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Strobel

[11] **3,742,401**

[45] **June 26, 1973**

[54] **MULTI-POLE LATCH SYSTEM HAVING MEANS TO DEFEAT SINGLE POLE LATCHING**

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[73] Assignee: **ITE Imperial Corporation,** Philadelphia, Pa.

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[52] **U.S. Cl.** **335/9,** 335/21, 335/166, 335/167

[51] **Int. Cl.** **H01h 73/02**

[58] **Field of Search** 335/8, 9, 10, 21, 335/166, 169, 170, 167, 25

[56] **References Cited**

UNITED STATES PATENTS

3,460,075	8/1969	Yorgin et al.	335/9
3,614,685	10/1971	Ellsworth et al.	335/166

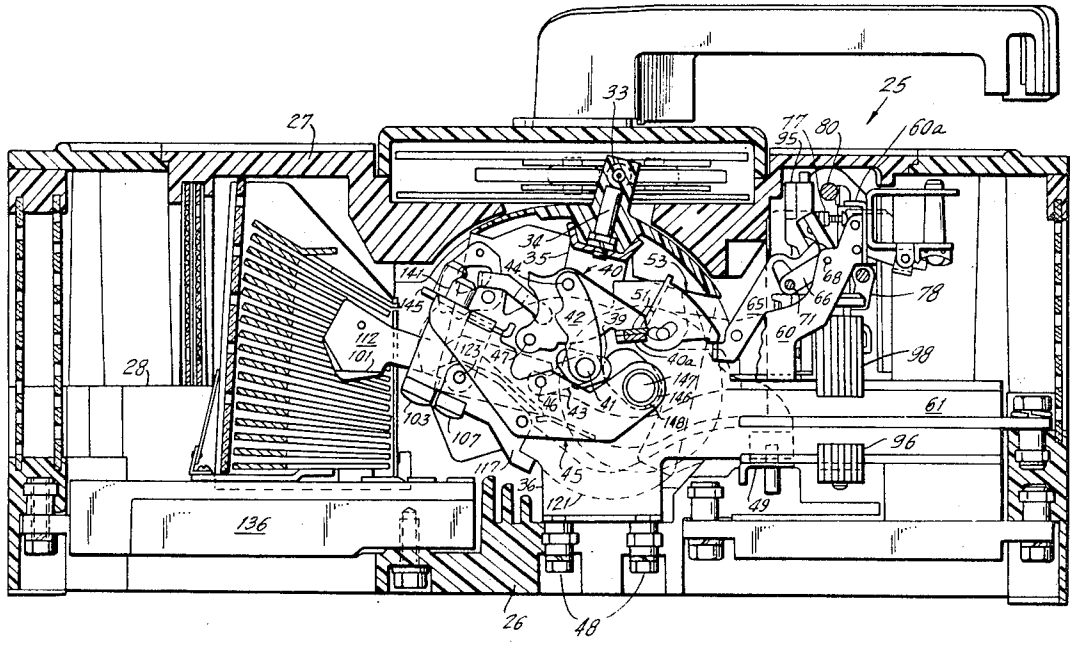
Primary Examiner—Harold Broome

Attorney—Sidney G. Faber, Bernard Gerb et al.

[57] **ABSTRACT**

A multi-pole circuit breaker having an individual spring powered overcenter toggle operating mechanism with a releasable cradle is provided with a defeater means, independent of the cradle latches, to prevent closing of the contact mechanism until such time as the cradles of all operating mechanisms are latched.

