United States Patent [19]

Nicol

[11] **3,863,042**

[45] **Jan. 28, 1975**

[54] **CIRCUIT BREAKER WITH ELECTRICAL AND MECHANICAL TRIP INDICATION**

[75] Inventor: **Ronald Nicol,** Trenton, N.J.

[73] Assignee: **Heinemann Electric Company,** Trenton, N.J.

[22] Filed: **Aug. 1, 1973**

[21] Appl. No.: **384,702**

[52] **U.S. Cl.** .... **200/153 T,** 335/17

[51] **Int. Cl.** **H01h 3/46**

[58] **Field of Search** .... 200/153 T, 153 R, 153 G; 335/17, 13

[56] **References Cited**

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3,720,891	3/1973	Nicol	335/17
3,742,402	6/1973	Nicol et al.	335/17
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Primary Examiner—Harold Broome
Attorney, Agent, or Firm—Denny & Patane

[57] **ABSTRACT**

A circuit breaker having a handle stop for restraining the handle in a "tripped" or central position after the circuit breaker is electrjcally tripped to mechanically and visually indicate the tripped position.

Also, an actuator is supported within the case of the circuit breaker and pivoted by the linkage mechanism (only when the latter is electrically tripped). During manual opening and closing of the circuit breaker contacts, the linkage mechanism does not pivot the actuator.

Pivoting of the actuator (upon electrical tripping of the linkage mechanism) causes the actuator to engage and activate an auxiliary switch.

When the circuit breaker handle is moved to the "Off" position from the "tripped" or central position, the linkage mechanism simultaneously releases the actuator and the auxiliary switch is deactivated.

27 Claims, 23 Drawing Figures

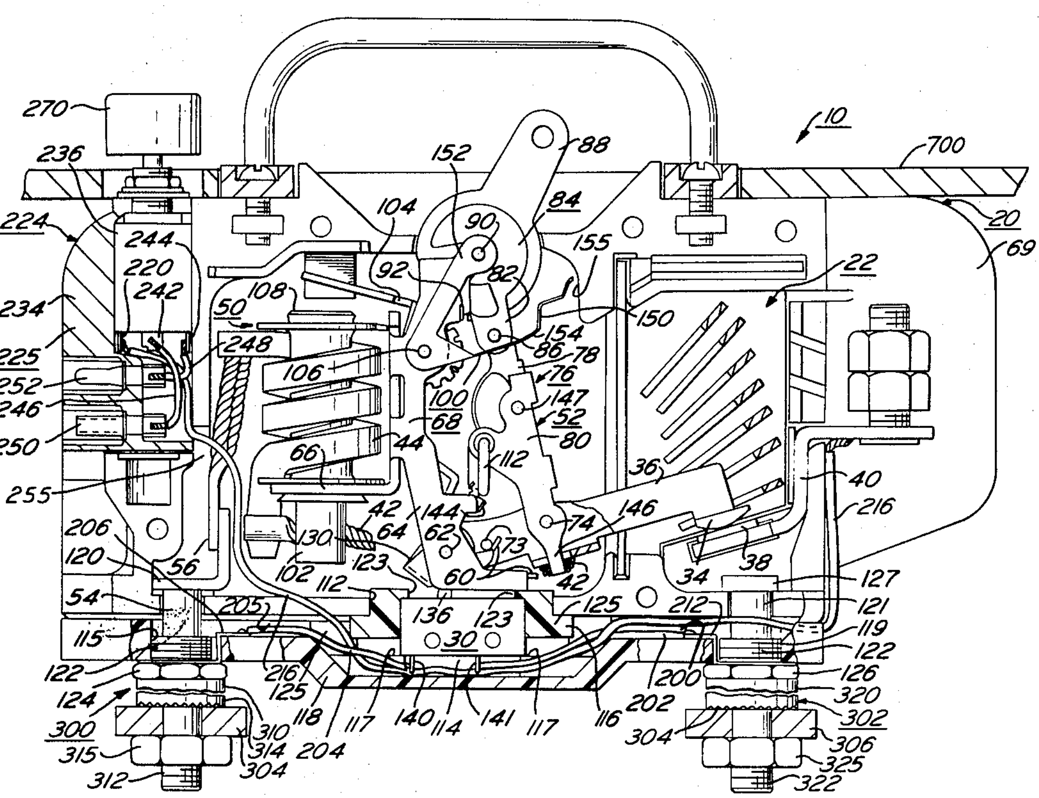


FIG. 1

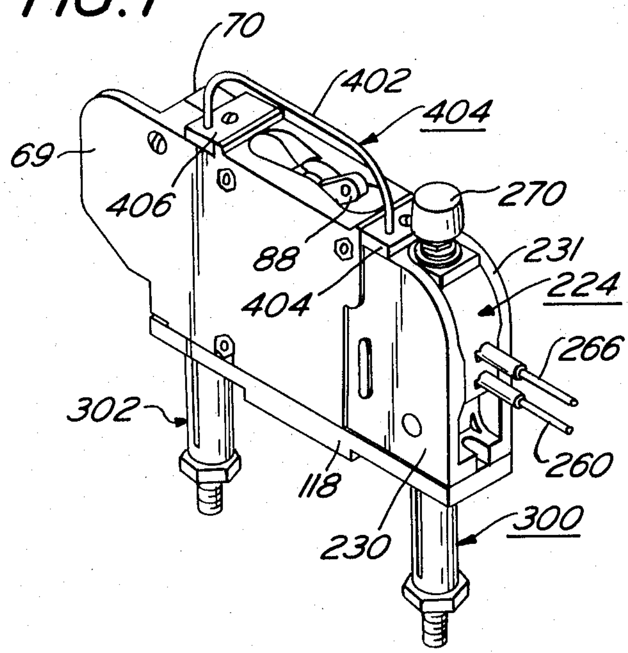


FIG. 10

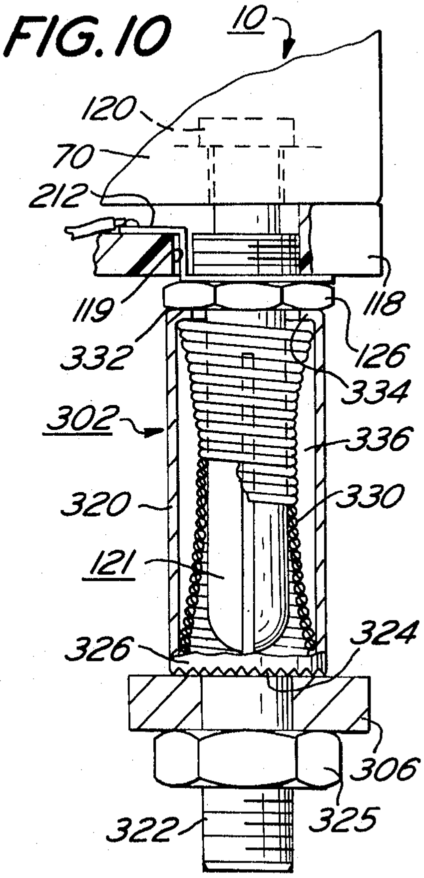
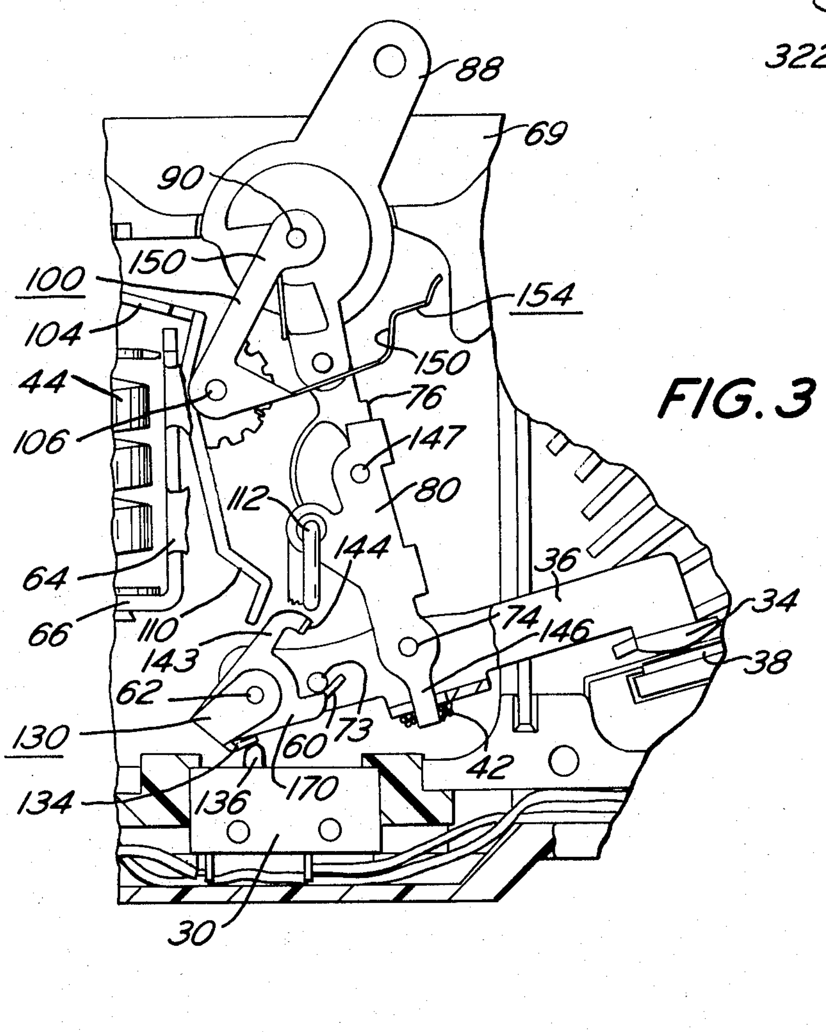


