United States Patent

Orosz, Jr. et al.

[15] **3,688,237**

[45] **Aug. 29, 1972**

[54] **FUSED CIRCUIT BREAKER**

[72] Inventors: **Alex Orosz, Jr.,** Beaver Falls; **Lawrence B. St. Clair,** Beaver, both of Pa.

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

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[52] **U.S. Cl.** .....**337/7,** 200/153 LA, 337/146

[51] **Int. Cl.**...**H01h 73/06,** H01h 73/50, H01h 85/56

[58] **Field of Search**.....337/5, 6, 7, 145, 146; 335/175; 200/153 LA

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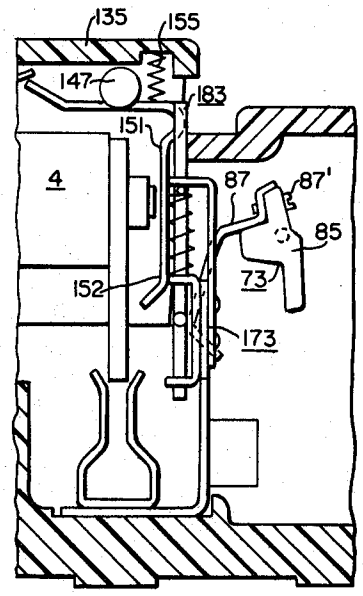
Primary Examiner—Bernard A. Gilheany
Assistant Examiner—Dewitt M. Morgan
Attorney—A. T. Stratton, Clement L. McHale and W. A. Elchik

[57] **ABSTRACT**

A fused circuit breaker with means for tripping the breaker upon removal of the fuse cover.

