

April 16, 1935.

H. C. GRAVES, JR

1,997,772

ARC CONTROLLING STRUCTURE

Filed Feb. 26, 1932

3 Sheets-Sheet 1

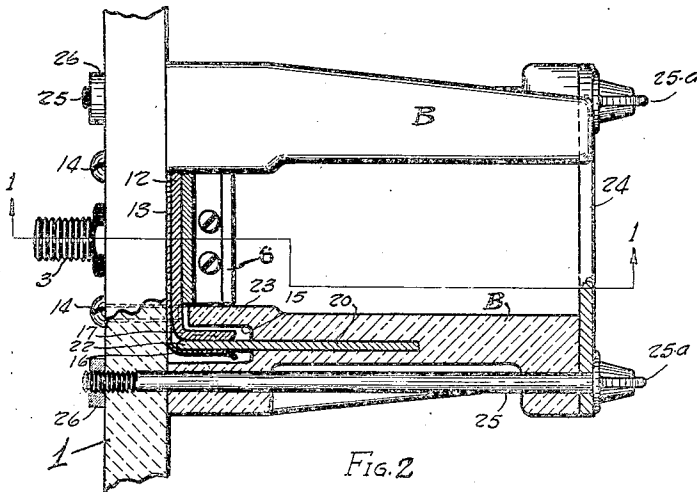


FIG. 2

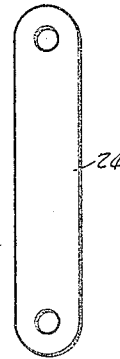


FIG. 3

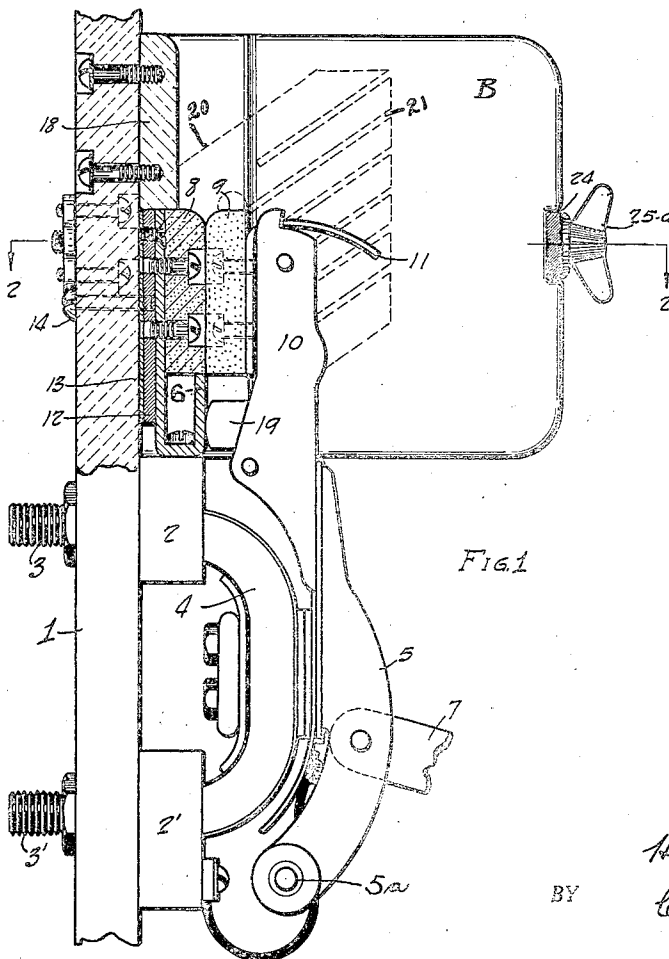


FIG. 1

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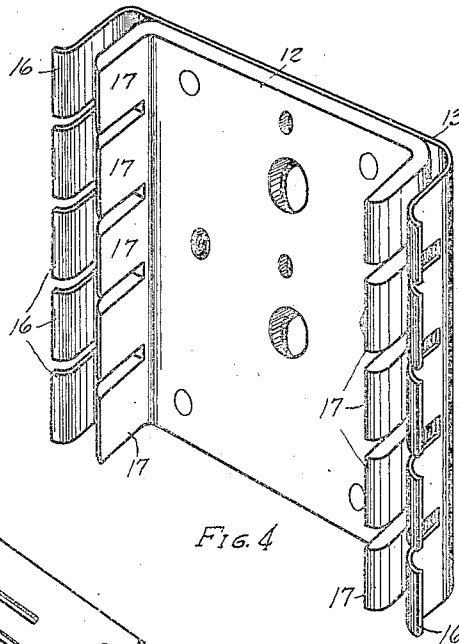


