United States Patent [19]

Brumfield

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[45] **Jan. 1, 1974**

[54] **POSITIVE ON POSITION INDICATOR**

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[73] Assignee: **I-T-E Imperial Corporation,** Philadelphia, Pa.

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[21] Appl. No.: **275,622**

[52] **U.S. Cl.** ..... **200/153 G,** 200/DIG. 42

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

[58] **Field of Search** ..... 200/DIG. 42, 153 G, 200/153 H, 67 PK, 167 R; 337/59; 335/191

[56] **References Cited**

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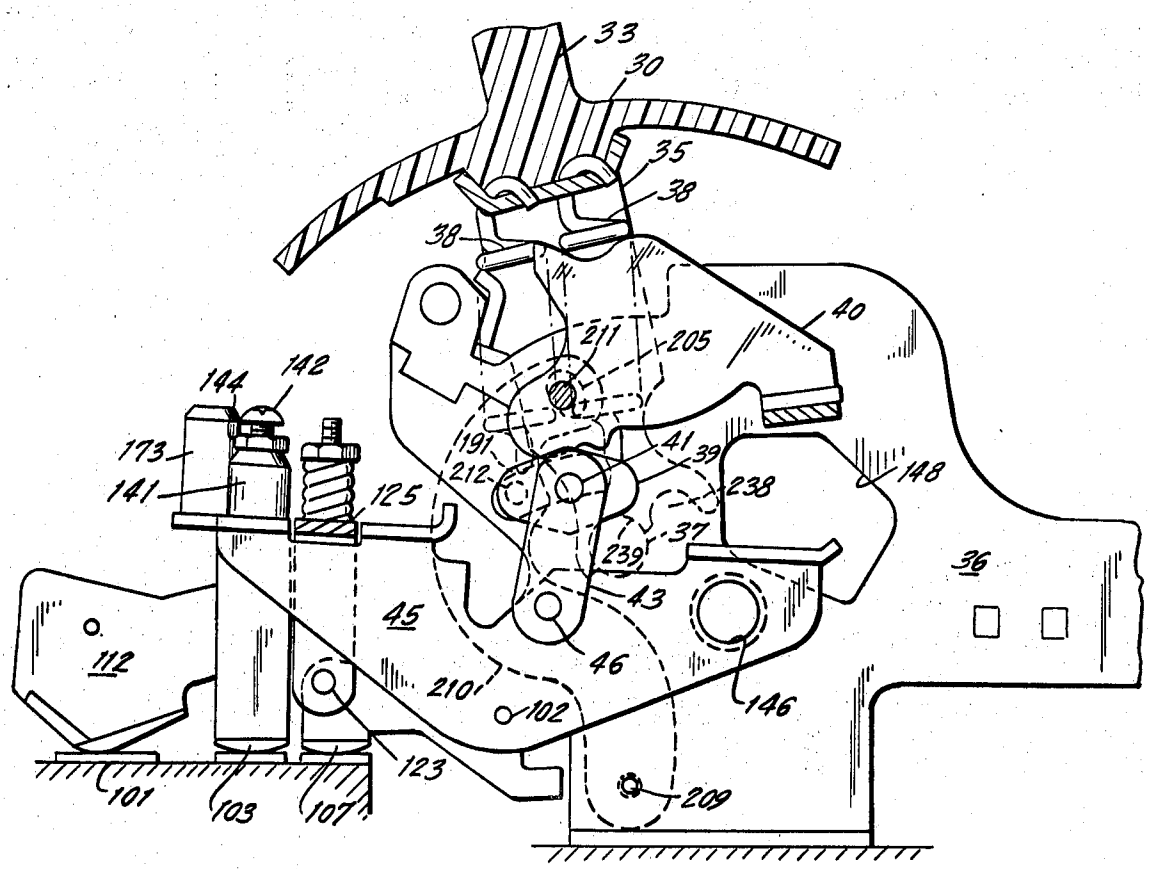
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Primary Examiner—J. R. Scott
Assistant Examiner—Robert A. Vanderhye
Attorney—Sidney G. Faber et al.

[57] **ABSTRACT**

A molded case circuit breaker having spring powered over-center toggle contact operating mechanisms is provided with means to prevent the operating handle from moving to its off position unless the contacts are open. This means may engage the toggle near the knee thereof to assist in driving the toggle over center during opening movement of the handle.