FIG. 3



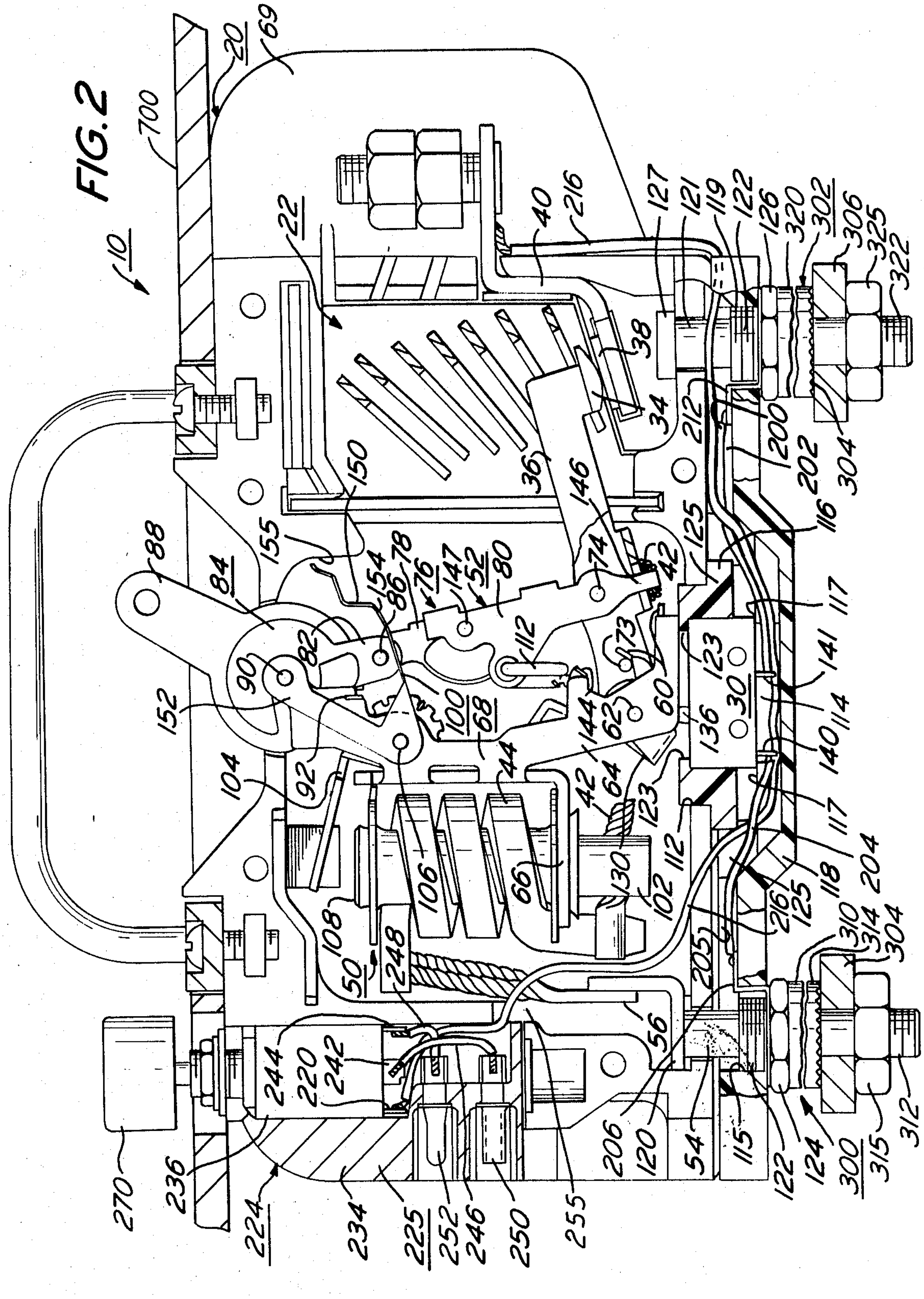
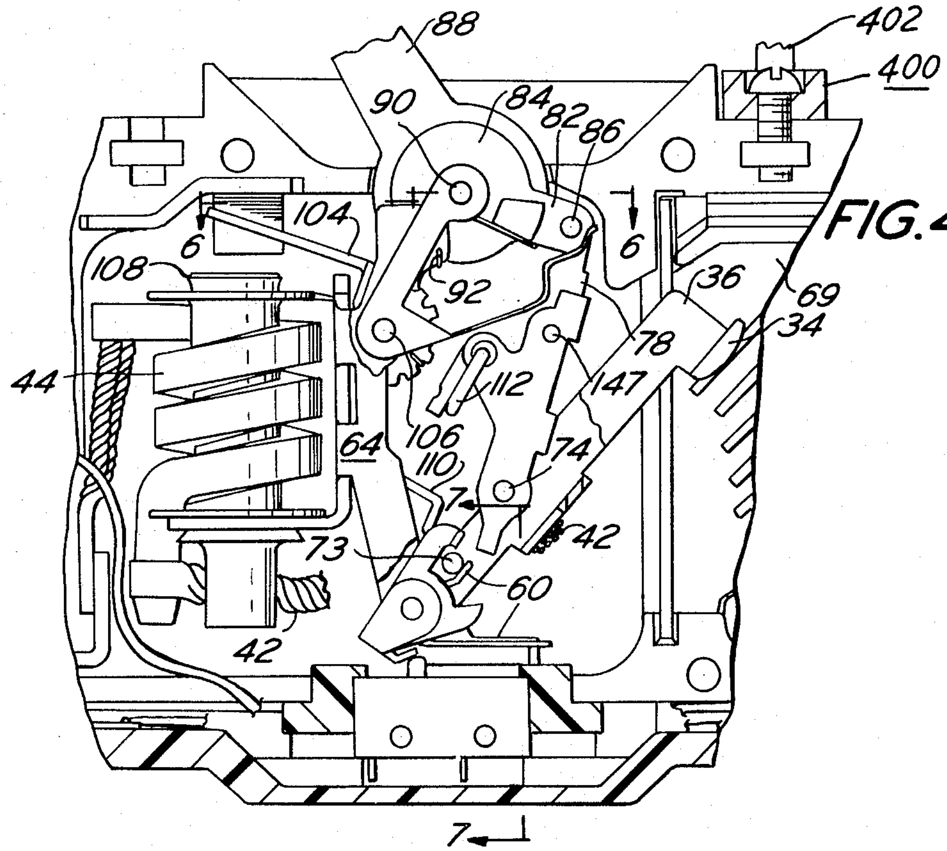


FIG.2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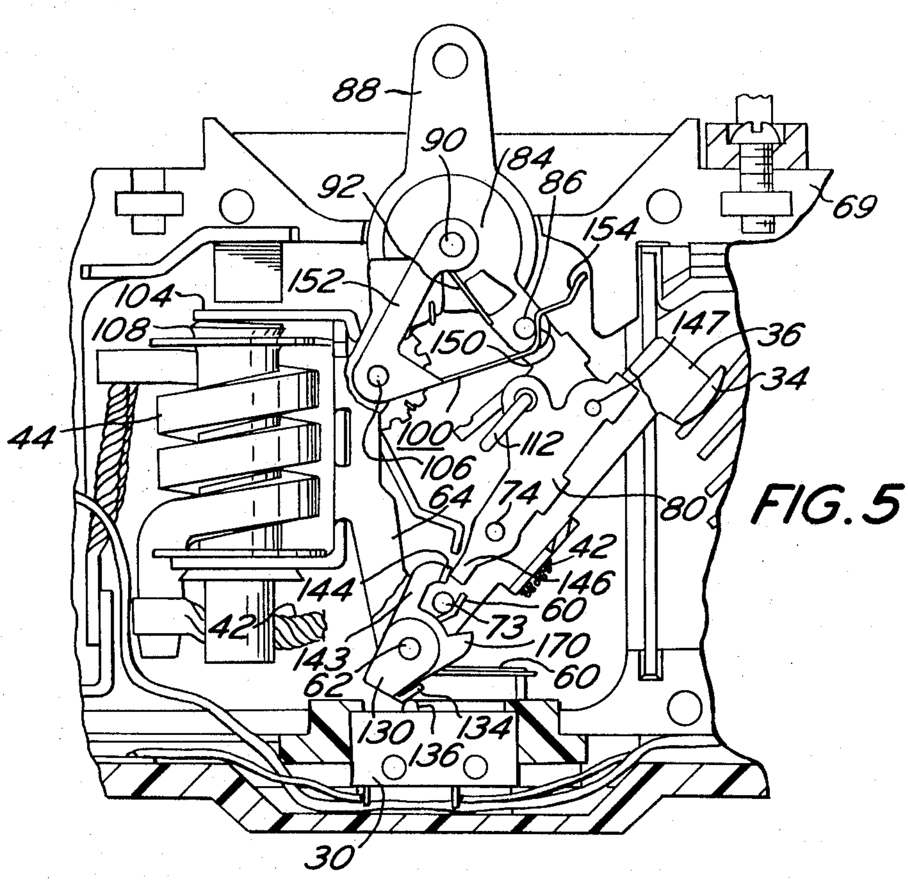
402
400
90
84
82
86
104
6
6
108
92
36
69
34
78
44
112
147
106
64
74
110
7
42
73
60
42
7

FIG. 4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69
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184
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86
154
152
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36
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44
100
106
112
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80
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146
144
60
42
73
143
170
62
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130
134
136
30

FIG. 5

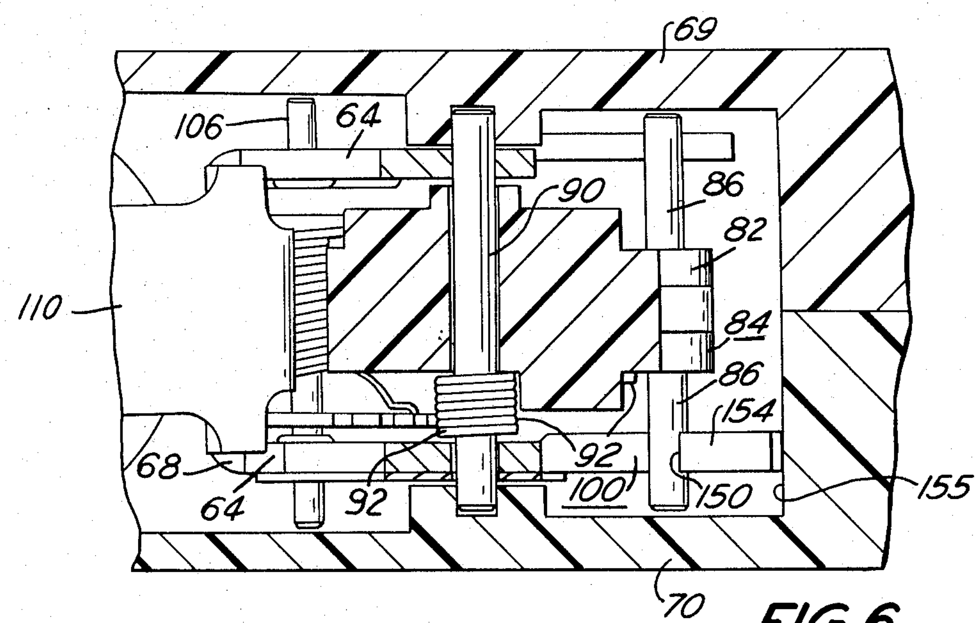
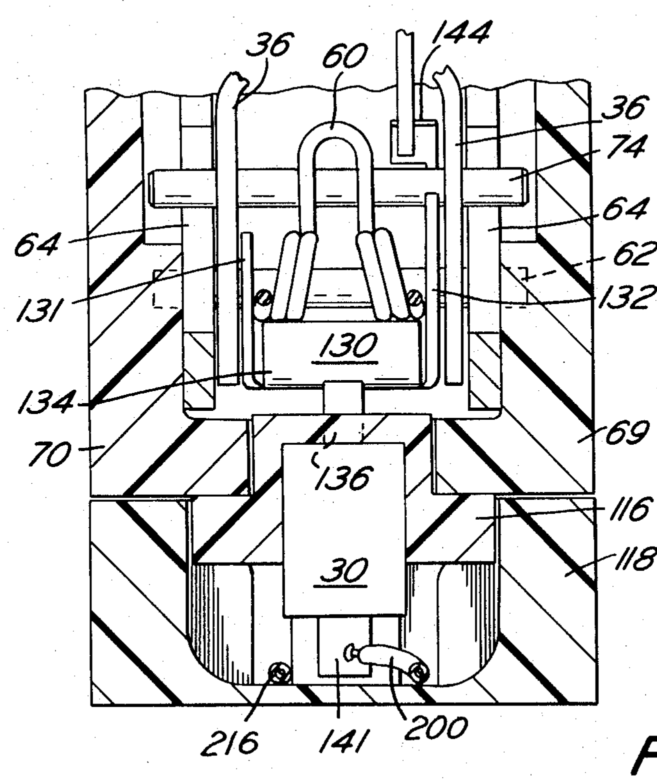

69
106
64
90
86
82
110
84
86
154
92
68
100
150
155
64
92
70

FIG.6


36
60
144
36
74
64
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132
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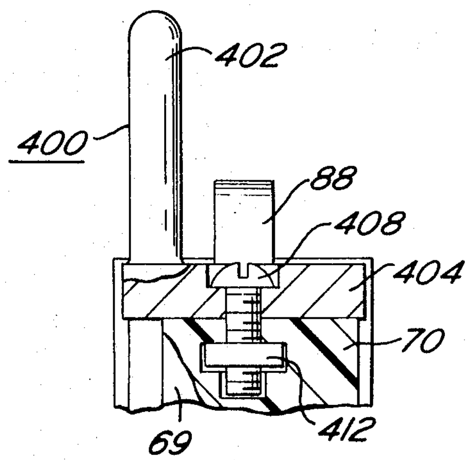
134
70
69
136
116
118
30
216
141
200

