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Wallace et al.

[11] **3,748,609**

[45] **July 24, 1973**

[54] **CIRCUIT INTERRUPTER**

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[73] Assignee: **Westinghouse Electric Corporation,** Pittsburgh, Pa.

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[52] **U.S. Cl.** **335/174,** 335/18

[51] **Int. Cl.** **H01h 9/20**

[58] **Field of Search** 335/174, 175, 20, 335/40, 167, 168, 169, 170, 18

[56] **References Cited**

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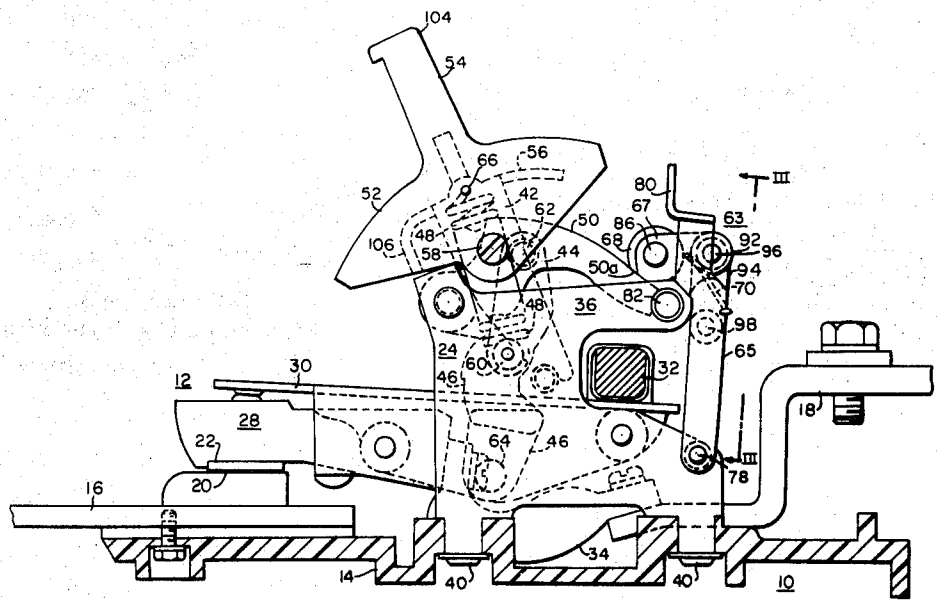
[57] **ABSTRACT**

A circuit interrupter, such as a switch or a circuit breaker, comprising relatively movable contact means, operating means releasable to open the contact means, and trip means which may be responsive to ground fault currents through the contact means to effect the release of the operating means to open the contact means upon the occurrence of ground fault currents.

