Dec. 31, 1963 W. H. MIDDENDORF 3,116,387

TOGGLE COMMON TRIP INTERLOCK FOR MULTI-POLE CIRCUIT BREAKERS

Filed Dec. 10, 1958 3 Sheets-Sheet 1

Fig. 1

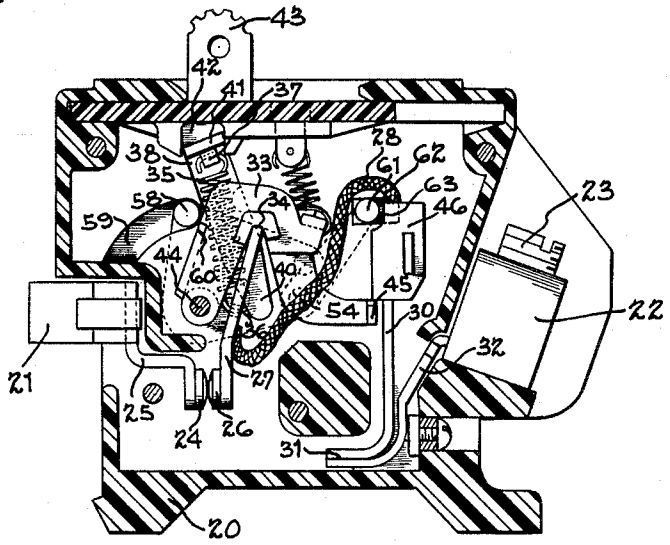
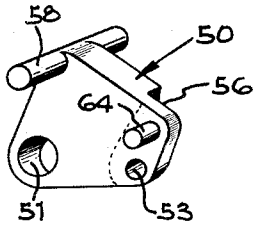


Fig. 6



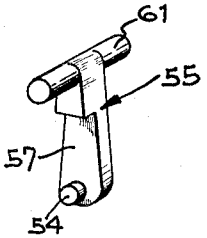


Fig. 7

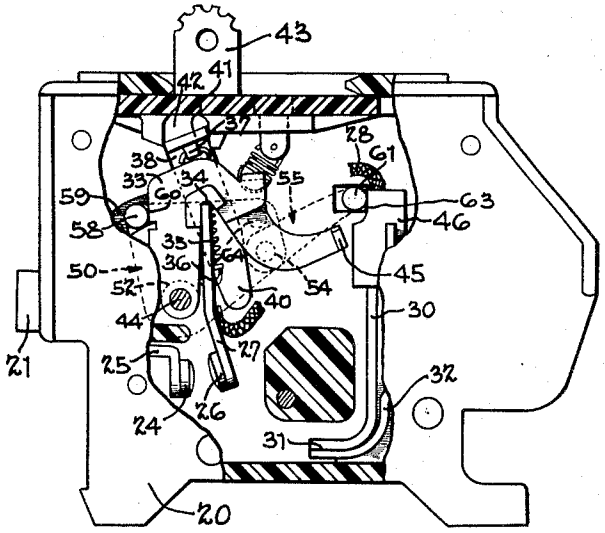


Fig. 2

INVENTOR.
William H. Middendorf.
BY
Wood, Herron & Evans.
ATTORNEYS.

