July 6, 1965 W. W. KREBS ET AL 3,193,646

INTERLOCK FOR MULTI-POLE CIRCUIT BREAKERS

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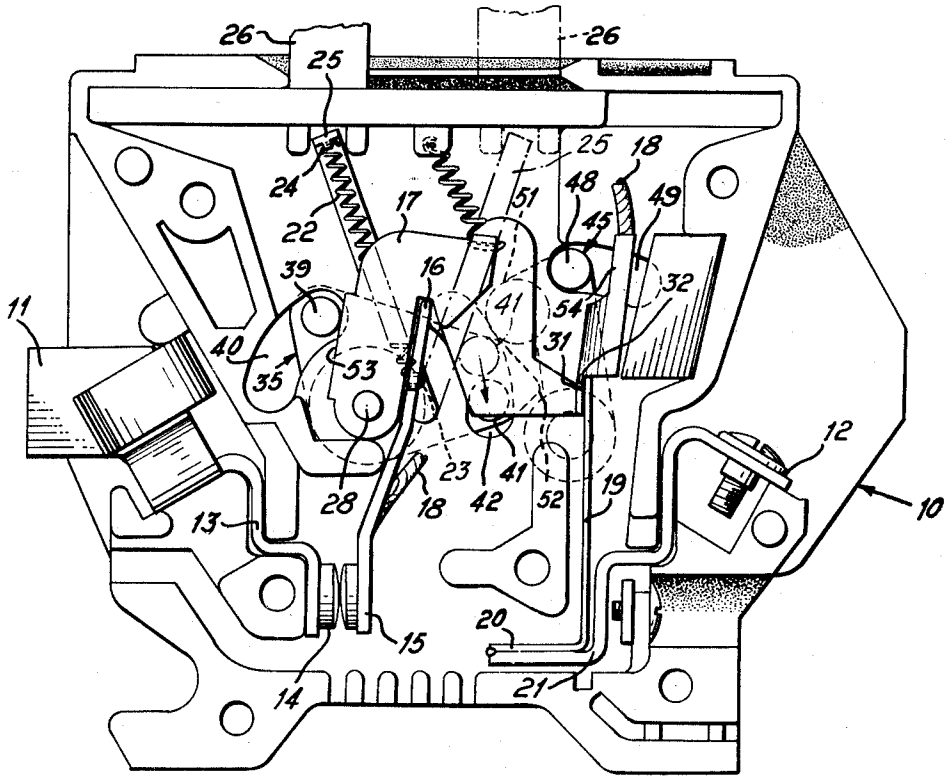