12 Claims, 4 Drawing Figures



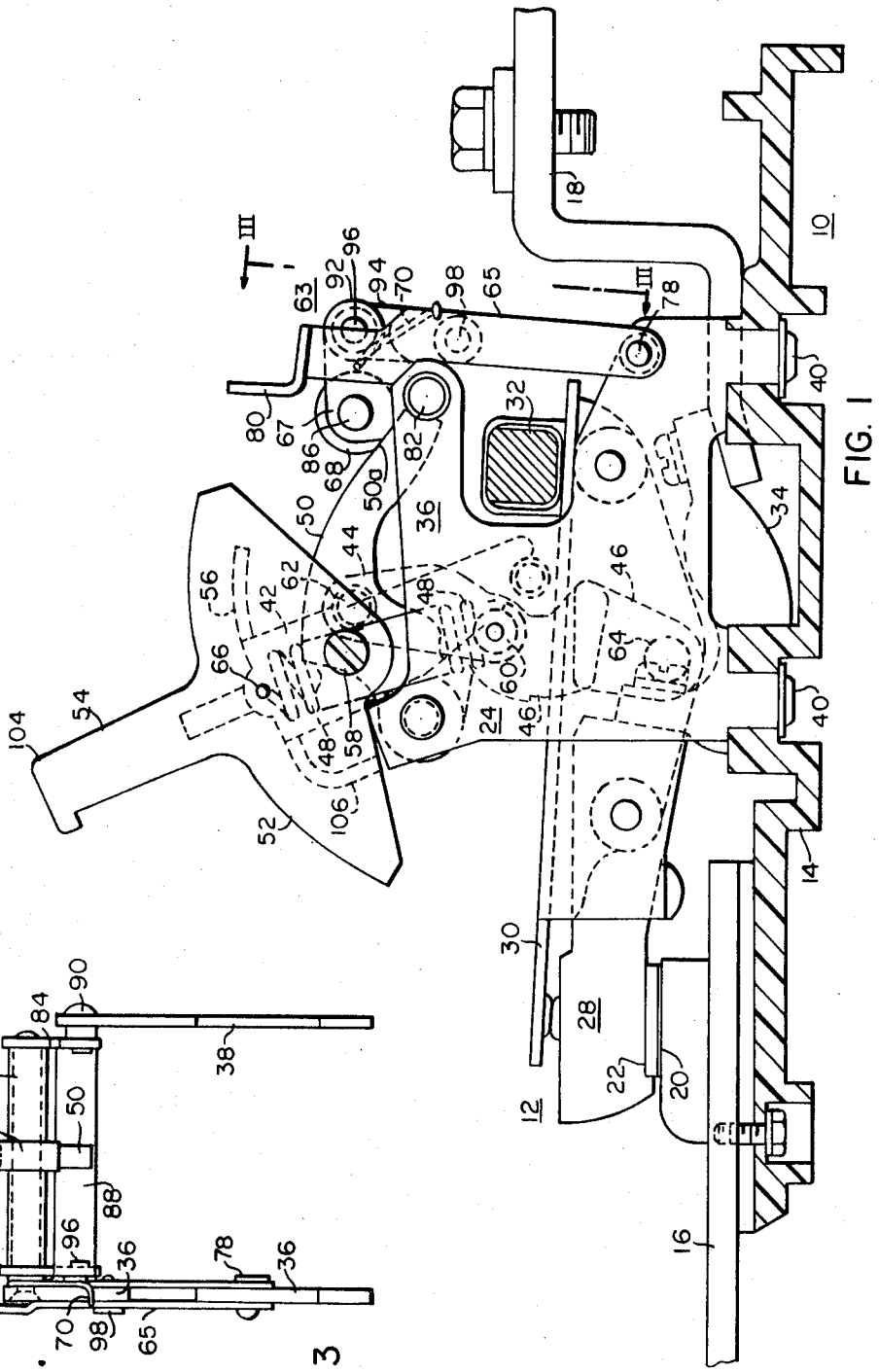


FIG. 1

FIG. 3

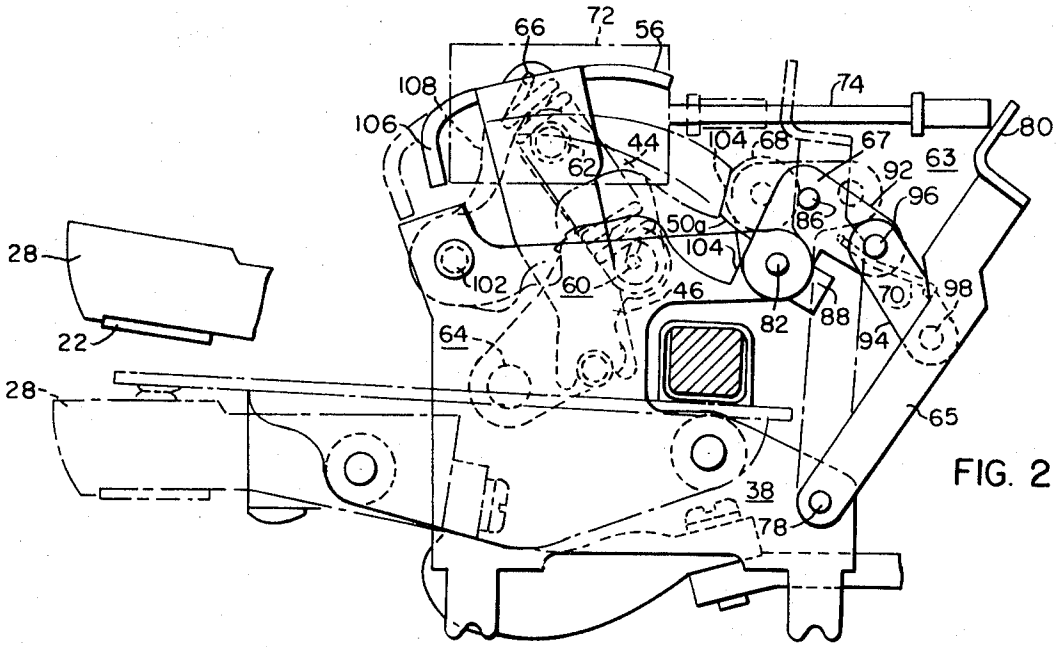

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FIG. 2

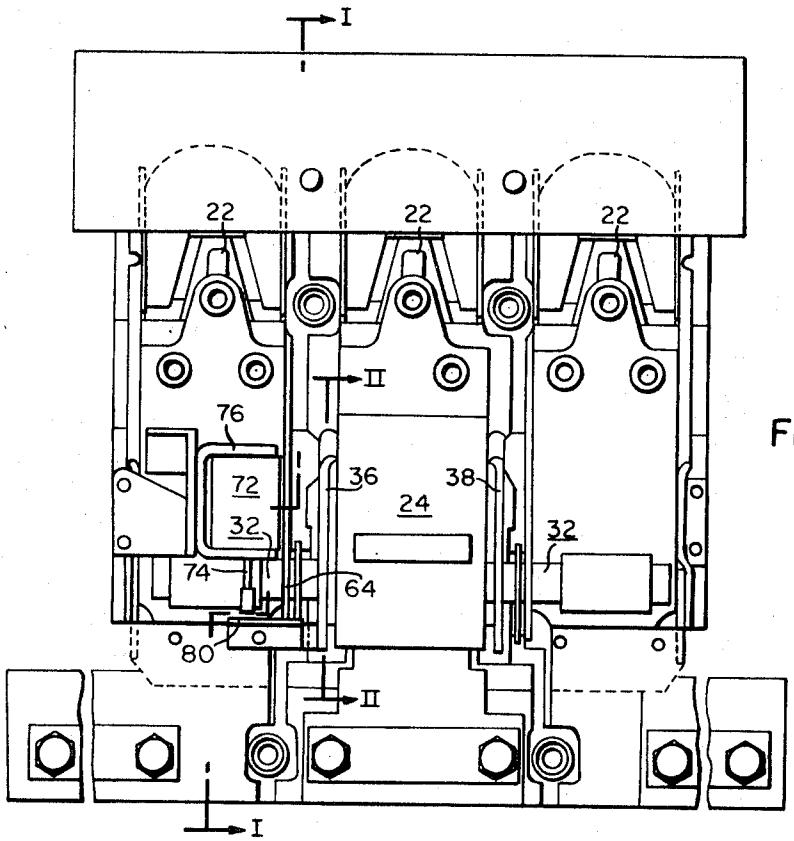
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FIG. 4

CIRCUIT INTERRUPTER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to circuit interrupters having an energizable release device for opening the contacts in the interrupter upon the occurrence of ground fault current through the contacts or upon the application of an energizing current for any purpose.

2. Description of the Prior Art

Recently electrical wiring circuits have been installed with circuit interrupters such as switches and circuit breakers that are provided with ground fault trip means for opening the circuit when a ground fault occurs. Indeed, the desirability of providing ground fault protection has been widely accepted in recent years and has resulted in the production of ground fault devices of the various kinds. Among other things, many such devices including ground fault protection that are currently available are unable to open a current or circuit interrupter, such as a conventional residential circuit breaker, due to insufficient force generated by the ground current. Accordingly, there is a need for a device for tripping a switch or current interrupter by means of a shunt trip actuated by a ground current or other energizing current.

