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CIRCUIT BREAKER CONTACT AND ARC EXTINGUISHING MEANS

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FIG. 1.

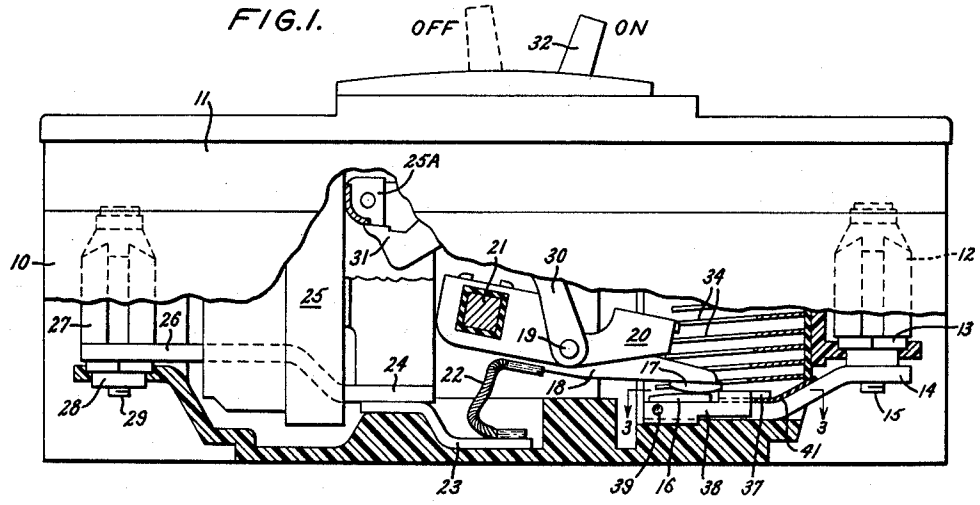


FIG. 2.

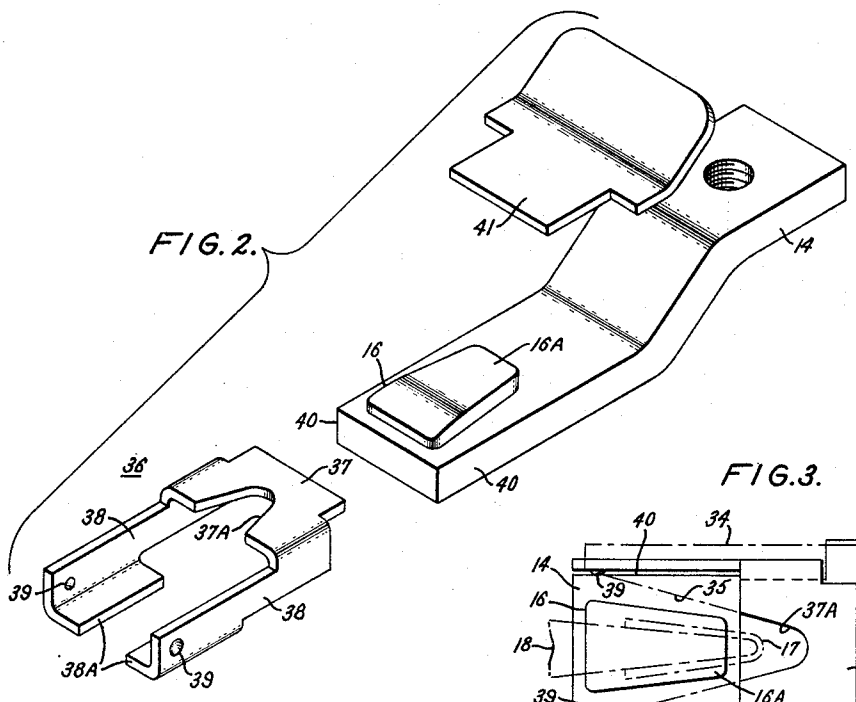
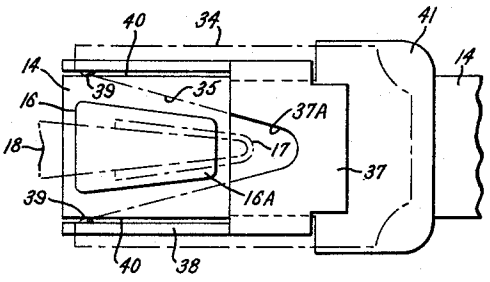


FIG. 3.



