May 8, 1951 M. BINGENHEIMER ET AL 2,551,822

CIRCUIT INTERRUPTER ARC EXTINGUISHER

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Fig. 1.

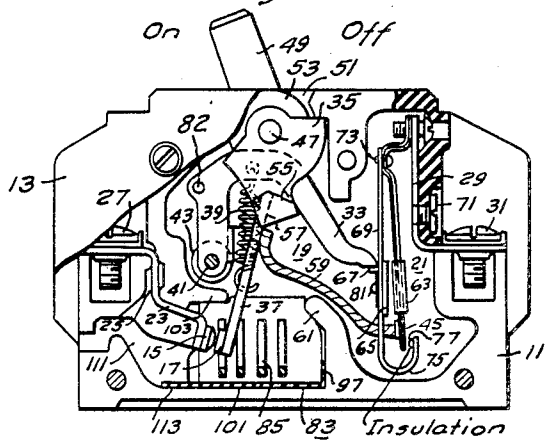


Fig. 2.

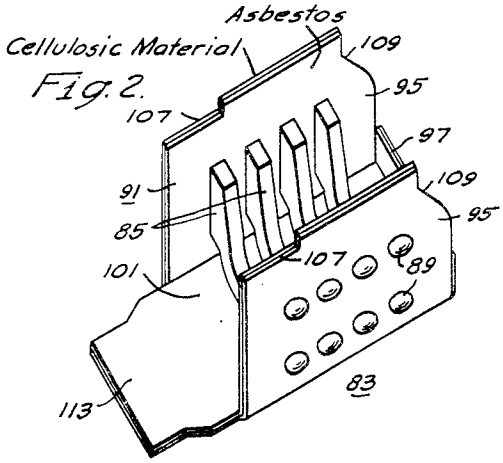


Fig. 3.

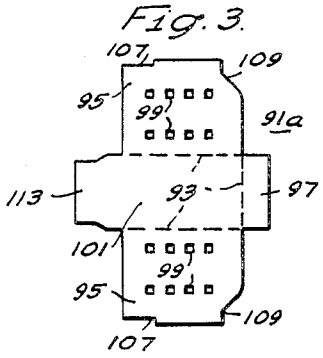


Fig. 4.

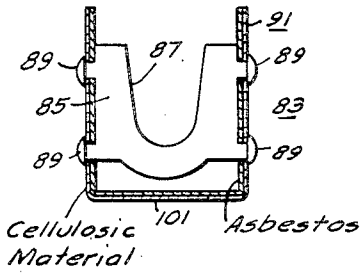
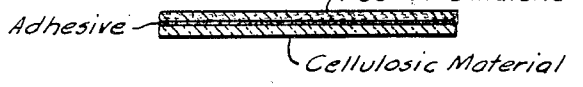


Fig. 5.



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CIRCUIT INTERRUPTER ARC EXTINGUISHER

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6 Claims. (Cl. 200—144)

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This invention relates to circuit breakers and more particularly to arc extinguishers for dissipating and extinguishing the arc.

The principal object of the invention is to provide a simple and inexpensive, but effective arc extinguisher for a circuit breaker.

A further object of the invention is to provide a circuit interrupter arc chute which is readily and cheaply blanked and formed in a punch press, and then easily handled and assembled without breakage into an arc extinguisher, which gives off a minimum of inflammable gas and thus reduces arcing and increases the ability of the circuit interrupter to safely interrupt heavy currents.

Another object of the invention is to provide a circuit breaker with an arc extinguisher of the spaced magnetic plate type in which the housing for enclosing and supporting the plates is composed of coextensive composite sheet material comprising two adhesively bonded layers, one of which layers consists of a sheet of asbestos and the other layer comprises a supporting backing of a relatively rigid fibrous cellulosic material.

Another object of the invention is to provide a circuit breaker with an arc extinguisher of the spaced magnetic plates having an insulating housing for enclosing and supporting the plates composed of a composite sheet material comprising two adhesively bonded layers, one of the layers being composed of asbestos and the other layer consisting of a fibrous cellulosic material of sufficient stiffness to permit forming the composite sheet into the shape of the housing and to allow the plates to be fastened thereto and maintained in a predetermined position.

The novel features that are considered characteristic of the invention are set forth in particular in the appended claims. The invention itself, however, both as to structure and operation, together with additional objects and advantages thereof will be best understood from the following detailed description thereof when read in conjunction with the accompanying drawing.

In said drawing:

Figure 1 is a side elevational view, partly in section, of a circuit breaker embodying the invention.

Fig. 2 is an enlarged perspective view of the arc extinguisher.