SUMMARY OF THE INVENTION

In accordance with this invention it has been found that the foregoing problem may be overcome by providing a circuit interrupter having relatively movable contact means and means releasable to effect opening of the contact means, trip means including first and second levers operable for effecting automatic release of the releasable means when a ground fault occurs or energizing current is applied for any purpose, the levers being operable between latched and unlatched positions relative to the releasable means, the trip means also including an electromagnetic trip device responsive to ground fault currents through the contacts or the application of an energizing current to effect movement of the first lever to the unlatched position, the trip means being biased in the latched position, the releasable means including a releasable lever having an end portion movable between said positions, the second lever having a roller engageable with the end portion in the latched position and being rollable to a non-engaging position of the end portion in the unlatched position, and a connecting link extending between the first and second levers.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical sectional view taken on the line I—I of FIG. 4 and embodying the principles of the invention;

FIG. 2 is a vertical sectional view taken substantially along the line II—II of FIG. 4 and showing the circuit interrupter in the tripped position;

FIG. 3 is a vertical sectional view taken on the line III—III of FIG. 1 and embodying the principles of the invention; and

FIG. 4 is a top plan view of the switch shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. 1 of the drawings a circuit interrupter or switch is generally indicated at **10**. It comprises a switch structure **12** which is mounted on a molded base **14** of electrically insulating material, and which is disposed between spaced electrical conductors **16** and **18**.

The switch **10** is of the multi-pole type and the mechanism may be of the general type disclosed in U.S. Pat. No. 2,508,178, issued May 16, 1950 to T. Lindstrom et al., and assigned to the assignee of the present invention. The switch **10** includes a stationary contact **20** and a movable contact **22** for each pole of the device. A common operating mechanism, generally indicated at **24** (FIG. 1), is provided for simultaneously actuating three movable contacts **22** (FIG. 4) to open and closed circuit positions. The stationary contact **20** is rigidly mounted on the inner end of the conductor **16** which has a line terminal (not shown) connected to the outer end. The movable contact **22** for each pole is rigidly mounted on a contact arm **28** supported on a switch arm **30** which is rigidly secured on the end of a tie bar **32** that extends across all of the poles (FIG. 4) of the switch for movement together to open and closed circuit positions. The contact arm **28** is connected by a flexible conductor **34** to the conductor **18** which is secured to the base **14** in a suitable manner such as by a screw (not shown).

The operating mechanism **24** for the switch structure **12** is disposed in the center compartment (FIG. 4) of the mechanism and is supported on a pair of laterally spaced frames **36** and **38** which are secured to the base **14** by suitable means such as screws **40**. The operating mechanism comprises a forked operating lever **42**, a toggle comprising links **44** and **46**, overcenter springs **48**, and a releasable lever or pivoted cradle **50**. An arcuate insulating shield **52** is mounted over the operating end of the operating lever **42** and is provided with an integral switch handle **54**. The shield **52** is mounted over an intermediate portion **56** of the operating lever **42** and is secured in place by suitable means such as screws **58** attached to the forked portions of the lever **42**, only one of which is shown in FIG. **1**.

The toggle links **44** and **46** are pivotally connected together by a knee pivot pin **60**. The toggle link **44** is pivotally connected by a pivot pin **62** to the cradle **50** and the toggle link **46** is pivotally connected to the switch arm **30** for the center pole by a pivot pin **64**. The overcenter springs **48** are connected under tension between the knee pivot pin **60** and the outer end of the operating lever **42** at pivot pin **66**.

The switch structure for the circuit breaker **12** is operated to the open operating position by manipulation of the handle **54** in a clockwise direction to the "off" position, actuating the overcenter springs **48** to cause collapse of the toggle links **44** and **46** (FIG. 2), thereby causing opening movement of the switch arms **30** for all of the poles of the switch in a well-known manner.