FIG. 4

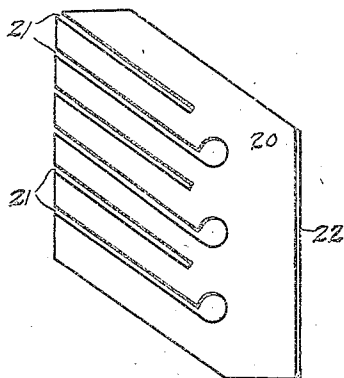


FIG. 5

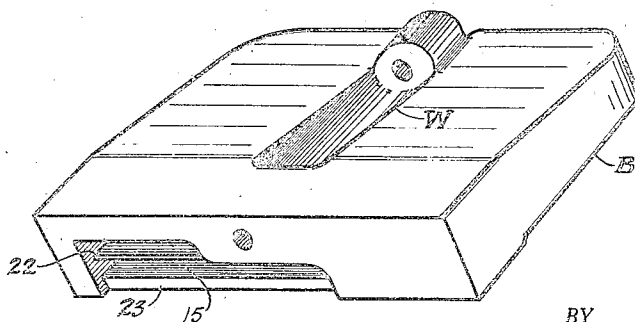


FIG. 6

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FIG. 7

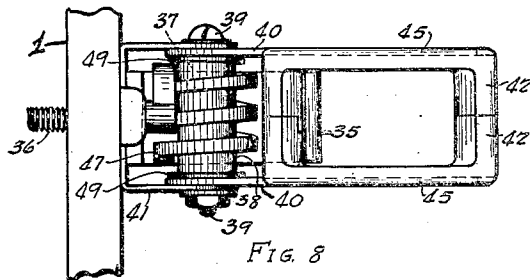
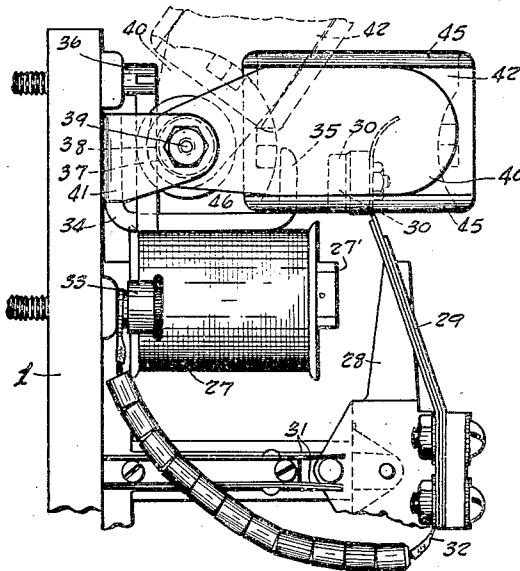


FIG. 8

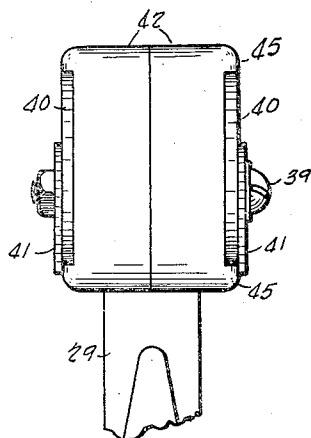


FIG. 9

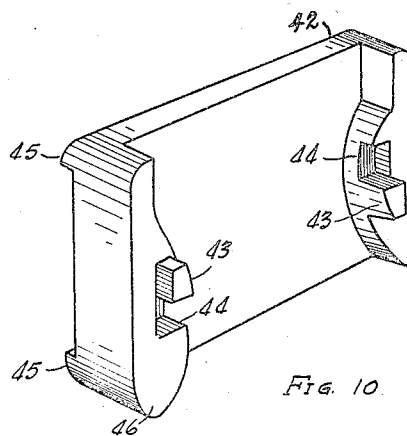


FIG. 10

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UNITED STATES PATENT OFFICE

1,997,772

ARC CONTROLLING STRUCTURE

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Application February 26, 1932, Serial No. 595,246