2 Claims, 7 Drawing Figures



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2 Sheets-Sheet 1

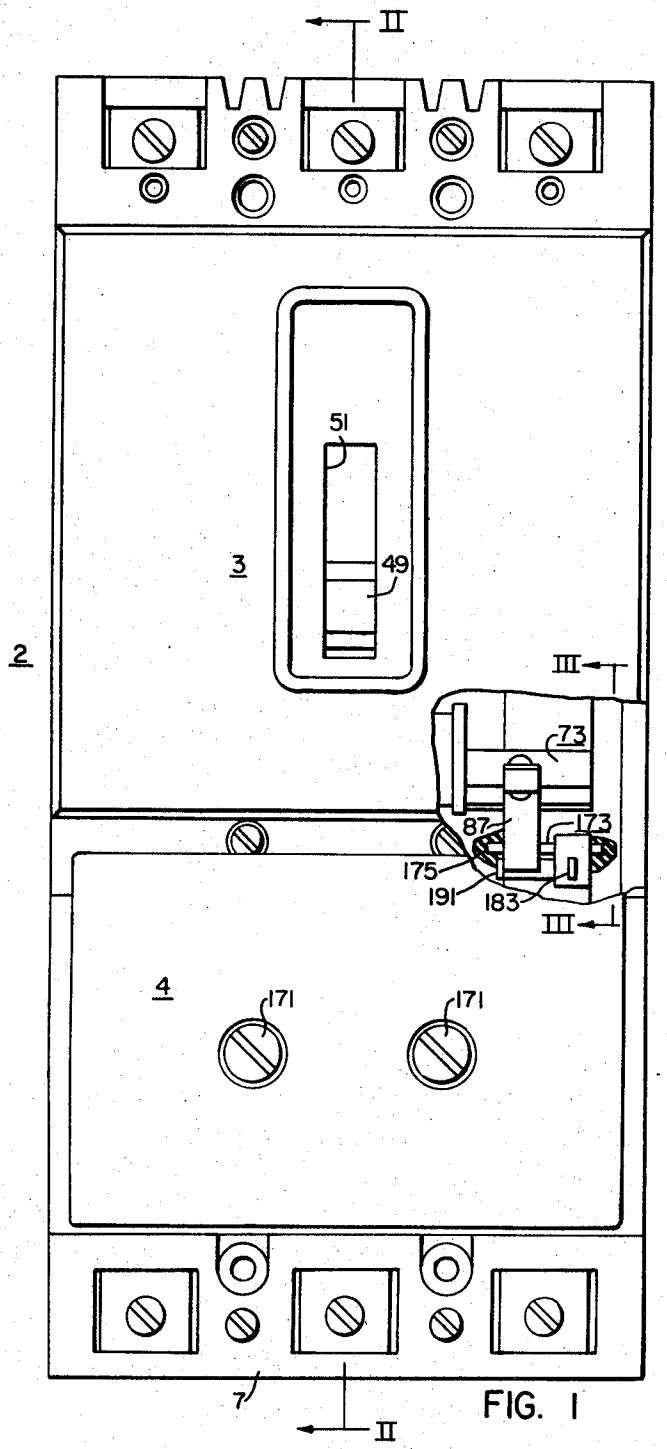


FIG. 1

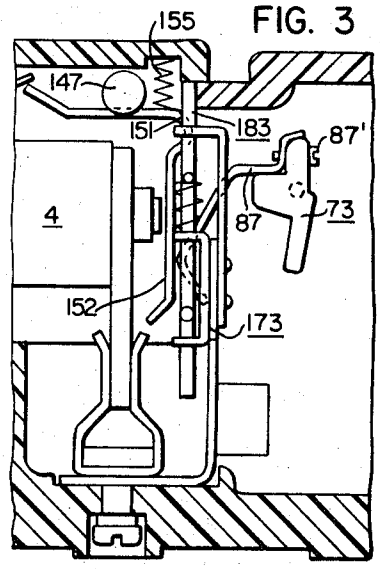


FIG. 3

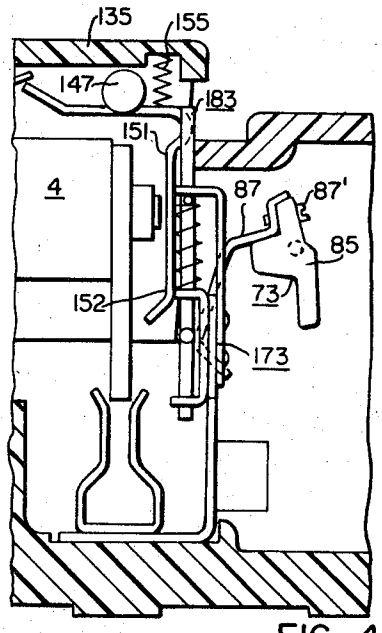


FIG. 4

WITNESSES

Theodore F. Wrobel

Alfred G. Colizzi

INVENTORS

Alex Orosz, Jr.

Lawrence B. St Clair

William A. Elchik

ATTORNEY

FIG. 5.

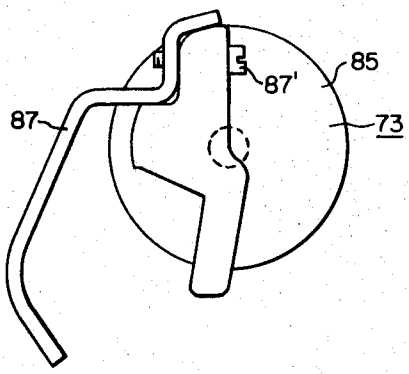
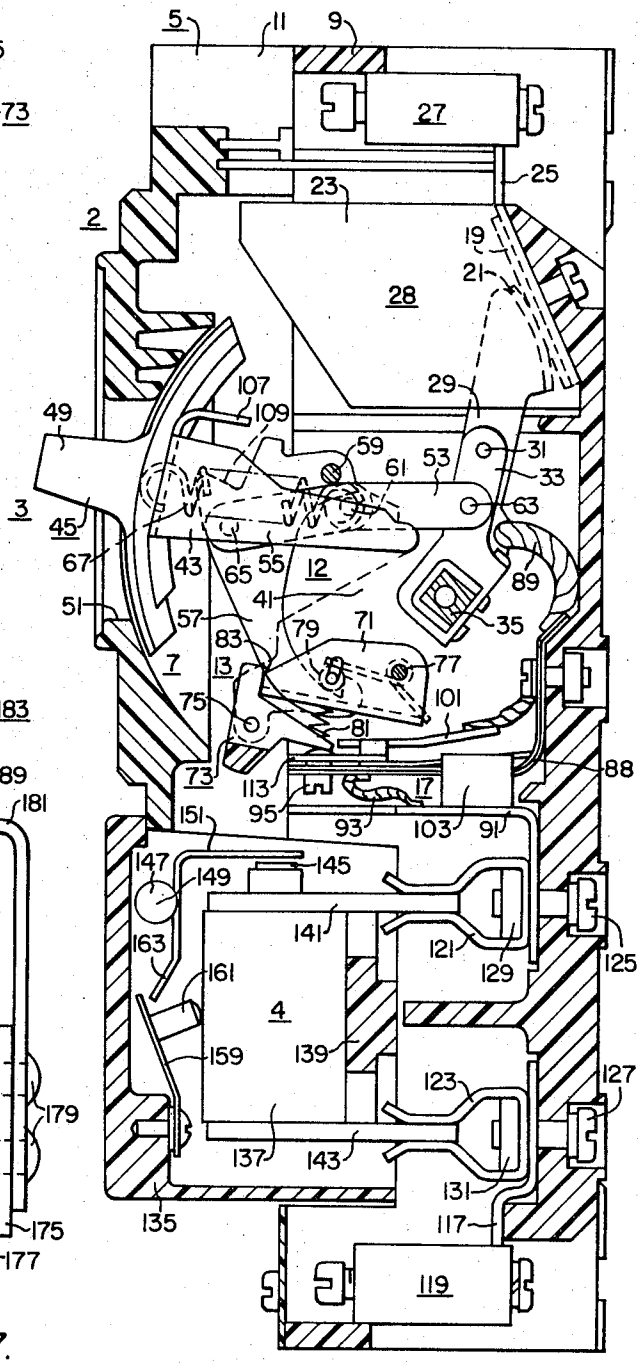


