

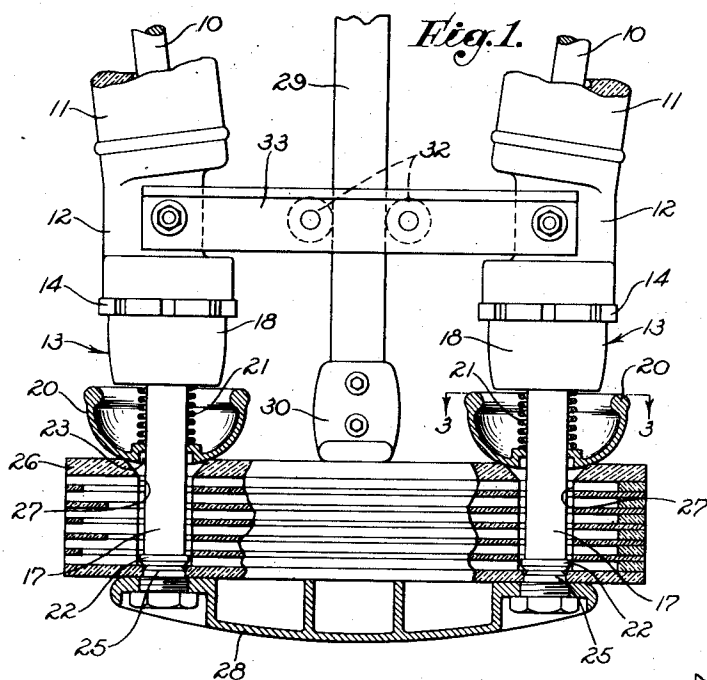
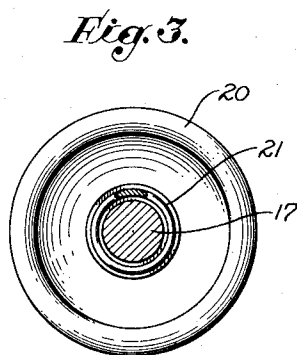
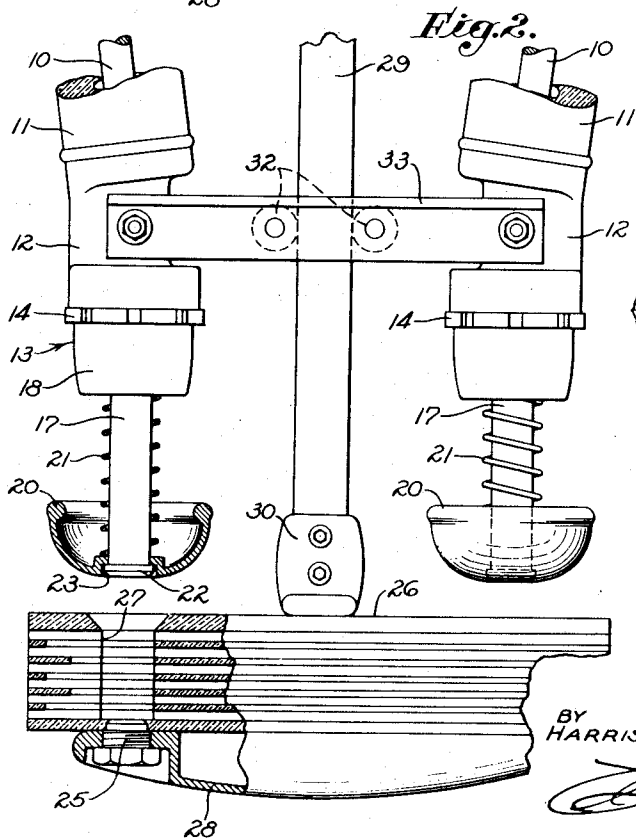
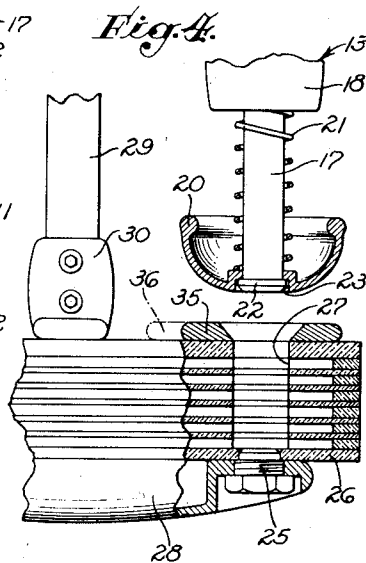
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SHIELDED CONTACT CONSTRUCTION FOR CIRCUIT BREAKERS