Trip means are provided for automatically opening the switch **10** when a ground fault occurs or an energizing current is applied. The trip means being generally indicated at **63** comprises a "knuckle" type linkage which is movable between latched and unlatched positions with regard to the cradle **50**. In the latched position, the "knuckle" linkage goes "overcenter" and the linkage is held in tension (FIG. 1) by the springs **48** of the operating mechanism **24**. More particularly, the trip means **63** includes (FIG. 2) a lever **65**, a lever or bellcrank **67**, a roller **68**, and a biasing spring **70**. In addition, the trip means **63** includes an electromagnetic

device such as a solenoid 72 (FIGS. 2 and 4) having a plunger 74. The solenoid 72 is suitably mounted such as by a bracket 76 on a supporting frame of the circuit breaker, as shown in FIG. 4, where the plunger 74 is adapted to move the lever 65 in response to any abnormal current occurring through the contacts 20 and 22 as the result of a ground fault.

The lever 65 is mounted on the frame 36 (FIG. 1) by a pivot pin 78. The lever 65 is provided with a flange 80 by which the lever is moved clockwise to the position shown in FIG. 2 by the plunger 74 when the solenoid 72 is actuated. The bellcrank 67 is pivotally mounted on the frame 36 by a pivot pin 82 and cooperates with a shaft support member 84 for mounting the shaft 86. The preferred construction of the bellcrank 67 and the shaft support member 84 includes an interconnecting portion 88 which with the bellcrank and support member form a U-shaped unit that is disposed between the frames 36 and 38. The shaft support member 84 is pivotally mounted on the upper end of the frame 38 by a pivot pin 90 (FIG. 3). The shaft 86 supports the roller 68 which is rotatably mounted on the shaft and which cooperates with the cradle 50 in a manner set forth below.

The bellcrank 67 includes an outturned portion 92 which extends to the right as viewed in FIGS. 1 and 2. A connecting link 94, as best shown in FIG. 2, extends between the bellcrank 67 and the lever 65. A pivot pin 96 connects the link 94 to the bellcrank 92 and a pivot pin 98 connects the link to the lever 65. The spring 70 which is mounted on the pivot pin 96 has opposite end portions connected to the lever 65 and the bellcrank 67 for biasing the trip means 63 in the counterclockwise or latched position as shown in FIG. 1.

During normal operation of the circuit breaker 10 the trip means 63 is disposed in the latched position with the roller 68, composed of a hard material such as hardened steel, disposed over an end portion 50*a* on the upper side of the cradle 50 to hold the cradle in the lowermost (latched) position. In that position, the contacts 20 and 22 may be opened and closed in a normal manner by manual manipulation of the handle 54 in the clockwise and counterclockwise directions. Thus, the cradle 50 is retained in the latched position under normal electric current conditions. When an abnormal operating condition occurs such as a ground fault, the condition is detected by conventional ground fault detection device (not shown) which device transmits an electric current to the solenoid 72, causing the plunger 74 to move outwardly (to the right as viewed in FIG. 2) and to thereby rotate the lever 65 clockwise to the position shown. This action moves the roller 68 away from the latched position of FIG. 1 and the cradle 50 is thereby free to rotate counterclockwise about its mounting shaft 102 the ends of which are seated in the spaced-frames 36 and 38. Upon release of the cradle 50, the springs 48 operate to pivot the cradle counterclockwise about its pivot and to change the line of action of the springs so that the springs collapse the toggle links 44 and 46 from the extended positions of FIG. 1 to the collapsed position of FIG. 2 and to thereby raise the contact arm 28 to the open position in a conventional manner.

