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R. H. NAU ET AL
CIRCUIT INTERRUPTER

2,225,791

Filed Sept. 30, 1938

2 Sheets-Sheet 1

FIG. 1.

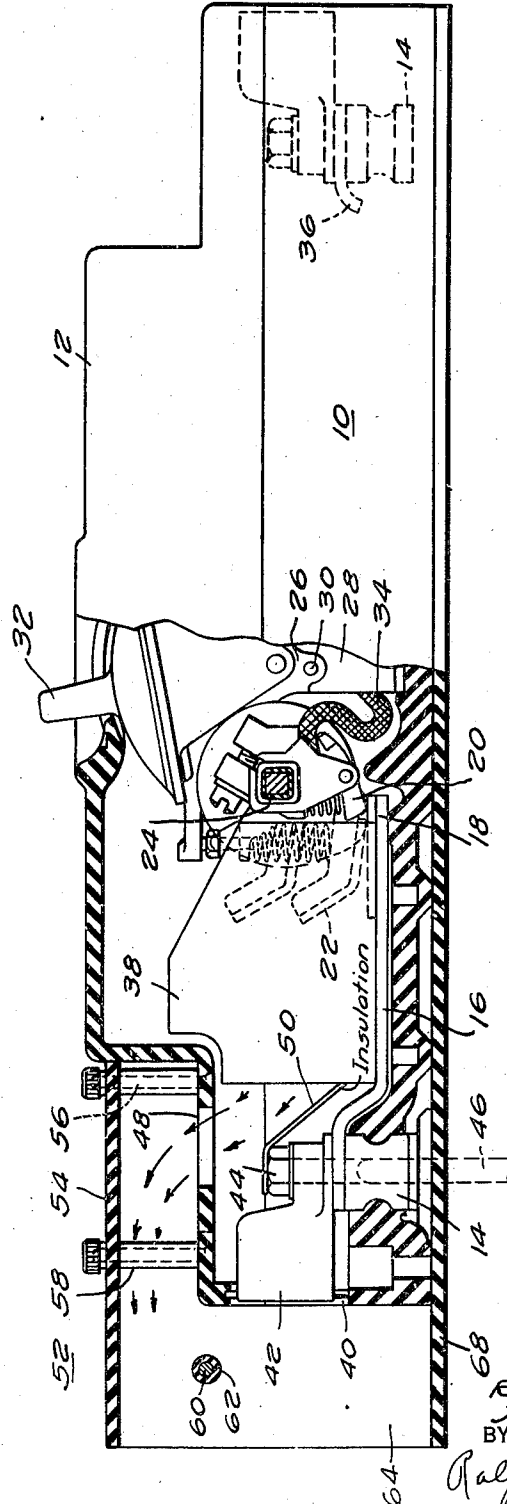


FIG. 4.