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SHIELDED CONTACT CONSTRUCTION FOR
CIRCUIT BREAKERS

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6 Claims. (Cl. 200—144)

My invention relates to circuit breakers and the like, particularly the contact structure of a circuit breaker, and is directed to improved means to facilitate the opening of a circuit breaker and to prevent flashover across the contacts when in open position.

The breakdown voltage between two contacts across a given dielectric depends not only upon the distance separating the contacts, but also upon the shape and dimensions of the contacts. If the distance between the two contacts is relatively great for a given potential difference, distance is the predominating factor, and the shape and dimensions of the contacts may ordinarily be neglected. For example, if the contacts of a circuit breaker separate by as much as 40 inches, the distance will govern, even in circuits carrying currents at high potential. In the advance of the circuit breaker art, emphasis has shifted to speed of operation, and to make it possible to open a high voltage circuit in a fraction of a second, the distance of separation may be reduced to as little as four inches, reliance for breaking the circuit being placed on new methods of quenching arcs rather than distance of separation. At such limited spacing of the contacts, however, the shape and dimensions of the separated members may be the factors that determine the likelihood of flashover.

A general object of my invention is to minimize the dielectric flux density between the open contacts of a circuit breaker by attention to the shape and dimensions of the charged elements of the circuit and of associated conductors in the dielectric of the circuit breaker. Such attention to shape leads to spherical configurations, and other shapes providing smooth surfaces of lateral expansiveness.

Such shapes, however, are incompatible in the case of most circuit breakers with the requirement that at least one of each pair of contacts be elongated to enter longitudinally a relatively restricted passage in some arc-quenching means. An important object of my invention is to provide a construction to resolve in a contact construction the conflict between design for distribution of electrostatic stress and design for cooperation with an arc-quenching member. More specifically, my object is to provide a contact assembly having an elongated configuration in a closed position of the circuit breaker and a configuration presenting laterally extending surfaces at the leading end of the contact assembly in the open position of the circuit breaker.

In one of the forms of my invention, in addition

to relying on the shape of the contacts and elements connected thereto, it is my object to insert additional elements in the electrostatic field of the contacts to provide a condenser grouping, by means of which grouping dielectric lines of force are diverted from paths that might, in the operation of the circuit breaker, develop lowered resistance to flashover.

A further object of my invention is to provide a contact construction incorporating yielding means to accelerate the opening movement of the circuit breaker.

Other objects and advantages of my invention will be apparent from the detailed description to follow considered with the accompanying drawing, in which:

Fig. 1 is a view partly in section of a portion of a circuit breaker pertinent to my invention, the contacts being shown in the closed circuit position;

Fig. 2 is a similar view with the contacts in open circuit position;

Fig. 3 is a section taken as indicated by the line 3—3 of Fig. 1; and

Fig. 4 is a fragmentary view similar to Fig. 2, indicating the construction of a modified form of my invention.

The specific forms of my invention chosen for the purposes of disclosure will be described as incorporated in a circuit breaker of the type disclosed in my copending application, Serial No. 146,786, filed June 7, 1937, entitled "Method of and apparatus for interrupting an electric circuit." It will be understood that the principles of the invention may be applied to other types of switching devices as well.