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CIRCUIT BREAKER CONTACT AND ARC EXTINGUISHING MEANS

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Our invention relates to contact and arc extinguishing assemblies, and particularly to such an assembly for use in electric circuit breakers which are required to interrupt high short-circuit currents.

A particularly effective known way of interrupting an arc is to move it into an arc extinguishing device or "arc chute" having a number of spaced metallic plates.

In attempting to interrupt higher short-circuit currents in such assemblies without increasing the overall size of the assembly, a particularly difficult problem is to cause the arc, once created, to move quickly away from its point of formation into the stacked arc chute plates so as to be quickly cooled and extinguished thereby. If such movement does not occur quickly enough, an undesirable amount of contact material is vaporized, and a large amount of ionized gases created, causing danger of restriking and of pole-to-pole or "three-phase" failure, with consequent complete destruction of the device.

This problem is especially acute in circuit breakers in which the relatively movable contacts are carried by the ends of elongated conductive members extending in substantially opposite directions from the area of meeting of the contacts, and therefore of generation of the arc. In such an arrangement, the current path while arcing is occurring is such that there is no definite tendency of the magnetic effects of the current path on the arc to move the arc in the desired direction.

It is an object of the present invention to provide a circuit breaker contact and arc extinguishing assembly which will cause the arc to move quickly away from its point of inception and into an array of stacked metallic plates, to cause rapid extinction thereby.

It is another object of the invention to provide means for moving an arc quickly into a series of arc extinguishing plates without the vaporization of an excessive amount of metallic material in the process.

In accordance with the invention in one form, there is provided a contact and arc extinguishing assembly comprising a movable contact and a stationary contact. The movable contact is carried by an elongated contact arm. The stationary contact is carried by an elongated terminal member, extending in a direction substantially opposite to that of the contact arm. Arc cooling and extinguishing means is provided adjacent the area of meeting of the contacts, comprising a series of stacked, spaced metallic plates, each having a notch cut therein from one edge. A magnetic arc runner is also provided having a first, generally U-shaped, portion including a bight portion extending substantially co-planar with the stationary contact, on one side thereof. The arc runner includes elongated side portions which extend alongside the aforesaid elongated terminal member and which have localized points of contact with the supporting terminal member at the end thereof.

In addition, the arc runner has an angular notch cut in the bight portion, whereby the arc can move an appreciable distance away from the contact proper before encountering the metallic material of the arc runner.

The invention will be more fully understood from the following detailed description, and its scope will be pointed out in the appended claims.

In the drawing,

FIGURE 1 is a side elevation view of an electric circuit breaker incorporating the invention, portions of the casing being cut away;

FIGURE 2 is an exploded perspective view of a stationary contact assembly as utilized in FIGURE 1, and

FIGURE 3 is a plan view taken generally on the line 3—3 of FIGURE 1.

In the drawing, the invention is shown in FIGURE 1 as incorporated in an electric circuit breaker comprising an insulating casing having a base 10 and a cover 11 of molded insulating material. The circuit breaker illustrated is a three-pole circuit breaker, that is, it is adapted to control electric current in three separate electric paths, each of said paths comprising a "pole" portion of the circuit breaker. For the purposes of the present invention, the current path through the central one of said poles only will be described. It will be understood, however, that the invention is equally applicable to single, two, or three-pole devices, the construction at the other poles being substantially identical.