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2 Sheets-Sheet 2

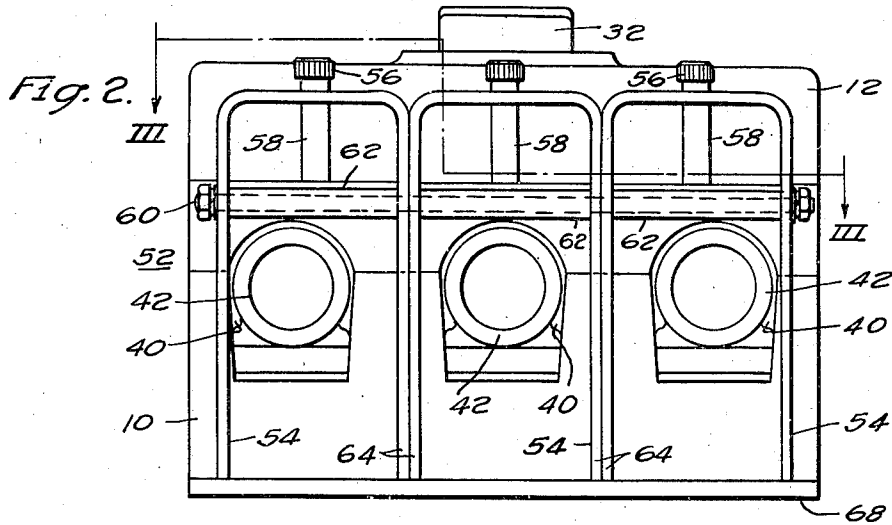
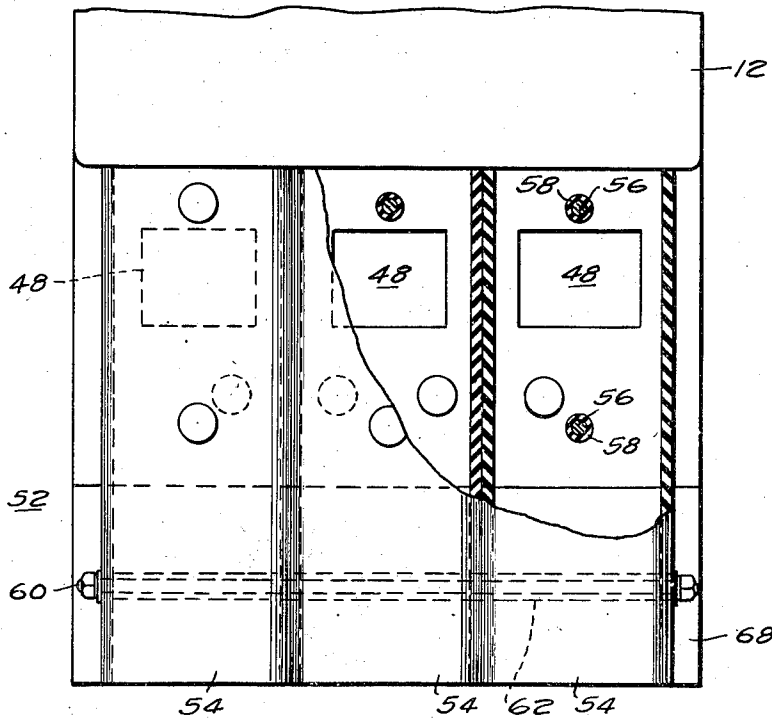


Fig. 3.

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2,225,791

CIRCUIT INTERRUPTER

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11 Claims. (Cl. 200—168)

This invention relates to circuit interrupters, and particularly to improvements in enclosed circuit breakers of the air break type.

In recent years there has been an increasing demand for completely enclosed circuit breakers of the air break type for use as protective devices in circuits up to 600 volts A. C. and 250 volts D. C. Breakers for this class of service have been developed which have a current interrupting capacity of 20,000 amperes. In order to meet various service requirements, provisions have been made for making circuit connections to the breaker terminals either in front or in back of the panel upon which the breaker is mounted. In making the front connection it is customary to provide an opening in the end of the breaker housing for the connecting cable or conductor. The rear connection is usually made by means of a rigid conductor or stud extending through the base of the breaker housing and the panel support.

We have discovered that the openings through the end of the breaker housing, if left unobstructed, except for a flame arresting screen, are adequate to vent the arc gases from within the housing when the breaker is back connected even during interrupting operations involving a current of 20,000 amperes at 600 volts A. C. or 250 volts D. C. However, when the breaker is front connected, the pressure generated by the arc gases within the housing during circuit interruptions of the above-named magnitude may be sufficient to cause fracture of the housing and also cause electrical breakdown across the terminals due to the intense blast of ionized gas towards the terminals.

The main object of our invention is to provide an enclosed circuit breaker of the aforesaid type, the interrupting capacity of which is independent of the external circuit connection to the breaker.

A further object of our invention is the provision of an air breaker circuit interrupter of the enclosed type, in which the arc gases are diverted about the line terminals to prevent flash-over across the terminals during circuit interruption.

