuit breaker may be similar to the operating mechanisms well known in the art and forms no part of my instant invention. That is, the interrupter may be provided with a time delay and instantaneous trip mechanism so as to release a common trip latch on the occurrence of an over-current or short-circuit condition.

A single handle assembly 40 is provided for the simultaneous manual opening and closing of the poles of the circuit breaker.

The interrupter is provided with a toggle and cradle assembly 41 which, either through the operation of the operating spring assembly 42 for automatic operation or through the manual operation of the handle assembly 40, functions to move the cooperating contacts 10—11 from their engaged position to their disengaged position.

Common tripper bar 43, which is connected to the contact arms 44 associated with each pole of the circuit breaker, insures the simultaneous operation of all poles of the circuit breaker. Thus, as noted, the operating mechanism illustrated in Figure 1 is merely illustrative of well known operating mechanisms and forms no part of my instant invention.

The arc chute 20 is provided with a plurality of spaced plates 21a, b, c, etc. In the figures, I have illustrated my invention in connection with a molded case circuit breaker although it will be apparent to those skilled in the art that my invention is not limited thereto.

Thus, in a molded case circuit breaker in which a magnetic blow out coil is not usually used, the arc plates are preferably made of a magnetic material to thereby direct or force the arc into an arc chute for more rapid arc extinguishing. Thus, in this instance, the plates 21a, b, c, etc., would be made of a magnetic material. The plates 21 are preferably slotted, as best seen in Figures 2a, 3a and 4a, wherein said slots define a volume through which the movable contact 10 moves. Thus, for example, when the movable contact 10 moves from the engaged position of Figure 2 to the disengaged position of Figures 3 and 4, the contact moves in a plane which extends into the volume defined by the slots of the arc plates 21. The housing 23 is provided for the plurality of spaced arc plates 21. The housing 23 has a substantially U-shaped configuration when viewed from above, as seen in Figures 2a, 3a and 4a, and has legs 24 and 25 in a base or back section 26.

As best seen in Figures 3a and 4a, the base 26 of the housing 23 is provided with a plurality of openings 28a, b, c, etc. A substantially rigid insulating plate 29 may be positioned between the arc chute 20 and the rear terminal connector 31. The insulated plates 29 may be positioned within the slots of the mounting 32. The arc shield 30, to which my invention is directed, has a substantially rectangular configuration, as best seen in Figure 5. The arc shield 30 is preferably made of an insulated material such as laminated melamine or vulcoide and should also have the properties of being flexible.

In a typical application of my novel arc shield to a molded case circuit breaker, the arc shield has a thickness of  $\frac{1}{32}$  of an inch. As best seen in Figures 2 and 3, the arc shield 30 is positioned in back of the arc chute 20 and seals off the plurality of openings 28a, b, c, etc., of the arc chute housing 23. The arc shield 30 in

4

the illustration is provided with a cut away portion 33 so that it can be positioned behind the arc chute 20.

Due to the flexible characteristics of the insulating arc shield 30, it is urged against the base 26 of the housing 23 thereby sealing off or closing the plurality of openings 28a, b, c, etc. Thus, when the circuit breaker contacts 10—11 are in the closed engaged position, the venting openings 28 will be closed off by arc shield 30.

As has heretofore been noted, it is desirable to provide venting openings 28 in the rear of the arc chute housing 23 in order to provide an escape path for the gases and ionized air which are created by the heat and arc at the cooperating contacts 10 and 11 during circuit interruption. That is, since the hot gases and ionized air permit either the arc to be sustained or a restriking of the arc, it is necessary to remove same from the immediate environment of the cooperating contacts during circuit interruption. However, it is not only necessary to remove these gases from the environment of the cooperating contacts but it is also necessary to prevent these gases from forming a gap between the movable contact 10 and the rear terminal connector 31 as this might permit a striking of the arc between the movable contact 10 and the rear terminal stud 31 which would be very difficult to extinguish and result in operational failure of the circuit interrupter.

Heretofore, a striking of the arc between the rear of the arc chute housing 23 and the rear terminal connector 31 has been prevented by providing adequate spacing between these two members. However, in the circuit breaker of my invention, it is desired to make a compact circuit interrupter so that the rear terminal connector 31 is in close proximity to the rear of the arc chute housing 31 and hence, additional means are provided in order to prevent the striking of an arc to the rear terminal connector 31. To this end, I have provided a flexible arc shield 30 which, in its normal position, as seen in Figures 2 and 2a, covers all of the venting openings 28 in the rear of the arc chute housing 23 and is positioned between the arc chute housing and the rear terminal connector 31.

By experimentation, I have found that the arc shield 30 not only prevents the striking of an arc to the rear terminal connector 31 but also substantially increases the interrupting capacity of the circuit interrupter. As clearly seen by comparison of Figures 2 and 3, the arc shield 30 is deformed during the circuit interruption. It is further noted that after the circuit breaker has interrupted several short-circuit currents that the arc shield 30 is further deformed to a substantially U-shaped configuration, as best seen in Figures 4 and 4a. Hence, by observing the configuration of the arc shield 30 following the first and subsequent circuit interruptions, it is believed that the shield 30 fluctuates during the circuit interruption period. That is, although the arc shield 30 is initially positioned so as to be urged against the rear of the arc chute housing 23, to thereby close off all of the openings 28 in the housing, it is substantially deformed into an arcuate shape against the insulating plate 29, as best seen in Figures 3 and 3a, and as heretofore noted, is further deformed if the circuit interrupter is subjected to a series of fault current interruption, as seen in Figures 4 and 4a.