13 Claims. (Cl. 200—147)

My invention relates to arc controlling structure for switches, automatic circuit breakers, relays and equivalent circuit controlling mechanisms.

structure, with the barriers raised to position permitting removal;

Fig. 8 is a plan view of the barrier assembly, with the barriers in normal position;

Fig. 9 is a front view of the barriers and pole pieces in position;

Fig. 10 is a perspective view of one of the halves of the barrier structure.

The quick interruption of the arc formed at contact elements in switching mechanism, such as a circuit breaker, is essential to prevent damage, not only to the contact elements themselves, but to surrounding parts of the switch mechanism. The motion of the arc is frequently controlled or influenced by magnetic poles, usually disposed on either side of the contacts between which an arc may be formed, and the arc is moved upwardly, lengthened or extinguished by the action of the magnetic field between the pole pieces, provided the field is of proper direction. To establish the magnetic field, a coil, associated with core and pole pieces of magnetizable material, for example, iron, nickel-iron alloy and the like, is so disposed with respect to the switch contacts as to produce upon their separation the arc-controlling magnetic field.

In circuit breakers of the larger capacities, a strip of iron, which comprises the poles setting up the magnetic field for controlling the arc, may be located in a part turn of the arc circuit and embrace the arcing contacts. These poles must be protected from the arc, so that barriers of arc resistance material, for example asbestos with a suitable binder, are placed between the poles and the arc path. This barrier structure surrounds the arcing contacts and tips which after some use are burned by the arc; and the barrier structure is removable to permit cleaning or replacement of the contact elements.

Figs. 1 to 6 disclose one form of the invention. Referring to Fig. 1, a supporting panel 1 of insulation, for example slate, carries fixed main contact terminals 2 and 2' secured by bolts 3, 3' by means of which connection is made to the external circuit. The movable main contact element 4 is carried by an arm 5 pivotally mounted at 5a to a fixed bracket (not shown); the bridge 4 is moved into and out of engagement with the fixed terminals 2, 2' by means of the circuit breaker operating mechanism, not shown, but generically represented by the link member 7. The usual further appurtenances, such as electro-magnetic closing and tripping mechanism, common in the art, are not shown.

The secondary or auxiliary contact system com-

In accordance with my invention, the arc-controlling structure comprises magnetizable elements, disengageably attached to each other; more particularly a relatively fixed magnetizable element of the magnet system detachably engages pole structure, preferably a pair of poles; and more particularly the engaging portions of the relatively fixed and detachable elements are so formed that one element is received between flanges or clips on the other.

Further in accordance with my invention, the detachable magnetizable elements or poles are carried by or embedded in barrier structure, removably supported or positioned by the fixed magnetic structure; more particularly, and in accordance with one modification, the removable barriers have recesses through which an edge of the removable pole piece is exposed, and the exposed portion detachably engages clip structure on the yoke or fixed element of the magnet secured to the supporting panel.

In another modification, a barrier is slidably supported on a leg of a generally U-shaped magnet, and may readily be removed by sliding it in a given direction, as forwardly, until clear of the magnet legs; the barrier structure encloses the arc and preferably comprises identical halves, each of the character aforesaid, with complementary lugs and recesses to prevent relative sliding between the halves.

My invention relates to the features of construction, combination and arrangement of the character hereinafter disclosed and claimed.