Another object of our invention is the provision of barrier means for enclosed circuit breakers adapted for either front or back connection, which barrier serves as an auxiliary unit for preventing the arc gases discharged from the several poles of the breaker from causing electrical failure across the front connected line terminals.

Other objects and advantages relate to details of the breaker structure and will appear more

fully in the following description when taken in connection with the accompanying drawings, in which:

Figure 1 is a side view of the interrupter of our invention having portions thereof broken away for the purpose of more clearly showing the structural features thereof,

Fig. 2 is an enlarged end elevation view of the circuit interrupter shown in Fig. 1.

Fig. 3 is a fragmentary view of the interrupter partially in plan and partially in section as viewed along the line III—III of Fig. 2, and

Fig. 4 is a fragmentary sectional view of a portion of the breaker housing.

Referring to the drawings, the circuit interrupter housing consists of a base 10 of box-like form, preferably constructed of molded insulating material and a cover 12 also preferably formed of molded insulating material. The base 10 and cover 12 are so arranged as to accommodate the complete structure of a multi-pole breaker.

For the purpose of illustration, a three-pole structure is shown, as is more apparent from Figs. 2 and 3. At each end of the base 10 is a plurality of, in this instance three, line terminals 14 to which external circuit connections are adapted to be made. The left-hand line terminal 14, as viewed in Fig. 1, is connected by a suitable conductor 16 to a stationary contact 18. The stationary contact 18 cooperates with a moving contact assembly comprising a main contact 20 and an arcing contact 22. The moving contact assembly, including the main contact 20 and the arcing contact 22, are carried by a suitable support such as a cross shaft 24 which, in turn, is carried by a contact actuating member 26 pivotally mounted upon a frame member 28 by the shaft 30.

The actuating member 26 is associated with suitable operating mechanism including the oscillatable lever 32 for operating the movable contacts 20 and 22 into and out of engagement with the stationary contact 18. The movable contacts 20 and 22 are connected by means of a flexible shunt 34 to a suitable electro-responsive trip mechanism, not shown, which in turn is connected by a conductor 36 to the right-hand line terminal 14.

The electro-responsive trip mechanism referred to may be of a standard and well known type used in breakers of this kind and need not be illustrated or described. Upon separation of the moving contacts 20 and 22 from the stationary contact 18 during conditions of load, an arc is established between the stationary contact 18 and

the arcing contact 22, which arc is adapted to be extinguished by a suitable arc extinguishing device shown at 38. The arc extinguishing device 38 is preferably of the multi-plate arc splitting type, in which the arc is driven into a plurality of spaced metallic plates of magnetic material by the magnetic reaction set up by the arc within the plates. For further details of the arc extinguishing device structure, reference may be had to the application of Jerome Sandin, Serial No. 182,484, filed December 30, 1937, now Patent 2,160,681, issued May 30, 1939, and assigned to the assignee of the instant application.

The left-hand end of the interrupter housing is provided with three apertures 40, through which the incoming lines to the left-hand line terminals 14 extend in the event that the interrupter is to be front connected. In making the front connection, the incoming lines are provided with a cable terminal 42 which may be secured to the breaker terminal 14 by means of a stud 44. In the event that the interrupter is to be back connected, the cable terminal 42 is omitted and the apertures 40 are closed with a suitable flame arresting screen, not shown. Connection in the latter instance to the line terminals 14 are then made by means of studs 46 passing at right angles through the supporting panel.

It will be noted in the event that the back connection is employed, the apertures 40 for each of the respective poles of the interrupter are substantially free from obstructions and provide adequate venting for the discharge of arc gases emanating from the left-hand end of the respective arc extinguishing devices 38. However, in the event that the interrupter is front connected and the incoming lines are connected by means of the cable terminals 42, as shown in Fig. 1, the apertures 40 are substantially closed, thereby permitting very little discharge space for the escape of gas from the discharge end of the arc extinguishing devices 38.

