May 30, 1939. J. SANDIN 2,160,681

CIRCUIT INTERRUPTER

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Fig. 1.

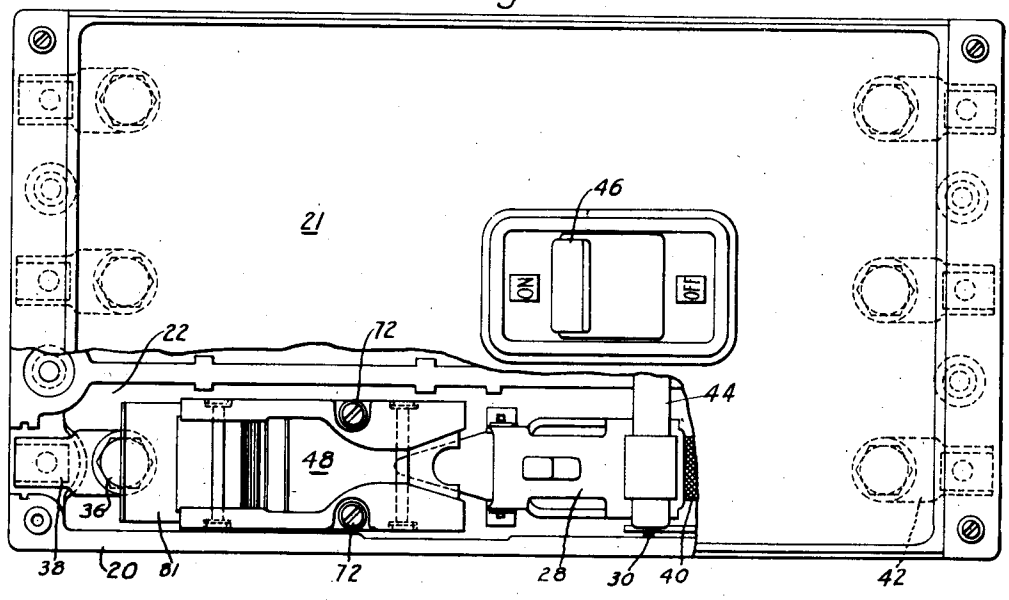
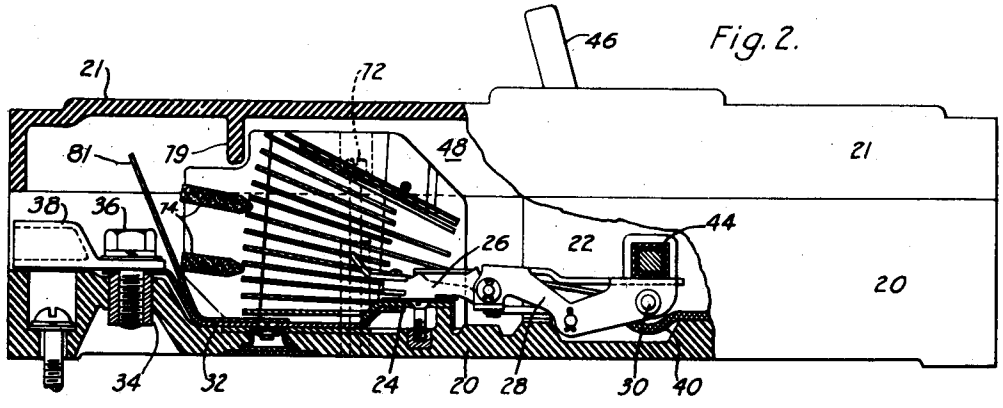


Fig. 2.



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CIRCUIT INTERRUPTER

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Fig. 3.