FIG.7

FIG. 9



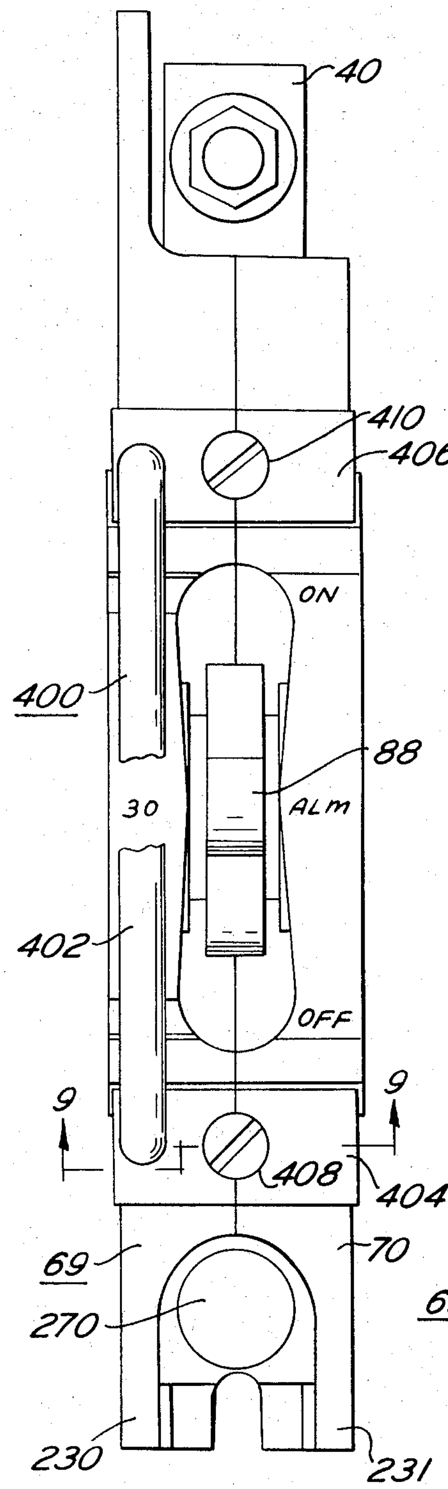


FIG. 8

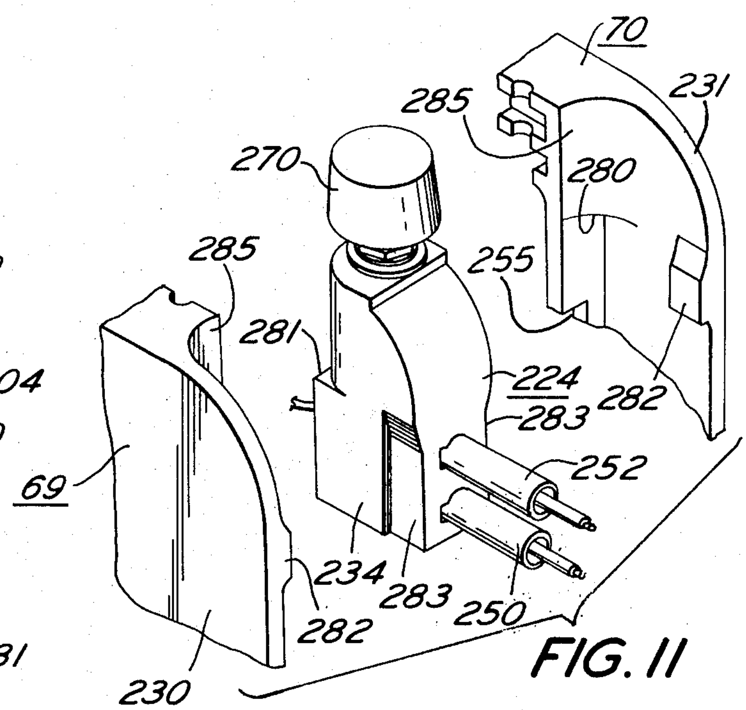
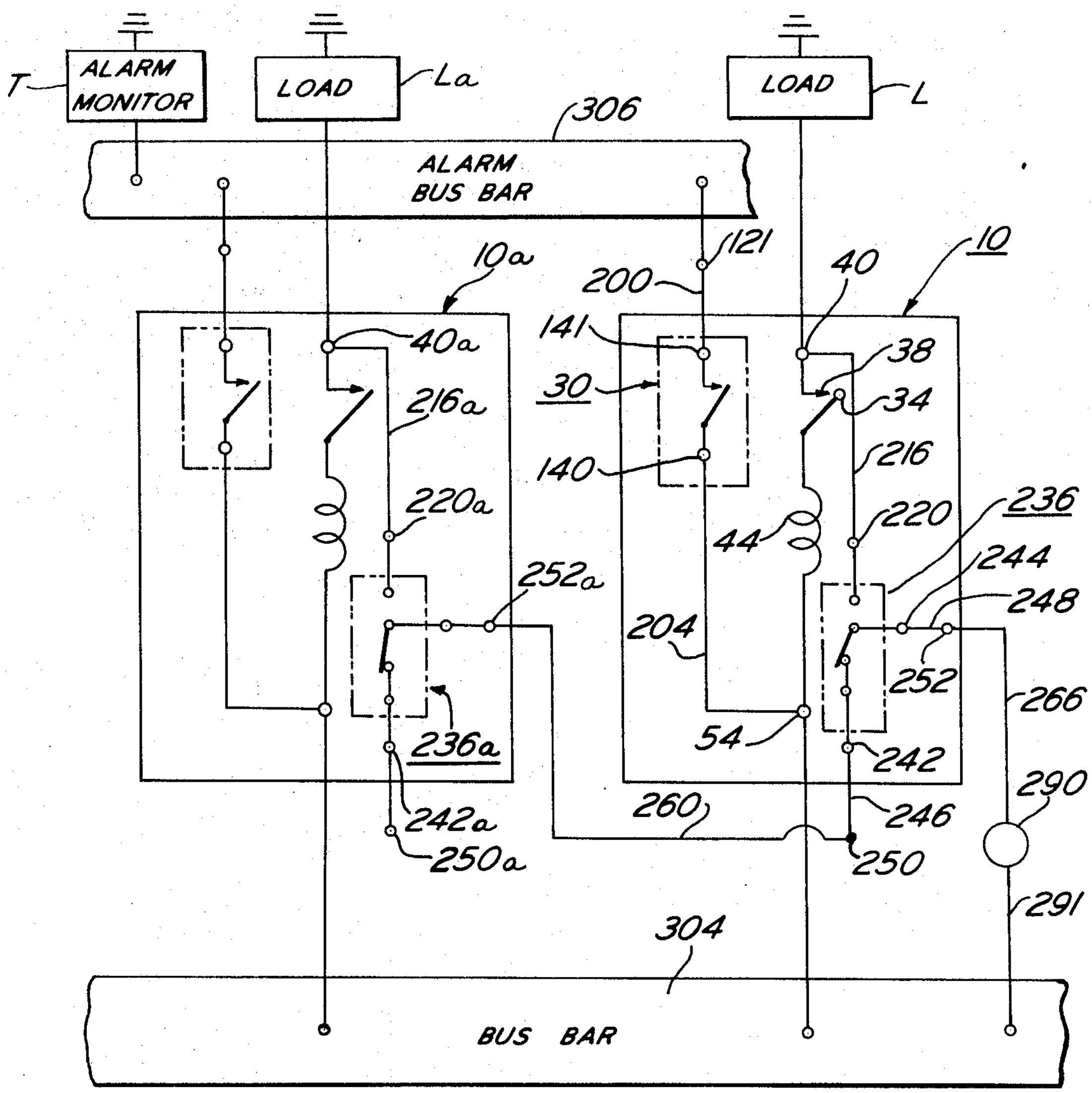


FIG. 11


ALARM MONITOR
T
LOAD
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LOAD
L
306
ALARM BUS BAR
121
200
10a
40
10
141
40a
38
30
34
216a
216
140
220a
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236
44
244
252a
248
204
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266
236a
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242
290
260
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242a
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250a
291
304
BUS BAR

FIG. 13

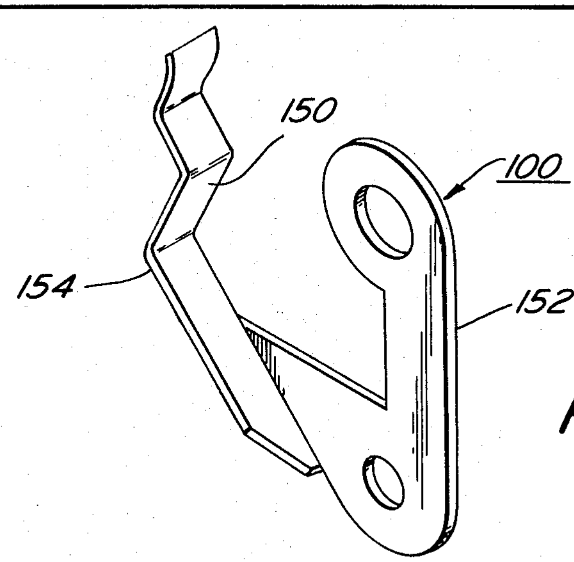
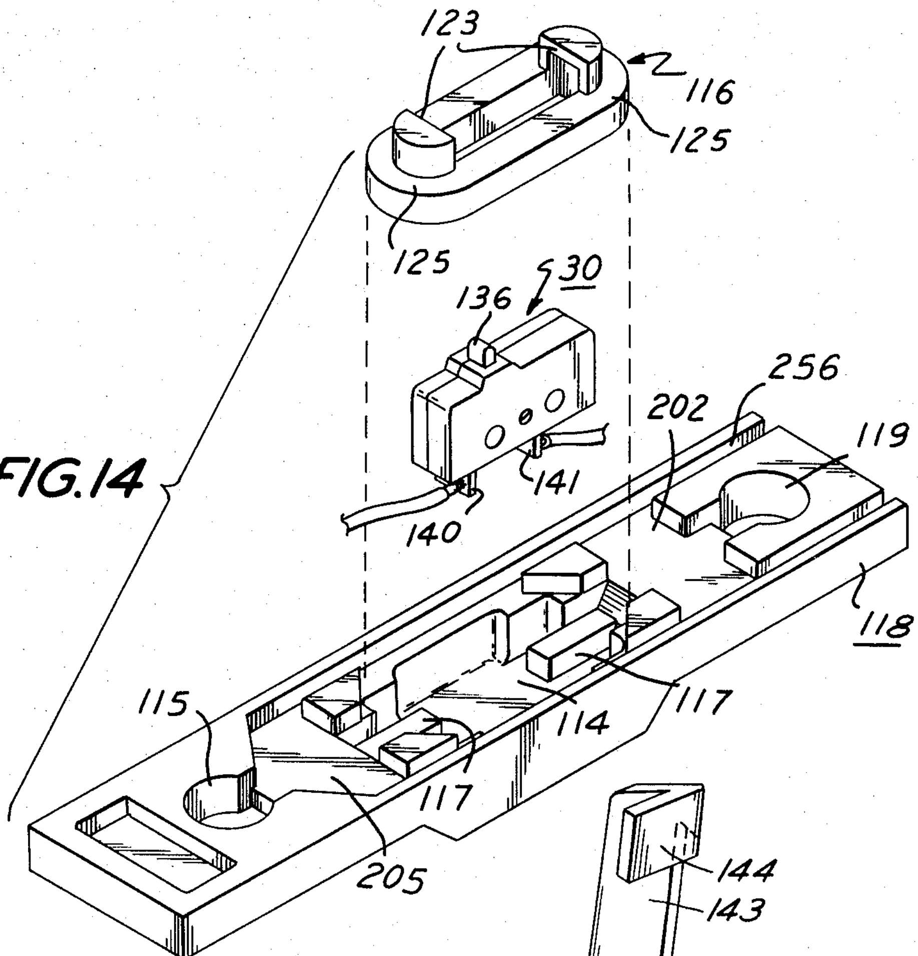