9 Claims, 10 Drawing Figures



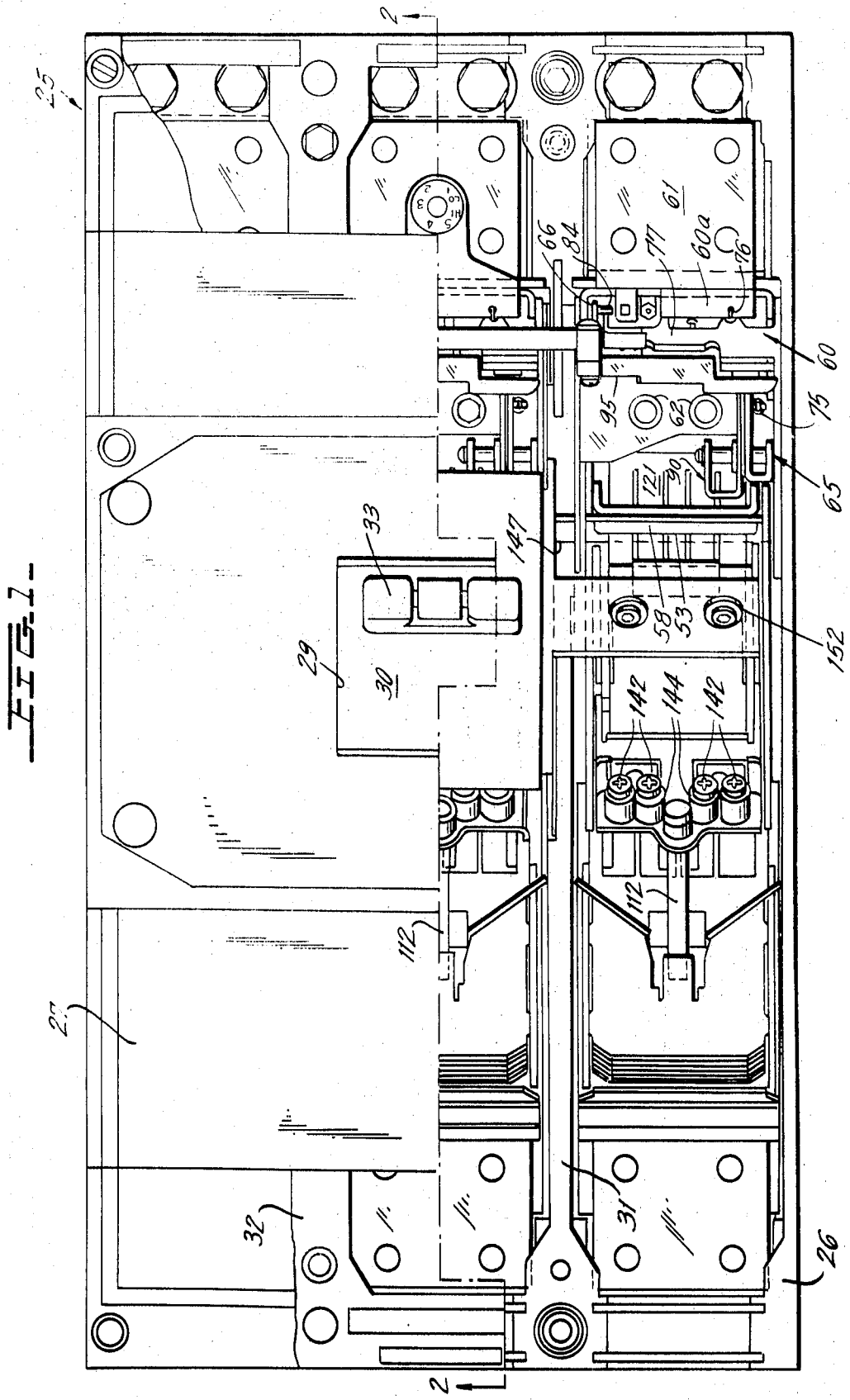

2
25
66
84
111
61
60a
16
60
15
95
62
65
121
90
33
147
58
53
152
29
30
142
144
142
112
112
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2

FIG. 1

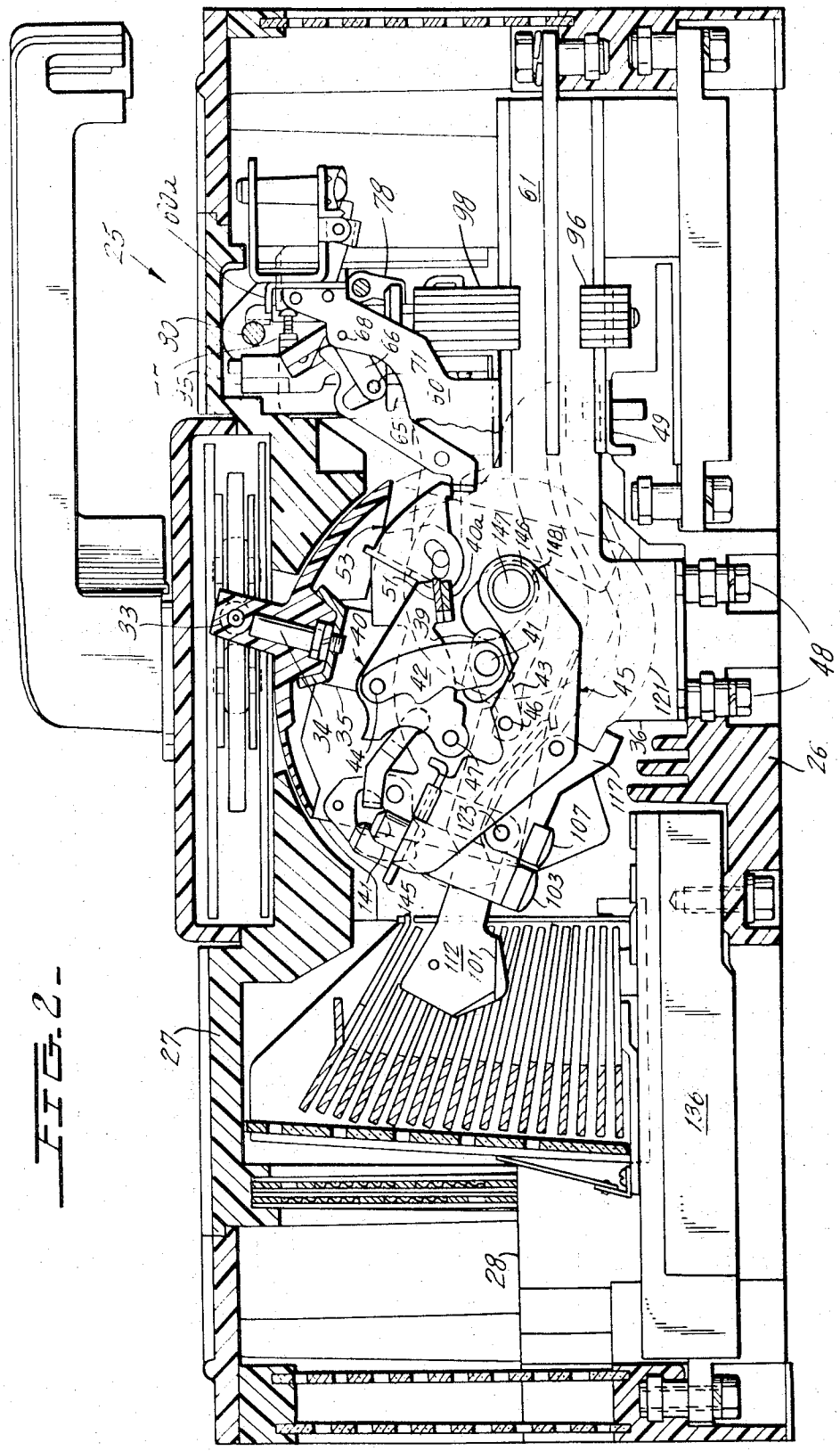

25
102a
78
98
61
96
32
68
66
71
30
65
49
53
51
40a
147
148
148a
33
40
39
41
42
43
45
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121
34
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123
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107
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141
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101
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136
28

FIG. 2.