An incoming line terminal 12 is provided, supported on the base 10 by an insert 13, connected to a first elongated terminal member 14 by suitable means such as by a screw 15. The terminal member 14 carries a stationary contact 16, which is adapted to be contacted by a movable contact 17 which is carried by a second elongated conductor in the form of contact arm 18. The contact arm 18 is pivotally supported by suitable means such as by a pivot pin 19, on a main contact arm 20. The contact arm 20 is attached to a contact cross-arm 21 by suitable insulated means, not shown, which serves to gang together all the corresponding contact arms of the poles of the circuit breaker. The contact arm 18 is connected by a suitable flexible connector 22 to a conductor 23, which in turn is connected to an input terminal 24 of a current responsive assembly or "trip unit" 25. The trip unit 25 has an outgoing or load terminal strap 26 which is connected together with a load terminal 27 to an insert 28 by suitable means such as by a screw 29.

All of the contact arms 18 are adapted to be moved between open and closed circuit positions by suitable operating mechanism, not shown, including an operating link 30 and a releasable member 31 releasably engaged by a latch portion 25A of the trip unit 25. The operating mechanism is adapted to be operated manually by means of a manually engageable handle member 32 projecting through an aperture in the top wall of cover 11. The trip unit 25 contains current responsive means for releasably retaining the member 31 in latched condition as shown. Upon the occurrence of predetermined current conditions, the member 31 is released, causing automatic opening of the contacts. The releasable member 31 is adapted to be re-engaged with the trip unit 25 following tripping, by movement of the manually operable handle 32 to its "off" position, indicated in dotted lines.

For the purpose of aiding in the cooling and extinction of the arc, a series of stacked spaced metallic plates 34 are provided. Each of said plates is generally rectangular and has a generally V-shaped notch 35, see FIGURE 3, cut therein from one edge. The plates 34 are supported in superimposed spaced or stacked relation by suitable means, not shown, such as an insulating fiber supporting wall at their outer edges.

As shown particularly in FIGURE 2, the elongated conductor 14 which supports the stationary contact 16 is provided with a magnetic arc runner indicated in FIGURE 2 generally at 36. The arc runner 36 is generally U-shaped, having a bight 37, which is generally co-planar with the contact 16 when the parts are assembled, see FIGURE 1. Connected to the bight portion 37 are elongated side extensions 38 which extend along opposite side edges of the conductor 14 to a point adjacent the

end of the conductor 14 which supports the contact 16. The bight portion 37 is generally co-planar with the contact 16 and is positioned on the side of the contact 16 in which it is desired to move the arc.

The extensions 38 are provided with projections 39, which contact opposite side edge portions 40 of the conductor 14 adjacent the contact-supporting end. The bight portion 37 also has a generally U-shaped notch 37A cut therein. The bight portion 37 is insulated from the corresponding portion of the conductor 14 by suitable means such as by an insulating spacer 41.

In operation, upon the occurrence of high short-circuit currents, it has been found that the arc is moved quickly from its point of inception, in the area 16A of the contact 16 outwardly onto the bight portion 37 of the arc runner 36 and then into the spaced arc chute plates 34, quickly extinguishing the arc.

For example, a circuit breaker of the type shown incorporating the invention, rated at 225 amperes nominal rating, when tested in a power system capable of delivering 14,000 peak amperes at 600 v. under short-circuit conditions, the short-circuit was interrupted successfully within one cycle. Under the same test, the same circuit breaker, using conventional types of arc runners either failed completely to pass the required testing by reason of destruction of the device, or caused so much burning and damage to the circuit breaker, including vaporization and scattering of molten particles, as to render the breaker unusable thereafter.

While the specific phenomena occurring during the process of arc interruption is difficult to state with assurance of accuracy, it is believed that the arc runner 36, being of generally U-shaped configuration, and surrounding the stationary contact 16 on three sides, serves to draw the arc toward the bight portion of the U by its magnetic action. At the same time, vaporization and scattering of molten metal particles is avoided by the fact that no part of the runner 36 is close to the contact 16, especially in the immediate neighborhood in which the arc is first created. Thus, in this vicinity, the arc runner 36 comprises only the side portions 38 and the bent-over flanges 38A, neither of which is exposed directly to the newly formed arc.