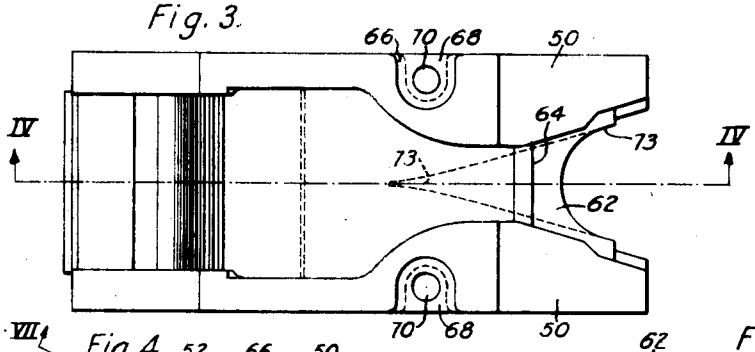


Fig. 4.

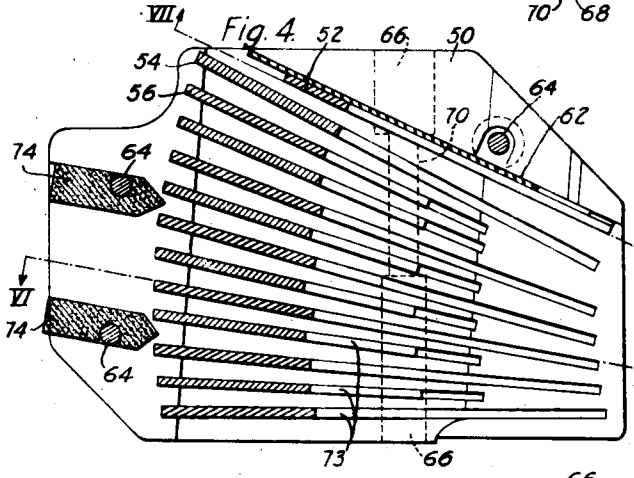


Fig. 5.

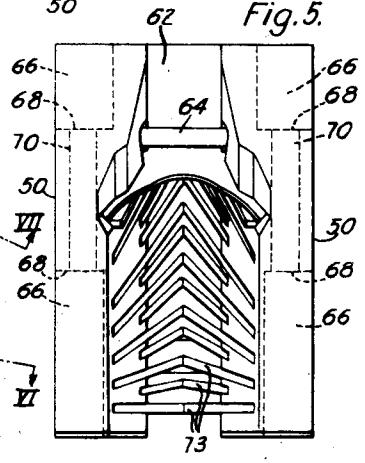


Fig. 6.

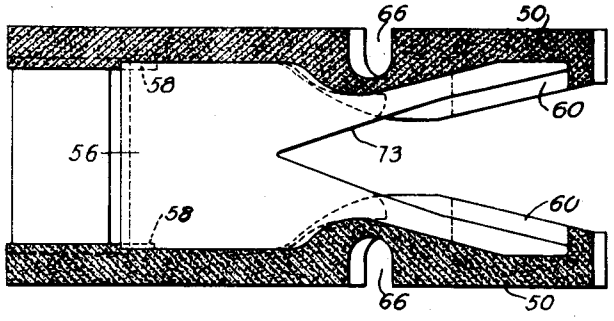
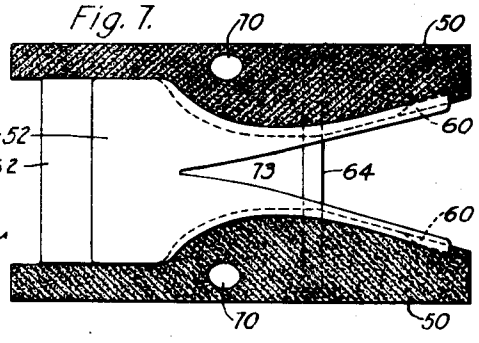


Fig. 7.



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CIRCUIT INTERRUPTER

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Fig. 8.