Fig. 3 is a plan view of the punching from which the arc extinguisher housing is formed.

Fig. 4 is an enlarged transverse sectional view of the arc extinguisher.

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Fig. 5 is an enlarged sectional view showing the laminated housing material.

The present invention is illustrated as applied to a circuit breaker of the type disclosed in application Serial No. 592,804, filed May 9, 1945, by Melvin Bingenheimer and assigned to the assignee of this invention.

Referring to Fig. 1 of the drawing, the circuit breaker comprises a housing 11 and a cover plate 13 therefor, both constructed of molded insulating material, stationary contact means 15, movable contact means 17, an operating mechanism 19 and a trip device 21.

The stationary contact 15 is rigidly secured to the inner end of a multi-angular terminal member 23 which is seated in an angular slot 25 in the molded housing 11. The outer end of the terminal 23 is provided with a connecting means 27 for connecting the terminal 23 in an electric circuit. At the opposite end of the housing 11 is disposed a terminal 29 which at its inner end supports the trip device (to be later described) and which is provided with a connector 31 at its outer end for connecting the terminal in an electric circuit.

The movable contact 17 is rigidly secured on the free end of a U-shaped switch arm 37 having its legs 57 supported in recesses in the legs 55 of a U-shaped operating lever 35. The operating lever 35 is pivotally supported on a pivot pin 47 mounted in a suitable opening in the housing 11 and a matching opening in the cover 13. An operating spring 39 is connected under tension between the switch arm 37 and a releasable carrier 33 pivoted on a pin 41 supported in companion openings in the housing 11 and the cover 13. Spacers 43 are provided to maintain the carrier 33 properly spaced from the walls of the housing and the cover plate.

The operating lever 35 is provided with an operating handle 49 molded integral therewith and extending through an opening 51 in the housing 11. The operating lever is also provided with an arcuate member 53 molded integral therewith co-operating with the housing 11 to substantially close the opening 51 in any position of the handle 49. The switch arm 37 is electrically connected by means of a flexible connection 59 to one end of a bimetal element 45 forming a part of the trip device 21 and which is suitably secured, preferably by welding, to the inner end of the terminal 29.

The switch arm 37 is operated to manually open and close the contacts by manipulation of the handle 49. Movement of the handle in a

clockwise direction from the full line position carries the legs 57 of the switch arm 37 across to the left of the line of action of the operating spring 39 which then biases the switch arm to the open position and causes movement of the switch arm to open position with a snap action.

The contacts are manually closed by reverse operation of the handle. Counterclockwise movement of the handle 49 from the "off" position to the "on" position moves the legs 57 of the switch arm 37 across to the right of the line of action of the spring 39 which thereupon acts to close the contacts with a snap action.

The circuit breaker is adapted to be tripped open instantaneously in response to the overloads above a predetermined value, or a short circuit, and after a time delay on lesser overloads by means of the trip device 21. Operation of the trip device 21 releases the carrier 33 whereupon the overcenter spring moves the carrier clockwise moving the line of action of the overcenter spring 39 to the right of the center line of the switch arm 37. Thereafter the spring 39 acts to move the switch arm to open position with a snap action. The movement of the carrier 33 is arrested by engagement with a projection 61 of the housing 11.

The trip device 21 comprises the bimetal element 45 connected by means of the flexible conductor 59 to the switch arm 37, an electromagnet including a channel-shaped core member 63 and a movable armature 65, a latch element 67 and a resilient member 69 rigidly secured to the bimetal element for supporting the armature 65. The terminal 29 is secured to the end wall of the casing 11 by means of a screw 71 and the bimetal element 45 is rigidly secured by suitable means such as welding to the upper inner end of the terminal 29. Just below the point of attachment of the bimetal element to the terminal 29 the bimetal element is formed inwardly at right angles and then downwardly for a short distance substantially parallel to the terminal 29 to form a flat surface to which the resilient member 69 is secured. The resilient member or spring 69 is secured to the bimetal element by means of a rivet 73. Below the rivet 73 the bimetal extends downwardly at a slight angle to the terminal 29. The lower end of the spring 69 is looped as shown at 75 (Fig. 1) and the upwardly extending end thereof carries an insulating button 77 for insulating the free end of the bimetal element 45 from the free end of the spring 69.

The channel-shaped core member 63 straddles the bimetal element 45 and is secured thereto preferably by welding. The armature 65 is secured to the spring 69 adjacent the core member 63 by means of a rivet 81 which also serves to secure the latch element 67 to the spring 69.