We have discovered that unless other provisions are made for the escape of gas, sufficient pressure may be built up within the interrupter housing to cause fracture thereof during the interruption of extremely heavy current overloads. The absence of further venting means also causes the cable terminals 42 to be subjected to a direct blast of ionized gas emanating from the arc extinguishing devices 38 which may cause in some instances electrical breakdown between terminals and consequent failure of the interrupter.

In order to avoid these difficulties, we have provided the cover 12 of the interrupter with three apertures 48 through which the gas discharged from the respective arc extinguishing devices 38 may pass exteriorly of the housing. The portions of the upper walls in the cover 12 that are adapted to be removed for the purpose of forming the apertures 48 are preferably provided in the form of knock-outs 49, as more clearly shown in enlarged scale in Fig. 4. Thus if the consumer desires to use the back connection for the breaker, the knock-out portion 49 is allowed to remain in place but if the front connection is to be used, the knock-out portion 49 is removed so as to provide the apertures 48.

In order to protect the terminal stud 44 from the direct action of the gas, an inclined insulating plate 50 is provided which also assists in directing the gas blast upwardly through the apertures 48. Although the apertures 48 in themselves are sufficient to prevent direct action of the respective arcs upon the line terminals,

the particular arrangement is objectionable in that during severe overloads considerable flame may appear therethrough.

In order to suppress the flame emanating from the apertures 48, as well as to prevent flashover due to the escape of hot ionized gases therefrom, we have provided a barrier construction generally indicated at 52. The barrier 52 is preferably constructed of three separate channel members 54 of insulating material; the two parallel side portions of each channel member 52 having a rectangular cut-out portion so as to cause the respective channels to conform to the shape of the interrupter housing.

Each channel member 54 is secured to the cover 12 by means of screws 56 which are insulated from the arc gases by a tubular sleeve of insulating material 58. The three channel members 54 in this instance are united together by a tie bolt 60 passing laterally therethrough in conjunction with sleeves 62 of insulating material surrounding the tie bolts for maintaining the side walls of the channel members in proper spaced relation. The lower edges 64 of the side walls of the channel members 54 extending beyond the end of the breaker housing are adapted to engage a base plate 68 disposed between the breaker housing and the breaker panel support.

From the foregoing description it will be apparent that during circuit interruption the gas discharged from the separate arc extinguishing device 38 will be deflected upwardly through the apertures 48 and again deflected, as shown, by the arrows in Fig. 1, by the channel members 54. Each channel member 54 confines the arc gases from each pole to an individual path of considerable length, thereby causing the gases to be cooled and deionized prior to emanating from the barrier structure. It is thus seen that danger from flashover due to the discharge of hot ionized gas has been eliminated.

Although we have shown and described a specific circuit interrupter structure, 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.

We claim as our invention:

1. In a circuit interrupter, contact means for establishing an arc, a box-like closure of insulating material for housing said contact means, a cover of insulating material for said closure, an opening in the end of said closure serving as a vent and means on said cover of insulating material adapted to be removed in the event said opening in the end of said closure is obstructed to provide a vent opening through which the gases may be discharged.

2. In a circuit interrupter, contact means for establishing an arc, an arc extinguishing device for extinguishing said arc, a box-like closure for housing said contact means and said arc extinguishing device, a cover for said closure, at least one circuit connecting terminal within said closure adjacent one end thereof, two openings in said closure disposed respectively through the end and the base thereof to provide alternate directions of approach in making circuit connections to said terminal, said opening in the end of said closure serving as a vent when the circuit connection is made through the base of said closure, and a knock-out portion in said cover adjacent said terminal adapted to be removed when circuit connection is made through said 75

opening in the end of said closure to provide a vent opening through which the gases from said arc extinguishing device are discharged.

3. In a circuit interrupter, contact means for establishing an arc, a box-like closure of insulating material for housing said contact means, an opening in one wall of said closure normally serving as a vent, and means at another part of said closure removable in the event the first said opening is obstructed to provide a vent opening through which the gases may be discharged.