In Figs. 1 and 2, two conductors 10 in the circuit to be controlled extend downwardly through porcelain tubes 11 in the circuit breaker. The conductors may terminate in end members 12 to which are adjustably threaded contact units 13 having lock nuts 14. These contact units, as described in my copending application, Serial No. 150,662, filed June 28, 1937, entitled "Yielding contact unit," include elongated contact elements 17, which contact elements are yieldingly mounted in bodies 18 but may, nevertheless, be referred to as comprising the fixed set of contacts of the circuit breaker.

Slidably mounted on each of the contact elements 17 is an electrostatic shield 20 that is continuously urged toward the leading end of the contact by yielding means such as a helical spring 21 embracing the contact and compressed between the shield and the body 18 of the contact

unit. To limit outward movement of the shield 20, the leading end of the contact element 17 is enlarged to provide an annular shoulder 22, the shield having a recess 23 complementary to the shoulder, such that the shield and the end of the contact present a substantially continuous smooth surface in the open position of the circuit breaker, as indicated in Fig. 2.

The complementary set of movable contacts 25 are carried by a movable arc-quenching member 26, each of the movable contacts being in a passage 27 positioned and dimensioned to receive the corresponding fixed contact 17. The conductor 28 interconnecting the movable contacts 25 is for the purpose of my invention relatively extensive in lateral dimensions to serve as a shielding means or means for distributing dielectric stress.

The arc-quenching member 26, which is at all times immersed in a body of liquid dielectric such as oil, is connected to an operating rod 29 of non-conducting material by a suitable bracket means 30. The operating rod 29 is caused, by suitable actuating mechanism (not shown), to reciprocate longitudinally between two guide rollers 32 carried by a cross bar 33 that interconnects the two end members 12.

The operation of the invention will be apparent from the foregoing construction. When the circuit breaker is in closed circuit position, the contacts 17 yieldingly abut the contacts 25 in the passages 27 of the arc-quenching member 26, the shields 20 being held in retracted position by impingement against the arc-quenching member, as shown in Fig. 1. As soon as the downward movement of the rod 29 moves the arc-quenching member clear of the fixed contacts 17 to open the circuit, the springs 21 move the shields 20 to the leading ends of the contacts 17, with the result that, in the open position of the circuit breaker, the contact assembly and the associated elements have the configurations and disposition shown in Fig. 2, which configurations and disposition discourage concentration of dielectric flux and tend to prevent flashover from any voltage surge caused by circuit interruption or some abnormal condition. In the absence of the shields 20, with an ordinary narrow conductor interconnecting the contacts 25, dielectric lines of force would tend to be concentrated in the paths between cooperating contacts and between the fixed contacts 17 that remain connected with the circuit. With the addition of the shields 20, however, and the substitution of the laterally extensive conductor 28 for the usual narrower conductor, the dielectric lines of force are distributed more uniformly and there is less likelihood of flashover, even if carbon deposits in the arc-quencher offered paths of lowered resistance.

In the operation of a circuit breaker of the type under consideration, the contact-receiving passages 27 are subjected to high temperature arcs every time the circuit breaker operates with the resulting tendency for carbon to form along the interior walls of the arc-quencher. The primary object of the second form of my invention shown in Fig. 4 is to divert at least some electrostatic flux from this passage, thereby keeping the flux density along the passage low relative to the resistance offered by the carbon path.

The construction shown in Fig. 4 differs from the construction previously described solely in the addition of electrostatic shielding means in the form of metal bodies 35 on the exterior of the arc-quenching member 26 in positions asso-

ciated with the entrances to the passages 27. It will be apparent to those skilled in the art that in the open position of the modified circuit breaker, a condenser group is formed by the two shields 20, the shield 28 and the metal bodies 35, the contacts 17 being considered as parts of the shields 20, and the contacts 25 being considered as parts of the shield 28. Preferably, the bracket 30 will also be of metal to cooperate with the metal bodies 35 to divert electrostatic flux. It will be apparent that the farther each of the two bodies 35 is extended toward the bracket member 30, as indicated by the dotted line at 36 in Fig. 4, the greater the diversion of electrostatic stress from a path through the arc-quenching member 26, especially if the bracket 30 is made of metal.

