April 15, 1947. H. D. DORFMAN ET AL 2,419,125

CIRCUIT BREAKER

Filed June 24, 1941 2 Sheets-Sheet 1

Fig. 1.

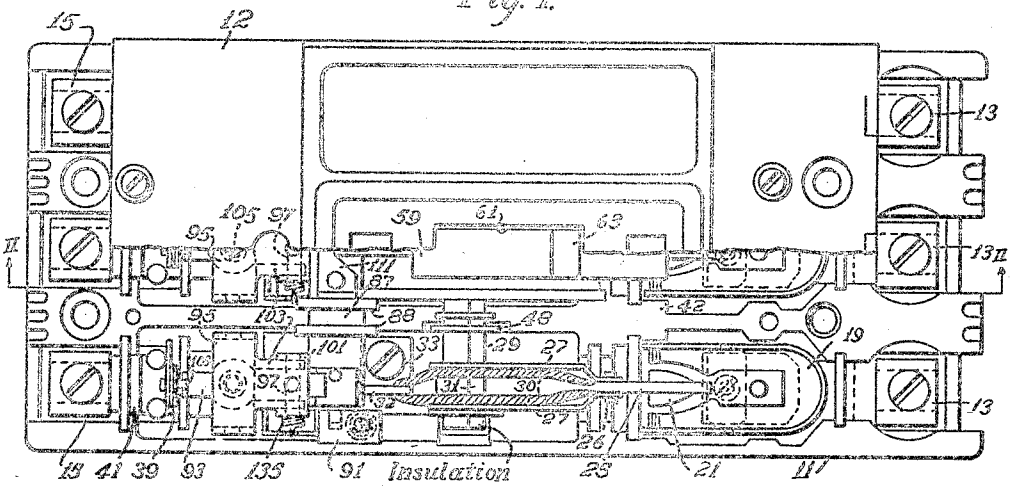
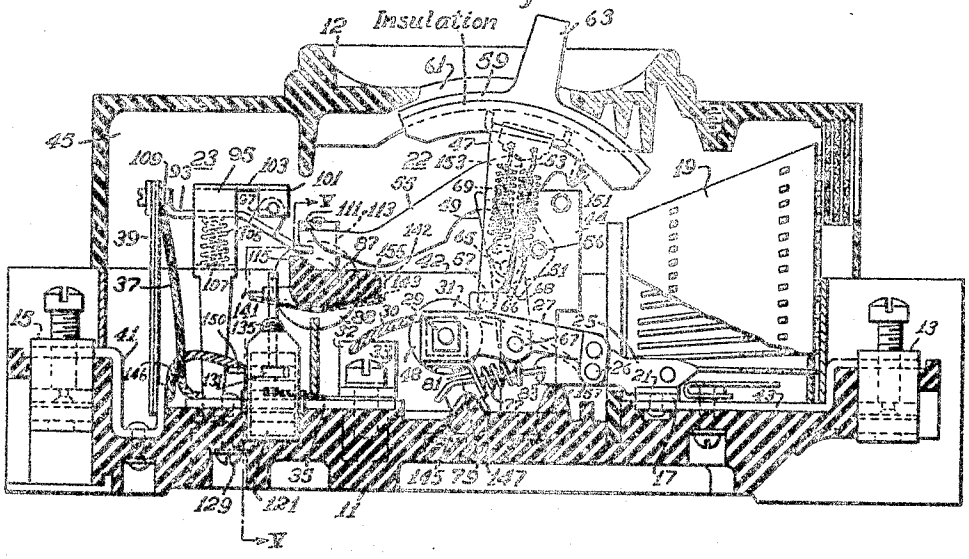


Fig. 2.



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Filed June 24, 1941 2 Sheets-Sheet 2

Fig. 3.