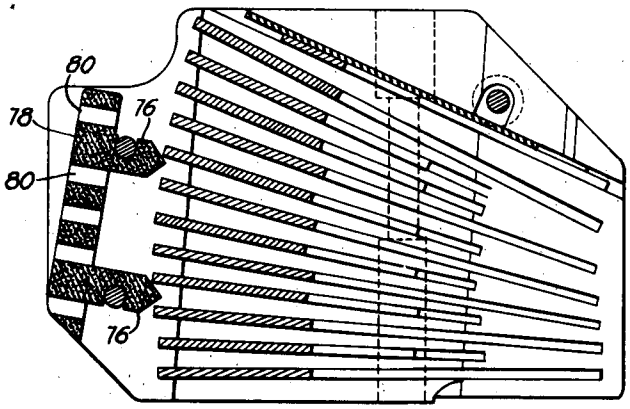


Fig. 9.

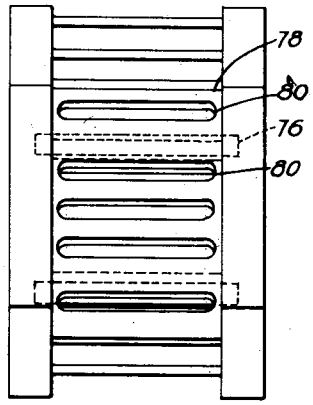


Fig. 10.

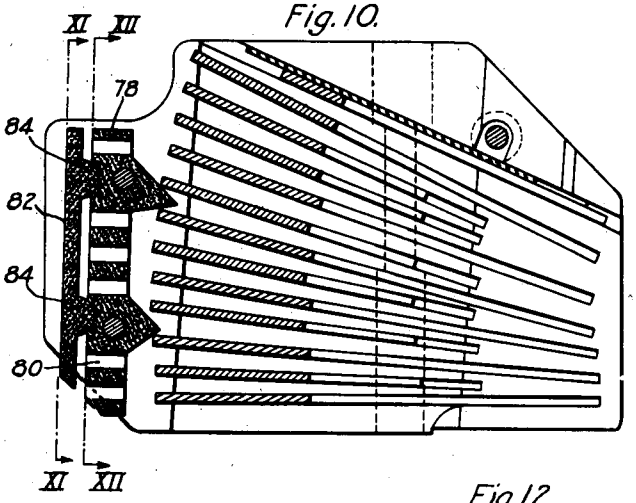


Fig. 11.

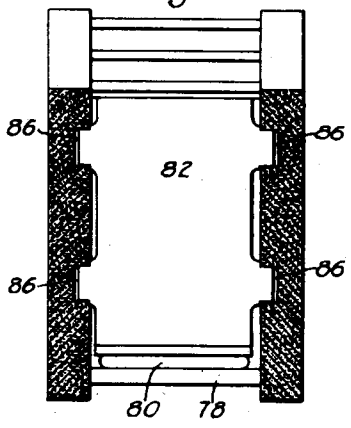
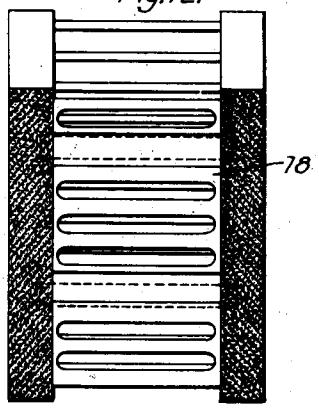


Fig. 12.



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UNITED STATES PATENT OFFICE

2,160,681

CIRCUIT INTERRUPTER

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Application December 30, 1937, Serial No. 182,484

8 Claims. (Cl. 200—147)

This invention relates to circuit interrupters and more particularly to arc extinguishing devices of the type which utilize a plurality of spaced plates of conducting material for deionizing the arc stream.

The main object of my invention is to provide a simple compact arc extinguishing structure, the separate parts of which are held together as a unit and which are of such construction to permit the unit to be positively mounted upon a breaker but which may be easily removed and replaced.

A further object of my invention is directed to a new and improved means for supporting the deionizing plates of an arc extinguishing structure of the foregoing type.