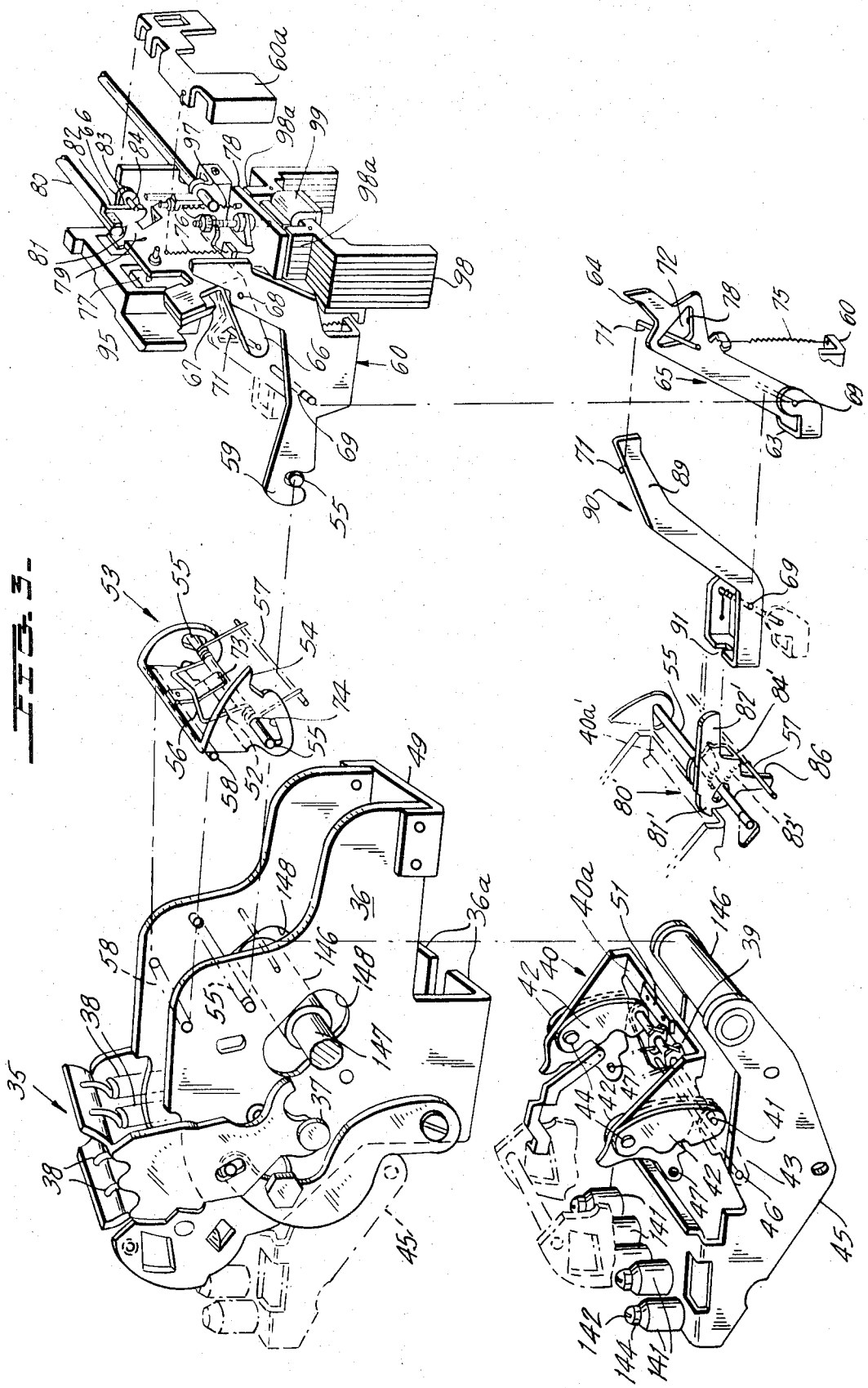

60a
98a
99
98
60
59
55
53
57
54
56
58
52
49
148
36
36a
146
147
35
38
37
45
40a
51
39
40
42
44
41
43
46
141
142
144
64
72
78
75
71
65
63
69
90
89
91
40a'
82'
84'
86
80'
81'
83'

FIG. 3

FIG. 4

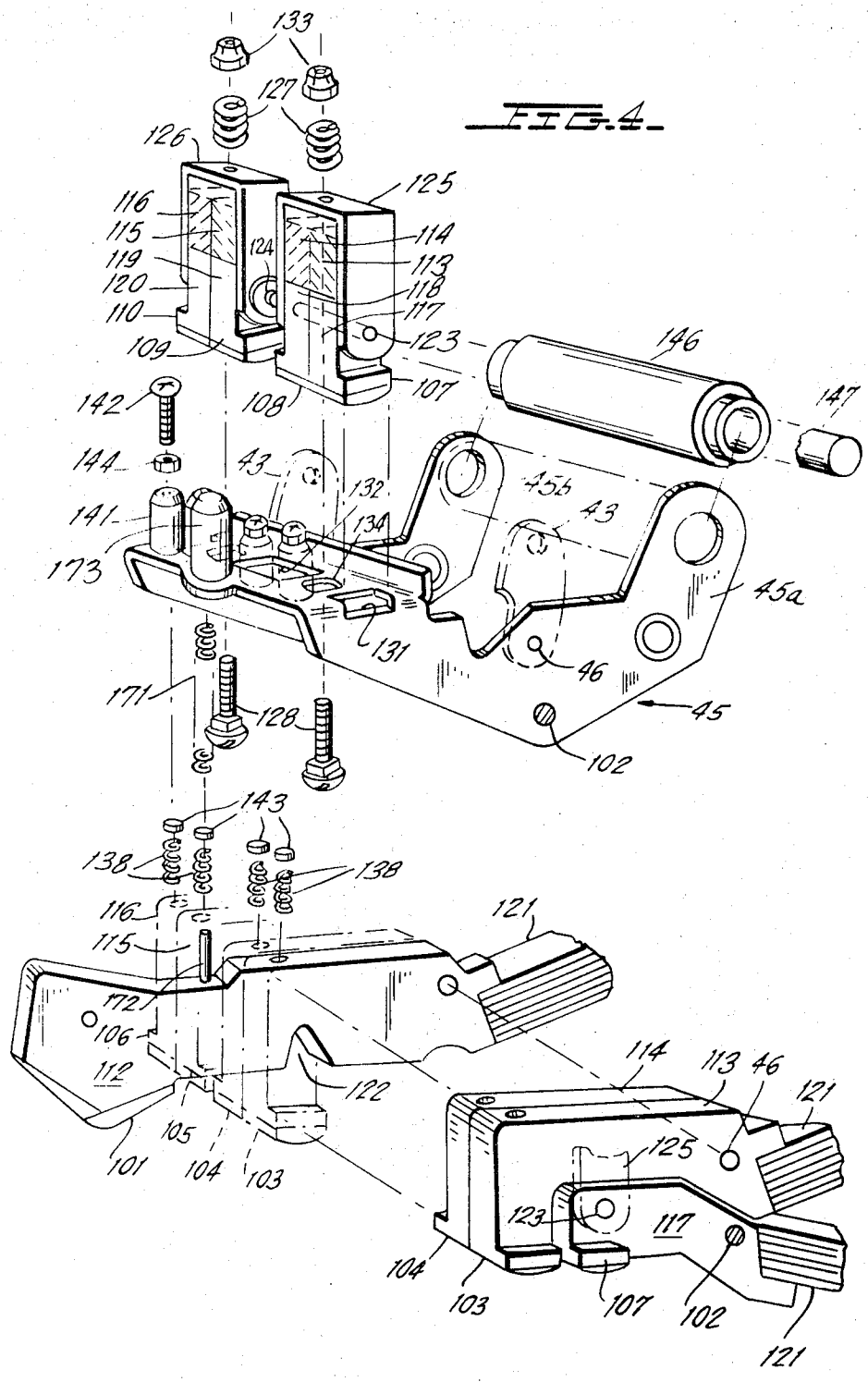

133
127
126
125
116
115
119
120
110
109
124
114
113
118
117
123
107
108
146
147
142
144
43
132
141
134
173
45a
131
46
45
171
128
102
143
138
116
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172
106
112
105
101
104
103
121
122
114
113
46
125
123
117
107
102