4. In a multiple circuit interrupter, a plurality of contact means for establishing a plurality of arcs, a box-like closure of insulating material for housing said contact means, at least one opening for each pole in one wall of said closure normally serving as vents, means at another part of said closure removable in the event the first said openings are obstructed to provide at least a second vent opening for each pole through which the gases may be discharged, and barrier means of insulating material secured to and mounted on the outside of said closure of insulating material for maintaining the arc gases issuing from said second vents of the respective poles apart until said gases have cooled sufficiently to prevent flashover between poles during a circuit interrupting operation.

5. In a circuit interrupter, contact means for establishing an arc, a box-like closure of insulating material for housing said contact means, an opening in one wall of said closure normally serving as a vent, and a weakened wall portion at another part of said closure forming a knockout portion removable in the event the first said opening is obstructed to provide a vent opening through which arc gases may be discharged.

6. In a circuit interrupter, contact means for establishing an arc, a box-like closure of insulating material for housing said contact means, an opening in one wall of said closure through which a circuit connection to said contact means can be made, alternate means for making a circuit connection to said contact means, said opening serving as a vent for arc gases when said alternate circuit connection is used, and a weakened portion in one wall of said closure forming a knockout portion removable to provide a vent opening for the discharge of gases when said opening is obstructed by a circuit connection.

7. In a circuit interrupter, contact means for establishing an arc, a box-like closure for housing said contact means, an opening in said closure through which a circuit connection to said contact means may be made, means for making an alternate circuit connection to said contact means, said opening serving as a vent for arc gases when said alternate circuit connection is used, a second opening in said closure for venting the arc gases when said first opening is obstructed by a circuit connection and deflecting means mounted upon said closure adjacent said second opening for directing the arc gases away from said closure.

8. In a circuit interrupter, contact means for establishing an arc, a box-like closure for housing said contact means, a removable cover for said closure, an opening in said closure through which a circuit connection to said contact means may be made, means for making an alternate circuit

connection to said contact means, said opening serving as a vent for arc gases when said alternate circuit connection is used, a second opening disposed in said removable cover for venting the arc gases when said opening is obstructed by a circuit connection and a barrier member carried by said cover adapted to cool the arc gases escaping from said vent opening and disposed to deflect said gases in a direction at an angle to the normal direction of escape from said second opening.

9. In a circuit interrupter, a box-like closure, a circuit connecting terminal disposed within and adjacent one end of said closure, separable contact means within said closure for establishing an arc, means for extinguishing said arc disposed between said separable contact means and said terminal, said closure having a depth at its terminal end just sufficient to accommodate said circuit connecting terminal and a greater depth intermediate the ends thereof to accommodate said separable contact means and said arc extinguishing means, said arc extinguishing means discharging gas in a direction toward said terminal, means providing an opening in a wall of said closure adjacent said terminal for the discharge of arc gases from said arc extinguishing means, and a channel member of insulating material removably secured to said closure in covering relation with respect to said opening and further disposed with respect to said closure so that two adjacent outer walls thereof close at least one end and the open side of said channel member to provide a gas discharge passage for directing the arc gases away from said closure.

10. In a circuit interrupter, contact means for establishing an arc, a box-like closure of insulating material for housing said contact means, an opening in one wall of said closure normally serving as a vent, means at another part of said closure removable in the event the first said opening is obstructed to provide a vent opening through which the arc gases may be discharged and a barrier member of insulating material mounted on the outside of said chamber in covering relation with respect to said second vent opening to cool the arc gases issuing from said second vent opening and direct them away from said closure.

11. In a multi-pole circuit interrupter, a plurality of contact means for establishing a plurality of arcs, a box-like closure for housing said contact means, at least one opening for each pole in one wall of said closure through which circuit connections to said contact means may be made, means for making alternate circuit connections to said contact means, said openings serving as vents when said alternate circuit connections are used, at least one additional opening for each pole in said closure for venting the arc gases when said first openings are obstructed by circuit connections, and barrier means removably mounted on the outside of said closure for maintaining the arc gases issuing from said additional openings apart until said gases have cooled sufficiently to prevent flashover between poles during a circuit interrupting operation.

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