United States Patent [19]

Dietz

[11] **3,711,748**

[45] **Jan. 16, 1973**

[54] **ELECTRIC PLUG-ON CIRCUIT BREAKER WITH MEANS FOR ASSURING TRIPPING OF THE BREAKER BEFORE UNPLUGGING**

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[22] Filed: **May 7, 1971**

[21] Appl. No.: **141,201**

[52] **U.S. Cl.** **317/112**, 335/35, 337/7

[51] **Int. Cl.**.....**H02b 1/04**

[58] **Field of Search** ..317/112, 119; 335/23, 35, 173; 337/7, 48

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[57] **ABSTRACT**

A molded case electric circuit breaker has plug-on jaws at the line end arranged to plug onto edge portions of flat bus bars, stacked in spaced face to face relation, upon movement of the circuit breaker line and foremost along a fixed path on a mounting pan to a plugged position, and to disconnect from the bar upon opposite movement of the circuit breaker along said path.

The breaker has a push-to-test pin accessible through a hole in its case for movement by an inserted tool to an operating position in which it rocks a trip bar to circuit breaker tripping position.

The breaker has a safety device comprising a settable element spring biased so that when released it moves to an operative position wherein it drives the pin to the pin operating position, and an element, arranged in fixed position along said path, which cooperates with the settable element and holds it in an inoperative position only while the jaws and bus bar are in plugged relation, and which releases the settable element so that the element is moved by its spring to the pin operating position prior to unplugging the jaws from the bus bars as the circuit breaker is moved in an unplugging direction from its plugged position, and at all times while the circuit breaker is removed from the pan.

8 Claims, 5 Drawing Figures

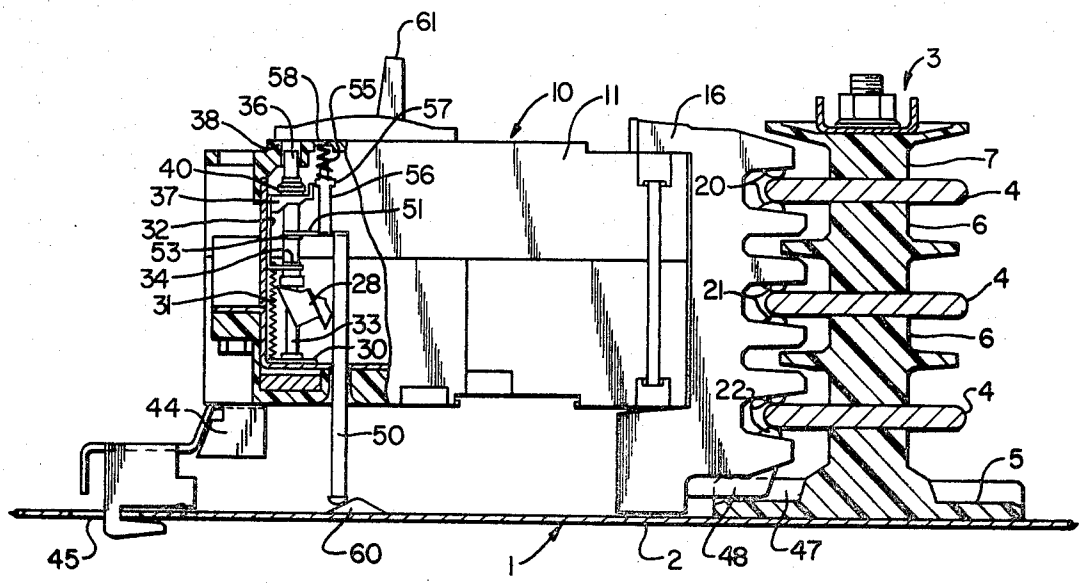
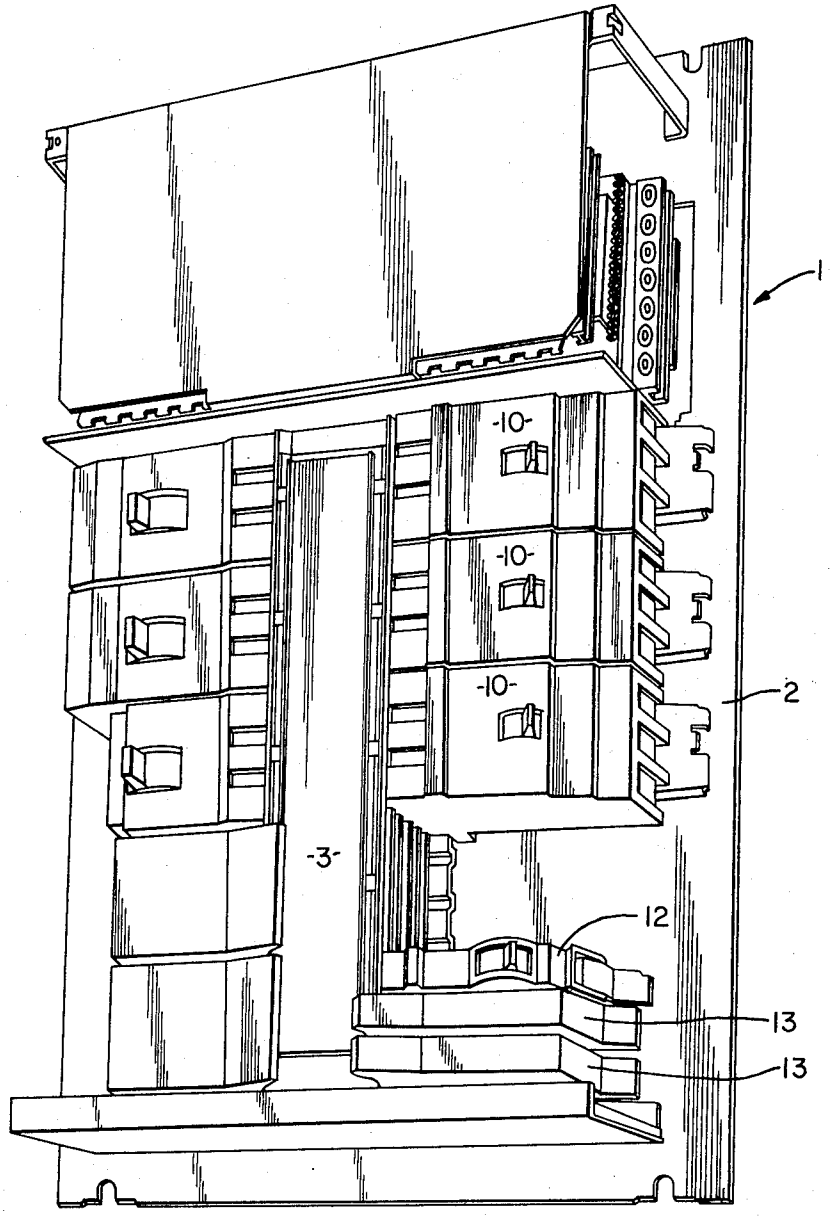