150
100
154
152

FIG. 12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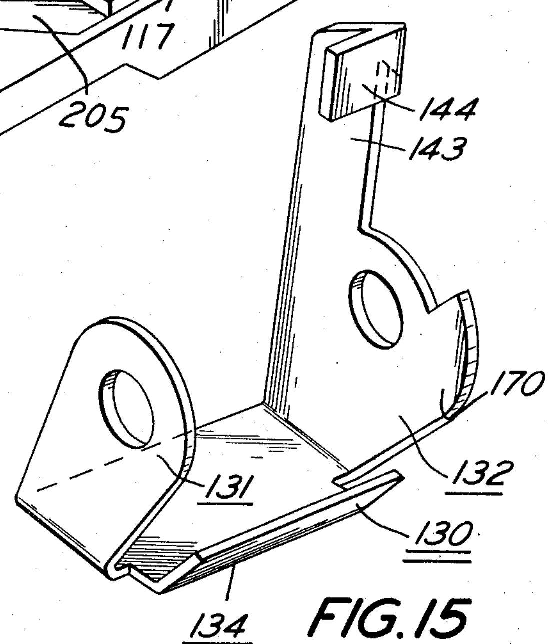
205

FIG. 14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143
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132
131
130
134

FIG. 15

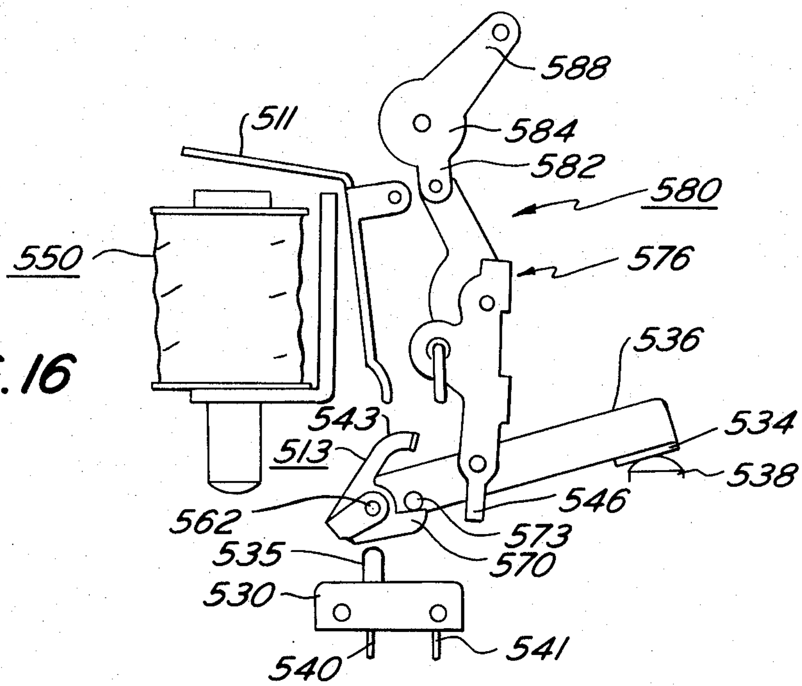
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FIG. 16

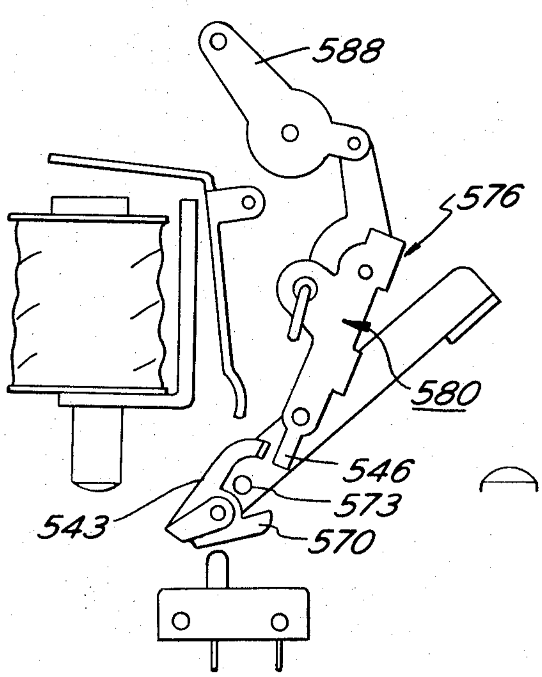
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FIG. 17

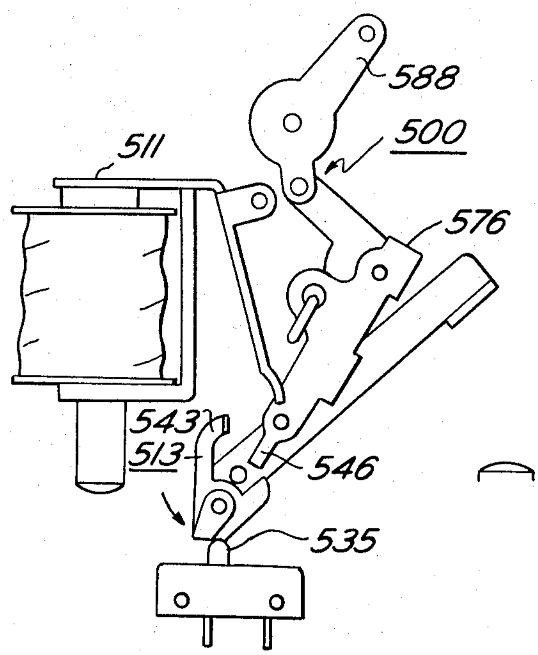
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FIG. 18

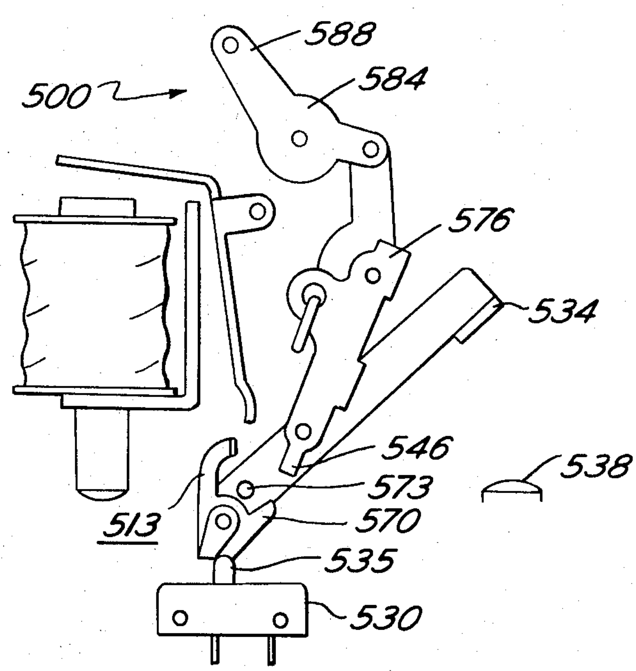
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FIG. 19

FIG. 20

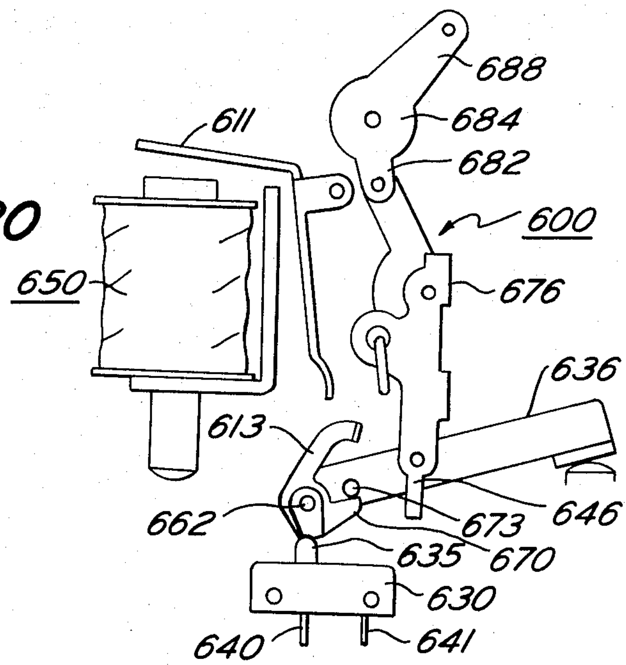
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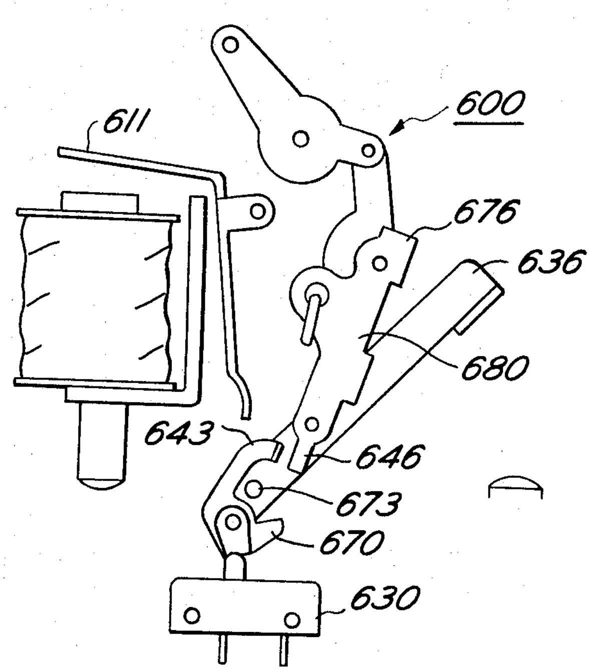
FIG. 21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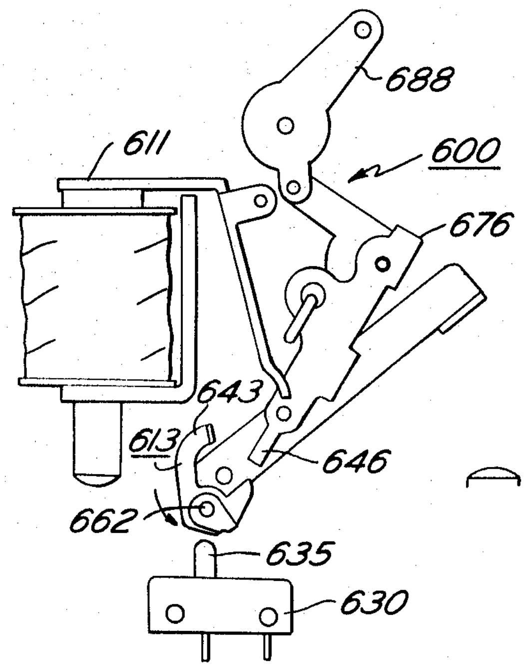
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FIG. 22

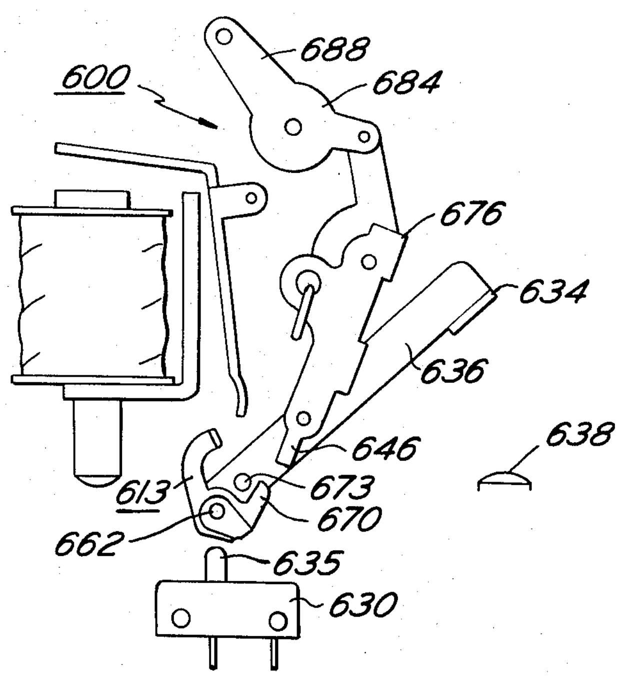
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FIG. 23

CIRCUIT BREAKER WITH ELECTRICAL AND MECHANICAL TRIP INDICATION

BACKGROUND OF THE INVENTION

This invention relates generally to electric circuit breakers of the electromagnetic type and more particularly to circuit breakers with arrangements for indicating the electrically tripped "open" condition of the circuit breaker.