Dec. 31, 1963 W. H. MIDDENDORF 3,116,387

TOGGLE COMMON TRIP INTERLOCK FOR MULTI-POLE CIRCUIT BREAKERS

Filed Dec. 10, 1958 3 Sheets-Sheet 2

Fig. 4

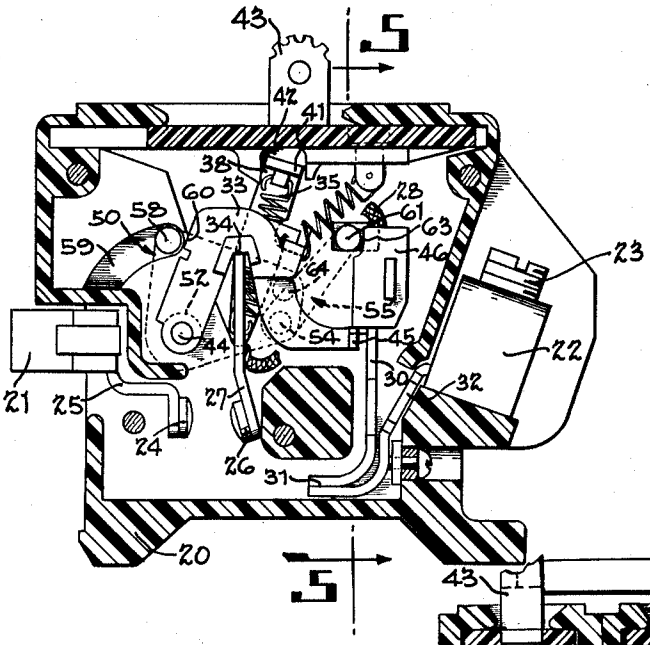
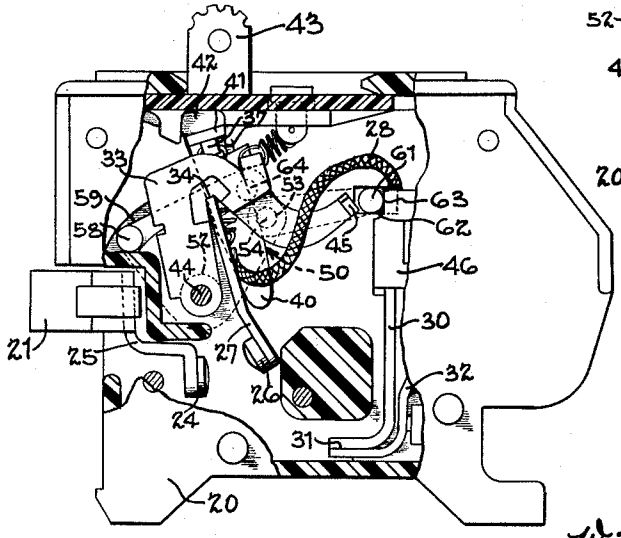


Fig. 3



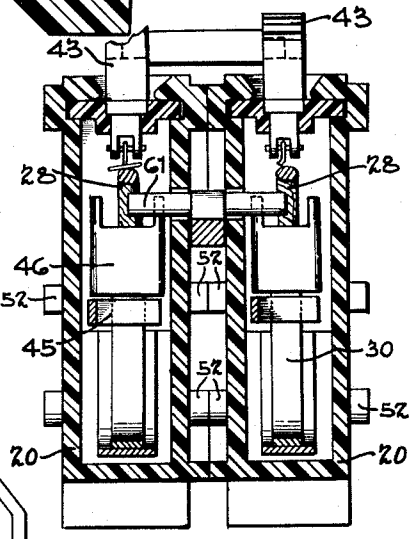


Fig. 5

INVENTOR.
William H. Middendorf.
BY
Wood, Herron & Evans
ATTORNEYS.