Fig. 1.



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Fig. 4

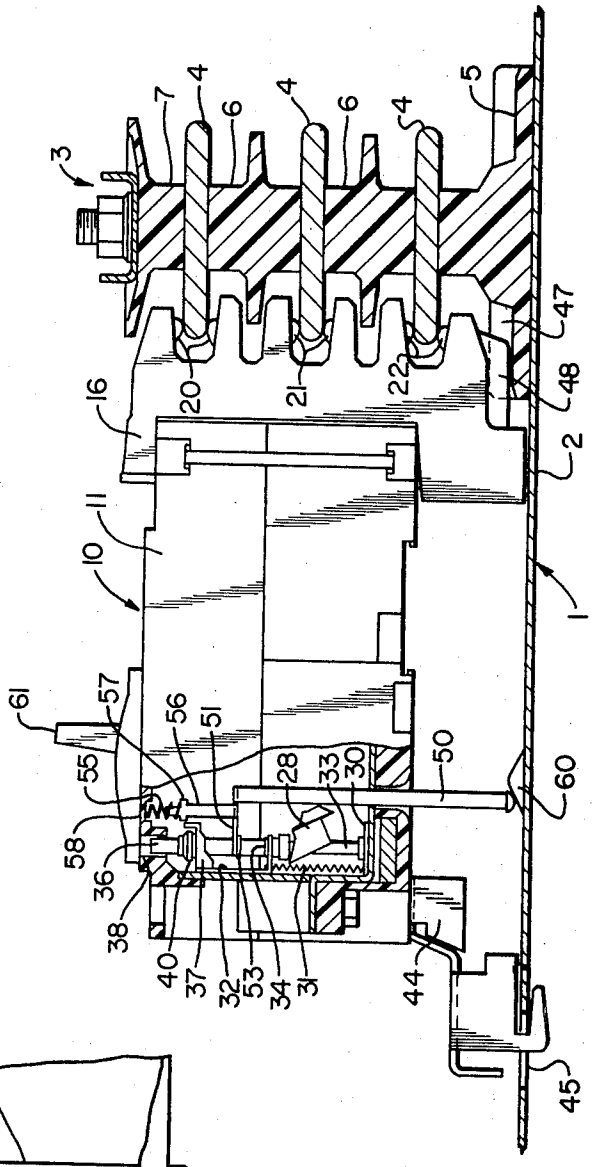
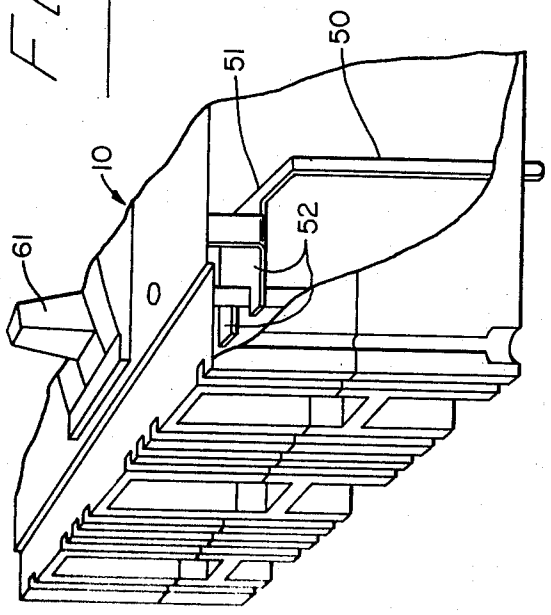