FIG. 10

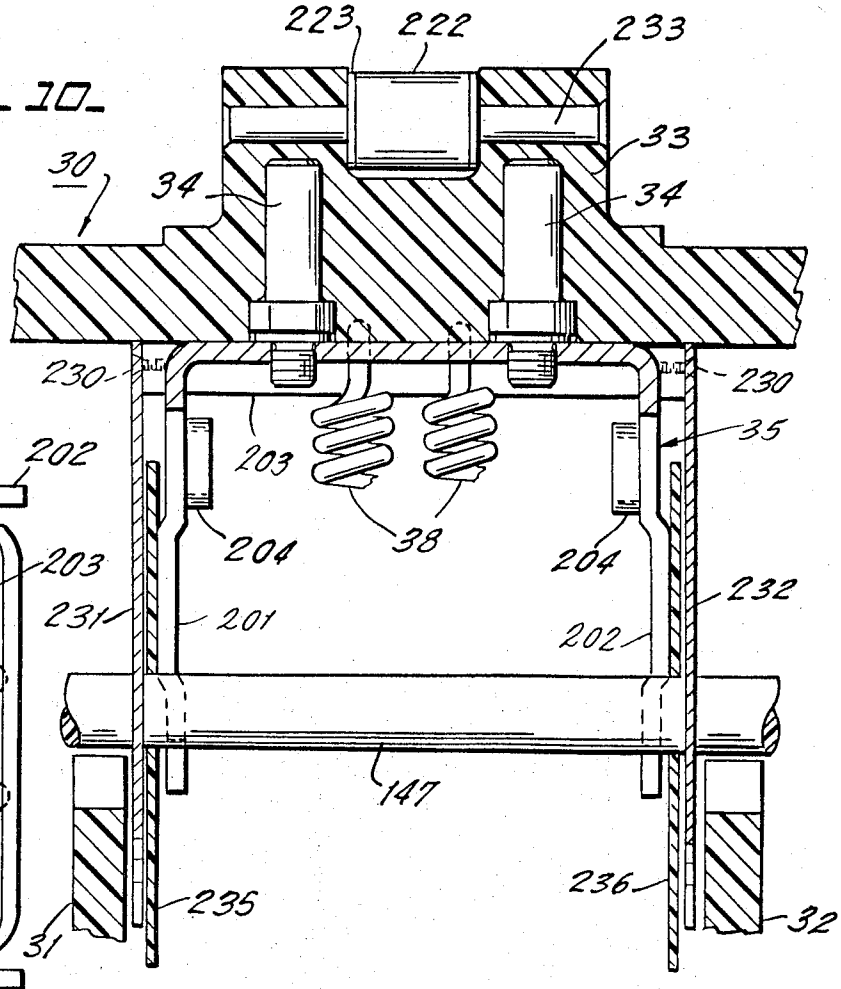


FIG. 6

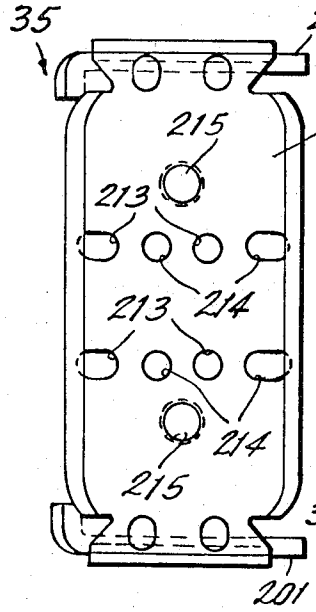


FIG. 5

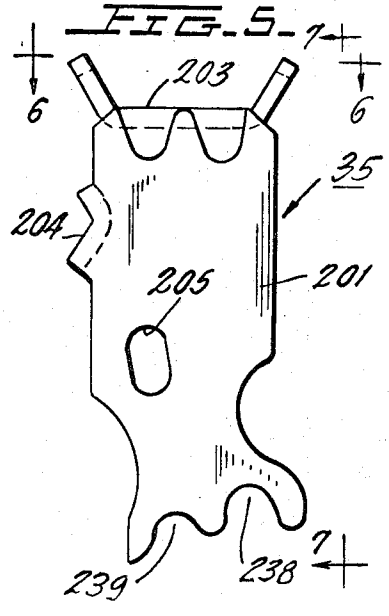


FIG. 7

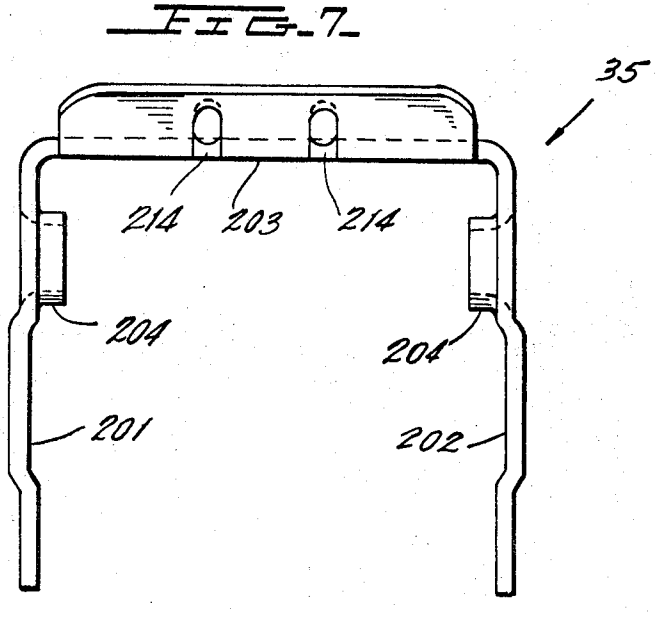


FIG. 8.