The latch element 67 normally engages and restrains the carrier 33 in operative position as shown in Fig. 1. Upon the occurrence of an overload current below a predetermined value of, for instance, 1000% of normal rated current, the bimetal element 45 deflects moving its free lower end toward the right (Fig. 1). The bimetal element 45, through the insulating button 77, moves the spring 69 in the same direction and causes the latch element 67 to release the carrier 33 whereupon the operating mechanism functions in the previously described manner to automatically open the contacts.

Before the contacts can be closed following an automatic opening operation, it is necessary to reset and relatch the mechanism. This is accomplished by moving the handle 49 clockwise to the full open position during which movement the leg 55 of the operating lever 35 engages a pin 82 in the carrier 33 and moves the carrier counterclockwise about its pivot 41. Near the end of its counterclockwise movement, the free end of the carrier 33 wipes by the latch member 67, slightly flexing the spring 69. Thereafter the switch arm is moved to close the contacts 15—17 in the previously described manner by movement of the handle 49 counterclockwise to the closed position.

Upon the occurrence of heavy overload or short circuit, such for example as 1000% of rated current or over, the current flowing through the bimetal element 45 energizes the core member 63 a sufficient amount to instantaneously attract and operate the armature 65, releasing the carrier 33 and effecting instantaneous opening of the contacts.

An important feature of the invention is the novel arc extinguisher, indicated generally at 83, provided to quickly and safely extinguish the arc drawn when the current is interrupted.

The arc extinguisher 83 consists of a plurality of spaced arc splitting plates 85 of magnetic material, shaped as more clearly shown in Fig. 4. Each plate has a slot of 87 formed therein and is provided with a plurality of lugs 89 whereby the plates may be rigidly attached to the sides of a U-shaped supporting and insulating housing or enclosure 91.

Heretofore arc extinguishers have, in some instances, been provided with housings formed solely of fibre or cellulosic sheet material. Such materials, while possessing sufficient mechanical strength to permit forming into the shape of the housing and to properly support the arc plates, have under certain conditions the undesirable properties of emitting gas and deteriorating when subjected to the heat of the arc. The heat of the arc when confined to a relatively small space causes overheating of the fibre which emits gases due to the high temperature which when combined with the oxygen of the air may form a gas that is inflammable and may, under certain conditions, constitute a hazard. Asbestos is one material that is free from these objectionable characteristics but does not have sufficient mechanical strength to permit forming in punch presses into the shape of the housing or to permit rough handling in the shop during the assembly of the arc plates in their proper position.

According to the present invention, the housing or enclosure 91 is formed of coextensive composite sheet material comprising two adhesively bonded layers of which one layer is composed of sheet asbestos or asbestos containing material and the other layer comprises a supporting backing composed of a relatively rigid fibrous cellulosic material. The rigid fibrous cellulosic material is of sufficient stiffness to permit forming of the composite sheet into the shape of the housing 91, as illustrated in Fig. 2, and to allow the arc plates 85 to be fastened thereto and maintained in predetermined position as by riveting over the ends of the lugs 89 against the composite sheet. Suitable materials for such cellulosic fibrous sheet are fish paper, press board and vulcanized fibre. Its thickness should be at least three mils. The asbestos sheet is composed of asbestos paper of a thickness of at least three mils.

The two layers may be adhesively bonded by

glue, polyvinyl alcohol, starch adhesives or resinous coatings.

The housing 91 for the arc extinguisher is formed from the composite sheet of cellulosic material and asbestos by punching from the sheet a blank or punching 91*a* as shown in Fig. 3 of the drawing. The punching is scored along the lines 93 on the side comprising the fibre or cellulosic material so that the wings 95 which are to form the sides of the housing and the portion 97 may be formed upwardly without breaking the fibrous supporting portion of the housing. Holes 99 are punched in the wings or side portions 95 to receive the lugs 89 of the arc plates 85. The wings or side portions 95 and the portion 97 are then formed upwardly at right angles to the base portion 101 with the asbestos on the inside and so that the holes 99 in the opposing side portions 95 are in alignment. Thereafter the plates 85 are assembled in the housing with the lugs 89 projecting through the holes 99 in the sides and the ends of the lugs are riveted or otherwise formed over to rigidly attach the housing thereto.

Referring to Fig. 1 of the drawing it will be seen that the casing 11 is provided with the projection 61 and a transverse wall or partition 103. The side walls 95 of the arc extinguisher are each provided with recesses 107 and 109 which, when the extinguisher is assembled in the casing, cooperate respectively with the walls 61 and 103 to retain the extinguisher in the proper position without positively fastening the extinguisher thereto. Also formed in the molded casing 11 is a channel 111 for the purpose of venting the hot gases generated when the arc is drawn. The channel 111 is somewhat less in width than the width of the interior of the casing as defined by the side wall of the casing and the cover plate 13. The base portion 101 of the arc extinguisher is provided with a projection 113 which is formed to fit snugly within and projects into the channel 111 a sufficient distance to protect the base of the channel from the hot gases.