Fig. 2.



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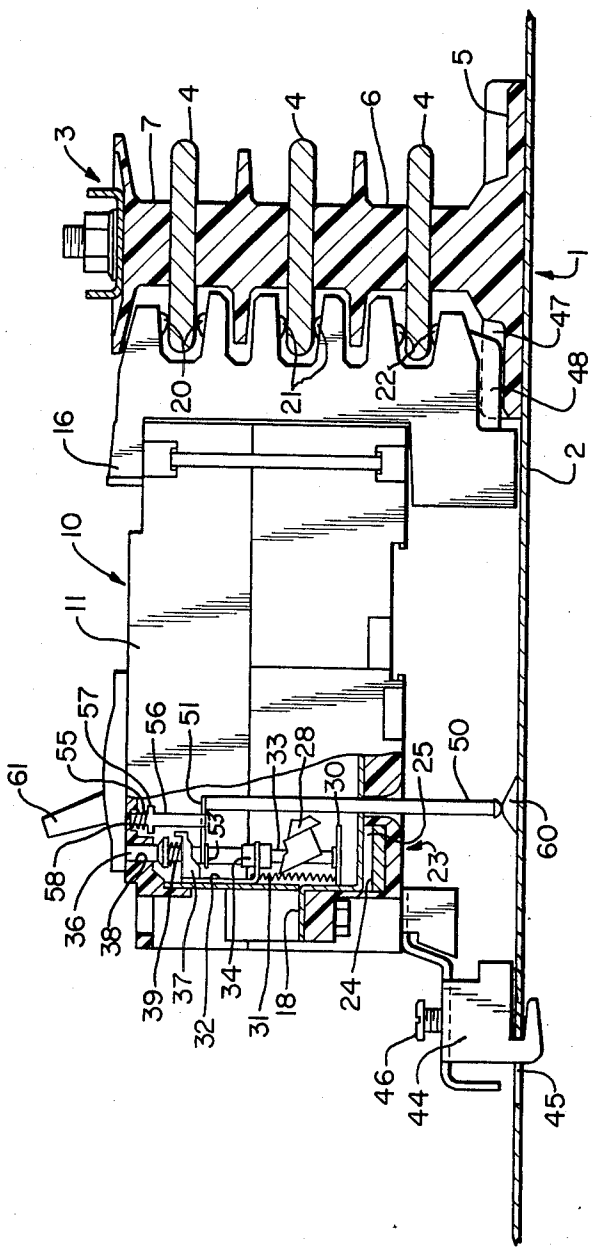


Fig. 3.