Fig. 1

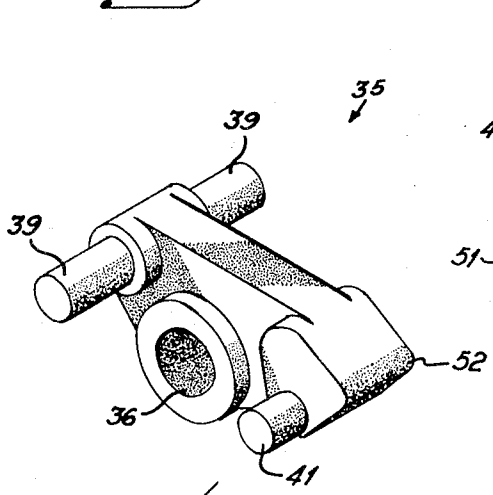


Fig. 2

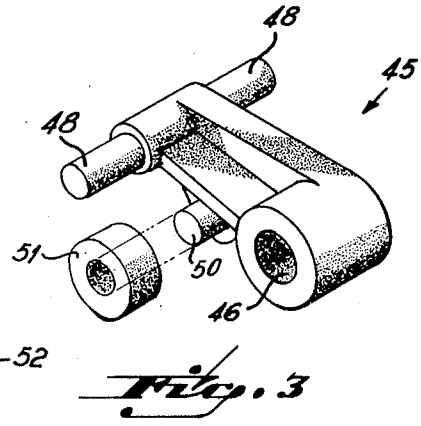


Fig. 3

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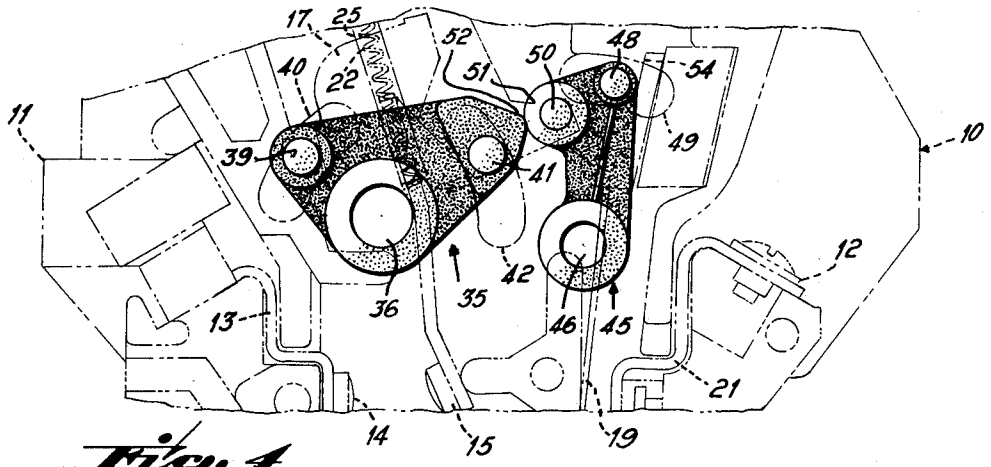