FIG. 2.



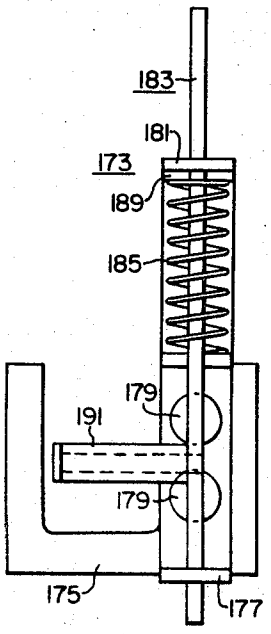


FIG. 6.

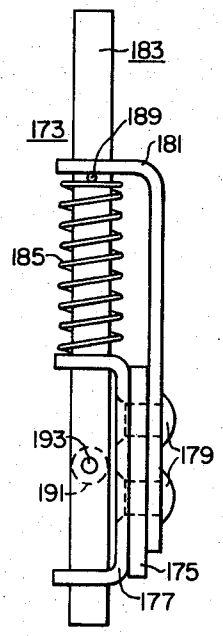


FIG. 7.

FUSED CIRCUIT BREAKER

BACKGROUND OF THE INVENTION

1. Field of the Invention

Fused circuit breakers of the type comprising an interlock for tripping the breaker upon removal of the fused cover and for maintaining the breaker in a tripped condition while the fuse cover is removed.

2. Description of the Prior Art

It is old in the art to provide fused circuit breakers with means for tripping the breakers upon removal of the fuse cover. These types of circuit breakers are disclosed, for example, in the U.S. Pats. to Edmunds, No. 2,888,535; to Dorfman et al. No. 3,009,038; to Scott Jr., No. 3,118,991; and to Majcher et al., No. 3,345,481. There is provided, by this invention, a fused circuit breaker combination with an improved tripping action for pivoting a trip bar to trip the breaker upon removal of the fused cover with the trip bar structure being engaged by a spring biased rectilinearly movable trip member. The trip member moves rectilinearly in a direction opposite a coexisting tangential direction relative to the pivotal movement of the trip bar structure. The improved tripping action facilitates the manufacture of a compact and dependable safety interlock in the fused circuit breaker.