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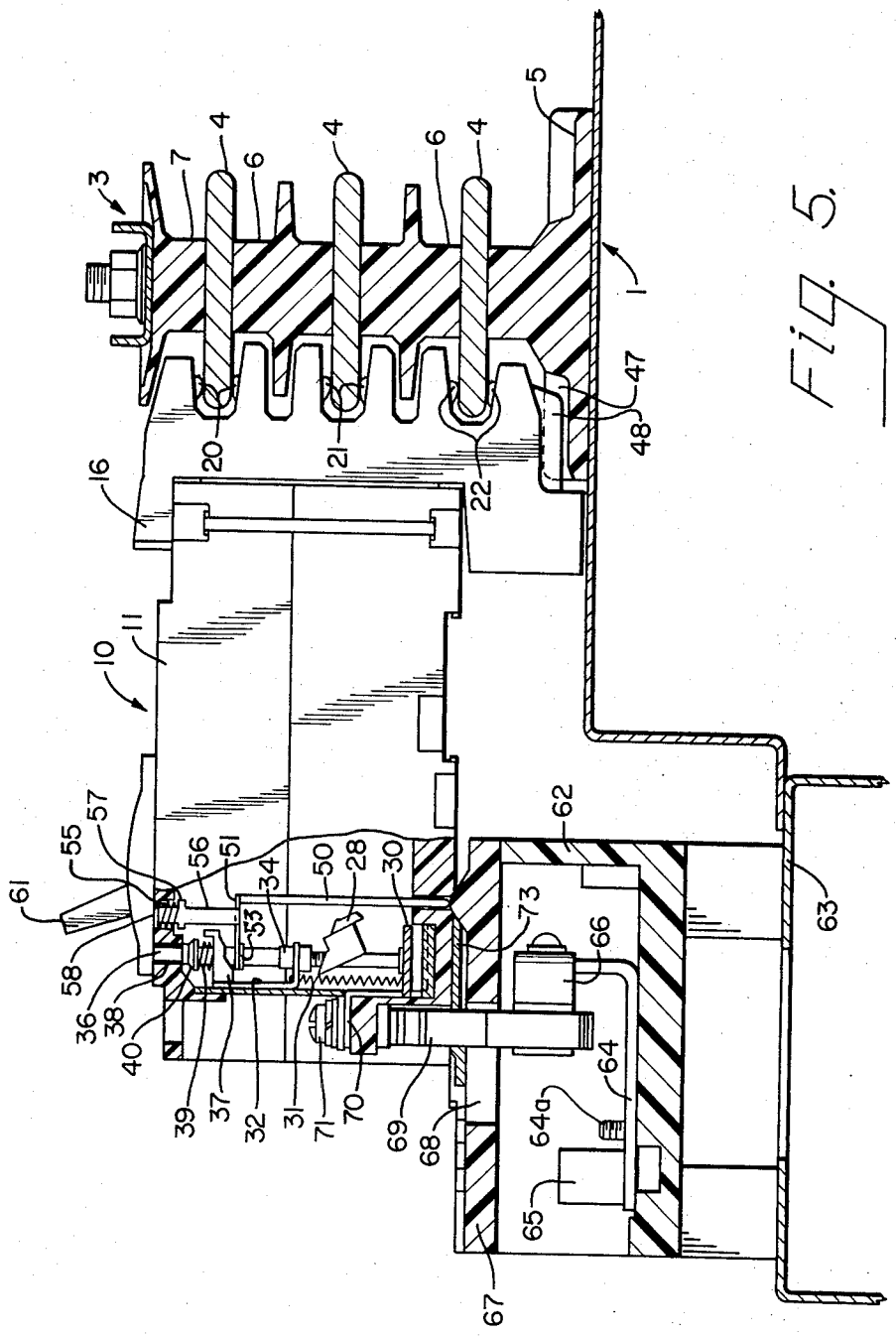


Fig. 5.

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ELECTRIC PLUG-ON CIRCUIT BREAKER WITH MEANS FOR ASSURING TRIPPING OF THE BREAKER BEFORE UNPLUGGING

This invention relates to molded case electric circuit breakers which have plug-on jaws at the line end which, in a connected position of the circuit breaker, are plugged onto a plurality of flat bus bars stacked with their faces parallel to a support or mounting pin, and having a push-to-test device accessible through a hole in the casing by a tool for tripping the circuit breaker, combined with a safety trip device so arranged so to trip the circuit breaker, in event the breaker is not turned off, prior to the disengagement of the jaws from the bus bars upon movement of the breaker to a disconnected position, and at all times when the circuit breaker is in other than connected position.

BACKGROUND OF INVENTION

The electric circuit breaker shown herein for purposes of illustration is of the basic type disclosed in U.S. Pat., to James H. Leonard et al., No. 3,341,791, of Sept. 11, 1967, entitled Electric Circuit Breaker with Improved Operating Mechanism. It is modified so that it can be plugged onto stacked bus bars, such as disclosed in U.S. Pat. to G. N. Jorgensen et al., Re. No. 26,737, of Dec. 9, 1969, entitled Electrical Panelboard, and may be mounted on a support or mounting pan as disclosed in U.S. Pat. No. 3,346,777, of Oct. 10, 1967, entitled Electric Circuit Breaker and Mounting Means Therefor.

The circuit breaker of the present invention employs a push-to-test device having a pin accessible by a tool for tripping the circuit breaker, broadly as disclosed in U.S. Pat. to B. W. Layton et al., No. 3,480,890, of Nov. 25, 1969, entitled Molded-Case Circuit Breaker with Manual Tripping Means Externally Accessible Only By A Tool.