Dec. 31, 1963 W. H. MIDDENDORF 3,116,387

TOGGLE COMMON TRIP INTERLOCK FOR MULTI-POLE CIRCUIT BREAKERS

Filed Dec. 10, 1958 3 Sheets-Sheet 3

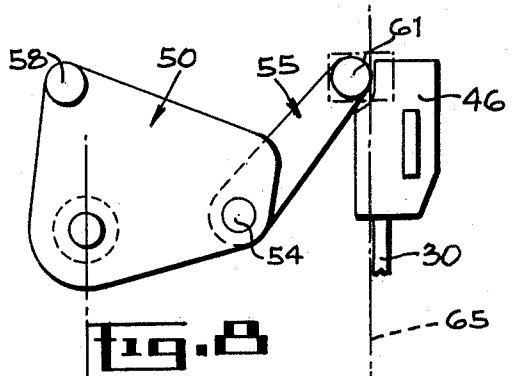


Fig. 8

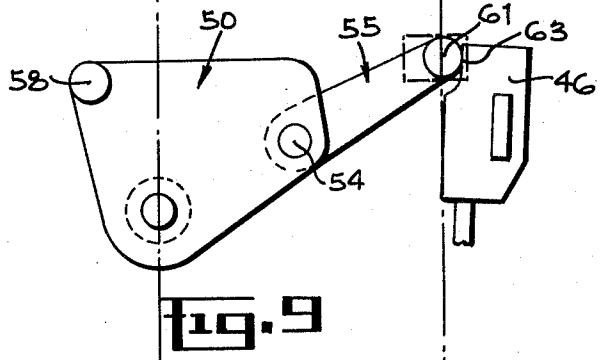


Fig. 9

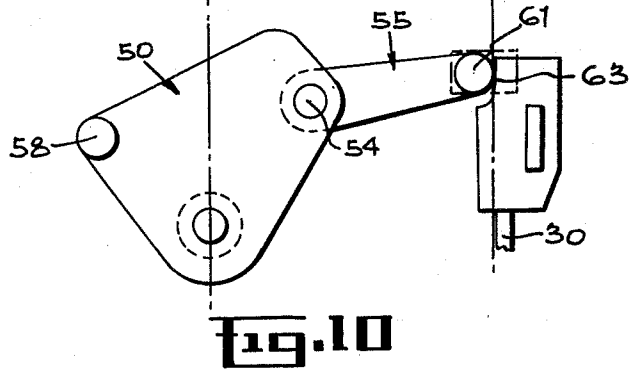


Fig. 10

INVENTOR.
William H. Middendorf.
BY
Wood, Herron & Evans
ATTORNEYS.

United States Patent Office 3,116,387 Patented Dec. 31, 1963

3,116,387

TOGGLE COMMON TRIP INTERLOCK FOR MULTI-POLE CIRCUIT BREAKERS

William H. Middendorf, Covington, Ky., assignor to The Wadsworth Electric Manufacturing Company, Inc., Covington, Ky., a corporation of Kentucky

Filed Dec. 10, 1958, Ser. No. 779,403
3 Claims. (Cl. 200—116)

This invention relates to a common trip interlock for multi-pole circuit breaker operation. The invention is directed more particularly to multi-pole circuit breaker combinations in which each circuit breaker has a contact carrier cooperating with a fixed contact and a bimetal operated latch engageable with the carrier for maintaining the contacts closed during normal operation.

In my previous work on common trip interlocks, as indicated by applications Serial Nos. 755,762, now Patent No. 2,977,443, and 756,857, now Patent No. 2,977,444, I have been concerned with the opening of contacts of adjoining circuit breakers when one circuit breaker has been tripped through overload without requiring actuation or physical engagement of the bimetals of the adjoining circuit breakers. The purpose of this work has been in part to avoid continuous straining of the bimetals which might tend to destroy their calibration. In certain of my earlier designs wherein the contact bar is movable with respect to a carrier, the carrier being latched to a bimetal, opening of adjoining breakers has been accomplished by direct engagement of the contact bar to open the contacts without disturbing the latched engagement of the bimetal and contact bar carrier.

The larger capacity circuit breakers, that is 100 amperes and greater, present an additional problem of common tripping in multi-pole combinations. The principal difficulty resides in the fact that considerably greater contact pressure is required in larger capacity circuit breakers. Because of the greater contact pressure in circuit breakers whose capacity is of the order of 100 amperes or greater, movement of the contact arm itself becomes increasingly difficult. It is found to be advisable therefore, to avoid attempting to move the contact bar against the heavy spring pressure.

While the unlatching of a carrier with respect to its bimetal by engagement with the carrier, without disturbing the bimetal and without forcible engagement of the contact bar, can be effected by breakers of the type disclosed in my applications Serial Nos. 642,018, now Patent No. 2,944,128, and 642,035, now Patent No. 2,934,624, such mechanisms are necessarily more expensive to construct and to assemble than circuit breakers which require only the usual single rotary movement of the carrier.