The invention provides an improved arc extinguisher having a relatively thin housing comprising a composite sheet consisting of asbestos and a fibrous cellulosic material of sufficient mechanical strength to support the arc plates and of relatively high heat resistance. The arc extinguisher also has low gas emission characteristics. The improved arc extinguisher embodying the features and characteristics previously set forth increases the safe current interrupting capacity of the circuit breaker.

While the invention has been disclosed in accaccordance with the provisions of the patent statutes, it is to be understood that various changes in the structural details and arrangement of parts thereof may be made without departing from some of the essential features of the invention.

We claim as our invention:

1. A circuit interrupter including a casing and means for establishing an arc, an arc extinguisher for extinguishing the arc including a plurality of spaced slotted conducting plates, a U-shaped insulating housing at least partially enclosing said plates, said housing being formed from a single relatively thin composite sheet consisting of two adhesively bonded coextensive layers, one of said layers being composed of asbestos and the other of said layers comprising a supporting backing consisting of a relatively rigid fibrous cellulosic material, and said casing being provided with recesses and projections for receiving and supporting said housing without said housing being positively fastened thereto.

2. A circuit interrupter including a casing and means for establishing an arc, an arc extinguisher for extinguishing the arc including a plurality of spaced slotted conducting plates, a generally U-shaped insulating housing comprising a base portion and integral side walls at least partially enclosing said plates, said housing being formed from a single relatively thin composite sheet consisting of two adhesively bonded layers, one of said layers being composed of asbestos and the other of said layers comprising a supporting backing consisting of a relatively rigid fibrous cellulosic material of sufficient stiffness to permit forming of said composite sheet into the shape of said housing and to allow said plates to be fastened to said side walls and maintained in predetermined position, means defining a channel communicating said arc extinguisher to the outside of said casing, and said housing having an integral portion extending into said channel.

3. A circuit interrupter including a casing and means for establishing an arc, an arc extinguishing means for extinguishing the arc including a plurality of metallic members, a U-shaped insulating housing comprising at base portion and integral side walls at least partially enclosing said metallic members, said housing being formed from a composite sheet consisting of a plurality of adhesively bonded coextensive layers, one of said layers being composed of sheet asbestos and the other of said layers consisting of a sheet of relatively rigid fibre of sufficient stiffness to permit forming said composite sheet into the shape of said housing, and said casing having recesses and projections for receiving and supporting said housing without said housing being positively fastened thereto.

4. A circuit interrupter including a casing and means for establishing an arc, an arc extinguishing means for extinguishing the arc including a plurality of spaced slotted plates, a U-shaped insulating housing enclosing at least three sides of said plates, said housing being formed from a relatively thin composite sheet consisting of a plurality of adhesively bonded coextensive layers one of said layers being composed of sheet asbestos of a thickness of at least three mils and the other of said layers consisting of a sheet of relatively rigid fibre of a thickness of at least three mils and of sufficient stiffness to permit forming said composite sheet into the shape of said housing, and said casing having recesses and projections for receiving and removably supporting said housing without said housing being positively fastened to said casing.

5. A circuit interrupter including a casing and means for establishing an arc, arc extinguishing means for extinguishing the arc including a plurality of metallic members, a U-shaped insulating housing for supporting and at least partially enclosing said metallic members, means defining a channel for venting the hot gases generated by said arc to the outside of said casing, said housing being formed from a composite sheet consisting of a plurality of adhesively bonded coextensive layers, one of said layers consisting of asbestos and the other of said layers consisting of a fibrous cellulosic material, and said housing having an integral portion extending into said channel.

6. A circuit interrupter including a casing and separable contact means for establishing an arc, an arc extinguisher for extinguishing the arc in-

cluding a plurality of spaced slotted plates each of said plates being provided with a plurality of projections, a U-shaped insulating housing for at least partially enclosing said plates, said housing being formed from a flat composite sheet comprising a layer of asbestos and a coextensive layer of cellulosic material adhesively bonded together, said housing being punched in predetermined shape from said composite sheet and provided with integral portions forming side members having holes punched therein for receiving said projections which are formed over to rigidly secure said plates to said housing, and said casing being provided with recesses and projections for receiving and supporting said arc extinguisher without said arc extinguisher being positively fastened thereto.

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