As fully disclosed in U.S. Pat. No. 3,341,791, such a circuit breaker is normally set, and turned OFF and ON while set, by an exterior operating handle. When set, the circuit breaker is latched in set position by latches which are releasable, respectively, by such means as electromagnetic mechanisms responsive to fault currents, or to sudden severe overloads, or to both, or by thermal mechanisms responsive to heat produced by long continued, but less severe, overloads. In many breakers all three latches and associated mechanisms are incorporated and the electromagnetic and thermal mechanisms are connected to a single or common rockable trip bar. The bar is spring biased to rotate about its axis in one direction to latching position, but, when rotated in the opposite direction by the one of the electromagnetic or the thermal mechanisms, releases the latches so that the breaker mechanism is tripped and its movable contacts are moved to open position.

The latches and mechanisms employed are themselves well known in the art and their specific structural features form no part of the present invention. The important features derived from the prior art and used in the combination of the present invention are (a) a trip bar which is rockable in one direction to unlatch a circuit breaker mechanism which thereupon trips the circuit breaker; (b) a push-to-test trip pin which can be operated from the exterior of the case by a suitable tool to rock the trip bar into a position to unlatch the mechanism for tripping; (c) plug-on jaws and associated bus bars arranged to be engaged edgewise by the jaws; and (d) a safety device, broadly such as disclosed in French U.S. Pat. No. 1,183,823, of Feb. 2, 1959, but arranged so that it assures that the circuit breaker is tripped before it is disconnected from the bus bars and before it is connected to the bars.

SUMMARY OF THE INVENTION

The present invention is directed primarily to the foregoing features combined with each other and with an additional feature which causes the push-to-test pin to be operated by the safety device so as to trip the circuit breaker prior to unplugging of the plug-on jaws from the bus bars, and to hold the push-to-test pin in tripping position while the circuit breaker is disconnected from its mounting pan.

Various specific objects and advantages of the present invention will become apparent from the following description wherein references is made to the drawings.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a perspective view of an electrical panel board and a plurality of circuit breakers of the present invention mounted thereon, certain parts being omitted for clearness in illustration;

FIG. 2 is a perspective view of part of a circuit breaker of the present invention, part of the case of the circuit breaker and other mechanism being omitted, to show the relation of the push-to-test pin and associated safety device;

FIG. 3 is an enlarged fragmentary sectional view taken generally along the line 3'3 of FIG. 1, parts thereof being shown in section for clearness in illustration, and showing the circuit breaker in the untripped position and connected to the power side of a circuit;

FIG. 4 is a view similar to FIG. 3 showing the circuit breaker in tripped condition, with the exterior operating handle in the tripped position, during disconnection of the circuit breaker from the power source; and

FIG. 5 is a view similar to FIG. 3 showing a like circuit breaker, but employing stab terminals for connecting it to load terminal conductors.

Referring to the drawings, a plurality of circuit breakers are shown mounted on an electrical panelboard, indicated generally at 1, including a mounting pan 2 carrying a stack, indicated generally at 3, of elongated insulators and a plurality of flat bus bars. The bus bars 4 are interleaved between a rear insulator 5, two intermediate insulators 6, and a front insulator 7. Mounted on the mounting pan 2 are three relatively large three pole molded case circuit breakers 10 which, if desired, may be interspersed with relatively small single pole molded circuit breakers 12 and with blank fillers 13.

For purposes of illustration herein, only one of the three pole circuit breakers 10 is described in detail.

Referring to FIGS. 2 through 4, the circuit breaker 10 has a two piece case 11 of molded material which, at its line end, is connected to a shroud 16 of insulating material. Terminal straps 18 are provided, one for each pole of the three pole circuit breaker. The straps 18 are connected through circuit breaker contacts (not shown) to pairs of plug-in jaws 20, 21, and 22, respectively, which are disposed at the line or power end of

the circuit breaker and are adapted to be plugged onto the front edges of the bus bars 4, respectively.

For purposes of illustration, only one strap 18 is shown herein. The strap 18 is associated with a magnetic release mechanism 23 which includes a magnetic core 24 of U-shaped structure having upturned marginal flanges 25. The strap 18 extends between the marginal flanges of core 25 so that currents through the strap produce flux in the core 24.

A common trip bar 28 is spring biased, clockwise in FIGS. 2 and 3, to rock to latching position with respect to the circuit breaker mechanisms and so remains while the circuit breaker is in the untripped condition so long as the currents through the strap 18 are within a normal operating range. The bar 28 is moved counterclockwise by electromagnetic mechanism to trip the circuit breaker in response to a fault current, or a temporary surge of lesser current beyond normal through the strap 18.