A valuable feature of my invention is the fact that the springs 21 accelerate the opening movement of the circuit breaker. The importance of this feature will be apparent if it is borne in mind; first, that by associating the yielding means with the zone of contact separation, as contrasted with incorporating the spring in the actuating mechanism of the circuit breaker, I am enabled to achieve a given effect with relatively light spring means, and; second, that since the speed with which a spring acts varies inversely as its mass, the speed or action of only a relatively light spring will act with a speed commensurate with the desired rapidity of circuit breaker operation.

Although I have described particular forms of my invention in specific detail for the purpose of this disclosure and to illustrate the principles involved, I am aware that substantial changes and modifications may be made without departing from the spirit of my invention; I reserve the right to all such changes and modifications that properly come within the scope of my appended claims.

I claim as my invention:

1. In a device of the character described, the combination of: a pair of cooperative contacts; an electrostatic shielding means associated with each of said contacts; and a body of conductive material spaced from both the contacts and their associated shielding means to divert electrostatic stress from between the two contacts when in open position.

2. An electric circuit breaker comprising a pair of relatively movable contacts, electrostatic shielding means associated with at least one of said contacts, and a conducting body positioned intermediate and in spaced relation to each of said contacts in the open circuit position thereof for diverting electrostatic stress.

3. In a device of the character described, the combination of: a set of contacts; a second set of contacts forming with said first set at least two cooperative pairs of contacts, said sets of contacts being adapted for relative movement to open and close a circuit; shielding means associated with the first set of contacts; shielding means associated with the second set of contacts; and intermediate shielding means forming with the first two shielding means a condenser group when the circuit is open for the purpose of lowering electrostatic stress across said pairs of contacts.

4. In a device of the character described, the combination of: two pairs of contacts adapted to open and close for making and breaking a circuit; electrostatic shielding means fixedly related to one contact of each of said pairs; electrostatic shielding means associated with the other contacts of said pairs; and an intermediate means

of conductive material independent of all the contacts to relieve electrostatic stress across each pair of contacts by setting up a condenser effect between said pairs of contacts.

- 5 5. In a device of the character described, the combination of: a set of contacts; a second set of contacts forming with said first set at least two cooperative pairs of contacts, said sets of contacts being adapted for relative movement to
10 open and close a circuit; arc-quenching structure fixedly associated with one of said sets of contacts, said structure having passages to receive the other set of contacts; electrostatic shielding means fixedly associated with the set of con-
15 tacts that is associated with said arc-quenching structure; electrostatic shielding means yieldingly associated with the other set of contacts to be retracted by said arc-quenching structure at the closed positions of the contacts; and means in-
20 cluding conductive material mounted on said arc-quenching structure intermediate said sets of contacts to set up a condenser effect between pairs of said contacts to reduce electrostatic stress between contacts along said passages.
- 25 6. In a device of the character described, the

combination of: a set of contacts permanently connected in a circuit; a second set of contacts forming with said first set at least two cooperative pairs of contacts, said sets of contacts being adapted for relative movement to open and close
5 a circuit; electrostatic shielding means interconnecting the contacts of said second set; arc-quenching structure fixedly associated with said second set of contacts, said structure having pas-
10 sages to receive the first set of contacts; individual electrostatic shields retractably associated with said first set of contacts; yielding means to urge said individual shields towards the ends of their associated contacts when the two sets of
15 contacts are separated, said individual shields being adapted to be retracted by impingement against said arc-quenching structure when the two sets of contacts are together; and means of conductive material mounted on said arc-quench-
20 ing structure to reduce electrostatic stress across each pair of contacts in their open-circuit positions by diverting the electrostatic stress towards an adjacent pair of contacts.

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