To describe the invention, and for illustration of some of the different forms it may take, reference is had to the accompanying drawings, in which:

Fig. 1 is a side elevational view, partly in section, taken along the line 1—1 of Fig. 2, of a circuit breaker embodying one form of the invention;

Fig. 2 is a plan view, with certain parts omitted, partly in section on the line 2—2 of Fig. 1;

Fig. 3 is a detail of an interbarrier brace;

Fig. 4 is a detail of the magnet yoke employed;

Fig. 5 is a detail of a preferred form of magnet pole, removed from its enclosing barrier;

Fig. 6 is a perspective view of a barrier and enclosed magnet pole;

Fig. 7 is a side elevational view of a relay embodying a modified form of barrier and magnet

prises a fixed shunt contact 6 secured to the upper part of fixed terminal 2, and connected to a fixed arcing contact 8 of carbon or other suitable material. Cooperating with the fixed shunt contact 6 is a movable shunt contact 19 carried by an arm or housing 10, secured to the arm 5, which also carries the movable arcing contact 9, of carbon or equivalent, engaging contact 8. The contacts 9 and 19 are biased toward their respective fixed contacts 8 and 6 by spring means (not shown) or equivalent enclosed within the housing 10. The arcing tip 11, secured to the back of movable arcing contact 9, prevents the arc from flashing over into the housing 10, or from reaching the back of the movable contact structure.

The magnetic structure for influencing or extinguishing the arc comprises an iron yoke member 12, positioned back of the fixed secondary contact structure, as shown in Figs. 1 and 2, which terminates in flanges or lugs 17 at its sides, and has secured thereto a second plate member 13 of spring metal, which may be magnetizable, having spring clips or elements 16 correlated to the elements 17 to form therewith an arrangement, similar to the female terminal of a knife blade switch, to receive other elements 20 of the magnetic circuit.

Fig. 4 shows a yoke comprising nested members 12 and 13 with their edges 16 and 17 flanged and slotted to form resilient jaws. This yoke is secured to the panel 1 by screws 14 and the auxiliary fixed contacts 6 and 8 are secured to the yoke, by screws, as shown, or by other suitable means.

Fig. 5 shows one of the legs 20 of the magnet system, the edge 22 of which is inserted between the jaws 16 and 17 of the magnet yoke 12, the edges 22 overlapping the clip or flange elements 17, so that the plates 20 form magnetic poles on either side of the arcing contacts. Since the yoke 12 is in effect within a loop traversed by the current of the circuit breaker, there is produced a magnetic field between the disengageable poles 20. This field is greatly increased during the opening of the breaker when all the current is flowing through the arc drawn between contacts 8 and 9 for controlling or extinguishing the arc. This powerful field aids in stretching the arc. Each of the pole pieces 20 is slotted at 21 to reduce heating effect due to eddy currents induced in the pole plates 20 which is of importance when the switch is used to control an alternating current circuit. The slots further influence the distribution of the magnetic flux.

A barrier B is positioned on either side of the contact structure to confine the arc and is composed of refractory insulating material molded around the pole pieces 20 to protect the same from the destructive effects of the arc and to form therewith a unitary blowout structure. Each barrier has a recessed portion 15 in its base into which the edge 22 of pole piece 20 projects, the recess also receiving the jaws 16 and 17 of the yoke which are thereby completely enclosed and protected from the arc. One side 23 of the recessed portion is shorter than the opposite side in order to provide clearance for the yoke structure. The blow-out units are firmly secured in place, and are cross-braced with respect to each other by a strap member 24 extending between the outer ends of the units. This strap and the units are secured to the panel by bolts 25 having on their front ends manually operable grips 25a and thread into nuts 26 which are secured to the panel to prevent their turning. The bolts and units are therefore demountable from the front

of the panel without requiring access to either the back of the panel or the sides of the units.

Fig. 6 is a perspective view of one of the blow-out units, removed from the panel, and shows how the same may be lightened by providing a webbed portion W, the bolts 25 passing through holes in the outer end and base portions of the barrier. While the barriers B are shown as arranged in symmetrical pairs, they may also be duplicates and therefore interchangeable, as in the case of barriers 42 of Figs. 7-10.

Figs. 7 to 10 show a modification of the invention. Referring to Fig. 7 there is shown a relay mounted on panel 1, and comprising an electromagnetic winding 27, connected in a control circuit, not shown, adapted to actuate a pivotally mounted armature 28 which is resiliently restrained by means of springs 31 to the position shown. The armature carries the contact arm 29, supporting a movable contact 30, connected in circuit by means of a conductor 32 secured to a binding post or terminal 33. When the magnet coil 27 is energized, the relay armature 28 will, under certain conditions, be drawn towards the pole piece 27' to close the circuit controlled by the relay at contacts 30 and 35.