As mentioned, and as disclosed in U.S. Pat. No. 3,341,791, it is customary to provide in circuit breakers latches which are operated to release by thermo-responsive mechanism which becomes heated by long sustained overload currents through the strap 18 insufficient to cause the magnetic release mechanisms to operate, and thereby rocks the bar 28 to tripping position. Rocking of the bar counterclockwise against the bias of its spring by any one of the latch operating mechanisms will trip the circuit breaker. The specific latching mechanism and their operating mechanisms form no part of the invention and, accordingly, only an electromagnetic release mechanism is discussed herein specifically.

The electromagnetic release mechanism illustrated in FIGS. 1 – 4 includes an armature 30 which is in magnetically attractive relation to the flanges 25 of the core 24. The armature 30 is biased, upwardly in FIG. 3, by a biasing spring 31 which is connected to a suitable bracket 32 in the casing. The spring 31 is of such force that it retains the armature 30 in raised position, as illustrated in FIG. 3, against any magnetic attraction due to flux in the core 26 caused by currents in the strap 18 within the normal operating range of the circuit breaker. The armature is drawn downwardly against the force of the spring 31 by flux generated by currents in excess of the normal currents. The armature 30 is carried on an upright rod 33 which, at its upper end has a cap portion 34 which extends through a hole in an arm 35 of the bracket 32 and is guided thereby for vertical reciprocation.

It is desirable at times to trip the trip bar 28 for testing the circuit breaker, and, for this purpose, the circuit breaker is provided with a push-to-test pin 36.

The push-to-test pin 36 is mounted for vertical reciprocation in a bracket 37 and with its upper end reciprocable in and guided by a passage 38 in one wall of the circuit breaker case 11. The pin 36 is biased upwardly to an extended position by a spring 39 interposed between a shoulder 40 and the rod and the bracket 37. In its extended position, the upper end of the pin 36 is near the top surface of the case 11 and it is accessible through the passage 38 by a suitable tool so that it can be depressed against the force of the biasing spring 39. The lower end of the pin 36 normally rests on the upper end of the cap portion 34 of the rod 33. If it is desired to trip the circuit breaker to test it, the push-to-test pin 36 is depressed, thus depressing the armature 30 the same as though it were drawn downwardly by the armature 30 and magnetic flux in the core 24, thereby causing the cap portion 34 to engage the trip bar 28 and rock it counterclockwise in FIGS. 2 and 3, against the bias of its spring, to a position for tripping the circuit breaker.

As mentioned, in installing or connecting the circuit breaker to the bus bars, it is desirable that the circuit breaker be supported on the pan 2 and then moved from its initial position along a predetermined path toward the bus bars so as to effect engagement of the various pairs of plug-on jaws 20, 21, and 22 with their associated bus bars 4. For this purpose, a suitable bracket 44 is provided on the load end of the case 11 and is adapted to be received in a suitable opening or slot 45 in the pan 2. The bracket is arranged to guide the load end of the circuit breaker as the circuit breaker is moved toward the bus bars, line end foremost, and is provided with a retaining screw 46 so as to retain the circuit breaker in position after the push-on jaws have engaged the bus bars 4. The rear insulator 5 is provided with grooves 47, extending transversely of the bus bars. Suitable ribs 48 on the rear or lower surface of the shroud 16 are received in and guided by the grooves 47. Generally the mating grooves and ribs are arranged one rib and one associated groove near each outer lateral limit of the circuit breaker case. In order to install the circuit breaker on the panel, it is placed in position such that the rear end of the bracket 44 can pass readily through the opening or slot 45, in which position the plug-on jaws are spaced transversely of and out of contact with their associated bus bars 4. At the same time, the ribs 48 are engaged at their outer ends with the outer portions of the grooves 47. With this alignment of the ribs 48 and grooves 47, the circuit breaker is pushed toward the bus bars so as to cause the plug-on jaws to engage their associated bus bars 4, and drawn away from the bus bars to disengage the jaws from the associated bus bars.

There is relatively little danger of any arcing or deleterious effects upon movement of the jaws into connected relation to the bus bars, whether the breaker is tripped or untripped, or OFF or ON. However, there is grave danger in disconnecting the plug-on jaws from the bus bars with the circuit breaker closed, particularly if a load is connected to the load side terminals of the circuit breaker. It is desirable, therefore, if an attempt is made to connect or disconnect the jaws from the bus bars, that the circuit breaker be tripped before connection or disconnection. For this purpose, a safety trip mechanism is provided.