SUMMARY OF THE INVENTION

A fused circuit breaker comprises an insulating housing structure and a fused circuit breaker structure supported in the insulating housing structure. The fused circuit breaker structure is a multi-pole structure comprising a pair of contacts for each pole unit and a trip bar structure pivotally movable about a fixed pivot in response to an overload in any of the pole units to effect simultaneous opening of all of the contacts. The trip bar structure comprises an insulating trip bar and an extension fixed to the trip bar. The fused circuit breaker structure also comprises a multi-pole fuse structure including a separate fuse for each pole in electrical series with a separate pair of the contacts. The insulating housing structure comprises an insulating fuse cover. A safety trip member is supported in the insulating housing structure for rectangular movement, and spring means is provided to bias the safety trip member toward the front of the fused circuit breaker toward a tripping position. When the fuse cover is mounted on the insulating housing structure the fuse cover engages the safety trip member to hold the safety trip member in an inoperative position against the bias of the spring means. Upon removal of the cover, a roller on the safety trip member engages an extension from the trip bar to pivot the trip bar structure to a tripped position. The engagement between the roller and the extension on the trip bar is such that the tripping action is effected even though the rectilinear movement of the safety trip member is in a direction opposite a coexisting tangential direction relative to the pivotal movement of the trip bar structure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view, with parts broken away, of a three-pole fused circuit breaker constructed in accordance with principles of this invention;

FIG. 2 is a side sectional view, through the center pole unit, taken generally along the line II—II of FIG. 1;

FIG. 3 is a partial sectional view, with parts broken away, taken generally along the line III—III of FIG. 1.

FIG. 4 is a view similar to FIG. 3 illustrating the position of parts when the fuse cover is removed;

FIG. 5 is an enlarged side elevational view of the trip bar structure seen in FIGS. 1–4;

FIG. 6 is an enlarged end view of the safety trip means seen in FIGS. 1, 3 and 4; and

FIG. 7 is a side view of the safety trip means illustrated in FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, and particularly to FIGS. 1 and 2, there is shown therein a circuit interrupter or fused circuit breaker 2 comprising a three-pole circuit breaker 3 and a removable three-pole fuse unit 4 connected in electrical series with the circuit breaker 3. The circuit breaker 3 comprises an insulating housing 5 and a circuit breaker mechanism 7 supported in the housing 5. The housing 5 comprises an insulating base 9 and an insulating cover 11 cooperating with the base 9 to enclose the circuit mechanism 7 that is mounted on the base 9. The circuit breaker mechanism 7 is of the type that is more specifically described in the U.S. Pat. to James P. Ellsworth et al. Pat. No. 3,525,959.

The circuit breaker mechanism 7 comprises an operating mechanism 12, a latch-and-trip means 13 and a thermal-and-magnetic trip device 17.

A stationary contact 19, a movable contact 21 and an arc-extinguishing unit 23 are provided for each pole unit of the breaker. The stationary contact 19 for each pole is rigidly mounted on the inner end of a conducting strap 25 that is secured to the base 9 and that extends outward to an external cavity where a well known type of solderless terminal connector 27 is secured to the outer end of the conductor 25. The movable contact 21 for each of the pole units is mounted on a movable contact arm structure 28. The movable contact arm structure 28 comprises a contact arm 29 that is pivotally mounted, by means of a pin 31, on a switch arm 33 that is fixedly secured to an insulating tie bar 35. The switch arms 33 for all of the pole units are secured to the common tie bar 35 for simultaneous movement with the tie bar that is pivotally mounted for movement about an axis normal to the plane of the paper in FIG. 2. A torsion spring in each pole unit biases the associated contact arm 29 in a clockwise (FIG. 2) direction about the switch arm 33 to provide contact pressure in the closed position of the contacts.

The operating mechanism 12 is a single operating mechanism disposed in the center pole unit compartment. The operating mechanism 12 is supported on two metallic rigid spaced supporting plates 41 that are fixedly secured to the base 9 in the one pole unit compartment. Only one of the plates is seen in FIG. 2. An inverted U-shaped operating member 43 is pivotally supported on the supporting plates 41 with the inner ends of the legs of the member 43 positioned in U-shaped notches in the plates 41. An insulating operating handle member 45 is fixedly secured to the front portion of the operating member 43. The operating handle member 45 comprises an insulating shield 47 and a handle 49. The handle 49 protrudes out through an opening 51 in the cover 11, and the shield 47 closes the opening 51 in all positions of the handle.