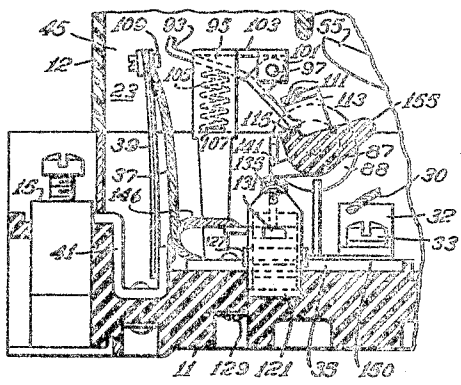


Fig. 4.

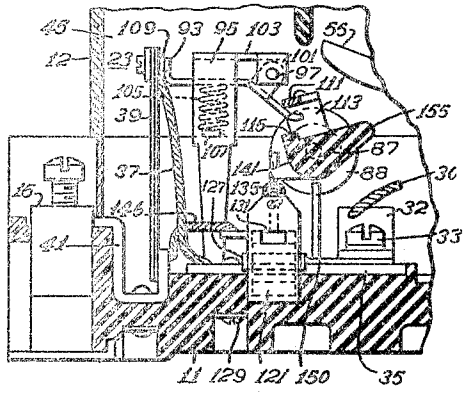
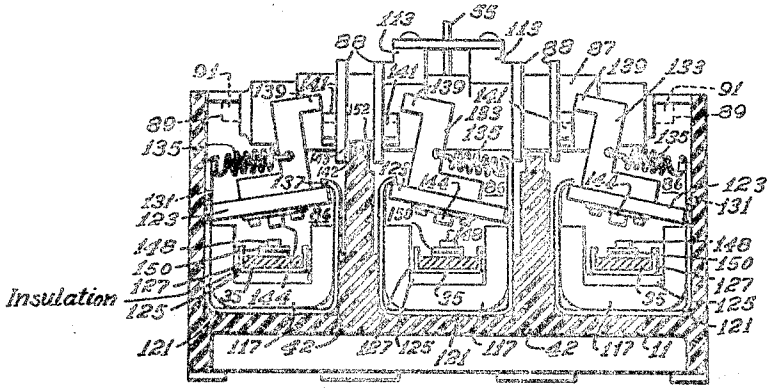


Fig. 5.



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2,419,125

UNITED STATES PATENT OFFICE

2,419,125

CIRCUIT BREAKER

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Application June 24, 1941, Serial No. 399,457

11 Claims. (Cl. 200—107)

1

This invention relates to circuit breakers and more particularly to multipole circuit breakers of the type which are tripped instantaneously on overload currents of predetermined magnitude and after a time delay on lesser overloads.

Certain features disclosed but not claimed in the application are fully disclosed and claimed in copending divisional application Serial No. 536,138, filed May 18, 1944, by H. D. Dorfman and G. J. Freese and assigned to the assignees of the instant invention.

One object of the invention is to provide a compact circuit breaker of improved construction which is simple and inexpensive to manufacture, and safe and reliable in operation.

Another object of the invention is to provide a multipole circuit breaker with improved means for electrically isolating the several poles from each other to prevent flashover between adjacent poles.

Another object of the invention is to provide a multiple pole circuit breaker having insulating partitions forming a separate compartment for each of the poles of the breaker and in which the parts common to all of the poles are provided with improved means cooperating with the partitions to electrically isolate adjacent poles.

Another object of the invention is to provide a multipole circuit breaker with an improved trip member of one piece moulded construction having a plurality of members moulded integral therewith cooperating with a partition wall forming separate compartments for the several poles of the breaker to more completely isolate adjacent compartments against flashover.

Another object of the invention is the provision of a circuit breaker having a trip device operated by a spring actuated trip member which is normally restrained by a thermally responsive bimetal element, also operated by an electromagnet which is arranged so that the air gap of the electromagnet can be relatively small without limiting or interfering with the resetting movement of the trip device.