The safety trip mechanism comprises a push rod 50 which at its lower end extends through a hole in the rear or bottom of the case 11 of the circuit breaker, and is mounted within the case 11 for vertical reciprocation. At its upper end, the rod 50 carries a transversely extending yoke 51 which has spaced arms 52 between which the push-to-test pin 36 passes. A suitable E-ring or locking washer 53 is provided on the pin 36 and is adapted to be engaged and pushed downwardly by the yoke arms 52 as the rod 50 is moved downwardly, thus, in effect, pushing the push to trip pin 36 downwardly so that the cap portion 34 of the magnetic armature rod

33 is pushed downwardly to tripping position. The rod 50 is normally biased downwardly by a spring 55. For operatively connecting the spring 55 to the rod 50, a finger 56 is mounted on, and extends upwardly from, the yoke 51 and has a shoulder 57 spaced from its upper end. The spring 55 is interposed between the shoulder 57 and an inverted socket 58 in the front or top wall of the case 11. The spring 55 is such strength that when the rod 50 is free to move downwardly the spring 55 can push downwardly on the lock washer 53 and drive the pin 36 downwardly against the combined forces of its spring 39 and the biasing force of the armature spring 31, thus causing the common trip bar 28 to trip the circuit breaker in the same manner as it would be tripped by the push-to-test pin. Thus, with the circuit breaker disconnected from the panel, the safety device assures that the circuit breaker is tripped as the rod 50 is then free and is moved downwardly and held extended by its spring 55.

Assuming, however, that the circuit breaker is placed on the wall of the mounting pan 2 in position to be moved into connected relation to the bus bars, it is desirable that the breaker remain in tripped position until the plug-on jaws have made firm contact with their associated bus bars. For this purpose, a cam 60 is provided, and is arranged to lie in the path of the lower end of the rod 50 as the circuit breaker is moved to and from final contact position with respect to the bus bars. The cam 60 is contoured so that, assuming that the push-on jaws are in contact with the bus bars, the cam holds the rod 50 in raised position against the force of the spring 55, and constrains it from operating the push-to-test pin. If the circuit breaker is moved to the left from the position shown in FIG. 3 to and beyond the position shown in FIG. 4, the lower end of the rod 50, starting from the position in FIG. 3 at the crest of the cam 60, in which it holds the spring 55 fully compressed so that the springs 31 and 39 can hold the push-to-test pin 38 in its raised extended position with the circuit breaker mechanism untripped, will begin riding down the cam 60. As the circuit breaker is moved farther to the left from the position illustrated in FIG. 4, the lower end of the rod 50 travels down the left side of the cam 60 allowing the spring 55 to extend and, through the medium of the yoke 52 and washer 53, to drive the pin 36, and thereby the cap portion 34 and rod 33 downwardly against the common trip bar 28 so as to rock it counterclockwise in FIG. 3 to tripping position. This occurs before the circuit breaker has been moved to the left from the position in FIG. 4 in which the plug-on jaws disconnect from their respective bus bars 4. Accordingly, the tripped position, illustrated in FIG. 4, occurs before the breaking of contact between the jaws and the bus bars.

On the other hand, in moving the circuit breaker toward connected position, the rod remains in the position illustrated in FIG. 4, in which it has caused the circuit breaker to be tripped, until the push on jaws are connected with the bus bars 4, whereupon continued movement to the right to final connected position, the rod is again lifted by the cam 60 so that it does not drive the push-to-test pin 36 to operating position. Thereby the trip bar remains in tripping position until after the contact with the bus bars is effected. Thereafter, of course, the circuit breaker can be set in the untripped position, with the operating handle 61 thereof in the ON or OFF position, and with the various latching mechanisms holding the movable contacts in closed position.

In FIG. 5 a similar circuit breaker is shown in the position illustrated in FIG. 3. In this particular circuit breaker, the load side contacts are carried in a separate housing 62 mounted on the front or upper face of a portion of a mounting pan 63, which corresponds to the pan 2. Mounted in the housing 62 is a conductor 64 secured in place by a bolt 64*a* and carrying a terminal connector 65 for receiving the end of an exterior load conductor.

The conductor 63 is provided with contact jaws 66 which are open to the left in FIG. 5. The housing 62 is provided with a cover 67, having an elongated slot 68 therein. A stab terminal 69 is connected to the load bar 70 of the circuit breaker, corresponding to the load bar 18 therefore described, and is connected to the housing of the breaker 70 by a suitable screw or bolt 71. The stab terminal extends rearwardly or downwardly and is insertable through the slot 68 when the breaker is lowered into position on the pan and housing 62 preparatory to sliding it toward the bus bars into connected position with the bus bars 4.