The most economical circuit breaker, therefore, will be one in which an elongated bimetal is fixed at one end and has, at the other end, a latch engageable with a carrier, the carrier being movable between latched and unlatched positions. To effect common tripping in such a circuit breaker organization, it is necessary to engage the bimetal to move its latch away from the carrier thereby permitting the carrier to swing its associated contacts away from the fixed contact.

In a circuit breaker of this type it has been an objective of the invention to provide a common trip interlock which will engage and force the bimetallic element to an unlatched position and thereafter release the bimetal to permit it to return to an unstrained position. Through the fulfillment of this objective of the invention, it is possible to avoid damage to the bimetal which occurs when the bimetal is forcibly held in a strained position over such a considerable period of time as to permit the bimetal to become permanently deformed or take a permanent "set."

It has been another objective of the invention to provide a common trip interlock for multi-pole circuit breaker operation in which the interlock comprises a toggle linkage driven by a tripped carrier from a non-tripped position through an over-center, extended position, in which the bimetal is engaged and unlatched, to a tripped position in which the bimetal is permitted to return to an unstrained position.

It has been another objective of the invention to provide a standardized common trip interlock which is adapted to be installed between any simliar circuit breakers, thereby reducing manufacturing and assembling costs. Such an interlock will be equally suitable for use with circuit breakers adjoined for either two pole or three pole operation.

It has been another objective of the invention to provide a common trip interlock for multi-pole circuit breaker operation in which the energy stored in the main spring of a tripped circuit breaker is made available momentarily to bend the bimetals of the untripped circuit breakers thereby to trip the adjoining circuit breakers and thereafter to permit all of the bimetals to return to an unstressed position.

It has been another objective of the invention to provide, in an interlock of this type, means by which the maximum force of the main spring of the tripped circuit breaker is not required for driving the bimetal of the adjoining circuit breaker to an unlatched position until the unlatched carrier of the tripped circuit breaker has acquired some kinetic energy from its spring urged initial movement to unlatched position. This prevents the common trip mechanism from delaying the opening of the overloaded breaker and allows a large force to be available momentarily from the kinetic energy of the moving parts.

It has been still another objective of the invention to provide a common trip interlock for multi-pole circuit breaker operation in which an interlock is reset to a non-tripped position when the circuit breaker is reset to a closed position, and during the course of resetting, an abutment on the interlock engages the bimetal temporarily to swing the bimetal away from the carrier latch so that rubbing between the carrier and bimetal latch is eliminated. Thus, a possible source of loss of calibration through the wearing of the latch surfaces is eliminated.

Briefly stated this invention contemplates locating an interlock between adjoining circuit breakers in a multi-pole combination, the interlock comprising a pair of toggle links which are driven by a tripped contact carrier from a retracted "non-tripped" position, through an extended "tripping" position to a retracted "tripped" position. In moving through these positions an abutment on one of the toggle links forces the bimetal of the adjoining untripped breaker out of latched engagement with its contact carrier, and thereafter permits the bimetal to return to its normal unstrained position. Thus, while the bimetal is momentarily bent for the purpose of common tripping, the bent position is not maintained long enough for it to take such a permanent set as to adversely affect its calibration.

These and other objectives of the invention will become more readily apparent from the following detailed description of the invention taken in conjunction with the accompanying drawings in which:

FIGURES 1, 2, 3, and 4 are cross-sectional views partly in elevation, showing the positions of the circuit breaker elements through their several stages of operation;

FIGURE 5 is a cross-sectional view taken along lines 5—5 of FIGURE 4;

FIGURE 6 is a perspective view of one interlock element;

FIGURE 7 is a perspective view of the other interlock element; and

FIGURES 8, 9 and 10 are diagrammatic views showing three conditions of the interlock.