The switch arm 33 for the center pole unit is operatively connected, by means of a toggle, comprising toggle links 53 and 55, to a releasable trip member or cradle 57 that is pivotally supported on the supporting plates 41 by means of a pin member 59. The toggle links 53, 55 are pivotally connected together by means of a knee pivot pin 61. The toggle link 53 is pivotally connected to the switch arm 33 by means of a pin 63, and the toggle link 55 is pivotally connected to the releasable trip member 57 by means of a pin 65. An overcenter spring 67 is connected under tension between the knee pivot pin 61 on the bight portion of the operating member 43.

With the releasable member 57 in the latched position seen in FIG. 2, the contacts are manually operated by movement of the handle 49. The contacts are opened by movement of the handle 49 in a counterclockwise direction from the closed or "on" position to the open or "off" position. This movement carries the line of action of the operating spring 67 to the left causing collapse of the toggle 53, 55 to thereby rotate the tie bar 35 in a counterclockwise direction to simultaneously move the movable contact arm structures 28 to the open position. The contacts are manually closed by reverse movement of the handle 49 from the "off" to the "of" position, which movement carries the line of action of the operating spring 67 to the right to erect the toggle 53, 55 to thereby rotate the tie bar 35 in a clockwise direction to move the movable contact arm structures 28 from the open position to the closed position seen in FIG. 2.

In addition to the releasable trip member 57, the latch-and-trip means 13 comprises a roller latch member 71 in the center pole unit of the breaker and a common insulating trip bar structure 73 that is common to all three-pole units of the breaker. The trip bar structure 73 is supported for pivotal movement, on pin means 75, about an axis that is normal to the plan of the paper as seen in FIG. 2. The roller latch member 71 is mounted for pivotal movement on a pin 77 that is supported on the plates 41. A roller member 79, that is movably supported on the roller latch member 71, engages a releasable member 57 to latch the releasable member 57 against clockwise tripping movement. The roller member 79 is mounted for limited travel on the member 71 in the manner described in the above-mentioned patent to James P. Ellsworth et al. U.S. Pat. No. 3,525,959. A coil spring 81 is supported between the roller latch member 71 and the trip bar structure 73 to bias the roller latch member 71 in a clockwise direction and to bias the trip bar structure 73 in a clockwise direction to the latching position seen in FIG. 2 wherein a hooked end portion 83 of the trip bar structure 73 latches the roller latch member 71 against tripping clockwise movement.

The trip bar structure 73 (FIG. 5) comprises an insulating trip bar 85 and a trip extension 87 secured to the trip bar 85 by means of a screw 87'.

There is a separate thermal-and-magnetic trip device 17 in each pole unit. Each of the trip devices 17 comprises a generally L-shaped bimetal 88 connected to the associated contact arm 29 by means of a flexible conductor 89 and to a terminal member 91 by means of a flexible conductor 93. An actuating screw 95 is supported on the free end of each bimetal 88 to engage a depending portion of the trip bar structure 73 to thermally trip the breaker when the bimetal 88 flexes to the tripping position. Each of the trip devices 17 also comprises a magnetic armature 101 pivotally supported in the associated pole unit and a magnetic stationary member 103 for attracting the armature 101 to effect magnetic tripping operations.

When the circuit breaker is in the latched position seen in FIG. 2, the tension spring 67 operates through the toggle link 55 and pivot 65 to force the trip member 57 in a clockwise direction about the pivot 59. Clockwise movement of the trip member 57 is restrained by the engagement of the free end thereof under the roller 79 of the roller latch member 71, with the trip member 57 pulling the roller latch member 71 in a clockwise direction about the pivot 77. Clockwise movement of the roller latch member 71 about the pivot 77 is restrained by the engagement of the latch portion 83 of the trip bar structure 73 with the roller latch member 71. The force of the roller latch member 71 against the trip bar structure 73 operates through the axis of the pivot of the trip bar structure so that clockwise movement of the roller latch member 71 is restrained by the trip bar structure 73 without tending to move the trip bar structure 73 about the axis thereof. Thus, the trip bar structure 73 is in a latching position latching the roller latch member 71 and releasable trip member 57 in the latched position seen in FIG. 2.