Fig. 4

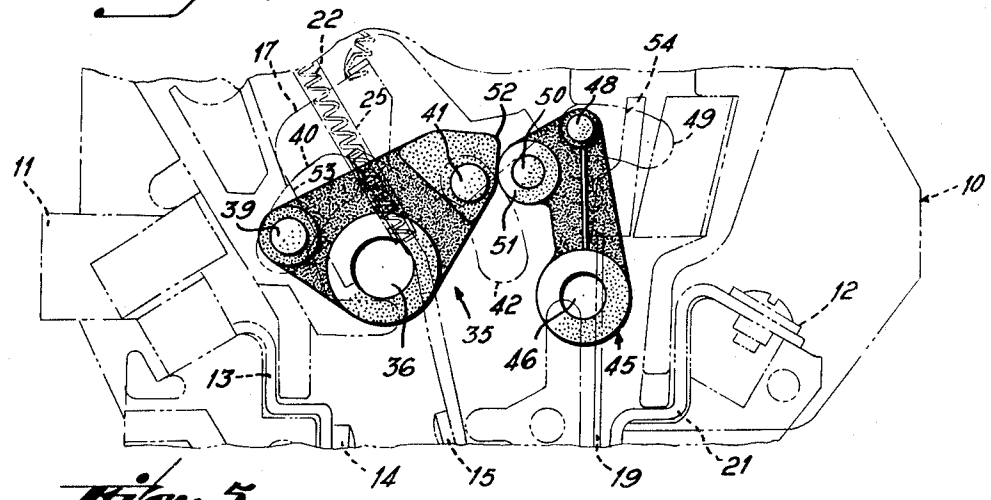


Fig. 5

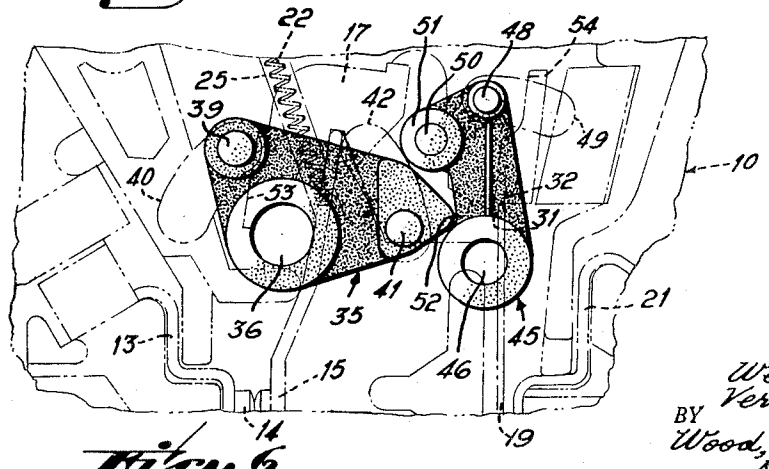


Fig. 6

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INTERLOCK FOR MULTI-POLE CIRCUIT BREAKERS

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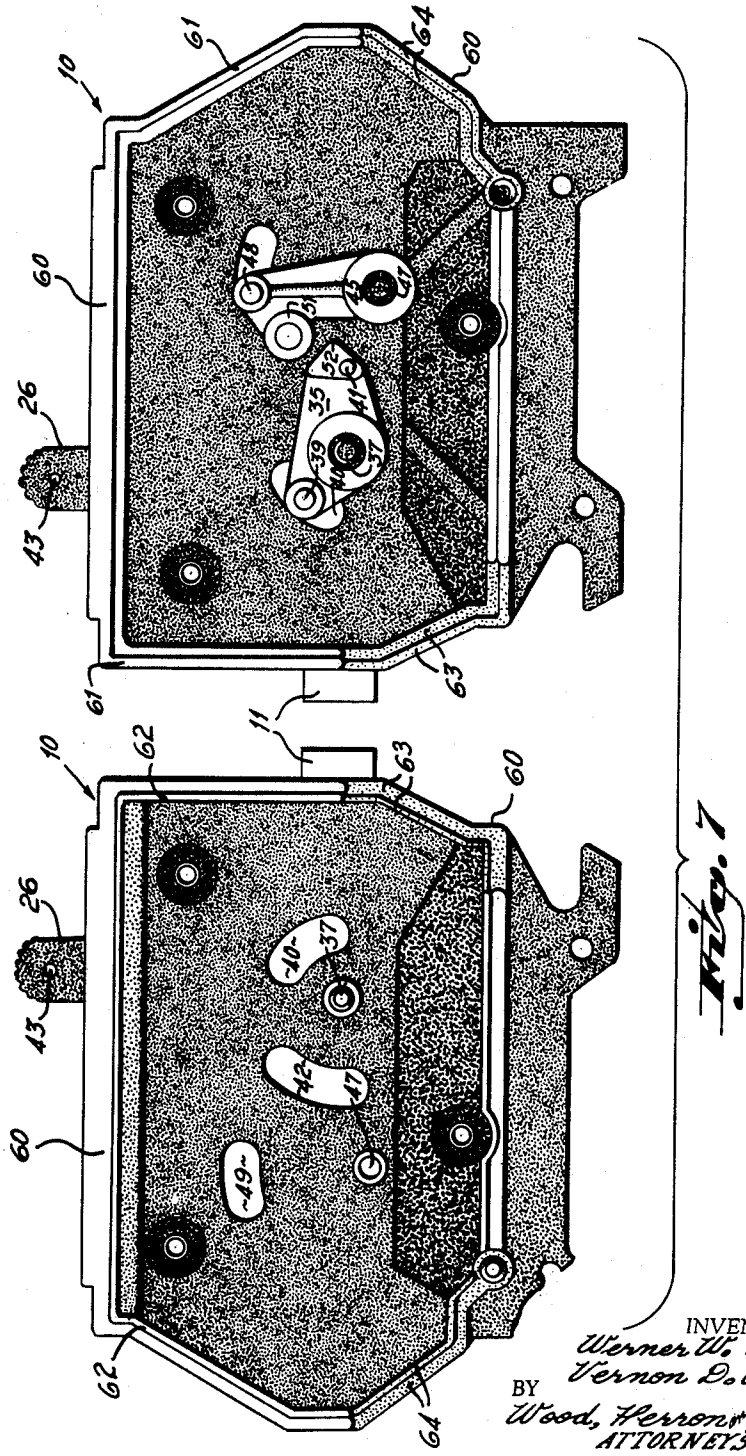