It appears that the arc shield 30 flutters or vibrates during the period of circuit interruption, to thereby operate like a butterfly valve or diaphragm, so that the hot gases and ionized air will escape upwardly through the channel existing between the fluttering arc shield 30 and the rear of the arc chute housing 23.

As heretofore noted, the interrupting capacity of the circuit breaker is substantially increased when the arc shield 30 of my invention is used.

It is believed that the fluttering action of the arc shield 30 functions to urge the gases and ionized air away from the cooperating contacts and housing of the arc chute so

that the gases rapidly escape upwardly by a chimney effect through the channel created by the arc shield.

Thus, it will be noted that by providing a flexible arc shield between the rear of an arc chute housing and the rear terminal connector, it is possible to both (a) prevent a flash-over from the movable contact to the rear terminal connector even though these two units are positioned in close proximity and still maintain openings in the rear of the arc chute housing to provide sufficient ventilation for the hot gases and ionized air and (b) substantially increase the interrupting capacity of the circuit interrupter.

In the foregoing, I have described my invention only in connection with preferred embodiments thereof. Many variations and modifications of the principles of my invention within the scope of the description herein are obvious. Accordingly, I prefer to be bound not by the specific disclosure herein but only by the appending claims.

I claim:

1. A circuit interrupter having a pair of cooperating contacts with an engaged and disengaged position; said circuit interrupter automatically opened on the occurrence of a fault current existing on the line being protected by said circuit interrupter; an arc chute surrounding said pair of cooperating contacts; said arc chute being comprised of a plurality of spaced plates; an insulated housing for said plurality of spaced plates forming a substantially U-shaped member having a base; said base forming the back of said arc chute structure and extending in a direction substantially parallel to the plane of movement of said cooperating contacts; said housing having a plurality of openings in the back thereof; a flexible arc shield made of insulated material sealing off said openings when said cooperating contacts are in the engaged position; said flexible arc shield bent away from said openings on the occurrence of circuit interruption to permit hot gases to exhaust from said arc structure through said openings.

2. In an automatic circuit interrupter having a pair of cooperating contacts with an engaged and disengaged position; said circuit interrupter automatically moving said cooperating contacts from said engaged position to said disengaged position on the occurrence of a fault current; an arc chute for said cooperating contacts; said arc chute being comprised of a housing and a plurality of slotted spaced plates; said cooperating contacts positioned within the area defined by the plurality of slots of said arc plates; said housing having a substantially U-shaped configuration and surrounding said plurality of arc plates; a plurality of openings in said housing; a flexible insulating member normally closing said plurality of openings; said flexible insulating member permitting hot gases created within said arc chute during circuit interruption to exhaust through said openings to a space existing between said arc shield and said arc chute housing when said circuit interruption occurs.

3. In an automatic circuit interrupter having a pair of cooperating contacts with an engaged and disengaged position; said circuit interrupter automatically opened

on the occurrence of a fault current to permit said cooperating contact to move from said engaged to said disengaged position; an arc chute for said circuit interrupter; said arc chute being comprised of a plurality of spaced slotted plates and a housing; said cooperating contacts moving in the space defined by said slots in said plurality of said arc plates; said housing having a substantially U-shaped configuration surrounding said plurality of arc plates; the base of said housing extending in a direction substantially parallel to the plane of movement of said cooperating contacts; a plurality of openings in the base of said housing; a flexible insulated arc shield urged against the base of said housing to seal off said plurality of openings when circuit interrupter cooperating contacts are in said engaged position; hot gases created by the arc drawn between the pair of said cooperating contacts when said circuit interrupter is automatically opened; venting through said plurality of openings and moving said arc shield away from said cooperating contacts.

4. In an automatic circuit interrupter having a pair of cooperating contacts with an engaged and disengaged position; said circuit interrupter automatically opened on the occurrence of a fault current to permit said cooperating contact to move from said engaged to said disengaged position; an arc chute for said circuit interrupter; said arc chute being comprised of a plurality of spaced slotted plates and a housing; said cooperating contacts moving in the space defined by said slots in said plurality of said arc plates; said housing having a substantially U-shaped configuration surrounding said plurality of arc plates; the base of said housing extending in a direction substantially parallel to the plane of movement of said cooperating contacts; a plurality of openings in the base of said housing; said automatic circuit interrupter having a rear terminal connector positioned in close proximity to the base of said housing; one of said cooperating contacts being electrically connected to said rear terminal connector; a flexible insulated arc shield positioned between said base of said arc chute housing and said rear terminal connector; said arc shield being urged against the base of said housing to seal off said plurality of openings when said circuit interrupter cooperating contacts are in said engaged position; said arc shield being moved away from said housing toward said rear terminal connector when said cooperating contacts of said circuit interrupter are being moved to disengaged position on the occurrence of a fault current; said arc shield forming a wall of a channel adjacent the base of said arc chute housing to permit the hot gases created by the arc drawn between the pair of cooperating contacts to escape through said plurality of openings.

#### References Cited in the file of this patent

##### UNITED STATES PATENTS

|           |          |              |
|-----------|----------|--------------|
| 2,160,681 | Sandin   | May 30, 1939 |
| 2,310,728 | Bartlett | Feb. 9, 1943 |

##### FOREIGN PATENTS

|         |         |               |
|---------|---------|---------------|
| 658,697 | Germany | Apr. 11, 1938 |
|---------|---------|---------------|