Circuit breakers with arrangements for indicating the electrically tripped "open" condition of the circuit breaker contacts are shown in U.S. Pat. No. 3,742,402 and 3,742,403, both assigned to the Heinemann Electric Company. Further, a circuit breaker of the electromagnetic type is shown, for example, in Camp U.S. Pat. No. 3,329,913, also assigned to the Heinemann Electric Company.

Such electromagnetic circuit breakers typically comprise a movable contact, mounted on a movable arm, and a stationary contact. An operating handle is coupled to the movable arm via a linkage mechanism, part of the linkage mechanism comprising a collapsible toggle assembly. The movable and stationary contacts are operated between the contacts "open" and the contacts "closed" positions by pivoting the operating handle. The circuit breaker further comprises an electromagnetic device which in response to predetermined electrical conditions, collapses the toggle assembly, to thereby electrically trip "open" the contacts.

The circuit breakers shown in U.S. Pat. No. 3,742,402 and 3,742,403 include auxiliary switches which are moved from an initial position, upon electrical tripping of the linkage mechanism, to a second position, upon electrical tripping of the circuit breaker, to indicate (in the second position) the tripped "open" condition of the circuit breaker contacts. The auxiliary switch remains in this second position until the circuit breaker contacts are manually reclosed at which time the auxiliary switch is reset to its initial position. Thus, to disconnect (or remove) the electrical signal provided by the auxiliary switch, it is necessary to move the circuit breaker handle to its contacts "on" position. However, if a fault current persists in the line, when it is attempted to manually reclose the contacts, it may not be desirable to do so.

BRIEF SUMMARY OF THE INVENTION

It is an object of this invention to provide a circuit breaker which has an auxiliary switch that is moved upon electrical tripping of the contacts and which can thereafter be moved back to its initial position without closing the circuit breaker contacts.

It is a further object of this invention to provide a circuit breaker which will indicate its electrically tripped "open" condition by movement of the handle to a central position while at the same time also activating an auxiliary switch to provide an electrical signal indicating the tripped "open" condition of the circuit breaker.

The present invention provides a circuit breaker which electrically indicates whether the circuit breaker has been electrically tripped "open" by activating an electrical auxiliary switch at such time and, by restraining the handle in a central or "tripped" position, to simultaneously provide a visual, mechanical indication of the electrically tripped "open" condition.

The arrangement for electrically indicating the electrically tripped "open" condition of the circuit breaker contacts comprises an electrical auxiliary switch located within the circuit breaker case and activated by a pivotal actuator. The actuator is pivoted into engagement with the auxiliary switch during the collapse of the circuit breaker linkage mechanism by engagement of the linkage mechanism with the actuator, but not during manual movement of the mechanism between the "on" and "off" positions or vice versa.

A stop plate is supported by the frame within the case and includes an abutment against which a portion of the pin connecting the handle link to the remainder of the mechanism initially comes to rest after electrical tripping. When it is desired to deactivate the auxiliary switch, the handle is moved to the "off" position, at which time the pin depresses the stop plate, permitting passage of the pin and of the handle to their "off" positions. As the pin and handle move to their "off" positions, the linkage mechanism is reset, i.e., the linkage mechanism is moved out of engagement with the actuator, freeing the actuator. Once the actuator is freed of the linkage mechanism, the auxiliary switch moves to its initial position and in so doing also moves the actuator to its initial position.

A handle guard is also provided to shield the operating handle and to provide a grasping means for removing the circuit breaker.

A compensating terminal assembly is provided to facilitate insertion of the terminals and compensate for assembly variations.

The foregoing and other objects of the invention, the principles of the invention and the best modes in which I have contemplated applying such principles will more fully appear from the following description and accompanying drawings in illustration thereof.

BRIEF DESCRIPTION OF THE VIEWS

In the drawings:

FIG. **1** is a top and front perspective view of a circuit breaker incorporating this invention;

FIG. **2** is an enlarged, side elevation of the circuit breaker shown in FIG. **1** with one of the half-cases removed, the circuit breaker being shown in the contacts "closed" position;

FIG. **3** is a partial, side elevation similar to that shown in FIG. **2**, but the frame has been broken away to better show portions of the linkage mechanism which are hidden in FIG. **2**;

FIG. **4** is a partial, side elevation similar to FIG. **3**, but showing the contacts "open" position;

FIG. **5** is a partial, side elevation similar to FIG. **4**, but showing the electrically "tripped" position;

FIG. **6** is a partial, sectional view taken along the line **6—6** in FIG. **4**;

FIG. **7** is a partial, sectional view taken along the line **7—7** in FIG. **4**;

FIG. **8** is a top view of the circuit breaker shown in FIG. **1**;

FIG. **9** is a partial, sectional view taken along the line **9—9** in FIG. **8**;

FIG. **10** is an enlarged, sectional view of the right hand or dummy terminal which is only partially shown in FIG. **2**;

FIG. **11** is a partial, exploded view of the two half-cases and the test switch secured therebetween;

FIG. **12** is a perspective view of the stop plate;

FIG. 13 is a schematic, electrical diagram of the test circuit;

FIG. 14 is a top perspective, exploded view of the auxiliary switch, the spacer and the base plate;

FIG. 15 is a top perspective view of the actuator;

FIGS. 16 through 19 are diagrammatic views and illustrate another embodiment of the actuator to engage the auxiliary switch upon electrical tripping "open" of the circuit breaker contacts, FIG. 16 showing the "closed" contacts position, FIG. 17 showing the normally "open" contacts position, FIG. 18 showing the momentary tripped "open" contacts position, and FIG. 19 showing the "open" contacts position following tripping of the circuit breaker; and

FIGS. 20 through 23 are diagrammatic views (similar to FIGS. 16 through 19) but illustrate a further embodiment of the actuator to engage the auxiliary switch upon electrical tripping "open" of the circuit breaker contacts, FIG. 20 showing the "closed" contacts position, FIG. 21 showing the normally "open" contacts position, FIG. 22 showing the momentary tripped "open" contacts position, and FIG. 23 showing the "open" contacts position following tripping of the circuit breaker.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, and in particular to FIGS. 1, 2 and 3, this invention comprises a circuit breaker 10 having a case 20 which houses a circuit breaker assembly 22. An auxiliary switch 30 is supported within the case 20 and located adjacent the circuit breaker assembly 22.

The operation of the circuit breaker assembly 22 is described in detail in U.S. Pat. No. 3,329,913, among others, hence, only a brief description will be given hereafter.

The assembly 22 comprises a movable contact 34 carried by a movable arm 36 and engageable with a stationary contact 38, the latter carried by a terminal 40. The movable arm 36 is connected by a flexible conductor 42 to one end of a coil 44 forming part of an electromagnetic device 50. The electromagnetic device 50, on predetermined electrical conditions, collapses a linkage mechanism 52 to trip "open" the contacts 34 and 38. The electrical circuit of the circuit breaker is completed by connecting the other end of the coil 44 to the terminal 54 by conductor 56. The collapsible linkage mechanism 52 is of the type that resets, i.e., relatches, automatically after the contacts 34 and 38 are tripped "open" and the handle 88 is moved to the "off" position by the handle spring 92, see Camp U.S. Pat. No. 3,329,913 among others.

Further, the movable arm 36 is biased by a spring 60 (FIGS. 2 and 7) toward the open position of the contacts 34 and 38 and is mounted on a pin 62 about which it pivots, the pin 62 being carried by two spaced plates 64 (FIG. 7) which are integral with an L-shaped member 66 and jointly form a frame 68 for carrying the coil 44. The end portions of the pin 62 extend into holes 63 (FIG. 7) formed in the opposed side walls of the half-cases 69 and 70 (FIGS. 1 and 7) to properly locate and support the assembly 22 inside the case 20. Another pin 73, carried by the movable arm 36, has end portions which engage the spaced plates 64 to limit the opening movement of the arm 36 in the position shown in FIG. 2.

The movable arm 36 is also connected by a pin 74 to the linkage mechanism 52 which includes a collapsible toggle assembly 76 having a toggle catch 78 and a U-link 80. The toggle catch 78 is in turn connected to an extension arm 82 of the pivotal handle link 84 by a further pin 86. The handle link 84 is formed with an integral handle 88 and pivots about a pin 90 having its end portions also carried by the spaced plates 64 (FIG. 6). A spring 92 is coiled about the pin 90 and has one end attached to one of the frame plates 64 and the other end of the spring 92 is in contact with the arm 82, the spring being stressed at all times so as to bias the handle link 84 in the counterclockwise direction, FIG. 2, to the contacts "open" (circuit breaker "off") position.

After tripping of the linkage mechanism 52 in response to an overload, for instance, the handle spring 92 automatically moves the handle link 84 from the contacts "closed" (circuit breaker "on") position of FIG. 2 toward the contacts "open" (circuit breaker "off") position of FIG. 5, but is prevented from doing so by the handle stop 100, resulting in the handle link 84 being restrained in the central position shown in FIG. 5 with the toggle assembly 76 not relatched, as would be the case but for the handle stop 100. When the handle 88 is manually moved past the handle stop 100, the handle spring 92 will move the handle link 84 to the contacts "open" or "off" position and automatically relatch the toggle assembly 76.

The frame 68 forms a part of the electromagnetic device 50 to which may be secured a time delay tube 102 housing a spring biased magnetizable core (not shown) movable against the retarding action of a suitable fluid to provide a time delay before tripping of the mechanism on certain overloads.

The operation of this type of linkage mechanism 52 and electromagnetic device 50 is specifically set forth in U.S. Pat. No. 3,329,913 and for purposes of brevity it will only be generally described herein as follows—as the pivotal handle 88 is moved from the contacts "open" positions to the contacts "closed" position, the toggle assembly 76 and the movable arm 36 all move down, against the bias of the spring 60, and move the contact 34 into engagement with the stationary contact 38 achieving the contacts "closed" (circuit breaker "on") position, illustrated in FIGS. 2 and 3.

The electromagnetic device 50 includes an armature 104 which is pivoted on a pin 106 whose end portions are also carried by suitable holes in the frame plates 64. Upon the occurrence of a predetermined overload condition, assuming the circuit breaker to be in the contacts "closed" position, the armature 104 is attracted toward the pole piece 108, either after a time delay period or virtually instantaneously, depending on the overload condition. The movement of the armature 104, toward the pole piece 108 causes the oppositely extending trip finger 110, which is integral with the armature 104, to pivot to the right as seen in FIGS. 2 and 4 and engage and trip the arm 112 forming part of the linkage mechanism 52, whereupon the toggle assembly 76 collapses and the movable arm 36 moves upward under the bias of the spring 60 to open the contacts 34 and 38. The collapsing motion of the toggle assembly 76 is independent of the position of the handle link 84 and the handle 84. The handle link 88 is then moved toward the contacts open position, under the pressure applied by the spring 92, but is prevented from completely doing so by the handle stop 100.