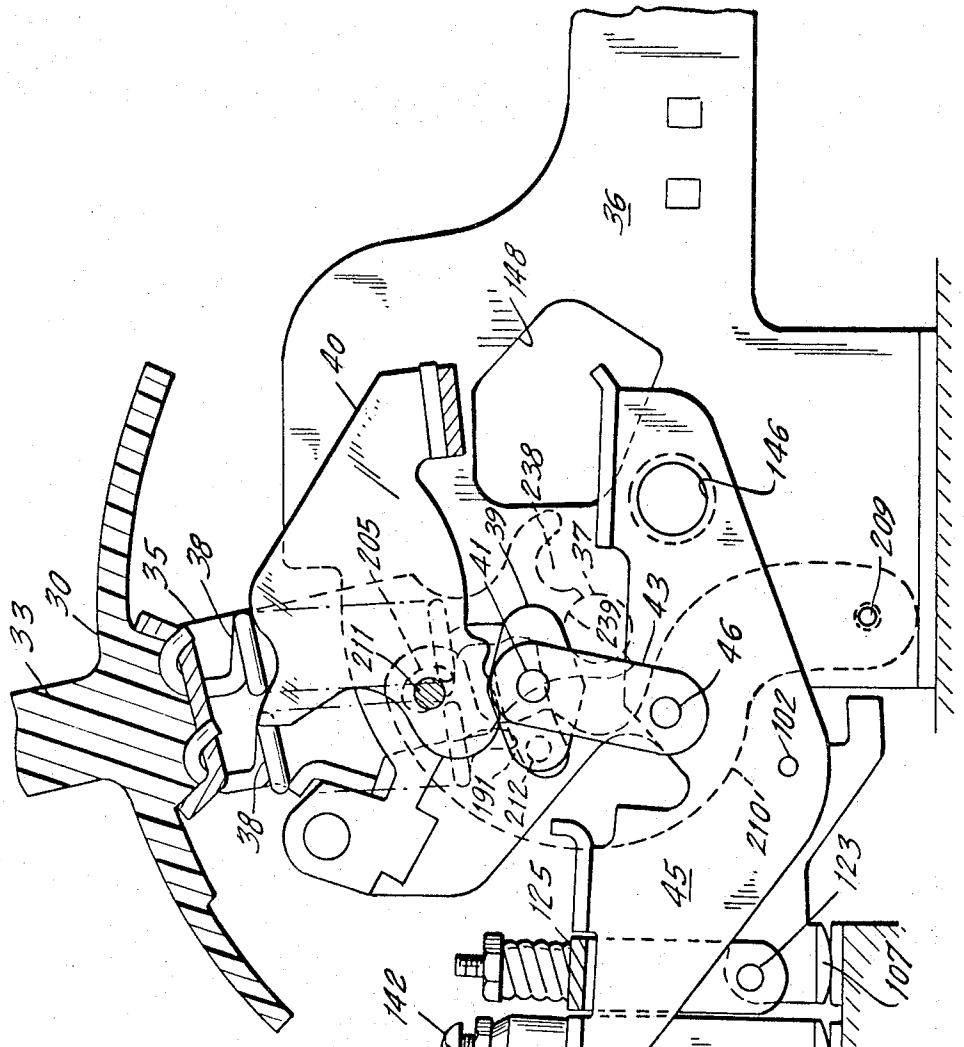
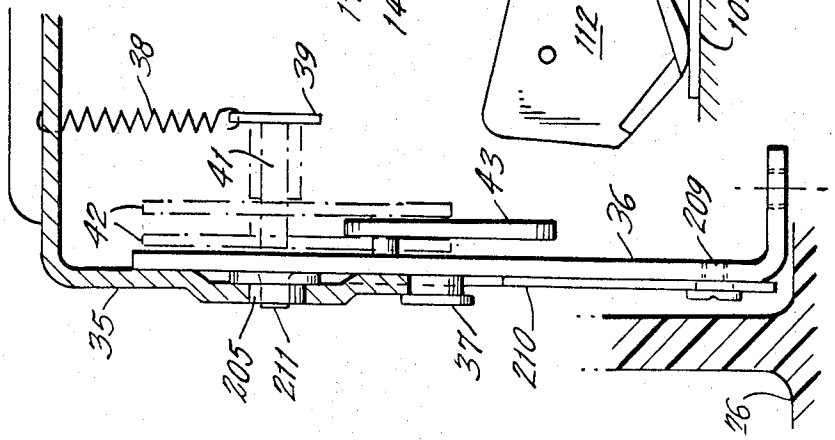

36
148
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146
238
209
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239
43
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FIG. 9.


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205
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371
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POSITIVE ON POSITION INDICATOR

This invention relates to circuit breakers having spring powered contact operating mechanisms and relates more particularly to circuit breakers of this type having novel means to prevent the circuit breaker handle from indicating an off condition unless the contacts are actually separated.

In many circuit breakers having over-center toggle type contact operating mechanisms, it is possible to move the handle to the off or open circuit position even though the contacts are closed because of welding or otherwise. This creates a dangerous condition because a serviceman will feel confident that the load-circuit being protected by the breaker is deenergized.

The prior art has sought to cope with this condition by constructing so-called visible break switches. In some cases inspection of the contacts of visible break switches requires the housing to be open. In other cases the housing may have a transparent part through which the contacts are visible, but this part soon becomes dirty so that view of the contacts becomes obstructed. In any event, the aforesaid prior art constructions require the servicemen to perform an extra procedure to determine whether the contacts are really open.

This invention provides a lever that positively prevents the handle from assuming its off position unless the contacts are open. In particular, this lever is connected between the operating member and frame of the contact operating member in such a manner that movement of the handle toward its off position moves the lever so that a projection thereon moves toward the knee of the mechanism toggle. The toggle will collapse only if the movable contact carrier moves to open circuit position.

Thus, if the contacts open, the toggle will collapse and will not block movement of the lever projection as the lever is moved by the handle as the latter moves toward its off position. However, if the contacts remain closed for any reason, the toggle cannot collapse and in the extended position thereof will block movement of the lever projection. This prevents movement of the lever which in turn prevents the handle from moving to its circuit open position.

Accordingly, a primary object of the instant invention is to provide novel means to prevent a circuit breaker handle from moving to its off position while the contacts remain closed.

Another object is to provide means of this type especially constructed for use with a spring powered overcenter toggle contact operating mechanism.

Still another object is to provide means of this type consisting of a lever whose movement is restrained by the toggle when extended and under such conditions the lever restrains movement of the operating handle to its open position.

These objects as well as other objects of this invention will become readily apparent after reading the following description of the accompanying drawings in which:

FIG. 1 is a plan view of a circuit breaker constructed in accordance with teachings of the instant invention.

FIG. 2 is a longitudinal cross-section taken through line 2—2 of FIG. 1, looking in the direction of arrows 2—2 and including a handle operating mechanism, not shown in FIG. 1.

FIG. 3 is an exploded perspective of one overcenter toggle mechanism and selected elements connected thereto.

FIG. 4 is an exploded perspective of the movable contact structure for one pole.