A more specific object of my invention is the provision of support means for the deionizing plates of an arc extinguishing device which facilitates movement of the arc into the plates.

Still another object of my invention is the provision of means for improving the performance of a multiple plate type arc extinguishing device. This may be accomplished by the use of structure which prevents the arc from restriking as a single arc across the ends of the deionizing plates after having been moved therethrough. The performance of the arc extinguishing unit is also improved by the provision of baffle members adjacent the gas discharge ends of the deionizing plates for cooling the hot gases, thereby preventing flame from issuing from the structure.

Other objects and advantages relating to the structural arrangement of the arc extinguisher will appear more fully in the following description, when taken in connection with the accompanying drawings, in which:

Figure 1 is a plan view of a circuit interrupter embodying the arc extinguisher of my invention and which has a portion of its cover broken away to reveal one of its arc extinguishing structures and a portion of the operating mechanism.

Fig. 2 is a side elevational view of the circuit interrupter of Fig. 1 showing a portion of the casing broken away and one of the arc extinguishing structures in longitudinal section.

Fig. 3 is a plan view of one form of the arc extinguishing device of my invention.

Fig. 4 is a longitudinal sectional view of the arc extinguishing device taken along line IV—IV of Fig. 3.

Fig. 5 is an end elevational view of the arc extinguishing device.

Fig. 6 is a sectional view of the arc extinguishing device taken along line VI—VI of Fig. 4.

Fig. 7 is another sectional view of the arc extinguishing device taken along line VII—VII of Fig. 4.

Fig. 8 is a longitudinal sectional view of a modified form of arc extinguishing device.

Fig. 9 is an end elevational view of the arc extinguishing structure shown in Fig. 8.

Fig. 10 is a longitudinal sectional view of a further form of arc extinguishing structure.

Fig. 11 is a sectional view of the arc extinguishing device of Fig. 10 taken along line XI—XI, and

Fig. 12 is a sectional view of the arc extinguishing device of Fig. 10 taken along the line XII—XII.

Referring to the drawings, the reference numeral 20 designates a base of a three-pole circuit interrupter provided with a cover 21. The base 20 and cover 21 are divided into three compartments 22, only one of which is shown, for receiving the respective poles of the interrupting structure. Each pole of the circuit interrupter comprises a fixed contact 24 and a movable contact 26 yieldingly supported upon the end of a contact arm 28 mounted for swinging movement about shaft 30. The fixed contact 24 is connected by a conductor 32 to a connector 34. The connector 34 is provided with a threaded stud 36 for clamping one of the line terminals 38 thereto. The movable contact 26 is connected by a flexible conductor 40 to a suitable electro-responsive device not shown, for tripping the pole unit mounted in the compartment 22. The electrical circuit from the electro-responsive tripping device terminates at the other line terminal 42 of the interrupter. The movable contact arms 28 are preferably insulatingly secured to a tie bar 44 which cooperates with a snap acting mechanism (not shown), including a hand operating lever 46 for moving the respective contacts 26 to open and closed positions. Each pair of contacts 24 and 26 are partially surrounded by an arc extinguishing unit generally indicated at 48 in Figs. 1 and 2, and shown in detail in Figs. 3 to 7, inclusive.

Each arc extinguishing unit 48 comprises a pair of spaced wall or support members 50 of insulating material which may be either refractory or fibrous in character. Although the refractory insulating materials, such as porcelain, are suitable, I prefer to use a cold molded material constituting 22% hydrated lime, 38% powdered silicate and 40% asbestos fibre. Other cold

molded compositions comprising 50% Portland cement and 50% asbestos fibre or 50% Portland cement, 15% barytes and 35% asbestos fibre may also be used. Horn fibre is also a suitable material from which the wall members **50** may be constructed. A porous refractory material comprising 30% talc, 2% feldspar and 68% clay is also suitable but less desirable than the cold molded materials since it is more brittle and less capable of withstanding shock.