Each circuit breaker of the type to which the interlock invention is applied in the illustrated embodiment is of known design. The circuit breaker comprises an insulative casing 20 to which are fixed a jaw-type bus connector 21 adapted to cooperate with a blade bus on a panelboard, and a solderless connector 22 having a clamping screw 23 by which the other side of the circuit breaker is connected in a circuit. A fixed contact 24 is connected by a strap 25 to the bus connector 21. A movable contact 26 mounted on a contact bar 27 is engageable with the fixed contact 24. A pigtail 28 connects the contact bar 27 and the movable contact 26 to a bimetallic element 30 fixed at 31 to a strap 32. The strap 32 is electrically connected to the solderless connector 22 so that a circuit may be completed through the following elements: jaw connector 21, strap 25, contacts 24 and 26, contact bar 27, pigtail 28, bimetal 30, strap 32, and solderless connector 22.

The contact bar 27 is pivoted at its upper end on a carrier or rocker 33 as indicated at 34. The contact bar is maintained in its engagement with the carrier by a main spring 35 connected at one end 36 to the contact bar and at the other end 37 to a handle lever 38. The handle lever 38 is pivoted at its lower end 40 to the casing and has its upper end 41 disposed in a recess 42 of a slidable operating handle 43. The handle 43 and handle lever 38 are manually movable to the positions illustrated by FIGURES 1 and 4.

The carrier 33 is pivoted to the casing at 44 and has a latch projection 45 which cooperates with a latch element 46 mounted on the free end of the bimetallic element 30. It should be understood that current responsive means such as a magnetic operator as shown in my Patent No. 2,848,577, could be used with or in place of bimetallic element 30. A position of latched engagement of the carrier with the latch element 46 is illustrated in FIGURE 1. In this position the main spring 35, acting in tension, forces the contact arm 27 clockwise about its point of engagement with the carrier to hold the movable contact 26 into engagement with the fixed contact 24. The spring 35 also acts through the contact arm on the carrier 33 to urge the carrier in a counterclockwise direction.

A separation of the latched engagement between the carrier and bimetal will permit the spring 35 to swing the carrier counterclockwise to the position shown in FIGURE 3, the carrier thereby swinging the contact bar 27 and its movable contact 26 to an open position out of engagement with the fixed contact 24.

The Interlock

The interlock is shown principally in broken lines in FIGURES 1–4 with the two main elements being shown in perspective in FIGURES 6 and 7. Fundamentally, the interlock is a toggle type linkage which moves through an over-center position during tripping to force the bimetals of adjoining circuit breakers out of latched engagement with their respective carriers. One of the links 50 is illustrated in FIGURE 6 and operates as a bell crank lever. The bell crank link 50 has a pivot hole 51 by which it is mounted on studs 52 molded integrally with the walls of adjoining casings. A smaller pivot hole 53 is formed in the bell crank link 50 to receive a pivot pin 54 on a trip link 55. The link 50 is recessed at 56 and the link 55 is recessed at 57 so that when the links are pivoted together to form the toggle linkage, the complete assembly is of substantially uniform thickness so as to be conveniently mounted within the space between adjoining circuit breakers as illustrated in FIGURE 5.

Bell crank link 50 is provided with a transverse operator pin 58 which projects into adjoining casings through arcuate slots 59 formed in the adjacent walls thereof. As indicated in FIGURE 1, the transverse operator pin 58 is located adjacent the carrier 33 of each circuit breaker

in a position to be engaged and driven by a surface 60 on the carrier.

The trip link 55 has a similar transverse trip pin 61 which projects into each of the adjoining casings through linear slots 62 formed in the side walls thereof. The pins 61 are disposed adjacent the free end of the bimetallic element in a position to engage a surface 63 on the latch element of the bimetal to drive the element and the bimetal away from the carrier.

A reset pin 64 is fixed to the bell crank link 50 and projects through a suitable slot into one of the casings a sufficient distance to be engaged by handle lever 38.

Operation

As the operation of the invention is described, it will become apparent that, except for a slight time lag, the elements of all adjoined circuit breakers move in the same manner and at the same time. It should be understood, therefore, that a description of the position and movement of the elements of one circuit breaker should suffice as a description of the position and movement of all circuit breakers of the combination except where otherwise indicated.