Another object of the invention is the provision of a circuit breaker having a rotatably mounted trip element, a spring actuated tripping lever normally restrained by a thermally responsive bimetal element and which is releasable to move the trip element to trip the breaker and which is resettable by a reverse movement of the trip element, in combination with a hinge type electromagnet operable at times to move the trip element to trip the breaker, the electromagnet having a small air gap and being disposed so that it does not limit or interfere with resetting movement of the trip element.

Another object of the invention is the provision of a multipole circuit breaker having a rotatably mounted trip bar which is biased to a normal

2

or latching position by having a flattened portion which cooperates with a spring wire or leaf spring which is supported at the ends in a recess in one of the partition walls of the circuit breaker housing so that it is protected from the heat and flame of the arc.

Another object of the invention is to provide a circuit breaker with an improved magnetic trip device having an armature disposed for operation in a plane parallel to the axis of a trip member and engageable with a projection on said member, said armature being normally out of the path of said projection to permit movement of the trip member to reset the trip device.

The novel features that are considered characteristic of the invention are set forth in particular in the appended claims. The invention itself, however, both as to structure and operation, together with additional objects and advantages thereof, will be best understood from the following detailed description of one embodiment thereof when read in conjunction with the accompanying drawings, in which:

Figure 1 is a front elevational view of the breaker with a part of the cover broken away to more clearly show some of the parts;

Fig. 2 is a vertical sectional view of the circuit breaker taken on line II—II, Fig. 1, and looking in the direction of the arrows, the breaker being shown in closed circuit position;

Fig. 3 is a detailed view of the trip device with the trip bar operated in response to operation of the thermal element;

Fig. 4 is a detailed view of the trip device with the trip bar operated by the electromagnetic trip means; and

Fig. 5 is a sectional view taken substantially along the line V—V of Fig. 2 and showing the assemblage of the electromagnets and the trip bar.

Referring to Figures 1 and 2 of the drawings, the circuit breaker includes a base 11 of moulded insulating material on which the several elements of the breaker mechanism are mounted. A cover 12 also of moulded insulating material is removably secured to the base and cooperates therewith to form an enclosing housing for the breaker mechanism.

The circuit breaker is of the multipole type, each pole comprising a pair of terminals 13 and 15, one disposed at each end of the breaker, a stationary contact 17, an arc extinguisher 19, and a movable contact 21. A common operating mechanism indicated generally at 22 is provided for simultaneously actuating the three movable contacts to open or to closed position, and a trip device indicated generally at 23 serves to effect automatic opening of the three sets of contacts in response to predetermined overload conditions in the circuit through any pole of the breaker.

Each of the movable contacts 21 is mounted on a contact arm 25 pivotally supported intermediate its ends on the free end of a pair of switch arms 27 by means of a pivot pin 26. The arms 27 for all of the poles are mounted on a rectangular tie bar 29 of insulating material, and each pair of the arms 27 are joined by a rectangular sleeve 31 surrounding the tie bar and secured thereto so that said tie bar and all of the switch arms 27 rotate as a unit, the tie bar being pivotally supported in the side walls of the breaker. The tie bar 29 extends transversely across the three poles of the breaker.

A flexible shunt conductor 30 connects the contact arm 25 with an angular terminal 32 secured by a screw 33 to one end of a conductor 35. The screw 33 also serves to secure the conductor 35 to the base 11. The other end of the conductor 35 is connected by a flexible conductor 37 to a point near the free end of a thermally responsive bimetal element 39. The other end of the bimetal 39 is rigidly secured to the inner end of a conductor 41, the terminal 15 being secured to the outer end of said conductor. Each of the stationary contacts 17 is mounted on the inner end of a conductor 43 having its outer end connected to the terminal 13.

The electrical circuit for each of the poles is essentially the same and extends from the terminal 13 through the conductor 43, stationary contact 17, the movable contact 21, the contact arm 25, the flexible shunt conductor 30, the terminal 32, the conductor 35, the flexible shunt conductor 37, the bimetal element 39 and the conductor 41 to the terminal 15.