Disposed between the wall members **50** are a plurality of deionizing plates **52**, **54** and **56** of conducting material. The opposed inner surfaces of the wall members **50** are provided with slots or channels as shown at **58** and **60** of Figs. 6 and 7 for receiving a portion of the side edges of the plates.

The uppermost slot in the wall members **50** has a somewhat greater width than the remaining slots so as to accommodate the side edges of both the plate **52** of conducting material and an additional plate **62** of insulating material. The wall members **50** are held in clamping engagement with the entire assemblage of plates by means of rivets **64** passing transversely through the wall members so as to unite plates and wall members in a unitary structure. Each wall member **50** is provided with spaced indentations or recesses extending from the outer surface inwardly, as shown at **66**, so as to provide an intermediate shoulder portion **68** which has a vertical bore **70** therethrough for receiving a mounting screw **72**. The mounting screw **72** is adapted to be screwed into the base **20**, thereby securely holding the arc extinguishing structure **48** as a unit in proper position with respect to the contacts **24** and **26**. This method of mounting the arc extinguishing structure facilitates the removal and replacement thereof for purposes of inspection and repair of either the arc extinguishing structure or the breaker contacts.

The arc extinguishing plates **52**, **54** and **56** have a V-shaped slot **73** formed in one end thereof, as shown in Figs. 3, 5, 6 and 7. As shown more clearly in Figs. 4 and 5, the arc extinguishing plates are more closely spaced at their slotted ends and are arranged with their slots in superimposed relation so as to form an aligned arc receiving groove in which the moving contact **26** is adapted to be moved for establishing an arc. Inasmuch as the arc extinguishing plates converge towards the slotted ends, the plates **56** are shorter than the plates **54** in order to maintain sufficient spacing between the ends of the plates to prevent insulation failure. The arc extinguishing plates **52**, **54** and **56** are preferably of magnetic material such as iron or other ferrous material so that when the arc is drawn between the contacts **24** and **26**, the magnetic reaction set up by the plates **52**, **54** and **56** will move the arc towards the apex of the slots and into the plates. The initial movement of the arc is effected chiefly by the plates **52** and **54** inasmuch as these plates have the side edges along their V-shaped slot extending on opposite sides of the arc. The shorter plates **56** come into play as the arc approaches the slots in these plates to thereby accelerate arc movement into all of the plates. As the arc reaches the end of the slots it is split into a plurality of short serially related arcs playing between the respective plates which arcs are extinguished by the deionizing action of the plates in a manner which is now well known in the art.

The opposed surfaces of the side wall members **50** adjacent the slots in the arc extinguishing plates taper inwardly in the direction of arc movement so as to provide a convergent entrance passage for the arc. The narrow constricted portion between the opposed wall members **50** extends a considerable distance along the arc receiving slots and again widens in the direction of arc movement as clearly shown in Figs. 1, 3, 5, 6 and 7. This tapering entrance portion, as provided by the side walls **50**, serves to contract the arc so as to facilitate entry thereof into the arc extinguishing plates **54** and **56**. I have discovered, however, that if the arc is permitted to strike to the side edges of the slots in plates **54** during the arc drawing process, considerable difficulty is experienced in effecting arc movement into the deionizing plates. In order to overcome this difficulty, the portions of the plates **54** on either side of the path of movement of the moving contact **26** are deeply embedded or recessed in the grooves **60**, as shown in Fig. 6. The uppermost plate **52**, however, is not recessed within the tapering portions of the wall members **50** as more clearly shown in Fig. 7, since this plate member serves as the upper arc terminal during arc movement towards the end of the slots.