The condition of the circuit breakers of the combination in their closed condition is illustrated in FIGURE 1. The toggle linkage in this "non-tripped" condition is retracted with its pivot pin 64 lying below a line drawn through the mounting stud 52 and trip pin 61. Upon overloading of one of the circuit breakers, the bimetallic element 30 flexes, carrying its latch element 46 toward the right and beyond the latch projection 45 of carrier 33. The thus freed carrier 33 is snapped counterclockwise by the action of spring 35 as described above. An intermediate condition of the circuit breaker prior to the completion of the swinging open of the carrier and contact arm is illustrated in FIGURE 2. In this intermediate condition the movement of the carrier has brought its surface 60 into engagement with the operator pin 58 counterclockwisely about the mounting stud 52. The rotation of the pin 58 and the bell crank link to which it is mounted swings the pivot pin 54 to an on-center, extended position in which the pivot pin 54 is in line with the mounting stud 52 and the trip pin 61. The extension of the toggle linkage through the movement from the position of FIGURE 1 to the position of FIGURE 2 causes the trip pin, linearly confined by its slot 62, to move toward the right into engagement with the surface 63 of the latch element 46 on the bimetal. The bimetals of all adjoining circuit breakers are thus forced toward the right (as viewed in FIGURE 2), thereby freeing their respective carriers from latched engagement with the bimetal.

If the bimetals were maintained in the strained condition illustrated in FIGURE 2, a permanent set might occur in the bimetal structure which would adversely affect the calibration of the circuit breaker. However, the carrier 33 continues to rotate counterclockwisely under the force of the spring 35 until the "tripped" position of FIGURE 3 has been attained. As illustrated by FIGURE 3, the carrier has forced the toggle linkage past the on-center, extended position. The toggle linkage continues to be retracted until the position of FIGURE 3 is attained through the force of the bimetals returning to their unstrained position, the bimetals bearing on trip pins 61.

FIGURES 8, 9 and 10 illustrate the relationship of the links of the interlock with respect to the bimetal latch element 46 upon which they operate as the links move from a "non-tripped" position through an intermediate, on-center, extended position shown in FIGURE 9 to a "tripped," retracted position as illustrated in FIGURE 10. The "tripping" movement toward the right of the trip pin 61 will be appreciated when its position with respect to a guide line 65 is compared with retracted positions in FIGURES 8 and 10.

The circuit breakers are reset in the usual manner by manipulation of their operating handles 43 which are suitably interconnected for unitary action as shown in FIG-

URE 5. The handles 43 are first moved toward the right until the position of FIGURE 4 is attained. The movement of the handles toward the right swings the operating levers 38 clockwise. The levers 38 engage the carriers to swing them to the position of FIGURES 1 and 4 for latched engagement with the elements 46 of the bimetals. Simultaneously, the operating levers 38 bear against the reset pin 64 on bell crank link 50 to swing the bell crank link clockwise so that the toggle linkage moves through the on-center, extended position back to the retracted position of FIGURE 1. As the toggle linkage moves through the extended, on-center position, the trip pin 61 is forced toward the right, as before, to move the latch elements 46 toward the right. As the latch elements 46 are moved toward the right, the carrier latch projection 43 passes by and thus avoids rubbing against the latch element as the projection 45 moves into latched position.

The operating handles 43 are thereafter moved toward the left until the position of FIGURE 1 is attained. The movement of the operating handles toward the left performs two functions for each circuit breaker, first, the operating handle carries the operating lever 38 counterclockwisely to swing the spring 35 past the over-center position with respect to the point of engagement 34 of the contact bar with the carrier. In this manner the contact bar is swung clockwise to snap contact 26 into tight engagement with the fixed contact 24. Second, the movement of the operating lever 38 counterclockwise brings the operating lever a sufficient distance away from the reset pin 64 of the toggle linkage so that the toggle linkage interlock is free to perform its common trip function as described above.