FIG. 5 is a side elevation of the spring supporting operating member of the contact operating mechanism.

FIGS. 6 and 7 are plan and side elevations respectively of the operating member of FIG. 5, looking in the directions of the respective arrows 6—6 and 7—7 of FIG. 5.

FIG. 8 is a side elevation of the contact operating mechanism for one pole with the near side of the frame removed.

FIG. 9 is an end view of one side of the mechanism frame showing mounting of a positive ON indicator lever and the position of the latter relative to elements of the mechanism that cooperate with this lever.

FIG. 10 is an enlarged fragmentary longitudinal cross-section of the handle showing its mounting to the operating member of the center pole.

Now referring to the figures. Three phase molded case circuit breaker 25 of FIGS. 1 and 2 includes an individual over-center spring-powered toggle operating mechanism. Prior art examples of circuit breakers having more than a single operating mechanism for all phases are disclosed in U. S. Pat. Nos. 2,067,935 and 3,125,653.

Circuit breaker 25 includes a molded housing constructed of base 26 and removable cover 27 joined along line 28 and provided with longitudinal internal partitions 31, 32 which divide housing 26, 27 into three longitudinally extending compartments, one for each phase of circuit breaker 25. Cover 27 is provided with aperture 29 through which stubby bifurcated extension 33 of operating handle means 30 extends. Each section of handle extension 33 receives an individual pin 34 extending upwardly from the web portion of inverted generally U-shaped operating yoke member 35 of the center phase. Operating members 35 of the outer phases are each secured to handle means 30 by a pair of screws 152.

Member 35 is pivoted to the spaced arms of generally U-shaped operating mechanism frame 36 at outwardly extending lugs 37. Bolts 48, received by threaded apertures of inturned edges 36a at the bottom of frame 36, fixedly secure the latter to base 26. Transverse tie member 49 is riveted to the arms of frame 36 to maintain spacing therebetween and to stabilize the frame structure.

Four-tensioned coil springs 38, each connected at one end thereof to the web of operating member 35, combine to constitute the main operating spring means for the overcenter toggle-type contact operating mechanism. The other ends of springs 38 are connected to spaced plates 39, 39 that are pivotally mounted to toggle knee pin 41 connecting upper 42 and lower 43 toggle links. The upper ends of upper toggle links 42 are pivotally connected to the spaced arms of latchable cradle 40 at pins 44, and the lower ends of lower toggle links 43 are pivotally connected to contact carrier 45 by rod 46 that extends between the spaced arms of contact carrier 45. The spaced arms of cradle 40 are positioned adjacent the inner surfaces of the spaced arms of frame 36 and are pivotally connected thereto by pins 47 that are secured to frame 36.

Under normal operating conditions plate **51**, secured to web **40a** of cradle **40**, is in engagement with forward latching surface **52** of auxiliary latch **53**. The latter is loosely mounted to pivot rod **55** extending between the spaced arm of mechanism frame **36** and slightly outboard thereof. The coiled end sections of torsion spring member **56** are wound about pivot rod **55**, with the ends of these sections bearing against rod **57** and auxiliary latch **53** to bias the latter counterclockwise against stop rod **58**. The ends of rods **57** and **58** are supported by the arms of frame **36**. Leaf spring **73** secured to auxiliary latch **53** bears against pivot rod **55** biasing latch **53**, so that rod **55** will normally lie at the central portion of V-shaped notch **74** of primary latch **53**.

The ends of rod **55** projecting outboard of mechanism frame **36** are engaged by the hooked portions at the forward extension **59** of the arms for U-shaped trip unit frame **60**, whose web portion is seated on a forward surface of load strap **61**, being secured thereto by bolts **62** that extend through clearance apertures in strap **61** and are received by threaded inserts molded in base **26**.

Rear latch tip **54** engages latch tip **63** at the U-shaped forward arm of primary latch **65**, whose rear latch tip **64** is engaged by latch plate **67** mounted on one leg of L-shaped carrier **66**. Primary latch **65** is pivotally mounted to trip unit frame **60** at stub shaft **69**, and the carrier is pivoted on rod **68** to frame **60**. Tension spring **75** biases primary latch **65** in a clockwise direction about pivot **69**. The other leg of carrier **66** is provided with transversely extending pin **71** that projects into triangular window **72** of primary latch **65** at a portion thereof near rear latch tip **64**, for a reason to be hereinafter explained. Tension spring **76**, connected between frame **60** and carrier extension **66***a*, biases carrier **66** in a counterclockwise direction about its pivot **68** toward latching position.

When automatic tripping occurs, carrier **66** in the faulted phase is moved clockwise either by the deflection of bimetal **77** or movement of magnetic armature **78**, causing latch plate **67** to release primary latch **65**, which in turn releases secondary latch **53** and permits main operating springs **38** to rotate cradle **40** in a counterclockwise direction to break toggle **42, 43**. The force from main spring **38** acts through cradle **40**, primary latch **53**, and secondary latch **65** to drive cam surface **78**, bounding opening **72**, against extension **71** to rotate carrier **66** clockwise, with surface **79** thereof engaging ear **81** of extension **82** on tripper bar **80** which extends between all three phases. This causes tripper bar **80** to rotate in a counterclockwise direction, so that extensions **82** in the non-faulted phases rotate counterclockwise with cam surfaces **83** thereof engaging transversely extending pin **84** of carriers **66** in the non-faulted phases, rotating them clockwise or in the tripping direction, to release the cradle latching systems in the non-faulted phases, so that the contacts of all three phases are open.

In order to prevent closing of the contacts of any one phase before the operating mechanisms of all phases are latched, circuit breaker **25** is provided with a defeater latching system including defeater latch **80'** and defeater lever **90**. Latch **80'** is pivotally mounted upon rod **55** and includes protrusion **81'** extending over the rear of cradle **40** when the latter is in latched position. Latch **80'** further includes protrusion **82'** extending over the forward end of defeater lever **90** in slot **91** thereof. Coiled tension spring **83'** is connected between stop rod **57** and latch **80'**, passing partially around rod **55**, to bias latch **80'** in a counterclockwise direction about its pivot **55** and maintaining this pivot in the basic position at the right end of slot **84'** in latch **80'**. This basic position is established through the engagement of latch stop surface **86** and stop rod **57**.

Slot **91** is in the web of the U-shaped forward portion of latch lever **90**, with the U arms having pivot pin **69** for lever **90** extending therethrough. Rear portion **89** of lever **90** is positioned below and in interfering relationship with transverse pin **71** mounted to latch plate carrier **66**.