The slot is sufficiently long so that when the breaker is lowered in place, the stab terminal passes endwise through the slot 68 and lies in a position to the left of the jaws 66 so that upon movement of the circuit breaker to the right to connected position, the stab terminal engages resiliently between the jaws 66. The width of the slot 68 is such that the stab terminal, by engaging the sides thereof, acts as a forward guide in much the same manner as the bracket 44 heretofore described.

In this form of the invention, if desired, a suitable bracket 73 may be provided and arranged as is the bracket 62 in the co-pending application of Wilhelm T. Hackenbroch, Ser. No. 2,149, filed Jan. 12, 1970, for cooperation with a suitable rack disclosed at 60 in the application, for the purpose of prying the circuit breaker from the unconnected position to the connected position, as illustrated in FIG. 4, should the frictional resistance to such movement so require.

Having thus described my invention, I claim:

1. A circuit breaker and safety trip combination, comprising:

a circuit breaker including a casing;

complementary contacts;

an external operating handle for opening and closing the contacts;

contact jaws for connection to, and disconnection from, bus bars, concurrently;

means supporting and guiding the circuit breaker for bodily movement along a predetermined path to a jaw connected position and to a jaw disconnected position, respectively;

a trip device operative when moved to one position to trip the circuit breaker;

a normally inactive push-to-test device movable, by a tool manipulatable from the exterior of the casing, to an active position, and mechanically connected to the trip device to move the trip device to its said one position when the push-to-test device is moved to its said active position;

means to restore the push-to-test device to its inactive condition when it is unconstrained;

characterized by:

a safety trip mechanism mechanically normally drivingly connected to the push-to-test device, and disconnectable therefrom, and operative, when drivingly connected, to move the push-to-test device to, and to hold the push-to-test device in, its said active position, and operative, when disconnected, to release the push-to-test device; and

operator means in fixed position along said path and normally drivingly disengaged from said safety trip mechanism, and drivingly engageable with said safety trip mechanism by said bodily movement of the circuit breaker to its said jaw connected position, and operative, when so engaged, to disconnect the safety trip mechanism from the push-to-test device.

2. The structure according to claim 1 wherein the safety trip mechanism includes:

a movable means connecting the safety trip mechanism to the push-to-test device;

biasing means normally operative for biasing the movable means from an inoperative position to an operative position wherein the movable means operates the push-to-test device to trip the circuit breaker; and

said operator means is cooperable with the biasing means to render the biasing means inoperative while the circuit breaker is in its connected position and to release the biasing means so that it can operate as the circuit breaker is moved along said path to said disconnected position.

3. The structure according to claim 2 wherein the push to test device includes a pin which is drivingly connected to a trip bar of the circuit breaker, and which is movable endwise in opposite directions along a given path in one of which directions it moves to a tripping position wherein it trips the trip bar;

spring means bias the pin in the opposite direction to an inoperative position; and

said biasing means is a spring which biases the movable means so as to apply to the pin a force in opposition to, and greater than, that of the spring means.

4. The structure according to claim 3 wherein the movable means is movable in opposite directions along a path parallel to the path of the pin and has a part movable therewith; and

said pin and part have coacting aligned facing shoulders which engage when said part moved in said one of the directions to a predetermined position and then, upon continued movement in said one of said directions, drives the pin to bar tripping position.

5. The structure according to claim 3 including means movable from an inoperative position by effects produced in response to a load current conducted by a circuit through the circuit breaker to an operative position in which it trips the bar; and

spring means yieldably holding the last named means in its inoperative position; and wherein

said pin is connected to the trip bar by said last mentioned means so that when the pin is moved to its tripping position it operates said last mentioned means thereby to trip the trip bar.

6. The structure according to claim 1 wherein electroresponsive means are provided and are operative in response to predetermined phenomena caused by currents in the circuit break to operate the trip device;

said electroresponsive means include a member movable relative to the push-to-test device, by electroresponsive means when the electroresponsive means are operative, to engage and operate the trip device; and

said push-to-test device is connected to said member for moving the member to cause it to engage and trip the trip bar.

7. The structure according to claim 1 further characterized in that a plurality of bus bars are mounted on the supporting means in stacked face to face relation to each other with the edges of the bars facing endwise of the path and aligned with the jaws, respectively, for connection thereto upon movement of the circuit breaker to said connected position;

complementary guide means respective to the first mentioned guide means are carried by the support; and

said safety trip mechanism includes an operator element in fixed position on the support, and a movable element having a portion disposed exteriorly of the casing and cooperable with, and moved by, the operator element as the circuit breaker is moved and guided along its path to effect said rendering of the safety trip mechanism operative and inoperative.

8. The structure according to claim 7 wherein said movable element is movable toward and away from said support, and the operator element is a cam.

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