Fig. 1

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INTERLOCK FOR MULTI-POLE CIRCUIT BREAKERS

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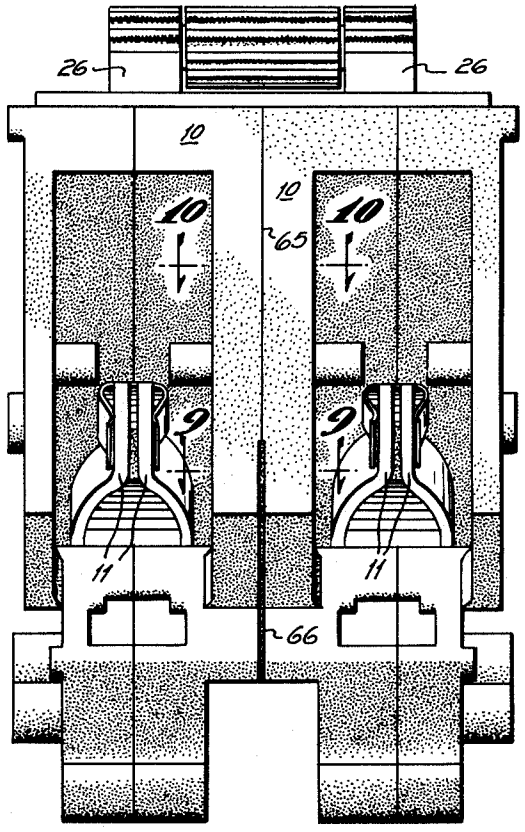


Fig. 8

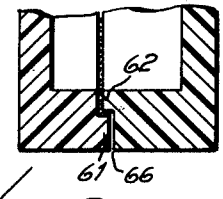


Fig. 9

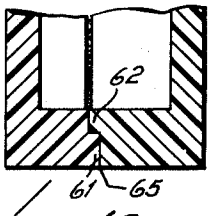


Fig. 10

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3,193,646

INTERLOCK FOR MULTI-POLE CIRCUIT BREAKERS

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4 Claims. (Cl. 200—116)

This invention relates to multi-pole circuit breakers and more particularly the invention is directed to an interlock through which the action of adjoining circuit breakers is interrelated and interconnected so as to effect the tripping of all interlocked circuit breakers upon the tripping of one circuit breaker.

More specifically, the invention is an improvement in the interlock described in co-pending application Serial No. 779,403 filed December 10, 1958, now Patent No. 3,116,387, granted December 31, 1963. That application discloses an interlock for use between two circuit breakers each of the type having its movable contact mounted on a spring-loaded rocker, the rocker being held in operative position by a current responsive element, as for example, a bimetallic strip. The interlock is a toggle linkage which is disposed between the casings of two adjoining circuit breakers. One toggle link is pivoted to the circuit breaker casings and is engageable by the rocker of either of the adjoining circuit breakers upon tripping. The other link is pivotally connected to the first link at one end thereof and has a pin projecting from each side of its other end, the pin riding in a slot in each of the adjoining circuit breakers, each slot being adjacent the current responsive member.

Upon automatic tripping of one pole (that is one single pole circuit breaker), the swinging of the first toggle link carries the second toggle link through an overcenter position while the projecting pins ride in and are directed by the circuit breaker slots and first forces the current responsive member of the untripped pole to a tripped position. Thereafter, as the linkage passes beyond the overcenter position, the force of the projecting pins on the current responsive member is relieved thereby permitting each current responsive member to relax to its normal position.

Insofar as its operating characteristics are concerned, the interlock described in that co-pending application is satisfactory in all respects. However, in the manufacturing of the assembly, care must be exercised to form the cooperating elements in such a manner as to minimize the frictional forces arising during its operation particularly those occurring between projecting pins and the slots in the associated circuit breaker casings on which those pins slide. In the molding of the casings the slots in each casing are formed by cooperating male and female die members which leave a flash projecting from the slot edges. The casing halves are, of course, tumbled to remove the burrs and flash but it is nevertheless difficult to obtain a perfectly smooth slot surface upon which the pins can slide freely. Additionally, in the assembly of the two casing halves, there is a possibility of a slight misalignment, that is, one casing half being slightly rotated with respect to the other casing half. That misalignment would put the two adjoining slots out of exact coincidence with each other so that the pin projecting between two slots would be forced against the upper edge of one slot only, for example, causing the toggle linkage to twist slightly and also altering the direction and distance traversed by the pins. There would thus be a further and variable increase in the frictional forces encountered due to binding of the second toggle link, and a decrease in the predictability of link travel due to reorientation of the slots.