In some instances, particularly in the extinction of heavy current arcs which travel with relatively high velocities due to the strong magnetic reaction propelling the same, the short arcs between the plates **52**, **54** and **56** may move beyond the ends thereof. In order to prevent the short arcs from moving beyond the plates and restriking into a single arc, I have provided two transversely disposed barriers **74** of insulating material, at medial points along the arc path. The barriers **74** have portions thereof extending between two adjacent deionizing plates so that in the event certain of the short arcs succeed in passing through the plates and tend to restrike as a single arc, there will be a sudden lengthening of the arc at the barriers which causes the arc to be extinguished. The barriers **74** also serve to cool the hot gases emanating from between the deionizing plates and in this respect assist in the suppression of the arc and flame caused by the hot gases.

Although the barriers **74**, as particularly shown in Fig. 4, have a certain cooling effect upon the discharged gases from between the deionizing plates, I have found that in certain instances it may be desirable to provide further means for cooling the gas and arresting the flame produced during circuit interruption. In Fig. 8, I have shown a modified structure of insulating material which combines a perforated baffle with the barriers previously described. In this particular instance, the barrier portions **76** have united integrally therewith a baffle plate **78** provided with openings **80** therethrough. The baffle plate **78** extends transversely between the wall members **50** in the direct path of the gas discharge from the spaces between the deionizing plates. Thus as the gas emerges from these spaces, it strikes the barrier portion **76** and the baffle plate **78** and is forced to flow through the openings **80**. During such movement through the openings in the baffle plate **78**, the gases are sufficiently cooled to arrest any flame which might appear at the edges of the deionizing plates. Additional baffle means of insulating material are provided, as shown in Fig. 2, by a transverse web section **79** in the cover **21** and also by a diagonally disposed L-shaped plate **81** for more effectively

cooling and suppressing the hot gases at the top and bottom of the arc extinguishing structure.

Figs. 10, 11 and 12 show a further modification of combined barrier and baffle plate arrangement for preventing the issuance of an arc beyond the end of the arc extinguishing structure. The arrangement shown in these figures is somewhat similar to that shown in Figs. 8 and 9 except that an additional barrier plate 82 is provided. The baffle plate 82 is spaced from the baffle plate 78 by two transversely extending ribs 84 which ribs are adapted to seat in aligned grooves provided transversely of the baffle plate 78. The ends of the ribs 84 extend beyond the sides of the plate 82 and are preferably embedded in suitable notches 86 provided in the side wall members 50. The width of the plate 82 is also somewhat narrower than the distance between the side wall members 50 in order to provide escapement for the gas passing through the apertures 80 in the baffle plate 78. This structure is believed to be somewhat more efficient than that shown in Figs. 8 and 9, in that it provides a circuitous path of greater length to be traversed by the escaping gas and consequently cools the gas to a greater degree, thereby insuring a complete arresting of flame.

Although I have shown and described specific arc extinguishing structures and the use thereof in a particular breaker 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.

I claim as my invention:

1. An arc extinguishing device for circuit interrupters comprising means of insulating material defining two opposed surfaces of an arc passage, said means of insulating material having a plurality of spaced grooves disposed along said opposed surfaces, a plurality of plates of conducting material disposed transversely between said opposed surfaces and having their side edges supported within said grooves, each of said plates having an arc receiving slot in one end thereof, a plurality of said plates having a part of their slot defining portions completely recessed in said means of insulating material to prevent an arc established adjacent said recessed portions from striking thereto.

2. An arc extinguishing device for circuit interrupters comprising a pair of spaced wall members of insulating material, said wall members having a portion of their opposed surfaces adjacent one end tapering towards each other to provide a converging arc receiving passage, a plurality of spaced metallic plates disposed between said wall members, said plates having a V-shaped slot in one end thereof and considerable portions thereof defining the sides of said slots completely embedded in said tapering portions of said wall members for preventing an arc from striking to said embedded portions.