Each of the three poles of the breaker is contained in a separate compartment formed by barriers 42 (Figs. 1, 2, and 5) moulded integral with the base 11 and extending the length of the breaker. These barriers 42 are in alignment with similar barriers 45, (Fig. 2) moulded integral with the cover 12 so that when the cover is in place the barriers 42 and 45 serve to insulate each compartment from the adjacent compartments and prevent flashovers.

The tie bar 29, which extends across all three poles of the breaker, is provided with annular flanges 48 disposed in recesses in the sides of the barriers 42 to prevent flashover through the openings in the barriers 42 and 45 provided to accommodate the tie bar.

The operating mechanism for the breaker illustrated generally at 22 (Fig. 2) is disposed in the compartment housing the center pole and is supported on a pair of frames 44 secured to the center part of the base 11. The operating mechanism includes a forked operating lever 47, a toggle comprising links 49 and 51, a pair of overcenter springs 53 and a releasable cradle 55 controlled by the trip device 23. The cradle 55 is pivotally supported on the frame 44 by a pivot pin 56. The inner ends of the forked operating lever 47 are rounded and are pivotally seated in recesses in the frame 44 as indicated at 57. An insulating shield 59 for covering an opening 61 in the cover 12 is mounted on the outer end of the operating lever 47 and a manual operating handle 63 integral with said shield projects through the opening 61 to permit manual operation of the breaker mechanism.

The toggle links 49 and 51 are pivotally connected together by a knee pin 65. The link 51 is pivotally connected by a pivot pin 67 to the pair of switch arms 27 for the center pole, and the end of the link 49 is bifurcated and pivotally engages a stud 69 on the cradle 55 being retained in engagement therewith by the tension exerted by the overcenter springs 53 between the knee pin 65 and the outer end of the operating lever 47.

The overcenter springs 77, operatively associated with the contact arms 25, surround contact arm operating members 79 and are compressed between angular brackets 81 secured to the pivoted ends of the arms 27 and shoulders 83 on the members 79. The springs 77 hold the ends of the members 79 in engagement with recesses in the inner ends of the contact arms 25. The members 79 and the contact arms form toggles for operating the contact arms 25.

As previously mentioned, the trip device 23 includes a bimetal element 39 for each of the poles of the breaker, said bimetal elements being connected in series in the circuit of their respective poles. The trip device also includes a series overload magnet 86 (Fig. 5) for each pole, and a trip bar 87 common to all of the poles. The trip bar 87 is of one piece moulded insulating material and is pivotally supported by means of pins 89 moulded in axial alignment in the ends of the trip bar and which rotatably support said bar in bearings 91 (Figs. 1 and 5) in the side walls of the circuit breaker housing.

The trip bar 87 extends across the three poles of the breaker through openings provided therefor in the barriers 42 and 45. In order to more completely insulate the compartments, the trip bar 87 is provided with a plurality of flanges 88 moulded integral with said trip bar and disposed one on each side of each of the barriers 42 and 45. These flanges are positioned close to the barriers and effectively prevent flashover through the opening provided in the barriers for the trip bar 87. Each pole of the breaker is provided with a latch lever 93 pivotally supported on a U-shaped frame 95 by a pivot pin 97. The frame 95 of each pole is suitably secured to the base 11 and is separate from the frames 95 of the other poles. The pivot pin 97 which supports the latch lever 93 is mounted in a pair of ears 101 formed on a projection 103 of the frame 95. A spring 105 compressed between a bar 107, supported in openings in the legs of the frame 95, and the latch lever 93 biases said lever in a clockwise or tripping direction. The latch lever 93 is normally prevented from rotating in a tripping direction by engagement of the latch end thereof with a latch 109 on the free end of the bimetal 39.

A latch member 111 secured to projections 113 moulded integral with the trip bar 87 normally engages the latch end of the cradle 55 and thereby restrains the cradle in operative position.