It has been an objective of the invention to obviate the necessity of forming substantially perfectly smooth slot edges to cooperate with the projecting pins and to eliminate the necessity of almost perfect alignment of the casing halves during assembly. This objective is attained by substituting for the driving and driven toggle links, a driving cam and a driven roller containing follower respectively. By employing the cam and follower system, it is not necessary to pivot the two elements together, that is, each is pivoted separately to the circuit breaker casing, and it is therefore not necessary to have the projecting pin which engages the current responsive member riding against the edges of casing slots. Rather, the driving and driven elements are pivotally mounted to the casing and their projecting pins which contact the circuit breaker mechanism move freely in the casing slots without contacting the slot edges and the effective travel of the follower pins is determined solely by the interlock parts.

It has been a further objective of this invention to provide a convenient and economical means to adjust the amount of travel of the projecting follower pins which force the current responsive member to a tripped position. Circuit breakers of this type are manufactured in a range of current ratings all ratings having the same mechanism except for the current responsive element. It may be necessary to alter the shape of that portion of the current responsive member which is struck by the projecting follower pins in order to obtain a desired electrical trip characteristic. This would necessitate a revision in the interlock parts in order to obtain the amount of follower pin travel required to effect tripping. This objective is attained in the cam and follower system by increasing or decreasing the diameter of the roller which is carried by the follower. The cam and follower which require complex and therefore expensive molds remain unchanged. A plurality of inexpensive molds could be made to produce rollers of any diameter required.

The advantages of the construction are that the tolerances of the elements need not be held as close as is required by the toggle linkage, a more effective throw of the current responsive element is obtainable from a given force of the contact carrying rocker through the reduction of friction forces, and manufacture and assembly is facilitated. Further, it is possible economically to adapt the cam and follower system to function properly when the circuit breaker mechanism differs from one ampere rating to another.

The several features of the invention will become more readily apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is an elevational view of a half of a circuit breaker casing having the operating mechanism positioned therein;

FIG. 2 is a perspective view of the driving cam of the interlock;

FIG. 3 is a perspective view, partly disassembled, of the driven follower of the interlock;

FIG. 4 is an elevational view showing the interlock members in "trip" position;

FIG. 5 is an elevational view showing the interlock members in "tripped" position;

FIG. 6 is an elevational view showing the interlock members in "non-tripped" position;

FIG. 7 is a disassembled elevational view of two circuit breakers between which the interlock is mounted;

FIG. 8 is an end elevational view of two adjoining circuit breakers;

FIG. 9 is a cross sectional view taken along line 9—9 of FIG. 8; and

FIG. 10 is a cross sectional view taken along line 10—10 of FIG. 8.

The interlock is employed in association with circuit breakers of well known design, those circuit breakers having been described in prior patents and applications including patent application Serial No. 779, 403. It should be understood that while the interlock is illustrated in combination with a particular type of circuit breaker, the interlock, of course, has application to other types of circuit breakers in which a movable contact is forcibly moved from closed position to an opened position, upon tripping and in which the circuit breaker is normally maintained in an operative condition by a current responsive latching mechanism.

As shown in FIG. 1, each circut breaker comprises a casing 10 (only one-half being shown in order to expose the operating parts) the circuit breaker having a line terminal 11 and a load terminal 12. The line terminal is connected by a strap 13 to a fixed contact 14. The fixed contact 14 is engageable by a movable contact arm 15 which is pivotally mounted at an end 16 to a rocker or carrier 17. A pigtail 18 connects the movable contact arm 15 to the upper end of a current responsive element 19. The other end 20 of the current responsive element is connected by a strap 21 to the load terminal 12.

The movable contact arm is maintained in engagement with a rocker 17 by a tension spring 22 which is connected at its lower end 23 to the contact arm and at its upper end 24 to an operating lever 25 which is pivotally mounted in the casing and lies flat against the casing wall. The upper end of the operating lever 25 is engageable by a handle 26 projecting from the top of the circuit breaker casing. The handle 26 is slidable between an operating position as shown in full line and a reset position shown in broken lines.