The fixed contact assembly of the switch or relay comprises a generally U-shaped copper bracket 34 having one leg secured to the supporting panel 1, the other leg forming the fixed terminal, aforesaid contact 35, and barrier support. One end of the magnetic blowout coil 47, shown in detail in the plan view of Fig. 8, is connected to bracket 34, and its other end to a binding post or terminal 36. The blowout coil has a magnetic core 37 preferably of iron, supported by the bracket 41 secured to and extending from the panel 1, and the core 37 passes through the coil and is insulated therefrom by a fiber bushing 38. Pivotaly mounted on the ends of the core, as by a screw 39, are flat pole pieces 40 of magnetizable material, overlapping the ends of the fixed magnetizable element or core 37, which are insulated from the coil 47 by the fiber washer 49. The pole pieces 40 in their normal position extend so that the contacts 30 and 35 open within, and the arc drawn between the contacts is extinguished by the magnetic field between the pole pieces.

A pair of barriers 42 of refractory insulating material enclose the contacts 30 and 35 on four sides to insulate and protect the pole pieces and coil from the arc, and are open at the top and bottom to receive the movable contact 35 and to provide a chute for directing the arc upwardly.

The barrier structure preferably comprises two identical halves which meet each other, as seen in the plan view of Fig. 8, and which have complementary lugs 43 and recesses 44, to prevent relative motion between the halves.

At the upper and lower edges of each half are outside flanges 45 which engage the top and bottom edges of the pole pieces 40, so that the pole piece and barrier assembly may be rotated as a unit about the pivot 39. The flanges 45 of the barriers are slidable on the edges of the pole pieces 40, and if the pole piece and barrier assembly is raised or rotated in a counter-clockwise direction, as viewed in Fig. 7, until the barriers clear the contacts 30 and 35, as indicated in dotted lines, the barriers may readily be removed by sliding them off the pole pieces 40 to afford free access to the contacts, for inspection, repair or replacement. The barriers may be replaced in position by sliding them along the pole pieces until they approach or touch the coil 47, and then

lowering or rotating the pole piece and barrier assembly until the inner barrier web 46 rests on the U-shaped bracket 34, as shown in Fig. 7, in which position the toe or contact 35 of the bracket holds and prevents the removal of the barrier.

The pole plate 20 and 40, of Figs. 2 and 7, respectively, as to some aspects of their function, determine the position of the magnetic field with respect to the arc, or determine the path of the magnetic flux with which the arc reacts.

In the example illustrated in Figs. 1-6 inclusive it will be noted that upon removal of the barrier structure from the panel or switchboard there is no part of the arc controlling structure as a whole, fixedly carried by the panel or switchboard, which extends outwardly from the front face of the board or panel materially beyond the fixed arcing contact 6.

Of all the arrangements hereinbefore described it is one of their aspects that each barrier structure comprises a plurality of barrier elements, so related to each other and to the magnetic elements, that, without tools, without need for lateral displacement of any of the magnetizable elements and without need for access to the rear of the panel or to either side of the barrier structure, it is demountable and removable forwardly from the switchboard or panel in a vertical plane normal to the vertical front face thereof, without need for lateral movement. This is of general advantage, and particularly of advantage where switches or circuit breakers provided with this structure are necessarily placed close to each other side by side upon the panel or switchboard. By the construction described even where the switches or circuit breakers thereof are so placed side by side upon the panel or switchboard, there is no need for access to either side of the removable barrier structure, since all manual operation essential for demounting the barrier structure is effected entirely from the front, and the removal of the structure is effected, as stated, entirely in a vertical plane normal to the front face of the board or panel. This structure has the further advantage that it may be removed without danger to the operator from, or interference with, adjacent circuit breakers or switches on the panel, and without danger from live parts of neighboring switches or circuit breakers.