The circuit breaker is shown in the closed position in FIG. 2. Upon the occurrence of a sustained overload current above a first predetermined value and below a second predetermined value in any of the pole units, the bimetal 88 in the overload pole unit becomes heated and flexes to the right with a time delay whereupon the screw 95 engages the trip bar structure 73 to rotate the trip bar structure 73 in a counterclockwise unlatching direction. This movement releases the roller latch member 71 whereupon the spring 67 operates to rotate the releasable trip member 57 in a clockwise direction to a tripped position. Upon movement of the releasable trip member 57 to the tripped position the line of action of the spring 67 is moved to the left, and the spring 67 causes collapse of the toggle 53, 55 to rotate the tie bar 35 in a counterclockwise direction to move the contact arm structures 28 to the open position. The operating handle 49 is stopped in a tripped position intermediate the open and closed positions to provide a visual indication that the circuit breaker has tripped open.

Before the breaker can be manually operated following an automatic tripping operation, the breaker mechanism must be reset and relatched. Resetting is effected by movement of the handle 49 from the intermediate position to a position slightly past the full "off" position. During this resetting movement of the handle 49, an extension 107 on the operating lever 43 operates against a shoulder 109 of the trip member 57 to rotate the trip member 57 in a counterclockwise direction about the pivot 59. During the resetting movement of the handle 49, the trip member 57 moves counterclockwise moving the toggle 53, 55 to the left whereupon a radius at the knee of the toggle 53, 55 engages the roller latch member 71 to move the roller latch member 71 in a counterclockwise direction about the pivot 77. During this movement, the latching end of the

releasable trip member 57 wipes past the roller 79, and the roller latch member 71 moves against the spring 81 to move the trip bar structure 73 in a clockwise direction to the latching position wherein the latch portion 83 on the trip bar structure 73 latches the roller latch member 71. Thereafter, the handle 49 can be manually moved between the "off" and "on" positions to operate the contacts in the same manner as was hereinbefore described.

Upon the occurrence of a more severe overload about the second predetermined value and below a third predetermined value in any of the pole units, the current flowing through the bimetal 88 energizes the associated magnetic members 101, 103 sufficiently to attract the armature 101 whereupon the armature pivots about a pivot intermediate the end thereof, and a part 113 on the upper side of the pivot of the armature 101 engages the trip bar structure 73 to rotate the trip bar structure in a counterclockwise direction to effect a tripping operation in the same manner as was hereinbefore described. The magnetic tripping operation is an instantaneous tripping operation, and the circuit breaker is reset following a magnetic tripping operation in the same manner as was hereinbefore described following the thermal time-delay tripping operation.

For each pole unit of the fused circuit breaker 2, a terminal member 117 (FIG. 2) is supported on the insulating base 9 spaced from the associated terminal 91. A solderless terminal connector 119 is supported at the outer end of each of the terminals 117. In each pole unit, a pair of fuse clips 121 and 123 are supported on the base 9 and connected to the associated terminals 91, 117 by means of a pair of bolts 125, 127 that cooperate with associated nuts 129, 131.

The removable three-pole fuse unit 4 comprises an insulating housing or cover 135 which is formed to provide three adjacent compartments. A separate fuse 137 is supported in each of the compartments of the fuse cover 135 by means of an insulating support 139 that is suitably secured to the cover 135. Each of the fuses 137 comprises a pair of terminals 141 and 143 which are plugged into the fuse clips 121, 123 when the fuse unit 4 is in the mounted position (FIG. 2) to connect the associated fuse in electrical series with the associated pole unit of the circuit breaker. Each of the fuses 137 comprises a spring loaded plunger or actuator 145 that is biased to move to the right (FIG. 2) when the associated fuse blows to release the plunger 145. The plunger and biasing means for operating it may be of any one of the forms disclosed, for example, in the patent to Rawlins et al., U.S. Pat. No. 2,435,844, issued Feb. 10, 1948.