While the invention has been described in connection with a particular type of circuit breaker utilizing a carrier, a pivotally mounted contact bar, and an over-center spring, it should be well understood that the invention is not limited to application with such a specific circuit breaker. Rather, the invention has application to all types of circuit breakers utilizing a current responsive member latched with respect to a contact carrying mechanism which may not be movable with respect to the movable contact. The disposition of the parts will only have to be altered slightly in order to apply the invention to different types of circuit breakers.

Having described my invention, I claim:

1. A common trip interlock for adjoining circuit breakers each having a casing, a fixed contact, a movable contact, a carrier for said movable contact, flexible current responsive means having a latch engageable with said carrier for holding said contacts in engaged position, said interlock comprising, a bell crank link pivoted to said casing, a toggle link pivotally mounted at one end to one end of said bell crank link, at the other end of said toggle link a transverse trip pin projecting from each side of said toggle link into adjoining casings adjacent said current responsive means, a cam slot in at least one of said casings through which said trip pin passes to confine said trip pin to substantially linear motion, a transverse operator pin fixed to the other end of said bell crank link, said operator pin projecting into adjoining casings adjacent respective carriers, said operator pin being engageable by either carrier, upon tripping, to move said links from a "non-tripped" position, through an on-center, extended position in which said trip pin engages and forces said current responsive means to an unlatched position, to a "tripped" position in which said trip pin moves away from said current responsive means to permit said current responsive means to return to an unstrained position.

2. A common trip interlock for adjoining circuit breakers each having a casing, a fixed contact, a movable contact, a carrier for said movable contact, flexible current responsive means having a latch engageable with said carrier for holding said contacts in engaged position, said interlock comprising, an operator link pivoted to said casing, a trip link pivotally mounted at one end to one end of said operator link, at the other end of said trip link a transverse trip pin projecting from each side of said trip link into adjoining casings adjacent said current responsive means, a cam slot in at least one of said casings through which said trip pin passes to confine said trip pin to substantially linear motion, a transverse operator pin fixed to the other end of said operator link, said operator pin projecting into adjoining casings adjacent respective carriers, said operator pin being engageable by either carrier, upon tripping, to move said links from a "non-tripped" position, through an on-center, extended position in which said trip pin engages and forces said current responsive means to an unlatched position, to a "tripped" position in which said trip pin moves away from said current responsive means to permit said current responsive means to return to an unstrained position.

3. A common trip interlock for adjoining circuit breakers each having a casing, a fixed contact, a movable contact, a carrier for said movable contact, flexible resilient current responsive means having a latch mounted thereon engageable with said carrier for holding said contacts in engaged position, said interlock comprising, an operator element movably mounted between said casings, a trip element movably mounted between said casings and being operably associated with said operator element, a transverse trip pin projecting from each side of said trip element into adjoining casings adjacent said current responsive means, a cam slot in at least one of said casings through which said trip pin passes to guide the movement of said trip pin, a transverse operator pin fixed to the other end of said operator element, said operator pin projecting into adjoining casings adjacent respective carriers, said operator pin being engageable by either carrier, upon tripping, to move said operator element from a "non-tripped" position, to a tripped position, said operator element forcing said trip element to move its transverse pin into engagement with the current responsive means of the adjoining breaker a sufficient distance in a first direction to effect disengagement of its latch, said current responsive means resiliently returning said transverse pin of said trip element in a direction opposite to said first direction after tripping of the adjoining breaker has been effected thereby relaxing the stress on said current responsive means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,222,312	Green	Nov. 19, 1940
2,318,085	Leonard	May 4, 1943
2,503,409	Platz et al.	Apr. 11, 1950
2,692,926	Cole	Oct. 26, 1954
2,779,831	Thomas	Jan. 29, 1957
2,797,277	Dorfman et al.	June 25, 1957
2,824,191	Christensen	Feb. 18, 1958
2,889,428	Kingdon et al.	June 2, 1959
2,875,289	Brunner	Feb. 24, 1959
2,878,332	Locher	Mar. 17, 1959
2,923,795	Martin	Feb. 2, 1960
2,967,917	Cole	Jan. 10, 1961