When the bimetal element 39 for any one pole is heated a predetermined amount in response to an overload current, it flexes in a direction to move the free end thereof toward the left (Fig. 2) and after a time delay unlatches the lever 93, whereupon the spring 105 rocks said lever in a clockwise direction. During this movement the end of the lever 93, disposed above a projection 115 moulded integral with the trip bar, strikes said projection and rocks the trip bar 87 counterclockwise causing the latch 111 to release the cradle 55. This permits the overcenter springs 53 to actuate the operating mechanism and open the contacts as will be more fully described later.

The trip device is also operated electromagnetically by means of the electromagnet 86 to instantaneously trip the breaker upon the occur-

rence of a heavy overload, for instance, 1000% or more of rated current or on short circuits in the circuit of any pole of the breaker.

For this purpose each pole of the breaker is provided with an electromagnet 86 including a U-shaped magnet core 117 (Fig. 5) mounted between the barriers 42 moulded integral with the base 11. A U-shaped magnet frame 121 spaces the core 117 from the base 11 and, at its upper ends, forms a mounting for an armature 123.

The conductor 35, which is secured to the base 11 by means of the screw 33 and a screw 129, extends through the U-shaped core 117 and thus secures the magnet unit to the base, the inner surface of the base being recessed to receive core 117 and magnet frame 121 as shown in Fig. 2. A spacer 125 is provided to space the conductors 35 from the magnet core and a channel-shaped length of insulation 127 between the conductor 35 and the spacer 125 insulates the core 117 from the conductor. Since the current flowing through the circuit of each of the poles traverses the conductors 35 said conductors serve to energize the electromagnets 86.

The armature 123 is pivotally mounted by means of a reduced portion 131 thereof projecting into an opening in one leg of the U-shaped magnet frame 121. A spring 135, having one end connected to a member 133 on the armature and its other end anchored on the one leg of the magnet frame, biases the armature 132 to its unattracted position. A cam 139 on the member 133 is adapted to engage an arm 141 moulded integral with the trip bar 87 upon energization of the electromagnet and cam the trip bar 87 counterclockwise (Fig. 2) to release the cradle 55.

The armature 123 is disposed for operation in a plane parallel to the axis of the trip bar 87 and when in its unattracted position the cam 139 thereon is disposed to one side and out of the path of movement of the projection 141 on the trip bar, as shown in Fig. 5, in order to permit clockwise rotation of said trip bar (Fig. 2) for the purpose of relatching the trip member 93. This arrangement of the parts permits a shorter tripping stroke of the armature and makes possible a smaller air gap which results in improved operating characteristics of the trip device and yet despite the relatively small air gap the electromagnet does not limit or interfere with resetting movement of the trip bar 87.

A wire or leaf spring 143, disposed in a recess 142 in one of the barriers 42 and supported at each end in the recess of the barrier, is tensioned against a flat surface 152 on the trip bar 87 to bias the trip bar in both directions toward its normal position. The spring 143 also prevents tripping of the breaker due to shock or jar. By enclosing the spring 143 in the recess 142 in the barrier 42 it is protected against the heat and flame of the arc incident to the rupture of the current.

Each of the armatures 123 (Fig. 5) has mounted thereon a contact 144 electrically connected to the conductor 41 by a flexible shunt conductor 146. Upon the occurrence of an overload in excess of a predetermined magnitude or a short circuit, the armature 123 is attracted by the magnet core 117 and moves the contact 144 into engagement with a contact 148 mounted on one end of a resilient contact blade 150 (Figs. 2 and 5) secured to the conductor 35, thereby shunting the current around the bimetal element 39. This prevents undue heating of the bimetal and aids in preserving the calibration thereof.

The arrangement of the armature 123 and of the contacts 144 and 148 is such that operation of the armature, upon energization of the magnet provides a wiping contact.