During normal relatching of circuit breaker **25**, inwardly protruding portions of the operating member **35** arms engage outboard portions of pin **44** to pivot cradle **40** clockwise, whereby the latter cams defeater latch **80'** away and moves below auxiliary latch **53**. Upon release of the circuit breaker operating handle **30**, the elements of the latch train **53, 65, 66** move into place. However, should any of these elements fail to properly engage or should cradle **40** not have been moved far enough to engage auxiliary latch **53**, cradle **40** will pick up defeater latch protrusion **81'**, causing clockwise rotation of defeater latch **80'**. In turn, this causes defeater latch protrusion **82'** to engage defeater lever **90** and rotate the latter counterclockwise, with the rear end **89** thereof contacting carrier extension **71** so that latch plate carrier **66** is pivoted in a clockwise or latch train releasing direction. During this releasing movement of carrier **66**, surface **79** thereof engages nose **81** of one trip bar extension **82** to rotate common tripper bar **80** in a counterclockwise direction, with the other extensions **82** on bar **80** engaging pins **84** on the latch plate carriers **66** of the other poles, thereby causing the latch systems of all other poles to be released.

The lower end of bimetal **77** is fixedly secured to shading coil **99**, and these elements are fixedly secured to molded frame member **95** secured to trip unit frame **60**. The horizontal leg of inverted U-shaped stationary magnetic frame member **98** passes through the center of coil **99**. Member **98** is secured to the rear of frame **60**, with the vertical legs of member **98** being on opposite sides of load strap **61**. The other U-shaped magnetic frame member **96** is secured directly to load strap **61**, with the ends of the arms for frame members **96** and **98** confronting one another in spaced relationship. Thus, current flowing in load strap **61** generates flux in magnetic frame **96, 98** which induces current flow in shading coil **99** and thereby generates heat that is conducted to bimetal **77** for heating thereof. Coiled tension spring **97**, connected between armature **78** and an element mounted to the rear transverse part **60***a* of frame **60**, biases the former away from two spaced legs **98***a* extending upward from the horizontal leg of member **98**, and is drawn downward toward legs **98***a* when overload currents generate sufficient magnetic flux in magnetic frame **78, 96, 98**.

With particular reference to FIG. **4**, it is seen that the movable contact structure for each phase of circuit breaker **25** includes eight main contacts **103-110** and a single arcing contact **101**. The latter contact **101** is mounted at the forward end of arm **112**, which is pivotally mounted to carrier **45** at toggle connecting rod **46**. Main contacts **103–110** are arranged in two parallel rows positioned to the rear of arcing contact **101** and

disposed at right angles to the plane of movement of arcing contact arm **112**.

Main contacts **103–106** in the forward row are mounted to individual contact arms **113–116** respectively, all pivotally mounted to carrier **45** on rod **46**. Main contacts **107–110** in the rear row are mounted to the forward end of the respective contact arms **117–120**, respectively, pivotally mounted to carrier **45** on rod **102**. All of the contact arms **112–120** are connected to load strap **61** by means of individual stacks **121** of flexible sheet conductors. Contact arms **113–116** are in alignment with and extend over the respective contact arms **117–120**, so that the latter group of arms **117–120** block downward movement of the former group of arms **113–116** to establish the open circuit position of contacts **103–106** in a manner which will hereinafter be seen. The open circuit position for arcing contact arm **112** is established through engagement thereof with aligned pins **123, 124** which mount the respective pairs of main contacts **117, 118** and **119, 120** to auxiliary carriers **125, 126** respectively. Notch **122** along the lower edge of arcing contact arm **112** provides clearance for pins **123, 124**.

Auxiliary carrier **125** is an inverted U-shaped member whose arms extend downwardly through cutouts **131, 132** in the web portion of contact carrier **45** and straddle four contact arms **113, 114, 117, 118**. Pin **123** secures contacts **117, 118** to the lower ends of the arms comprising auxiliary carrier **125**. The web of auxiliary carrier **125** is biased towards the web of contact carrier **45** by coiled compression spring **127**, which is wound around the threaded body of bolt **128** whose head is positioned below the web portions of contact carrier **45**. Self-locking nut **133** mounted to bolt **128** is rotated to adjust the loading of spring **127**, with the rectangular shoulder of bolt **128** cooperating with rectangular cutout in carrier **45** to prevent rotation of bolt **128**. Thus it is seen that in the open circuit position, spring **127** biases the web of auxiliary contact carrier **125** against the web of contact carrier **45**, and when the contacts are closed there is a space between the webs of these contact carriers **45, 125**, so that the force exerted by spring **127** acts to bias contacts **107, 108** into firm electrical engagement with their respective cooperating contact portions on line strap **136**.

The mounting of contact arms **119, 120** to auxiliary contact carrier **126** and mounting of the latter to contact carrier **45** is the same as the mounting of contact arms **117, 118** and auxiliary carrier **125**, so that this description will not be repeated.

Biasing forces for each of the contacts **103–106** in the forward row are provided by individual coiled compression springs **138**, and each of these springs is mounted in the same way so that only the mounting of one of these springs will be described. The lower end of spring **138** extends into depression **139** in the upper surface of main contact arm **113**, and the rear of spring **138** extends into tubular support **141** through the open bottom thereof. Support **141** is mounted to the upper surface of carrier **45** at the web portion thereof, and its upper end is threaded to receive adjusting screw **142** whose lower end bears against disc **143** abutting the upper end of spring **138**. If screw **142** is adjusted to set the contact pressure exerted by spring **138**, lock nut **144** is tightened to lock this adjustment.

In order to increase the area of engagement between main contacts **103–110** and their respective cooperating stationary main contacts in the very limited space available, it is noted that each of the main contacts is provided with a portion extending outward of its respective contact arm. That is, in order to utilize the space below arcing contact **112**, main contacts **104, 105, 108, 109** have been extended beyond their respective contact arms **114, 115, 118, 119** to project below arcing contact arm **112**. Similarly, main contacts **103, 106, 107, 110** have been extended outboard from their respective contact arms **113, 116, 117, 120**, to lie in the space below the outboard arms of auxiliary contact carrier **125, 126** and other elements used to connect the movable contact structure to the contact operating mechanism.

The forward end of arcing contact arm **112** is biased downward away from the web portion of contact carrier **45** by coiled compression spring **171** whose lower end is positioned by pin **172** extending upward from arm **112**. The upper end of spring **171** extends into tubular member **173**, on the upper surface of the carrier **45** web portion, through the bottom of member **173** and abuts the closed upper end thereof.