The rocker or contact carrier 17 is pivotally mounted at 28 to the casing and is normally urged by the tension spring 22 in a counter-clockwise direction to a position in which the contacts are opened. Movement in the counter-clockwise direction is resisted by the engagement of a latch abutment 31 on the rocker with a latch surface 32 on the upper end of the current responsive element 19. The movement of the current responsive element toward the right as viewed in FIG. 1 will release the latch abutment and permit the rocker 17 to swing rapidly in a counter-clockwise direction. In this manner, the circuit breaker has its contact opened when the current responsive member is moved upon the occurrence of overload current.

In circuit breakers of this type, it is the objective of the invention to coordinate the operation of two or more adjoining circuit breakers such that the tripping of one circuit breaker will automatically effect the tripping of the adjoining circuit breaker. This objective is attained by the employment of the interlock of the present invention, the interlock being mounted between two adjoining circuit breakers. The elements of the interlock are illustrated in FIGS. 2 and 3 and their relationship to the circuit breaker mechanism can be followed by reference to FIG. 1 and to FIGS. 4 to 6.

The interlock comprises two principal elements. The first is an operator or cam element 35 which has a cylindrical bore 36 adapted to cooperate with a pin 37 (FIG. 7) formed by two mating stubs molded integrally with the circuit breaker casing and projecting therefrom. The pin 37 is coaxial with the pivot 28 of the rocker 17.

A pin projects from each side of the cam element 35 and passes through curvilinear slots 40 formed in the adjoining casing walls. A reset pin 41 projects from one side of the cam element 35 at the end thereof remote from the pin 39. The reset pin 41 projects through a curvilinear slot 42 in one of the circuit breakers and is engageable by the edge of operating lever 25 as it is moved toward the reset position shown in broken lines in FIG. 1. Only one rest pin is required, for the handles 26 of adjoining circuit breakers are ganged together by an element having pins projecting through holes 43 (FIG. 7) in the respective operating handles. Accordingly, during reset, both operating handles will be moved simultaneously toward reset position, thereby assuring the movement of the cam member 35 toward reset position.

The other principal element of the interlock is the follower or trip element 45. That element has, in one end thereof, a bore 46 by which the element is pivoted on a pin 47 formed by two stubs projecting from and integral with the casings of the adjoining circuit breakers. At the other end of the member 45, a pin 48 projects into each of the adjoining circuit breakers, a curvilinear slot 49 being provided in each casing wall for that purpose. The follower element 45 has a pin 50 projecting from one side thereof and a roller 51 mounted on that pin. The roller 51 is, when the elements are in operative position, engageable by a generally V-shaped surface 52 which is a cam surface adapted to drive the roller 51 and its associated follower element 45 in a clockwise position, as viewed in FIG. 1. The shape of the follower element and the spacing of pins 48 and 50 is such as to permit the use of rollers 51 of varying diameters. Varying the diameter of the roller 51 will vary the distance of the throw or travel of pin 48 upon tripping. Thus, the interlock can be conveniently and economically adapted for use with circuit breakers which, because of different ratings, or trip characteristics may have different current responsive elements, requiring greater or lesser travel for tripping.

When the elements are in their operative position, the pin 39 of the cam element is engageable by a surface 53 on the rocker 17. It can be observed from FIG. 1 that upon release of the rocker 17, the surface 53 will engage the pin 39 and drive the element 35 forceably in a counter-clockwise direction. Because the pin 39 projects into both circuit breakers, the tripping of either rocker will effect the same motion of the cam element 35.

The pin 48 on the follower element on the other hand is engageable with a surface 54 at the upper end of the current responsive element 19. When the follower element 45 is moved in a clockwise direction as viewed in FIG. 1, the pin 48 will engage the surface 54 on the current responsive element and force it toward the right thereby effecting the unlatching of the engaged surfaces 31 and 32 of the rocker and current responsive element respectively.