The two approximate half-cases **69** and **70** form a main cavity for housing the circuit breaker assembly **22.** The two half-cases **69** and **70** include opposed openings **112** communicating with an opening **114** formed in a base plate **118.** The base plate **118** supports the auxiliary switch **30** upon abutments **117.** The auxiliary switch **30** is prevented from moving upward, as viewed in FIG. **2,** by a spacer **116** which has overhanging shoulders **123** and feet **125** trapped between the half-cases **69** and **70** and the abutments **117.** The bottom plate **118,** the spacer **116,** and the half-cases **69** and **70** are formed of suitable electrical insulating materials.

The base plate **118** is secured to the half-cases **69** and **70** by the previously mentioned terminal **54** and a dummy terminal **121** the terminals **54** and **121** extending through suitable holes **115** and **119** in the base plate **118.** Each of the terminals **54** and **121** include plates **120** and **127,** respectively, which extend into openings (not shown) in the opposed half-cases **69** and **70.** Each of the terminals **54** and **121** also include threaded portions **122** on which are threaded nuts **124** and **126** to bias the base plate **118** against the bottom surfaces of the half-cases **69** and **70.**

Nested between the two spaced legs of the movable arm **36,** as shown in FIG. **7,** is an actuator **130** pivotally carried by the pin **62.** The actuator **130** comprises arms **131** and **132** having aligned holes through which passes the pin **62.** The arms **131** and **132** are bridged by an integral heel **134** which is engageable with the upwardly biased button **136** of switch **30.** The switch **30** is a unitary member having its own insulating case and the internal arrangement of the switch **30** is such that the internal contacts (not shown) are normally open and the button **136** is biased upwardly, keeping the circuit between terminals **140** and **141** normally open.

The arm **132** of the actuator **130** includes a finger **143** extending upwardly, as shown, having a flag portion **144** turned at approximately a right angle to the plane of the finger **143.** Upon collapse of the toggle assembly **76,** and the opening of the circuit breaker contacts **34** and **38,** a downwardly extending extension **146** on one arm of the U-link **80** forcefully engages and pivots the actuator **130** from the positions shown in FIGS. **2** and **3** to the position shown in FIG. **5.** In so pivoting the actuator **130,** the heel **134** thereof engages and depresses the button **136,** closing the internal contacts of the switch **30,** the force transmitted to the actuator **130** by the collapsing toggle assembly **76** being substantially greater than the upward force or bias on the button **136** exerted by the internal linkage of the switch **30.**

As the toggle assembly **76** collapses, the handle spring **92** pivots the handle link **84** toward the contacts "open" or "off" position. However, the handle link **84** moves only to the central position shown in FIG. **5** and is restrained in this position by the abutment of an end portion of the pin **86** with a detent cam section **150** of the handle stop **100.** The cam section **150** extends upwardly and to the left and slightly overhangs the pin **86,** as shown in FIG. **5.** The pin **86** stops approximately in a straight line between the center of the handle pin **90** and the pin **147** between the toggle catch **78** and the U-link **80,** as shown in FIG. **5.**

The handle stop **100** comprises a plate **152** carried by the ends of the pins **90** and **106** shown in FIG. **2,** for example, and lies against one of the frame plates **64,** as shown in FIG. **6,** and between this frame plate **64** and the half-case **70.** The handle stop **100** further includes a spring or leaf portion **154** (of which the detent cam **150** is a part), the leaf portion **154** being bent at approximately a right angle from the plate **152** and back therefrom (relative to the plane shown in FIG. **5**).

Since the leaf portion **154** is relatively flexible, when the pin **86** engages the vertical section **150** it bends the leaf portion **154** downwardly, as viewed in FIG. **5,** or to the right, as viewed in FIG. **6,** into abutment with the adjacent wall **155** of the half-case **70,** the wall **155** being shown in FIG. **6.**

Thus, when the circuit breaker is electrically tripped "open" the handle **88** and the actuator **130** are pivoted to the positions shown in FIGS. **5** and **6,** the handle **88** providing a visual indication and the auxiliary switch **30** closing the contacts (not shown) of a circuit which provides the tripping "open" of the contacts **34** and **38.**

If it is desired to open the contacts (not shown) of the auxiliary switch **30,** after the tripped position of FIGS. **5** and **6** has been achieved, the handle **88** is manually pivoted counterclockwise from the position of FIG. **5** to the "off" position shown in FIG. **4.** In so doing, the pin **86** depresses the leaf **154** and the pin **86** rides up on the detent cam **150** (which at this time tends to bend down and out of the path of pin **86**) and the pin **86** frees itself of the cam surface **150** by moving up away from the leaf **156.** (As the pin **86** moves away from the leaf **154,** the leaf **154** springs away from the wall **155.**) Further, as the pin moves up away from the leaf **154,** the catch link **78** rotates clockwise (FIGS. **4** and **5**) and in so doing relatches the toggle assembly **76,** and carries the link extension **146** away from the flag **144,** releasing the actuator **130.** Since the button **136** is biased upward against the heel **134,** and since the heel slopes, as shown in FIG. **5,** a component of the biasing force on the button **136** now pivots the actuator **130** clockwise, about the pin **62,** resetting the actuator **130** to its initial position of FIG. **3.**

During manual "opening" and "closing" of the contacts **34** and **38,** by pivoting of the handle back and forth between the positions of FIGS. **2** and **4,** the link extension **146** is at all times clear or free of the actuator **130** and, hence, the button **136** of switch **134** is not depressed at such time.

Likewise, the pin **73** which is carried by the movable arm **36** and which limits counterclockwise movement of the movable arm **36** by abutment with the frame plates **64,** (FIGS. **2** and **5**) is spaced from the actuator **130** and does not engage the actuator **130,** as the pin **73** moves back and forth between the positions of FIGS. **2** and **4** during manual "opening" and "closing" of the contacts **34** and **38.** The movement of the pin **73** at such time is in the generally U-shaped space between the upstanding fingers **143** and **170,** the upstanding fingers being best illustrated in FIG. **15.**

However, if the upward spring bias on the button **136** should fail, when the handle **88** is pivoted to the "off" position, and, hence, the actuator **130** not be automatically reset to its initial position of FIG. **4,** the contacts (not shown) of the auxiliary switch **30** would erroneously continue to indicate the electrically tripped "open" condition. At such time, if the handle **88** were moved to the contacts "closed" position of FIGS. **2** and **3,** i.e., the movable arm **36** being pivoted down, the pin **73** would now engage the finger **170** and pivot the actuator **130** clockwise to its initial position, i.e., the position shown in FIGS. **2, 3** and **4,** at which time the contacts of the auxiliary switch **30** would open and the electrically tripped "open" position would no longer be shown (or sounded if an audible alarm is used) by the trip circuit, shown diagramatically in FIG. **13,** connected to the auxiliary switch.

On the other hand, if the contacts of the auxiliary switch **30** should for some reason snap open and impart on the button **136** an excessive upward force, the actuator **130** might rotate clockwise excessively. To prevent such excessive clockwise rotation the finger **143** will abut the pin **73** and stop the actuator in the position shown in FIG. **4.**

The terminal **141** of the auxiliary switch **30** is connected to a clip **212** by an insulated electrical lead **200** extending through a groove **202** in the base plate **118.** The other terminal **140** is similarly connected by an insulated electrical lead **204** extending through a groove **205** and to a clip **206.** The clip **206** extends from the groove **205** (in the base plate **118**) through the hole **115** for the terminal **54** in the base plate **118** and below the base plate **118.** The portion of the clip **206** below the base plate **118** is held captive to the base plate **118** by the nut **124,** as shown. Likewise, the clip **212** extends from the groove **202** (in the base plate **118**) through the hole **119** for the dummy terminal **121** in the base plate **118** and below the base plate **118.** The portion of the clip **212** below the base plate **118** is held captive to the base plate by the nut **126.**

The circuit breaker **10** also carries a momentary push-push switch device **224** for use in testing (or otherwise operating) the load protected by the circuit breaker **10.** The switch device **224** includes a terminal **220** to which is connected an insulated electrical lead **216** which extends through the cavity of the circuit breaker **10** from a hole **255** in the left hand end wall (FIGS. **2** and **11**), formed by the two half-cases **69** and **70.** The lead **216** also extends through a groove **256** in the base plate **118,** shown in FIG. **14,** and is connected to the load terminal **40,** as shown in FIG. **2.**

The switch device **224** is held captive between opposed end walls **230** and **231,** respectively, of the half-cases **69** and **70,** as shown in FIG. **11.** The switch device **224,** as shown in FIG. **2,** comprises a housing **234** carrying a momentary push-push switch module **236** secured by a threaded stem and nut arrangement extending through an opening at the top of the housing **234.** The back of the housing **234** is open to facilitate access thereto.

The switch module **236,** FIG. **2,** further includes terminals **242** and **244** to which are secured further leads **246** and **248,** respectively. The leads **246** and **248** are in turn connected to further terminals **250** and **252** by which the switch module **236** may be connected to an external circuit, as shown diagrammatically in FIG. **13.** The terminals **250** and **252** are carried by and extend through the switch housing **234** (between the end walls **230** and **231** of the half-cases **69** and **70**).

FIG. **13** further illustrates diagrammatically the circuit breaker **10** and an adjacent circuit breaker **10*a*.**

The switch modules **236** and **236*a*** of the two circuit breakers **10** and **10*a*** are interconnected as shown. Switch module **236** is connected at terminal **252** by wire **266** to a lamp **290** and by another wire **291** to bus **304.** Electrical lead wire **260** connects terminal **250** to terminal **252*a*.** The terminal **250*a*** is plugged. (If a third circuit breaker, not illustrated, is to be connected to the series, terminal **250*a*** would be connected to a terminal [of the third breaker] corresponding to the terminal **252*a*,** by a suitable wire.)

The test switches **236** and **236*a*** are single pole, double throw switches, The contacts **250** and **252** are closed in switch **236** and the contacts **250*a*** and **252*b*** are closed in switch **236*a*.**

The terminal **220** of the switch module **236** is connected by lead **216** to the load terminal **40,** and the circuit breaker **10*a*** has a lead **216*a*** which connects the terminal **220*a*** to the load terminal **40*a*.**

Loads L and L*a* are connected by suitable conductors to the load terminals **40** and **40*a*.** In one embodiment, the loads L and L*a* are capacitive loads and the switches **236** and **236*a*** provide a method to charge the loads when the circuit breaker contacts are open, by keeping depressed the button of the appropriate switch module **236** or **236*a*** for the time required.

Thus, it is seen that when the switch **236** is momentarily actuated and the circuit is closed between the terminals **220** and **244,** the terminals **220** and **244** are then in parallel with the circuit breaker contacts **34** and **38** and coil **44,** as shown, and all are in series with the load L, but it is normally intended that the switch **236** will be actuated (and the circuit between terminals **220** and **244** be closed) only when the circuit breaker contacts are open.

FIG. **2** illustrates only the button **270** of switch module **236** and when it is depressed the circuit between terminals **250** and **252** is opened and the circuit between terminals **220** and **252** is closed. Thus, depressing the button of any one of the switches **236** or **236*a*** will open the circuit to the succeeding switches and close the circuit of the circuit breaker whose button is depressed.

Lamp **290** is provided to show that the test circuit is closed and to limit the current in the circuit through switch modules.

While two circuit breakers **10** and **10*a*** have been diagrammatically illustrated in FIG. **13,** it will be understood that any number of circuit breakers may be interconnected in the manner illustrated and described.

Preferably the terminals **250** is a female terminal and terminal **252** a male terminal to assure correct electrical connections.

Referring to FIG. **11** it is seen that the case **234** is interfitted with and is captured between the opposed walls **230** and **231.** The walls **230** and **231** have abutments **280** overlying corresponding shoulders **281** to prevent upward movement of the case **234.** Further, the walls **230** and **231** include projections **282** nesting in recesses **283** to restrain downward and outward (to the right in FIG. **11**) movement of the case **234.** The case **234** is, of course, restrained from inward (to the left in FIG. **11**) movement by the wrap-around portions **285** of the walls **230** and **231.**

As indicated in FIGS. **2** and **10,** the terminals **54** and **121** are inserted into and carried by bus terminals **300** and **302.** The bus terminals **300** and **302** are in turn carried by bus bars **304** and **306,** respectively.