The fuse unit 4 also comprises a tripping bar structure 147 that is pivotally supported on the insulating cover 135 for pivotal movement about an axis 149 that is normal to the plane of the paper as seen in FIG. 2. The tripping bar structure 147 is common to all three of the pole units, and a separate arm 151 is secured to the tripping bar 147 in each of the pole units. As can be seen in FIGS. 3 and 4, the arm 151 in the one outside pole unit is longer, at 152, than the arms 151 in the other two pole units (FIG. 2). The part 152 of the one arm 151 (FIGS. 3 and 4) is an actuating part, of the tripping bar 147, which is disposed opposite the extension 87 of the trip bar structure 73 so that upon counterclockwise (FIGS. 3 and 4) movement of the tripping bar 147 the actuating part 152 will engage the extension 87 of the trip bar structure 73 to pivot the trip bar structure 73 to the tripped position. The tripping bar 147 is biased in a clockwise direction (FIG. 3) by means of coil spring 155 that is positioned between the one arm 151 and the insulating cover 135.

Upon the occurrence of a severe overload or short circuit above the third predetermined value in any of the pole units, the fuse 137 in that pole unit blows to interrupt the overloaded pole unit and the striker pin 145 (FIG. 2) is released whereupon the striker pin 145 operates against the associated arm 151 to pivot the tripping bar 147 in a counterclockwise (FIGS. 2 and 3) direction. During this movement, the actuating part 152 (FIG. 3) engages the extension 87 on the trip bar structure 73 to pivot the trip bar structure 73 in a counterclockwise direction to thereby trip the circuit breaker in the same manner as was hereinbefore described thereby opening all of the contacts in all of the pole units of the fused circuit breaker. The actuator or plunger 145 of the blown fuse will remain in the position holding the tripping bar 147 in the tripped position to thereby hold the trip bar structure 73 in the tripped position. The circuit breaker cannot be relatched and, therefore, it cannot be operated while the fuse unit, with a blown fuse therein, is in the connected position.

Referring to FIG. 1, it will be noted that a pair of elongated mounting bolts 171 extend through suitable insulating barriers in the insulating cover 135 with the bolts 171 being threaded into tapped openings in the base 9 of the circuit interrupter to secure the removable fuse unit 4 in the mounted position seen in FIGS. 1 and 2. When it is desired to remove the fuse unit 4, the mounting bolts 171 are loosened and the fuse unit 4 is pulled out as a unit. The fuses 137, tripper bar 147, insulating barrier 139 and missing fuse interlocks 159, 161, all of which are secured to the fuse unit cover 135, are pulled out as a unit with the cover 135. The fuse unit is mounted in position merely by forcing the fuse unit 4 down with the terminals 141, 143 moving into the terminals 121, 123, and thereafter the bolts 171 are tightened to secure the fuse unit 4 in the mounted position.

Improved means is provided for tripping the circuit breaker upon removal of the fuse cover 135 and for maintaining the circuit breaker in a tripped condition so long as the fuse cover 135 is removed. The safety trip means is indicated generally at 173 (FIGS. 1–4, 6 and 7). Referring to FIGS. 6 and 7, the safety trip means 173 comprises a generally U-shaped flat sheet metal supporting plate member 175. A generally U-shaped support plate 177 is fixedly secured to one side of one of the legs of the support plate 175 by means of a pair of rivets 179 which also secure an inverted L-shaped support plate 181 to the one leg of the U-shaped support plate 175 at the other side of the one leg of the support plate 175. A safety trip member 183 is supported for movement on the support members 177, 181. The member 183 passes through suitable openings in the opposite legs of the support member 177 and through a suitable opening in the one leg of the support member 181. A coil spring 185 is disposed around the member 183 and positioned between one