The spaced arms of contact carrier **45** are provided with rearward extensions **45*a***, **45*b*** that are spaced by and secured to shouldered cylindrical tube **146**. After all contact structures, operating mechanisms, latching devices, and automatic trip units are mounted to base **26**, and all adjustments to these mechanisms have been made, the contact structures of all phases are operated to the closed circuit position, so that the tubular members **146** of all phases are axially aligned and are positioned above barriers **31, 32** and the longitudinal sides of base **26**. Thereafter, cylindrical tie bar **147** is driven longitudinally in the members **146** of all phases to constitute a rigid mechanical connection between the movable contact structures of all phases. The fit between tie rod **147** and tubular members **146** is tight enough to prevent unintentional axial movement of tie rod **147**, yet permits tie rod **147** to be removed for convenient servicing and replacement of parts. Mechanism frame **36** is provided with aligned elongated slots **148** to provide clearances for movement of rod **147** during opening and closing of the movable contact structures.

The construction of operating member **35** is best seen by reference to FIGS. **5-9**. In particular, inverted U-shaped operating member **35** includes spaced arms **201, 202** connected at their upper ends by web **203**. Each arm is provided with an inwardly extending cradle engaging resetting protrusion **204**, and an elongated slot **205** which receives outwardly extending pin **211** at the upper end of an individual S-shaped lever **210** which, as will hereinafter be described, functions as the key element of a positive ON indicating means. Web **203** is provided with four pairs of apertures **213, 214** through which the upper ends of springs **38** are hooked. Threaded apertures **215** in web **203** receive the threaded ends of shoulder pins **34** (FIG. **10**) in the case of the center pole mechanism, and for the outer poles threaded apertures **215** receive fastening bolts **152**.

The lower or free end of each arm **201, 202** is provided with a pair of arcuate bearing notches **238, 239**. During assembly of the contact operating mechanism, frame supported bearing studs **37** are received by bearing notches **238**, and in this position of operating member **35** springs **38** are substantially relaxed, thereby permitting the mechanism elements to be moved readily to positions where they may be assembled conveniently.

After the mechanism elements are assembled, operating member 35 is moved to a new position wherein bearing studs 37 are received by arcuate notches 239. This repositioning of operating member 35 fully loads springs 38 for contact operation and contact pressure. This increase in spring pressure results from the fact that the distance between web 203, and operating bearing notch 239 is greater than the distance between assembly bearing notch 238 and spring supporting web 203, so that the repositioning of operating member 35 moves the upper ends of main spring sections 38 away from the lower ends thereof which are secured to members 39 pivotally mounted on toggle knee. Each S-shaped lever 210 is pivotally mounted to a pin 209 extending outward from the side of mechanism frame 36 (See FIGS. 8 and 9). At a point between pivot 209 and pin 211, lever 210 is provided with pin means 212 extending inwardly through a clearance aperture 191 in frame 36 to cooperate with lower toggle link 43 and prevent operating member 35, and handle 30 secured thereto, from moving to a contact open position unless the contacts are actually open.

More particularly, when handle 30 is moved in a clockwise direction with respect to FIG. 8 to open circuit breaker 25, acting through pin 211 in slot 205, operating member 35 moves lever 210 clockwise about pivot 209. This moves pin 212 on lever 210 toward knee 41 of toggle 42, 43. However, unless toggle 42, 43 collapses, and this may only occur when contact carrier 45 moves to open circuit position, lower toggle link 43 blocks movement of pin 212 so that pin 211 prevents handle 30 from pivoting clockwise to open circuit position. In the event there is a minor malfunction of the contact operating mechanism causing carrier 45 to stick in contact closed position, the engagement of pin 212 with link 43 may collapse toggle 42, 43 to bring about contact opening.

The constructions and functions of insulating disks 235, 236 (FIG. 10) mounted on movable contact tie bar 147, and barrier sheets 231, 232 mounted to handle 30 by screws 230 are described in one or more of the copending applications referred to in the following paragraph of this application. Similarly, the constructions and functions of roller 222 and washers 223 all mounted to handle extension 33 by roll pin 233 are described in one or more of the aforesaid copending applications.

For those features of construction in circuit breaker 25 that have not been described in detail herein, reference is made to one or more of the copending applications Ser. Nos. 275,568, 275,577, 275,446, 275,578, 275,507, 275,454, 275,508, 275,621, 275,623, 275,624, 275,569, 275,522, 275,521, and 275,523, all filed of even date herewith, and all assigned to the assignee of the instant invention.

Although there has been described a preferred embodiment of this novel invention, many variations and modifications will now become apparent to those skilled in the art. Therefore, this invention is to be limited not by the specific disclosure herein but only by the appending claims.

The embodiments of the invention in which an exclusive privilege or property is claimed are defined as follows:

1. A circuit breaker including cooperating contact means, an overcenter toggle mechanism for moving said contact means between open and closed positions, and a handle operable between circuit breaker ON and OFF positions corresponding to the respective open and closed positions of said contact means; said mechanism including toggle means operatively connected to said contact means, main spring means operatively connected to said toggle means to furnish opening and closing forces for said contact means, and an operating member connected to said handle and movable therewith to change the relative positions of the line of action of said means and the knee of said toggle means for driving the toggle means overcenter thereby opening and closing said contact means; pivoted lever means connected to said operating member and having a part cooperating with said toggle means to block movement of said lever means in a first direction until said toggle means is collapsed in a contact means opening direction; with movement of said lever means in a first direction being blocked by said toggle means, said lever means acting through said operating member restraining said handle from moving to its said OFF position; said mechanism also including a frame; one end of said lever means being pivotally mounted to fixed pivot means on said frame with the other end of said lever means being connected to said operating member so as to normally be movable thereby; said part of said lever means cooperating with said toggle means being disposed between said fixed pivot means and the connection between said lever means and said operating member.

2. A circuit breaker as set forth in claim 1 in which one end of the main spring means is connected to the operating member and the other end thereof is connected to the knee of the toggle means; said operating member being mounted to said frame on another fixed pivot means.

3. A circuit breaker as set forth in claim 1 in which the frame includes spaced side walls between which said toggle means is disposed; said lever means including first and second levers disposed adjacent to and movable parallel to the respective side walls.

4. A circuit breaker as set forth in claim 3 in which the operating member is generally of inverted U-shape having first and second arms connected at their upper ends by a web to which the main spring means is connected; said arms at their lower ends being mounted to the respective side walls on another fixed pivot means.

5. A circuit breaker as set forth in claim 4 in which the first and second levers are connected to the respective first and second arms.

6. A circuit breaker as set forth in claim 5 in which individual cooperating pin-slot means connect the levers to the respective arms.

7. A circuit breaker as set forth in claim 6 in which the levers are disposed outboard of said side walls and the side walls are disposed between the arms of the operating member.

8. A circuit breaker as set forth in claim 7 in which the ends of said levers connected to the arms of the operating member are interposed between said arms and the side walls of the frame.

9. A circuit breaker as set forth in claim 8 in which the connection between each of the first and second levers and the respective first and second arms includes a pin extending outward from the lever into a slot in the arm.

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