The bus terminal **300** comprises a cylindrical sleeve **310** (having a longitudinal slot) and an integral threaded stud **312** of reduced diameter relative to the sleeve **310** so as to define a face **314** (having a knurled edge) abutting the upper surface of the bus bar **304.** The threaded stud **312** extends through a suitable hole in the bus bar **304** and is retained thereto by a nut **315.**

Similarly, the bus terminal **302**, FIG. **10**, comprises a cylindrical sleeve **320** and an integral threaded stud **322** of reduced diameter relative to the sleeve **320** so as to define a face **324** (having a knurled edge) abutting the upper surface of the bus bar **306**. The threaded stud **322** extends through a suitable hole in the bus bar **306** and is retained thereto by a nut **325**.

The sleeve **320** is of tubular shape having an open, upper end and a lower end closed by end wall **326**. Seated upon the wall **326**, centrally within the sleeve **320** is spring **330**. The spring **330** is preferably closely coiled, and the spring coil diameter progressively decreases along the length of the spring, so as to have its smallest diameter at the midportion thereof and its largest diameter on both ends of the spring, as illustrated. The largest diameter of the spring (at its ends) is approximately that of the inside diameter of the sleeve **320**.

The spring **330** is retained within the sleeve by bending over the upper portion or lip **332** of the sleeve so as to compress the spring **330** against the end wall **326**, as shown.

The smallest diameter of the spring **330**, on its inside, is slightly less than the outside diameter of the dummy terminal **121**, to frictionally receive the dummy terminal **121**. However, the opening **334** into the sleeve and the annular gap **336** between the spring **330** and the inside wall of the sleeve are sufficiently large to permit the central or midportion of the spring **330** to distort to one side or another, as the dummy terminal **121** enters the spring **330**, if the terminal **121** is not centrally aligned with the longitudinal axis of the bus terminal **302**. (While not illustrated in detail, the terminal **54** has a lower portion, similar to the lower portion of the terminal **121**, as shown in FIG. **10**, which is frictionally received in the bus terminal **300**.)

Normally the bus terminals **300** and **302** are fixed to the bus bars **304** and **306** and thereafter the circuit breaker terminals **51** and **121** are inserted into the bus terminals **300** and **302**. The lateral flexibility of the spring **330** together with the annular gap **336** into which it may move, tends to accommodate a certain amount of deviation between the center-to-center distance of the circuit breaker terminals **51** and **121** vis-a-vis the bus terminals **304** and **306**.

Referring to FIGS. **1, 8** and **9** in particular, the circuit breaker **10** includes a handle grip and guard **400**. The handle grip **400** comprises an inverted U-shaped guard handle **402** secured at its ends to lugs **404** and **406**. The lugs **404** and **406** are placed upon the upper surface of the half-cases **69** and **70**, as shown in FIG. **9**, on opposite sides of the handle **88**. The grip handle **402** is preferably placed to one side of the longitudinal axis of the circuit breaker **10**, as illustrated, and provides a convenient arrangement for pulling the circuit breaker **10** from the bus terminals **300** and **302** while tending to guard the handle **88** from accidental movement.

The lugs **404** and **406** are provided with suitable holes through which extend screws **408** and **410**. The screws **408** and **410** extend between the half-cases **69** and **70**, as shown, and into threaded nuts **412**, FIGS. **2** and **9**. The nuts **412** are captive in suitable slots formed in the abutting walls of the half-cases **69** and **70**.

FIG. **13** also shows the schematic, electrical diagram of the alarm or auxiliary circuit. It is seen that the alarm or auxiliary switch **30** has internal contacts which are normally "open," i.e., its contacts are "open" when the button **136** is raised or is in its upward position, as shown in FIGS. **3** and **4**.

Further, even though the auxiliary switch terminal **140** is connected by lead **204** to the circuit breaker terminal **54** (which is, of course, electrically energized when the circuit breaker contacts **34** and **38** are "closed") the circuit to the trip alarm T is open at such time and no signal is given nor any alarm sounded.

However, upon electrical tripping of the circuit breaker contacts **34** and **38**, the actuator **130** rotates counterclockwise, as viewed in FIG. **5**, and depresses the button **136**, closing the internal contacts of the auxiliary switch **30**, whereupon current flows from the terminal **54**, through the lead **204**, the terminal **140**, the internal contacts of the auxiliary switch **30**, the terminal **141**, the lead **200**, the terminal **121**, the bus bar **306**, and to the alarm device T, and thereafter to ground, as shown in FIG. **13**.

Referring to FIGS. **16** through **19**, another embodiment of this invention is illustrated. In FIGS. **16** through **19**, only the portions of a circuit breaker **500** which are essential to the understanding of this embodiment are illustrated, the illustrations being primarily diagrammatic sketches of the parts involved.

The circuit breaker **500** comprises a handle **588** forming part of a handle link **584** having an arm **582**. The arm **582** is connected to the automatically resettable toggle assembly **576**. The toggle assembly **576** is pivotally connected to the movable arm **536**.

An electromagnetic device **550** including a pivotal armature **511** is provided to trip the toggle assembly **576** on predetermined overloads.

The circuit breaker **500** also includes an actuator **513**. The movable arm **536** and the actuator **513** are pivotally mounted on a pin **562** carried by a frame (not shown), but similar to the frame **64** of the previous embodiment.

Further, the circuit breaker **500** includes an auxiliary switch **530**. The auxiliary switch **530** has internal contacts connected to the terminals **540** and **541**, the internal contacts being normally open, i.e., being open when the button **535** is in its raised position, the position shown in FIG. **16**. Preferably the button **535** reciprocates along a vertical line which passes through the center of the pin **562**. As shown in FIG. **16**, a pin **573** engages a finger **570** of the actuator **513** restricting counterclockwise movement thereof.

When the handle **588** is turned counterclockwise, to the "off" or contacts "open" position shown in FIG. **17**, the toggle assembly **576** and the movable arm **536** all move from the position shown in FIG. **16** to that shown in FIG. **17**. At this time, the pin **573** moves counterclockwise away from the finger **570** toward the finger **543**, but does not engage the latter. Note also that at this time the extension **546** of the U-link **580** moves toward the finger **543**, but also does not engage the latter.

Assuming the circuit breaker **500** to be in the contacts "closed" or "on" position, the position shown in FIG. **16**, upon the occurrence of predetermined electrical conditions, the armature **511** is pivoted to the position shown in FIG. **18**, and the toggle assembly **576** unlatches, whereupon the toggle assembly **576** collapses to the momentary position shown in FIG. **18**. At such time the extension **546** forcefully engages the finger **543** and causes the actuator **513** to pivot counterclockwise into engagement with the button **535**, depressing the latter to the position shown in FIG. **18** with the button **535** entering a recess or detent formed in the lower surface of the actuator **513**, as shown. When the button **535** is depressed to the position shown in FIG. **18**, the internal contacts of the auxiliary switch **530** are closed. The actuator **513** remains in the position shown in FIG. **18**, but the toggle assembly **576** and the handle **588** pivot to the position shown in FIG. **19**, i.e., the toggle assembly **576** relatches automatically and the handle link **584** moves to the "off" or "contacts" open position.

In the position of FIG. **19**, the internal contacts of the auxiliary switch **530** are closed, so that the circuit to the trip alarm (not shown) or other device connected to the terminals of the auxiliary switch is energized. To deenergize the trip alarm, i.e., to open the internal contacts of the auxiliary switch, the handle **588** is rotated to the contacts "closed" position, the position shown in FIG. **16**. In so doing, the pin **573** engages the finger **570** and rotates the latter clockwise, lifting the actuator **513** off of the button **535** which is then free to move upwardly (under its internal bias) to the position shown in FIG. **16**, opening the internal contacts of the auxiliary switch and, thereby, opening the alarm circuit. To effect the opening of the auxiliary switch contacts it is only necessary to move the movable arm **536** so that its movable contact **534** makes only momentary (or almost makes) contact with the stationary contact **538**. Under some conditions or with some loads, it is permissible to so momentarily close the circuit breaker contacts, but if not, then the embodiment of FIGS. **1** through **15** is preferred.

Referring to FIGS. **20** thorugh **21**, a further embodiment of this invention is illustrated. In FIGS. **20** through **21**, only the portions of a circuit breaker **600** which are essential to the understanding of this embodiment are illustrated, the illustrations being primarily diagrammatic sketches of the parts involved.

The circuit breaker **600** comprises a handle **688** forming part of a handle link **684** having an arm **682**. The arm **682** is connected to the automatically resettable toggle assembly **676**. The toggle assembly **676** is pivotally connected to the movable arm **636**.

An electromagnetic device **650** including a pivotal armature **611** is provided to trip the toggle assembly **676** on predetermined overloads.

The circuit breaker **600** also includes an actuator **613**. The movable arm **636** and the actuator **613** are pivotally mounted on a pin **662** carried by a frame (not shown), but similar to the frame **64** of the first embodiment.

Further, the circuit breaker **600** includes an auxiliary switch **630**. The auxiliary switch **630** has internal contacts connected to the terminals **640** and **641**, the internal contacts being normally closed, i.e., being closed when the button **635** is in its raised position, the position shown in FIGS. **22** and **23**. Preferably the button **635** reciprocates along a vertical line which passes through the center of the pin **662**. As shown in FIG. **20**, a pin **673** engages a finger **670** of the actuator **613** restricting counterclockwise movement thereof.

When the handle **688** is turned counterclockwise, to the "off" or contacts "open" position shown in FIG. **21**, the toggle assembly **676** and the movable arm **636** all move from the position shown in FIG. **20** to that shown in FIG. **21**. At this time, the pin **673** moves counterclockwise away from the finger **670** toward the finger **643**, but does not engage the latter. Note also that at this time the extension **646** of the U-link **680** moves toward the finger **643**, but also does not engage the latter.

Assuming the circuit breaker **600** to be in the contacts "closed" or "on" position, the position shown in FIG. **20**, upon the occurrence of predetermined electrical conditions, the armature **611** is pivoted to the position shown in FIG. **22**, and the toggle assembly **676** unlatches, whereupon the toggle assembly **676** collapses to the momentary position shown in FIG. **22**. At such time the extension **646** forcefully engages the finger **643** and causes the actuator **613** to pivot counterclockwise out of engagement with the button **635**, releasing the latter which then rises to the position shown in FIG. **22**, the button **635** leaving the recess or detent formed in the lower surface of the actuator **613**, as shown. When the button **635** is raised to the position shown in FIG. **22**, the internal contacts of the auxiliary switch **630** are closed. The actuator **613** remains in the position shown in FIG. **22**, but the toggle assembly **676** and the handle **688** pivot to the position shown in FIG. **23**, i.e., the toggle assembly **676** relatches automatically and the handle link **684** moves to the "off" or "contacts" open position.

In the position of FIG. **23**, the internal contacts of the auxiliary switch **630** are closed, so that the circuit to the trip alarm (not shown) or other device connected to the terminals of the auxiliary switch is energized. To deenergize the trip alarm, i.e., to open the internal contacts of the auxiliary switch, the handle **688** is rotated to the contacts "closed" position, the position shown in FIG. **20**. In so doing, the pin **673** engages the finger **670** and rotates the latter clockwise, the actuator **612** then depressing the button **635** until the latter seats in the recess or detent, the position shown in FIG. **20**, opening the internal contacts of the auxiliary switch and, thereby, opening the alarm circuit. To effect the opening of the auxiliary switch contacts it is only necessary to move the movable arm **636** so that its movable contact **634** makes only momentary (or almost makes) contact with the stationary contact **638**. (Under some conditions or with some loads, it is permissible to so momentarily close the circuit breaker contacts, but if not, then the embodiment of FIGS. **1** through **15** is preferred.) During the momentary contact of the contacts **634** and **638**, the actuator **613** latches upon the button **635** at the detent and the upward bias on the button **635** together with the fact that it is aligned with the pin **662**, keeps the actuator **613** in the position of FIG. **20**, even though the movable arm **636** returns to the "off" position of FIG. **21**.