The circuit breaker mechanism is shown in Fig. 2 in the closed circuit position with the trip device 23 in untripped position. When the trip bar 87 is rocked in unlatching direction in response to an overload in the circuit through any one of the poles, the latch 111 disengages the cradle 55 and permits the overcenter springs 53 to rotate the cradle clockwise about its pivot 56. At the start of this rotation of the cradle 55, a projection 68 on the cradle 55 engages a stud 66 on the toggle link 51 and starts the toggle 49—51 in the direction to cause its collapse. Continued movement of the cradle 55 causes the center line of the toggle link 49 to move to the right of the line of action of the springs 53 which act to complete the collapse of the toggle. This rocks the arms 27 counterclockwise carrying the contact arms 25 and the movable contact 21 therewith to open the circuit of the breaker. This operation of the mechanism also causes the handle 63 to be moved to an indicating position intermediate the open and closed positions.

In the closed circuit position (Fig. 2) the line of action of the overcenter spring 77 is above the pivot 26 of the contact arm 25 and biases the contact arm in a clockwise direction about its pivot providing pressure for the contacts. When the arms 27 are rotated counterclockwise, as above described, a tail 145 on the toggle member 79 strikes a projection 147 on the base 11 causing the toggle 79—25 to move overcenter. This rocks the contact arm 25 counterclockwise about its pivot 26 which opens the contacts a greater distance than would be possible if the movable contact were mounted directly on the arms 27.

Following each automatic operation of the breaker due to operation of the trip device 23 in response to an overload current, it is necessary to reset the mechanism to operative condition before the contacts can be reclosed. This is effected by rotating the manual lever 47 from its tripped position to its extreme counterclockwise or open position. This movement of the lever 47 is transmitted to the cradle 55 by a hooked projection 151 engaging a portion 153 of the cradle. As the cradle 55 is rotated in a counterclockwise direction, the latch end thereof passes the latch member 111 and engages a projection 155 molded integral with the trip bar 87, rocking the trip bar clockwise slightly past its normal position to relatch the cradle 55. During the clockwise resetting movement of the trip bar 87, the projections 115 thereon engage the ends of the trip levers 93 and rock said levers counterclockwise to relatch them with the latches 109 on the bimetal elements 39.

After the cradle 55 has been relatched, the contacts can be closed manually by moving the lever 47 clockwise to its closed circuit position. During this movement the line of action of the overcenter springs 53 crosses to the right of the pivot 69 of the toggle link 49 causing the toggle 49—51 to move overcenter and rock the arms 27 quickly clockwise to close the contacts. As the switch arms 27 approach the closed position, the arm 25 strikes a projection 157 on the base 11 at a point to the left of the pivot 26 (Fig. 2) causing clockwise rotation of the contact arm 25 about its pivot 26 moving the spring 77 overcenter above the pivot 26. This causes the contacts to

close with a snap action and applies pressure to the closed contacts after they are closed.

The contacts are opened manually by moving the lever 47 in a counterclockwise direction about its pivot to the open position. This movement carries the line of action of the springs 53 to the left of the pivot 69 of the toggle link 49 and the force exerted by said springs now biases the toggle 49—51 away from its overcenter position. Before the lever 47 reaches its extreme counterclockwise or open position, this force becomes sufficient to cause the toggle to quickly collapse, and since the toggle link 51 is pivotally connected to the switch arms 27 for the central pole, these arms are rotated counterclockwise causing opening of the contacts for all of the poles. The contacts are closed manually in the manner previously described.

The circuit breaker is trip free, i. e., operative automatically in response to predetermined abnormal circuit conditions in any one of the poles thereof irrespective of the position of the operating lever 47.

The arc extinguishers 19, there being one provided for each pole of the breaker, are of the spaced plate type and comprise, generally, a stack of slotted plates of magnetic material positioned adjacent the paths of movement of the movable contacts 21. The presence of these plates causes the arc resulting from the rupture of the circuit to be drawn in the direction toward the ends of the slots where the arc is broken up into a plurality of short arcs, and these short arcs are quickly cooled and extinguished.