What I claim is:

1. In combination, a support, separable contacts, one of which is secured to said support, between which an arc is drawn, magnetic blowout structure comprising a magnetizable pole element, magnetic means on said support by which said pole element is detachably engaged, means spaced forwardly from the point of engagement positively securing said pole element to said last-named means and manually releasable from the front of said pole element for permitting removal of said pole element by access substantially solely to the front thereof, said means on said support to which said pole element is secured projecting from said support to a distance not substantially exceeding the distance to which said fixed contact extends from said support.

2. In combination, a support, separable contacts, one of which is secured to said support, between which an arc is drawn, magnetic blow-out structure comprising a magnetizable pole element, magnetic means on said support by which said pole element is detachably engaged, means spaced forwardly from the point of engagement positively securing said pole element to

said last-named means and manually releasable from the front of said pole element for permitting removal of said pole element by access substantially solely to the front thereof, said means on said support to which said pole element is secured projecting from said support to a distance not substantially exceeding the distance to which said fixed contact extends from said support, and refractory means protecting said pole element from the arc comprising with said pole element a unit demountable from said support.

3. In combination with separable contacts, structure for controlling the arc drawn between said contacts comprising a fixed magnetizable element, a movable magnetizable pole element overlapping said fixed element to produce an arc-controlling magnetic field, and a member spaced from one of said elements to form therewith a clip in which the other of said elements is received.

4. In combination with separable contacts, structure for controlling the arc drawn between said contacts comprising a fixed magnetizable element, a coating magnetizable element, barrier structure by which said last-named element is carried, and means for removably securing said barrier element in fixed position with respect to said contacts with said magnetizable elements in coating relation to produce an arc-controlling magnetic field, said barrier structure having a recess in which the ends of said magnetizable elements meet in overlapping relation.

5. In combination with separable contacts between which an arc is drawn, a blow-out device comprising a fixed magnetizable element, pole pieces secured at opposite ends thereof, and duplicate barrier elements slidably received by said pole pieces and having interlocking surfaces preventing relative movement of said elements when in position on said pole pieces.

6. In combination with separable contacts between which an arc is drawn, a blow-out device comprising a fixed magnetizable element, pole pieces secured at opposite ends thereof, and interchangeable barrier elements slidably and individually received by said pole pieces and having interlocking surfaces preventing relative movement of said elements when in position on said pole pieces.

7. In combination with separable contacts between which an arc is drawn, a blow-out device comprising pole pieces, and opposed barrier elements detachably engaging said pole pieces, opposed surfaces of said barrier elements having projections provided with interlocking faces, said opposed surfaces and projections defining, respectively, side and end walls of an arc chamber, each barrier element being reversible and interchangeable with the other.

8. In combination with a circuit-controlling device having movable contact structure, individual blow-out units on opposite sides of the path of movement of said contact structure, each comprising an arc barrier and a magnetic member embedded therein, and a stationary magnetic bridging member detachably engaged by the magnetic members of said individual units.

9. In combination, a panel, a blow-out unit comprising an arc barrier and a magnetic element embedded therein, means carried by said panel detachably engaged by said element, said element and said means being constructed and arranged for removal of said unit from said panel by movement substantially solely normal to said panel, and means disposed at the front

of the unit effective positively to secure said unit to said panel.

10. In combination with separable contacts between which an arc is drawn, a fixed magnetizable member, and blow-out units detachably engaging opposite ends of said magnetizable member, each of said units being removable independently of the other of said units.

11. In combination with separable contacts between which an arc is drawn, a fixed magnetizable member, blow-out units detachably engaging opposite ends of said magnetizable member, each of said units comprising a barrier and a magnetizable element embedded therein, each of said units being removable independently of the other of said units by access solely to the front of said units.

12. In combination with separable, contacts

between which an arc is drawn, of a fixed magnetizable member, blow-out units each detachably engaging an end of said member, and means positioned at the front of said units positively securing them in position and manually releasable from the front of said units for permitting removal of said units by access substantially solely to the front thereof.

13. In combination, a support, separable contacts between which an arc is drawn, of a blow-out device comprising removable barrier units each having a recess, and magnetic structure carried by said support and disposed adjacent said separable contacts, said magnetic structures extending into said recesses detachably to receive said elements and to be protected from arcs between said contacts.

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