If desired, a handle stop, similar to the handle stop **100** described in connection with the embodiment of FIGS. **1** to **16**, may be added to the embodiments of FIGS. **17** to **23** in which event the handle will be restrained in an intermediate position while to provide a visual indication of the electrically tripped condition while the auxiliary switch provides an electrical signal.

From the foregoing it is seen that the actuator **130** and auxiliary switch **30** arrangement of the embodiment of FIGS. **1** to **15** requires a handle stop means, such as the handle stop **100**, to restrain the actuator **130** in engagement with the button **136** of the auxiliary switch **30** so as to close the internal contacts of the latter to provide an electrical signal indicating the electrically tripped position of the circuit breaker contacts **34** and 38. In the actuator - auxiliary switch embodiments of FIGS. 16 to 23, the arrangement is such that the auxiliary switches 530 or 630 continue to signal the electrical tripped condition of the circuit breaker contacts, even though the handle has moved directly to the "off" position, i.e., the handle stop means restraining the handle has been omitted. Of course, if desired, a handle stop restraining the handle in an intermediate or tripped position may be added to the embodiments of FIGS. 16 to 23. If the handle stop 100 is omitted from the embodiment of FIGS. 1 to 15, only a momentary closing of the auxiliary switch 30 will take place, and if the circuit connected to the auxiliary switch terminals, is constructed to be actuated by this momentary closing, it may be sufficient.

In the embodiment of FIGS. 1 to 15, the auxiliary switch contacts are opened when the handle is moved from the central or tripped position to its "off" position, i.e., the alarm may be turned "off" without reclosing the circuit breaker contacts. In the two embodiments of FIGS. 16 to 23 it is necessary to turn the handle to the "on" position and to move the movable contact of the circuit breaker to or toward the contacts closed position in order to reset the actuators.

In all three embodiments, the actuators float freely about the pin on which they are mounted. This pin is the same about which the movable contact arm pivots. In all three embodiments, the actuators are located between the frame plates of the circuit breaker. In all three embodiments, rotation of the actuator is limited by another pin carried by the movable contact arm, this pin being the same pin which limits the opening movement of the movable contact arm. Further, this second pin may reset the actuator of FIGS. 1 to 15 and does reset the actuators of FIGS. 16 to 23.

In all three embodiments, this second pin pivots back and forth between two fingers of the actuator without engaging either one during (manual) opening and closing of the circuit breaker contacts.

Further, in all three embodiments the actuators are engaged by an extension of the U-link of the toggle assembly as the toggle collapses after it is tripped.

Also, in all three embodiments the auxiliary switch is fully enclosed within the circuit breaker, although, if desired, the terminals of the auxiliary switch could extend through the base plate.

While not illustrated, it is seen that the stop means provided by the pin 73 in the embodiment of FIGS. 1 to 15 could be formed by projections extending inwardly, for example, from one of the half-cases.

Further, while the actuators have been illustrated and described as supported between the frame plates, it will be seen that they could be supported otherwise within the circuit breaker.

Also, while the handle stop has been illustrated and described as supported on the handle and armature pins, it is seen that handle stop means secured directly to one or the other or both of the half-cases may be utilized.

While not specifically mentioned, it is understood that the two half-cases are secured together by rivets or other suitable fasteners extending through suitable holes in the half-cases.

It will be noted that the overall shape of the actuators of FIG. 1 to 15 and of the embodiment illustrated in FIGS. 16 to 19 is approximately the same because in both embodiments the internal contacts of the auxiliary switches are closed when the buttons are depressed. However, in the embodiment of FIGS. 20 to 23, the internal contacts of the auxiliary switch 630 are closed when the button 635 rises, see FIG. 22. Thus, the left hand side of the actuator 613 must be relieved so as to provide a space, FIG. 22, into which the button 635 may freely move at such time.

If desired a panel 700, FIG. 2, may be placed over the front of the circuit breaker.

Having described this invention, what I claim is:

1. a circuit breaker comprising a case,
a stationary contact,
a movable contact mounted on a movable arm,
a collapsible linkage connected to said movable arm for moving the contacts between the contacts "open" and the contacts "closed" positions,
means for collapsing said collapsible linkage upon predetermined electrical overloads to move the contacts from said "closed" to said "open" positions,
operating means connected to said collapsible linkage for moving the contacts between said "open" and "closed" positions,
said collapsible linkage moving in a first path when moving from the contacts "closed" position to the contacts "open" position under the influence of said operating means and in a second path when going from the contacts "closed" to the contacts "open" position due to an electrical overload, and
switch means associated with said collapsible linkage for indicating when said circuit breaker has been electrically tripped "open," and
an actuator pivotally mounted within said case and movable by said collapsible linkage from an initial position to a second position when said collapsible linkage moves through said second path,
said actuator activating said switch means upon movement to its second position to indicate the electrically tripped "open" condition, and
said switch means pivoting said actuator to its initial position after said collapsible linkage moves to the contacts "open" position due to an electrical overload.

2. The combination recited in claim 1 wherein said collapsible linkage pivots said actuator in one direction and said switch means pivots said actuator in the opposite direction, the force exerted upon said actuator by said collapsible linkage being greater than the force exerted by said switch means on said actuator.

3. The combination recited in claim 1 and further including
stop means for restraining said operating means in a position intermediate the "open" and "closed" positions of the contacts,
whereby said actuator is restrianed from moving back to its initial position after collapse of the collapsible linkage.

4. The combination recited in claim 3 wherein said collapsible linkage pivots said actuator in one direction and said switch means pivots said actuator in the opposite direction, the force exerted upon said actuator by said collapsible linakge being greater than the force exerted by said switch means on said actuator.

5. The combination recited in claim 2 wherein said switch means is a unitary electrical switch having its own insulating case.

6. The combination recited in claim **4** wherein said switch means is a unitary electrical switch having its own insulating case.

7. The combination recited in claim **6** wherein said case comprises two approximate half-cases, and said switch means is located intermediate portions of said half-cases.

8. The combination recited in claim **2** wherein said collapsible linkage includes a collapsible toggle.

9. The combination recited in claim **2** and further including stop means for limiting clockwise and counterclockwise movement of said actuator.

10. The combination recited in claim **9** wherein said stop means comprises a stop pin mounted on said movable arm.

11. The combination recited in claim **9** wherein said actuator includes two spaced fingers, one of said fingers being engageable by said collapsible linkage and said stop means, and the other finger is engageable only with said stop means.

12. The combination recited in claim **11** wherein said stop means is a stop pin mounted on said movable arm and further including a frame supported within said case, said movable arm and actuator being both pivotally mounted on said frame, said stop pin being also engageable with said frame to limit movement of the movable arm in the contacts "open" position.

13. The combination recited in claim **12** wherein said frame includes two spaced plates between which is disposed a portion of said movable arm, said actuator also being disposed in part between said spaced plates.

14. The combination recited in claim **9** wherein said stop means comprises two projections spaced from each other, formed on said case and extending inwardly toward said actuator.

15. The combination recited in claim **1** and further including reset means for returning said actuator to its initial position from its second position when said movable arm is moved to the contacts "closed" position.

16. The combination recited in claim **15** wherein said reset means also limits clockwise and counterclockwise rotation of said actuator.

17. The combination recited in claim **1** wherein both said actuator and said movable arm are pivotal about the same axis.

18. The combination recited in claim **15** wherein said actuator includes two fingers spaced from each other, and said reset means is positioned relative to said fingers so as to be movable back and forth between said fingers without engaging same during movement of said collapsible linkage between said contacts "open" and contacts "closed" positions when the linkage is not collapsed and said actuator is in its initial position.

19. The combination recited in claim **1** and further including

stop means for restraining said operating means in a position intermediate the "open" and "closed" positions of the contacts,

whereby said actuator is restrained from moving back to its initial position after collapse of the collapsible linkage,

said collapsible linkage pivots said actuator in one direction and said switch means pivots said actuator in the opposite direction, and the force exerted upon said actuator by said collapsible linkage being greater than the force exerted by said switch means on said actuator,

said switch means is a unitary electrical switch having its own insulating housing,

said case of said circuit breaker comprises two approximate half-cases,

said switch means is located intermediate portions of said half-cases,

said collapsible linkage includes a collapsible toggle,

a stop pin mounted on said movable arm for limiting clockwise and counterclockwise movement of said actuator,

said actuator includes two spaced fingers, one of said fingers being engageable by said collapsible linkage and said stop pin, and the other finger is engageable only with said stop pin,

a frame supported within said case,

said movable arm and actuator being both pivotally mounted about the same axis and on said frame,

said stop pin being also engageable with said frame to limit movement of the movable arm in the contacts "open" position,

said frame includes two spaced plates between which is disposed a portion of said movable arm,

said actuator also being disposed in part between said spaced plates.

20. a circuit breaker comprising a case,

a stationary contact,

a movable contact mounted on a movable arm,

a collapsible linkage connected to said movable arm for moving the contacts between the contacts "open" and the contacts "closed" positions,

means for collapsing said collapsible linkage upon predetermined electrical overloads to move the contacts from said "closed" to said "open" positions,

operating means connected to said collapsible linkage for moving the contacts between said "open" and "closed" positions,

said collapsible linkage moving in a first path when moving from the contacts "closed" position to the contacts "open" position under the influence of said operating means and in a second path when going from the contacts "closed" to the contacts "open" position due to an electrical overload, and

switch means associated with said collapsible linkage for indicating when said circuit breaker has been electrically tripped "open," and

an actuator pivotally mounted within said case and movable by said collapsible linkage from an initial position to a second position when said collapsible linkage moves through said second path,

said actuator activating said switch means upon movement to its second position to indicate the electrically tripped "open" condition, and

reset means carried by said movable arm for returning said actuator to its initial position from its second position when said movable arm is moved to the contacts "closed" position.

21. The combination recited in claim **20** wherein said reset means also limits clockwise and counterclockwise rotation of said actuator.

22. The combination recited in claim **20** wherein both said actuator and said movable arm are pivotal about the same axis.

23. The combination recited in claim **20** wherein said collapsible linkage includes a collapsible toggle comprising two links pivotally connected together and one

of said links forcefully engaging said actuator upon collapse of the toggle.

24. The combination recited in claim 20 wherein said actuator includes two fingers spaced from each other, and said reset means being positioned relative to said fingers so as to be movable back and forth between said fingers without engaging same during movement of said collapsible linkage between said contacts "open" and contacts "closed" positions when the inkage is not collapsed and said actuator is in its initial position.

25. A circuit breaker comprising a case,
said case including two half-cases and a separable base plate,
said half-cases defining a chamber,
a stationary contact and a movable contact within said chamber,
a collapsible linkage connected to said movable arm for moving the contacts between the contacts "open" and the contacts "closed" positions,
means for collapsing said collapsible linkage,
operating means connected to said collapsible linkage for moving the contacts between said "open" and "closed" positions,
said base plate defining a second chamber,
a unitary switch means disposed in said second chamber and extending into said first mentioned chamber,
said unitary switch means being actuatable by said collapsible linkage.
terminals extending through said half-cases and said base plate and secured thereto,
said unitary switch means being electrically connected to said terminals,
said terminals being adapted to fix said circuit breaker within a panelboard.

26. The combination recited in claim 25 and further including a clip connected to each terminal,
each clip having a hole through which the associated terminal extends,
each clip having a portion extending into said second chamber and connected thereby to said switch means, and
fasteners secured to said terminals and thereby securing said clips to said base plate.

27. The combination recited in claim 26 wherein said unitary switch means has a housing of electrical insulation material.

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