Features of the circuit breaker contact means construction shown and described in this application are fully disclosed and claimed in United States Patent No. 2,318,298, issued May 4, 1943, to Hiller D. Dorfman and Gerald J. Freese, and assigned to the assignee of this invention.

Having described the preferred embodiment of the invention in accordance with the patent statutes, it is to be understood that various changes and modifications may be made in the structural details disclosed without departing from some of the essential features of this invention. It is, therefore, desired that the language of the appended claims be given as reasonably broad interpretation as the prior art permits.

We claim as our invention:

1. In a multipole circuit breaker, a casing of insulating material having a partition forming separate compartments in said casing, a movable contact member disposed in each compartment, means including a rotatable member of insulating material extending across a plurality of said compartments for initiating an automatic operation of the movable contacts, said partition having an aperture therein through which the rotatable member extends, and a plurality of flanges molded integral with the rotatable member and disposed one on each side of the partition to close the aperture.

2. In a multipole circuit breaker, the combination of a casing of insulating material having one or more partitions to form separate compartments for the several poles of the breaker, a movable contact member in each compartment, a rotatable member extending across a plurality of the poles for simultaneously moving all of the contact members, said rotatable member extending through openings provided therefor in said one or more partitions and having flanges thereon cooperating with the one or more partitions to form flashproof joints between the compartments, releasable operating mechanism for operating the rotatable member, a trip bar of one piece molded insulating material extending across a plurality of the poles for releasing said operating mechanism, said trip bar extending through openings in said one or more partitions and having flanges molded integral therewith disposed at one side of and adjacent to each partition to form flashproof joints between the compartments, and current responsive means for causing actuation of the trip bar.

3. In a multipole circuit breaker, the combination of a casing of insulating material having one or more partitions to form separate compartments for the poles of the breaker said one or more partitions extending the length of the breaker, relatively movable contacts in each compartment, releasable operating mechanism operable to cause simultaneous opening of the contacts, and a trip device for releasing the operating mechanism comprising a trip bar of insulating material extending across a plurality of the poles and extending through openings provided therefor in at least some of said partitions, said trip bar being provided with a plurality of flange members molded integral therewith and disposed one adjacent each partition to close said openings and form flashproof joints, and a current responsive trip means for each of a plurality of the poles of the breaker each disposed in a corresponding one of said compartments and each operable to operate the trip bar.

4. In a multipole circuit breaker the combination of a casing of insulating material having a partition forming separate compartments in said casing, a movable contact member in each compartment, a trip device including a trip bar of molded insulating material extending across the compartments for initiating an operation of the movable contact members to cause opening of the circuits of the breaker, said partition having an aperture therein for receiving the trip bar, and a flange of insulating material integral with the trip bar, said flange cooperating with the partition to prevent flashover between the poles.

5. A multipole circuit breaker comprising a casing of molded insulating material having a partition wall forming separate compartments therein, a movable contact member in each compartment, a trip bar of one-piece molded insulating material extending across a plurality of said compartments to cause opening of the contacts, means biasing the trip bar to a normal position said biasing means being disposed in a recess in the partition wall, said partition wall having an opening therein through which the trip bar extends, and a plurality of flanges molded integral with said trip bar said flanges being disposed one on each side of the partition wall to prevent flashover between adjacent poles.

6. In a multipole circuit breaker comprising a casing of molded insulating material having a partition wall therein forming separate compartments, relatively movable contacts in each compartment, common operating mechanism for causing automatic opening of the contacts, said operating mechanism including a manual operating handle, a trip device including a trip bar movable from a normal position in a direction to trip the breaker and in another direction to reset the trip device, means biasing said trip bar to normal position, said biasing means being disposed in a recess in said partition wall for protection against the heat and flame of the arc, a plurality of projections on the trip bar, electro-

responsive means for engaging one of said projections to trip the breaker, and means operable by the manual handle to engage another of said projections to move the trip bar to reset the trip device.