It should be appreciated that because both of the elements 35 and 45 have fixed pivot points, their respective pins 39, 41 and 48 are free to move in the respective slots 40, 42 and 49 free from any engagement with the edges of the slots. The only frictional resistance to the movement of the elements 35 and 45 therefore comes only from the bearing surfaces formed between the bores 36 and 46 and their respective pins 37 and 47 respectively.

A peripheral flange 60 is molded integrally with each casing to project from that surface to which the interlock is mounted. The combined depths of the two flanges is sufficient to enclose the interlock while permitting the elements thereof to move freely during their operation. At the same time, the abutting flanges maintain the interlock substantially free from any dust which might be found in the area in which they are used.

As viewed in FIG. 7 the circuit breaker on the right has an outer ridge 61 forming a part of the flange 60 and the circuit breaker on the left has an inner ridge 62 forming a part of its flange 60. The flanges are recessed as at 63 adjacent the line terminals 11 and are recessed at 64 adjacent the location of the load terminals 12.

Referring to FIGS. 8, 9 and 10, where the flanges 60 are not recessed, a tight joint 65 is formed. Referring specifically to FIG. 9, where the flanges are recessed, a Z-shaped air gap 66 is formed.

The circuit breakers of the present invention may be employed to protect a 240 volt service to an electric range, for example. In such an application the line ter-

minals and the load terminals are at a potential difference of 240 volts. In practice they must be separated by ¾ of an inch through the air 1¼ inches over the casing. The air path requirement is easily met; but if there were a solid casing path directly between the points of contact of the terminals and the casing, the second requirement would be difficult to meet unless the circuit breaker casings were of unusually great width. The problem is solved by the air gap which interrupts the direct path over the casing between terminals and provides a path well over the minimum required length. The Z-shape of the path minimizes the possibility of foreign particles or objects being introduced into the interlock.

Operation

The manner in which the elements cooperate to effect multi-pole circuit breaker operation is best illustrated in FIGS. 4, 5 and 6. In FIG. 6 the elements are shown in the position which they occupy when the contacts are closed and the circuit breakers are in a "non-tripped" condition. In this position, the current responsive element **19** has its latching surface **32** in engagement with the latch abutment **31** on the rocker or contact carrier **17** and the bimetallic element is in an unstressed condition. The roller on the follower element **45** is in a position to be engaged by the cam element **52**.

When tripping of the circuit breaker occurs under overload conditions, the effect of the abnormally high current is to cause the current responsive element **19** to move away from the rocker **17**. If the element **19** is a bimetallic strip, the high temperature caused by the passage of high current through it causes the element to flex disengaging latching surfaces **31** and **32**. Alternate current responsive means may be employed such as a cooperative thermal-magnetic element or a magnetic type trip of the type disclosed in Patent No. 2,716,679. In either event, upon tripping of either circuit breaker due to overload, the released, spring-loaded rocker will strike the pin **39** with which it is associated and rapidly pivot the cam element **35** in a counter-clockwise direction. As the cam element **35** pivots in a counter-clockwise direction, the cam surface **52** forces roller **51** toward the right, thereby causing the follower element **45** to pivot clockwise. The extreme position in the clockwise direction is illustrated in FIG. 4. This is an instantaneous position which is attained as the elements pivot from the position of FIG. 6 to the position of FIG. 5. In this instantaneous position, it can be seen that the trip pin **48** is moved a substantial distance toward the right and, in moving toward the right, causes the current responsive element of the untripped circuit breaker to move toward the right. The movement of the latched surface **32** of the current responsive element **19** effects the unlatching of the adjoining circuit breaker.

The cam or operator element **35** continues its movement to the position of FIG. 5 under the urging of contact carrier **17**. As the element moves to the position of FIG. 5 the roller **51** rides over the cam surface **52** on the cam element **35** and thereafter moves toward the left as viewed in FIG. 5. The leftward movement permits the follower element **45** to pivot counter clockwise to release the pressure on the current responsive elements **19** of both of the circuit breakers. As shown in FIG. 5, the current responsive element assumes a released position after multi-pole tripping has been completed. In this released, unstrained position no stresses can be set up in the current responsive element which would tend to cause the element to lose its calibration.