Upon opening of the contacts 20 and 22 the energizing current may be discontinued or the ground fault which tripped the mechanism is corrected and the plunger 24 moves to the left or retracted position, whereupon the spring 70 acts to return the trip means 63 to the latched position. However, inasmuch as the roller 68 is now disposed against an end 104 of the cradle 50 (FIG. 2), it is necessary to manually move the handle 54 to a resetting position in a manner well known in the art. Thus, the handle 54 is manually rotated clockwise until a flange 106 of the intermediate portion 56 is brought into contact with an end 108 of the cradle 50 to rotate the cradle clockwise until the end 104 is lowered and the end portion 50a drops below the roller 68 to the latched position. The switch 10 is then in condition for reclosing the contacts 20 and 22 by rotating the handle 54 counterclockwise to the position shown in FIG. 1.

Accordingly, the device of the present invention satisfies problems that existed in the prior art with regard to ground fault phenomena. The device is particularly adapted for tripping a fusible switch by means of a shunt trip actuated by a ground current or an energizing current whereby a solenoid uses a minimal amount of force (ounces) to actuate a relatively much higher latch load (pounds); i.e., the device provides a highly satisfactory and advantageous mechanical advantage. Finally, prior art circuit interrupters of the general type described have not included suitable means for tripping the breaker upon the occurrence of a ground fault through the contacts or application of an energizing current.

What is claimed is:

1. A circuit interrupter comprising relatively movable contact means and means releasable to effect opening of the contact means, the releasable means comprising a releasable lever, trip means comprising tension linkage including first and second levers and a connecting link operable for effecting automatic release of the releasable means, the first and second lever being pivotally mounted respectively on first and second pivot pins, the connecting link being pivotally mounted on the first and second levers respectively on third and fourth pivot pins, the first and second levers being operable between latched and unlatched positions relative to the releasable lever, the trip means also including an electromagnetic trip structure adapted to respond to an energizing current to effect movement of the first lever to the unlatched position, and the second lever being movable by the first lever from latch to unlatched positions of the releasable lever upon operation of the electromagnetic trip structure.

2. The circuit interrupter of claim 1 wherein the trip structure is biased in the latched position.

3. The circuit interrupter of claim 1 wherein the electromagnetic trip structure is operable to move the first lever to the unlatched position.

4. A circuit interrupter comprising relatively movable contact means and means releasably to effect opening of the contact means, the releasable means comprising a releasable lever, trip means comprising tension linkage including first and second levers and a connecting link operable for effecting automatic release of the releasable means, the first and second lever being pivotally mounted respectively on first and second pivot pins, the connecting link being pivotally mounted on the first and second levers respectively on third and fourth pivot pins, the first and second levers being operable between latched and unlatched positions relative to the releasable lever, the trip means also including an electromagnetic trip structure responsive

to abnormal ground fault currents to effect movement of the first lever to the unlatched position, and the second lever being movable by the first lever from latched to unlatched positions of the releasable lever upon operation of the electromagnetic trip structure.

5. The circuit interrupter of claim 4 wherein the trip structure is biased in the latched position.

6. The circuit interrupter of claim 4 wherein the electromagnetic trip structure is operable to move the first lever to the unlatched position.

7. The circuit interrupter of claim 4 wherein the releasable lever is movable between latched and unlatched positions when the trip means is released, and the second lever having means engageable with the releasable lever in the latched position.

8. The circuit interrupter of claim 7 wherein the engageable means is a roller engageable with the releasable lever in the latched position, and rollable to a nonengaging position of the end portion in the unlatched position.

9. The circuit interrupter of claim 7 wherein the trip means are biased in the latched position.

10. The circuit interrupter of claim 9 wherein the second lever is a bellcrank.

11. The circuit interrupter of claim 9 wherein the application of a small force by the electromagnetic trip structure on the first lever effects a substantially larger force on the second lever.

12. The circuit interrupter of claim 9 wherein the contact means comprise a stationary contact, a movable contact, and a movable switch arm having the movable contact thereon; the releasable means comprising an operating lever, a switch handle, the releasable lever, an overcenter toggle operable by the operating lever to effect movement of the switch arm to opened and closed circuit positions, and the overcenter toggle being operatively connected between the releasable lever and the movable switch arm.

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