7. In a multipole circuit breaker, the combination of a casing of insulating material having a partition wall extending the length of the breaker to form separate compartments for the several poles of the breaker, a movable contact member in each compartment and connected for movement together by an insulated cross bar, releasable actuating means to cause operation of the contact members, a trip bar of one piece molded insulating material extending across a plurality of the poles, said trip bar being operable to release the actuating means, and a plurality of trip members one for each pole, each of said trip members being mounted on a separate frame supported in its corresponding compartment each trip member being releasable to cause operation of the trip bar, a current responsive means mounted in each of a plurality of said compartments each operable in response to predetermined conditions to cause release of a corresponding one of said trip members, and said partition wall extending the length of the breaker being unbroken except for openings accommodating said cross bar and said trip bar with a relatively tight joint.

8. In a multipole circuit breaker, the combination of a casing of insulating material having partition walls extending the length of the breaker to form separate compartments for the several poles of the breaker, a movable contact member in each compartment, a releasable actuating means operable to cause operation of the contact members, a trip bar of one piece molded insulating material extending across a plurality of the poles, said trip bar being operable to release the actuating means, and a trip means for each pole operable to cause operation of the trip bar, each trip means being mounted on a separate frame member in its corresponding compartment and being independent of any parts, other than said trip bar, in any other compartment.

9. In a multipole circuit breaker, the combination of a casing of insulating material having means forming a partition wall extending the length and depth of the interior of the casing and forming isolated compartments for the several poles of the breaker, a movable contact member in each compartment, an insulated member extending through an opening in said partition wall for connecting the contact members to move together and having means co-operating with the partition wall to substantially close the opening for said connecting member, releasable actuating means to cause operation of the contact members, a current responsive trip means mounted in each of a plurality of said compartments independently of the mounting of the current responsive trip means in any other compartment, an insulated trip bar extending through an opening in the partition wall for movement by any one of said trip members to cause release of the actuating means and opening of the contact members, and said trip bar having means co-operating with the partition wall to substantially close the opening through which the trip bar extends.

10. In a multipole circuit breaker, the combination of a casing of insulating material having means forming a partition wall dividing the casing into compartments for the several poles of the breaker, a movable contact member in each compartment, an insulated member extending through an opening in said partition wall for connecting the contact members to move together and having means co-operating with the partition wall to substantially close the opening for said connecting member, releasable actuating means to cause operation of the contact members, a plurality of current responsive trip means each having a separate frame mounted in one of said compartments independently of the mounting of the current responsive trip means in any other compartment, an insulated trip bar extending through an opening in the partition wall for movement by any one of said trip members to cause release of the actuating means and opening of the contact members, said trip bar having means co-operating with the partition wall to substantially close the opening through which the trip bar extends, and said partition wall extending the length and depth of the interior of said casing and co-operating with the contact connecting member and the trip bar as aforesaid, and being otherwise substantially unbroken, to form isolated compartments for the separate poles of the breaker.

11. In a multipole circuit breaker, a casing of insulating material, a plurality of pairs of contact members mounted adjacent one end of the casing, an insulated member extending across the casing and connecting one of each of said pairs of contacts for movement together, releasable actuating means to cause operation of the contact members mounted adjacent the mid-portion of the casing, a plurality of current responsive trip means mounted adjacent the other end of the casing, an insulated trip bar extending across said plurality of trip means for actuation by any one thereof to release said actuating means and cause opening of said contact members, said trip bar being the only member extending across said trip means, an insulated partition wall in the casing extending continuously from between said contact members at one end of the casing to between said trip members at the other end of the casing except for openings accommodating said insulated contact connecting member and said trip bar, and said insulated contact connecting member and said trip bar each having means co-operating with said insulated partition wall to substantially close said openings and thereby form isolated compartments for the several poles of the breaker.

HILLER D. DORFMAN.
GERALD J. FREESE.

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