On resetting of the circuit breakers, the handles **26** which are ganged together are first moved toward the right as viewed in FIG. 1 to a reset position. In moving the handles **26** toward the right, the operating lever **25** is pivoted in a clockwise direction to engage the reset pin **41** on the cam element **35**. Engagement of the operating lever **25** with the reset pin **41** causes the cam element **35** to pivot clockwise from the position of FIG. 5 back to the position of FIG. 6. At the same time, the operating lever **25** effects the resetting of the circuit breaker elements in the manner which has been described above. Thereafter the handles **26** are returned to the position illustrated in FIG. 1. Thus the circuit breakers have been returned to a position for further normal operation.

We claim:

1. A common trip interlock for adjoining circuit breakers each having a fixed contact, a movable contact, a carrier for said movable contact, movable current responsive means having a latch engageable with said carrier for holding said contacts in engaged position, said interlock comprising, a trip element and an operator element pivotally mounted between said breakers, one of said elements having a cam surface and the other of said elements having a roller engageable with said cam surface, a trip pin on said trip element engageable with said current responsive means, an operator pin on said operator element engageable by said carrier to move said operator element from a "non-tripped" position through a "trip" position to a "tripped" position, said operator element causing said trip element to move from a "non-tripped" position in which said trip element permits said current responsive means to remain latched with its carrier, to a "trip" position in which said trip pin first forces said current responsive means to move out of latched engagement with its carrier and then returns to its original position in which said current responsive means is in an unstrained position.

2. A common trip interlock for adjoining circuit breakers each having a fixed contact, a movable contact, a carrier for said movable contact, movable current responsive means having a latch engageable with said carrier for holding said contacts in engaged position, and an operator for manually opening and closing said contacts, said interlock comprising, a trip element and an operator element pivotally mounted between said breakers, one of said elements having a cam surface and the other of said elements having a roller engageable with said cam surface, a trip pin on said trip element engageable with said current responsive means, an operator pin on said operator element engageable by said carrier to move said operator element from a "non-tripped" position through a "trip" position to a "tripped" position, said operator element causing said trip element to move from a "non-tripped" position in which said trip pin permits said current responsive means to remain latched with its carrier, to a "trip" position in which said trip pin forces said current responsive means to move out of latched engagement with its carrier and back to its original position in which said trip pin permits said current responsive means to return to an unstrained position, and a reset abutment on said operator element engageable by said manual operator for returning said operator to a "non-tripped" position when said breaker is reset.

3. A common trip interlock for adjoining circuit breakers each having a fixed contact, a movable contact, a carrier for said movable contact, movable current responsive means having a latch engageable with said carrier for holding said contacts in engaged position, said interlock comprising, a trip element and an operator element pivotally mounted between said breakers, said operator having a cam surface engageable with said trip element, a trip abutment on said trip element engageable with said current responsive means, an operator pin on said operator element engageable by said carrier to move said operator element from a "non-tripped" position through a "trip" position to a "tripped" position, said operator element camming said trip element from a "non-tripped" position in which said trip pin permits said current responsive means to remain latched with its carrier, to a "trip" position in which said trip pin forces said current responsive means to move out of latched engagement with its car-

rier and back to its original position in which said trip pin permits said current responsive means to return to an unstrained position.

4. A common trip interlock for adjoining circuit breakers each having a fixed contact, a movable contact, a carrier for said movable contact, movable current responsive means having a latch engageable with said carrier for holding said contacts in engaged position, said interlock comprising, a trip element and an operator element pivotally mounted between said breakers, one of said elements having a cam surface and the other of said elements having pin and a roller removably mounted on said pin, said roller being engageable with said cam surface, a trip pin on said trip element engageable with said current responsive means, an operator pin on said operator element engageable by said carrier to move said operator element from a "non-tripped" position through a "trip" position to a "tripped" position, said operator element causing said trip element to move from a "non-tripped" position

in which said trip element permits said current responsive means to remain latched with its carrier, to a "trip" position in which said trip pin forces said current responsive means to move out of latched engagement with its carrier and back to its original position in which said trip pin permits said current responsive means to return to an unstrained position.

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