It is an important feature of the invention that, since the arc runner 36 is insulated or spaced from the conductor 14 at its bight portion 37A but in contact at the ends of the extensions 38, the current path, when the arc is on the bight portion 37, is along each of the opposite sides 38 to the points of connection 39, 40, with the conductor 14 and thence outwardly toward the line terminal end of the conductor 14. Thus the current follows an accentuated U shape at this time, which further intensifies the magnetic action, driving the arc further into the arc cooling and extinguishing plates 34. The existence of this current path is evidenced by the fact that in short-circuit testing, the projections 39 often become welded to the conductor 40 by the action of the current.

While the invention has been shown in one particular embodiment, it will be readily appreciated that many modifications thereof may readily be made, and we therefore intend by the appended claims to cover all such modifications as fall within the true spirit and scope of the invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. A contact and arc extinguishing assembly comprising:

(*a*) a pair of relatively movable contacts movable into and out of engagement with each other,

(*b*) an elongated conductor,

(*c*) at least one of said contacts being carried by one end portion of said conductor,

(*d*) a generally U-shaped arc runner carried by said conductor adjacent said one contact, said arc runner having a bight portion extending across said conductor on the side of said contact away from said end of said conductor,

(*e*) said bight portion having bent over side-portions extending along each side of said conductor to said end of said conductor, and

(*f*) said arc runner having a portion of said bight portion cut away whereby said arc runner serves to draw an arc toward said bight portion without vaporization or melting of metallic material of said runner.

2. A contact and arc extinguishing assembly comprising:

(*a*) a movable contact,

(*b*) a relatively stationary contact,

(*c*) a conductive terminal strap supporting said stationary contact at one end thereof,

(*d*) a generally U-shaped arc runner carried by said terminal strap comprising a bight portion extending across said conductor adjacent said contact on the side thereof opposite said end portion,

(*e*) said arc runner having side portions extending along opposite edges of said conductor to a point adjacent the end of said conductor, and

(*f*) means insulating said bight portion of said arc runner from said elongated conductor

(*g*) whereby the current path when an arc is in contact with said bight portion is such as to comprise a return-bent portion tending to move said arc away from said one end of said conductor, said bight portion having a portion thereof cut away to reduce melting and vaporization of metal of said runner by said arc.

3. An electric switch comprising:

(*a*) an insulating casing,

(*b*) a first elongated conductor mounted in said casing,

(*c*) a relatively stationary contact mounted on said first conductor adjacent one end thereof,

(*d*) an elongated contact arm pivotally mounted at one end in said casing,

(*e*) a relatively movable contact carried by said contact arm at the end thereof remote from said pivotally mounted end,

(*f*) said contact arm and said first conductor extending in opposite directions from the area of meeting of said contacts,

(*g*) a plurality of spaced metallic plates supported adjacent said relatively stationary contact, said plates having aligned notches cut therein from one edge thereof, said relatively movable contact being movable within the space defined by said notches,

(*h*) a generally U-shaped arc runner carried by said first elongated conductor, said arc runner comprising a bight portion extending across said conductor substantially co-planar with said stationary contact,

(*i*) said arc runner including a pair of elongated side portions extending along opposite edges of said first conductor, means insulating the bight portion of said arc runner from said elongated conductor, means electrically connecting the extremities of said side portions to said conductor adjacent said meeting area of said contacts, and

(*j*) said bight portion of said arc runner having a portion cut away in the direction of said first elongated conductor,

(*k*) whereby an arc generated between said relatively movable and stationary contacts is attracted toward said bight portion and into said arc extinguishing and cooling plates without melting a substantial amount of metal of said arc runner.

No references cited.