leg of the support member **177** and the one leg of the support member **181**. A spring support pin **189** passes through a suitable opening in the member **183** to support the upper end of the spring **185**. A roller member **191** is rotatably supported on a pin **193** that is fixedly secured to the member **183**. The spring **185** biases the member **183** to the upper actuating position seen in FIGS. **6** and **7**. The insulating base **9** of the fuse circuit breaker **2** is provided with suitable slot means in spaced insulating portions thereof. During assembly of the fused circuit breaker **2**, the safety trip means **173** (FIGS. **6** and **7**) is dropped down into position on the base **9** with the flat sides of the opposite legs of the support plate **175** moving down into the slot means which snugly receive the flat sides to support the safety trip means **173** against downward and lateral movement on the base **9**. Thereafter, the trip bar structure **73** is moved into the mounted position seen in FIGS. **2–4**, and the extension **87** on the trip bar structure **73** limits upward movement of the safety trip means **173** so that the safety trip means **173** is thereafter suitably captured on the insulating base **9**. As can be seen in FIG. **3**, when the fuse unit **4** is in the mounted position the insulating cover **135** of the fuse unit **4** engages the upper end of the actuator safety trip member **183** and holds the member **183** in the inoperative position seen in FIG. **3** against the bias of the spring **185**. As can be seen in FIGS. **3** and **5**, the extension **87** of the trip bar structure **73** is formed with a curved portion in proximity to the free end thereof which is positioned just over the roller **191**. When the insulating cover **135** is lifted from the mounted position seen in FIG. **3** to the disconnected position seen in FIG. **4**, the safety trip member **183** is released and the spring **185** biases the member **183** from the inoperative position seen in FIG. **3** to the tripping position seen in FIG. **4**. During this movement, the roller **191**, operating against the extension **87** of the trip bar structure **73**, rotates the trip bar structure **73** counterclockwise to the tripped position seen in FIG. **4** to thereby trip the circuit breaker in the same manner as was hereinbefore described. The roller **191**, in engagement with the extension **87**, will maintain the trip bar structure **73** in the tripped position seen in FIG. **4** to prevent relatching of the circuit breaker to thereby prevent operation of the circuit breaker so long as the fuse unit **4** is removed. When the fuse unit **4** is moved back to the fully mounted position seen in FIG. **3**, the cover **135**, operating against the safety trip member **183**, forces the actuator member **183** down to the inoperative position seen in FIG. **3** and maintains the member **183** in the inoperative position so long as the fuse cover **135** is in the mounted position. The safety trip member **183** is supported for rectilinear front-to-back and back-to-front movement in the housing of the circuit breaker. The safety trip member **183**, in moving rectilinearly frontward, directly engages the trip bar structure **73** to pivot the trip bar structure **73** to the tripped position. When the roller **191** engages the extension **87**, a movement is imparted to the extension having a component in a direction that is opposite the direction of rectilinear movement of the roller. The rectilinear tripping movement of the safety trip member **183** is opposite a coexisting tangential direction relative to the pivotal movement of the trip bar structure **73**.

Although the fused circuit breaker herein disclosed comprises plug-in fuses mounted on the insulating cover and removable as a unit with the insulating cover, it can be understood that the invention can also be utilized in a fused circuit breaker comprising bolt-type fuses bolted in position on the circuit breaker base with an insulating fuse cover removable independent of the fuses. In both cases, the removal of the cover member will actuate the safety trip means to trip the circuit breaker and to maintain the circuit breaker in the tripped condition so long as the cover is removed.

We claim:

1. A fused circuit breaker comprising an insulating housing structure, a fused circuit breaker structure supported in said insulating housing structure, said fused circuit breaker structure comprising a pair of contacts, a trip bar structure supported for pivotal movement about a fixed pivot, trip means comprising a movable member automatically moving in response to overload current conditions above a first predetermined value to pivot said trip bar structure to the tripped position to effect opening of said contacts, a fuse structure in a mounted position and comprising an insulating fuse cover, a fuse supported on said insulating fuse cover and being in electrical series with said contacts, upon the occurrence of severe overload current conditions above a second predetermined value higher than said first predetermined value said fuse blowing to automatically interrupt the current through said contacts, said fuse structure being removable from said fused circuit breaker, safety trip means comprising a support bracket structure and a safety trip member supported on said support bracket structure for generally rectilinear movement, said safety trip means further including spring means biasing said safety trip member on said support bracket structure toward a tripping position, said fuse structure in the mounted position thereof maintaining said safety trip member in an inoperative position, upon removal of said fuse structure said spring means moving said safety trip member rectilinearly to a tripping position, said safety trip member including an actuating roller movable therewith, upon movement of said safety trip member to said tripping position said actuating roller engaging said trip bar structure to pivot said trip bar structure to the tripped position, said insulating housing being formed with slot means therein, and said safety trip means being a preassembled assembly supported on said insulating housing captured in said slot means.

2. A fused circuit breaker according to claim **1**, and the direction of rectilinear tripping movement of said safety trip member being opposite a coexisting tangential direction relative to the pivotal movement of said trip bar structure.

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