3. An arc extinguishing device for circuit interrupters comprising a plurality of spaced plates of conducting material, said plates having a V-shaped slot in one end thereof to form an aligned arc receiving groove a pair of unitary support members of insulating material disposed on opposite sides of said plates for defining the side walls of an arc passage in which an arc is adapted to play, the opposed surfaces of said support members adjacent the sides of said slots tapering inwardly to provide an entrance portion for said arc passage which gradually decreases in width in a direction toward the closed end of said groove and in which an arc is adapted to be established, and recesses along the tapered surfaces of said support members for receiving the edges of a plurality of said plates.

4. In a circuit interrupter, a pair of spaced support members of insulating material, said support members having a plurality of spaced grooves along their opposed inner surfaces, a plurality of plates of magnetic material disposed between said support members with their side edges resting in said grooves, means for holding said support members in engagement with said plates, each of said plates having a V-shaped slot extending inwardly from one end thereof to form an aligned arc receiving channel, a plurality of said plates having portions adjacent either side of their slots extending beyond the remaining plates, and means for establishing an arc between said support members in a direction substantially normal to said extended portions of said plates, said extended portions of said plates being of substantially less width than the depth of the grooves in said support members in which said portions are disposed to prevent said arc from striking to said extended portions when it is established and during its movement by the magnetic reaction set up by said plates toward the end of said arc receiving channel.

5. An arc extinguishing device for circuit interrupters comprising a plurality of spaced metallic plates, each of said plates having an arc receiving slot in one end thereof, a pair of wall members of insulating material between which said metallic plates are disposed, the inner opposed surfaces of said wall members being provided with a plurality of longitudinally extending grooves for receiving the side edges of said metallic plates, and means for holding said wall members in engagement with said plates, each wall member having a pair of recesses extending inwardly from the outer surface thereof, said recesses in each wall member being elongated in a direction parallel to the outer surface thereof and disposed in spaced longitudinal alignment to provide an intermediate portion, said intermediate portion of each wall member having an opening therethrough in alignment with said recesses for the reception of securing means for mounting said device upon a suitable support.

6. In an arc extinguishing device, a pair of spaced support members of insulating material, a plurality of metallic plates disposed in spaced relation between said support members, each of said metallic plates having a slot therein for receiving an arc to be extinguished, means for moving an arc into said plates to form a plurality of short serially related arcs therebetween, plate means of insulating material supported between said support members and having a portion thereof disposed between two adjacent metallic plates to prevent the short arcs from moving beyond the ends of said metallic plates and reuniting into a single arc, and means associated with said plate means to assist the latter in cooling the arc gases discharged from the spaces between the metallic plates.

7. In a circuit interrupter, a plurality of plates of conducting material, said plates having an arc receiving slot in one end thereof, a pair of support members of insulating material disposed on opposite sides of said plates for holding said plates in spaced relation and for defining the side walls of an arc passage, means for establishing an arc

in the slots of said plates, means for moving said arc into said plates to form a plurality of short serially related arcs, a plurality of plates of insulating material disposed between said support members, each of said plates of insulating material having at least a portion thereof interposed between two adjacent plates of conducting material, said plates of insulating material preventing the reformation of said plurality of serially related arcs into a single arc across the ends of said plates of conducting material, and means associated with said plates of insulating material disposed adjacent the ends of said conducting plate to provide a circuitous path for the gas discharged from the spaces between said conducting plates for cooling said gas.

8. In a circuit interrupter, a stack of plates of ferrous material, said stack of plates having an aligned arc receiving slot in one end thereof, a pair of insulating wall members disposed on opposite sides of said stack of plates for holding the plates in spaced relation, means for establishing an arc within said slot, said arc being moved into said plates by the magnetic reaction set up therein by the arc and split into a plurality of short serially related arcs playing between said plates, and a barrier member of insulating material disposed between said wall members adjacent the ends of said plates, said barrier member having at least a portion thereof extending between two adjacent plates to prevent the short arcs from restriking as a single arc along the ends of said plates and a baffle portion extending transversely of the spaces between the ends of said plates, said baffle portion providing a circuitous path for the gas discharged from said spaces for cooling said gas.

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