8 Claims, 7 Drawing Figures



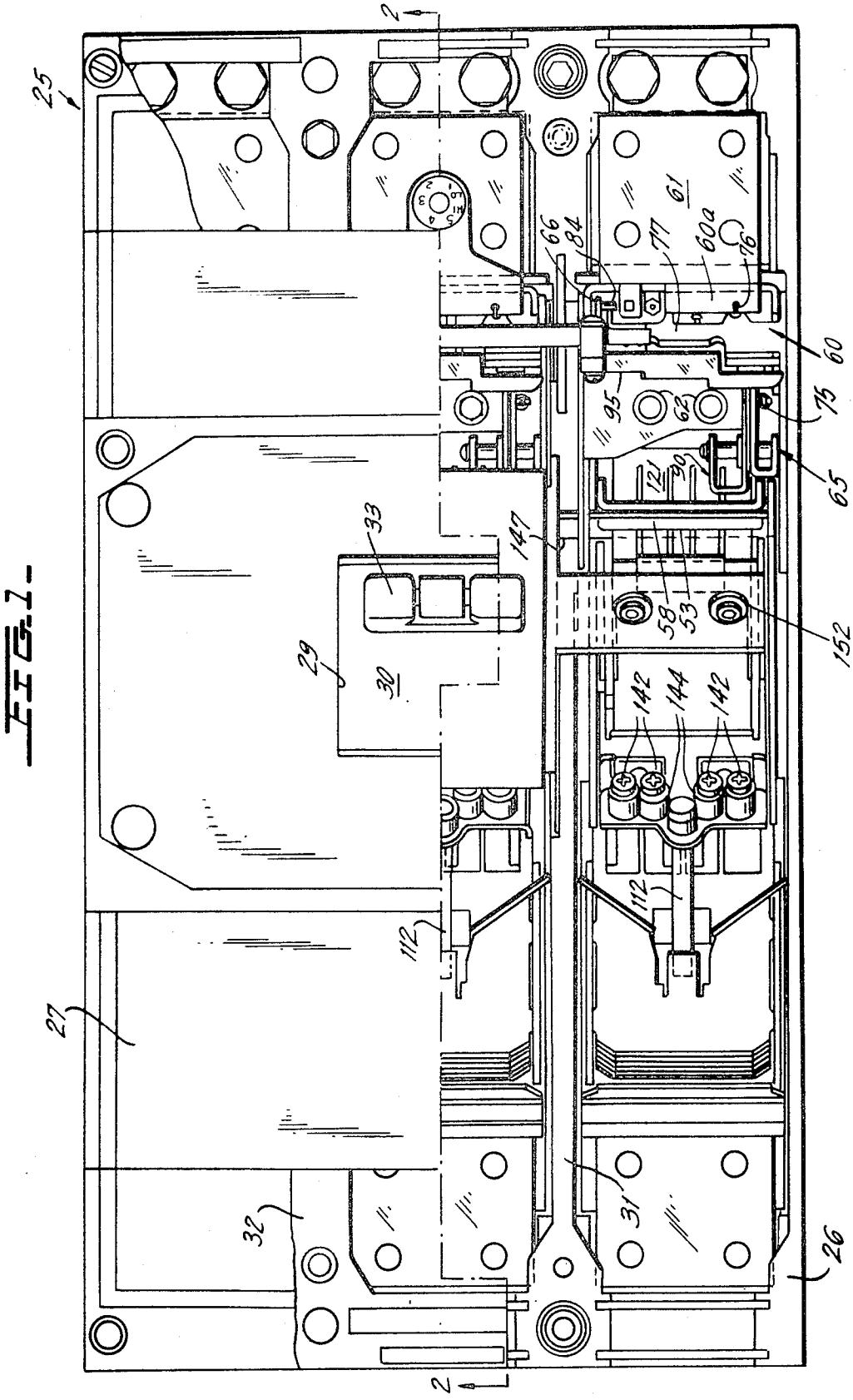

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FIG. 1.

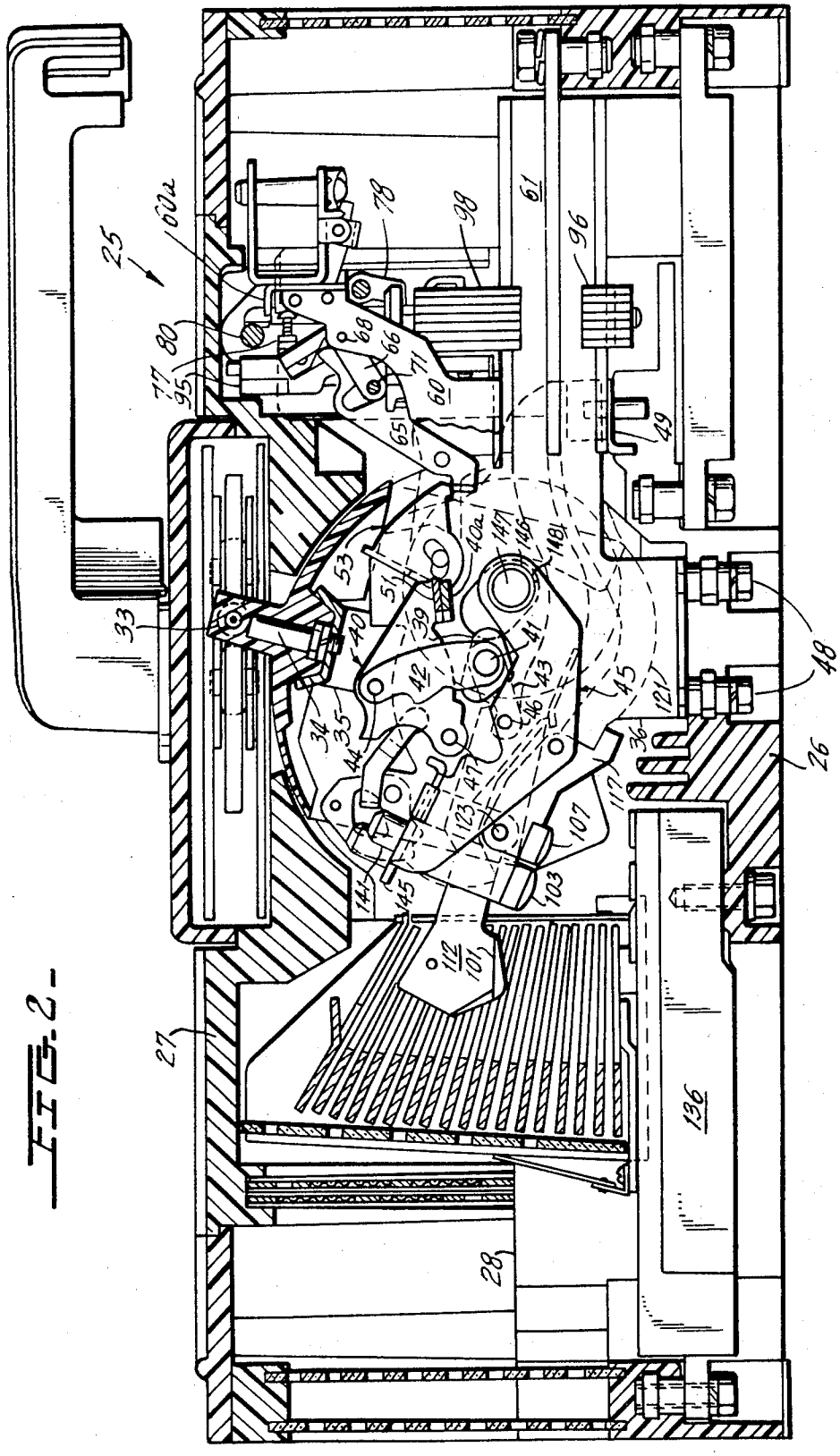

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FIG. 2.

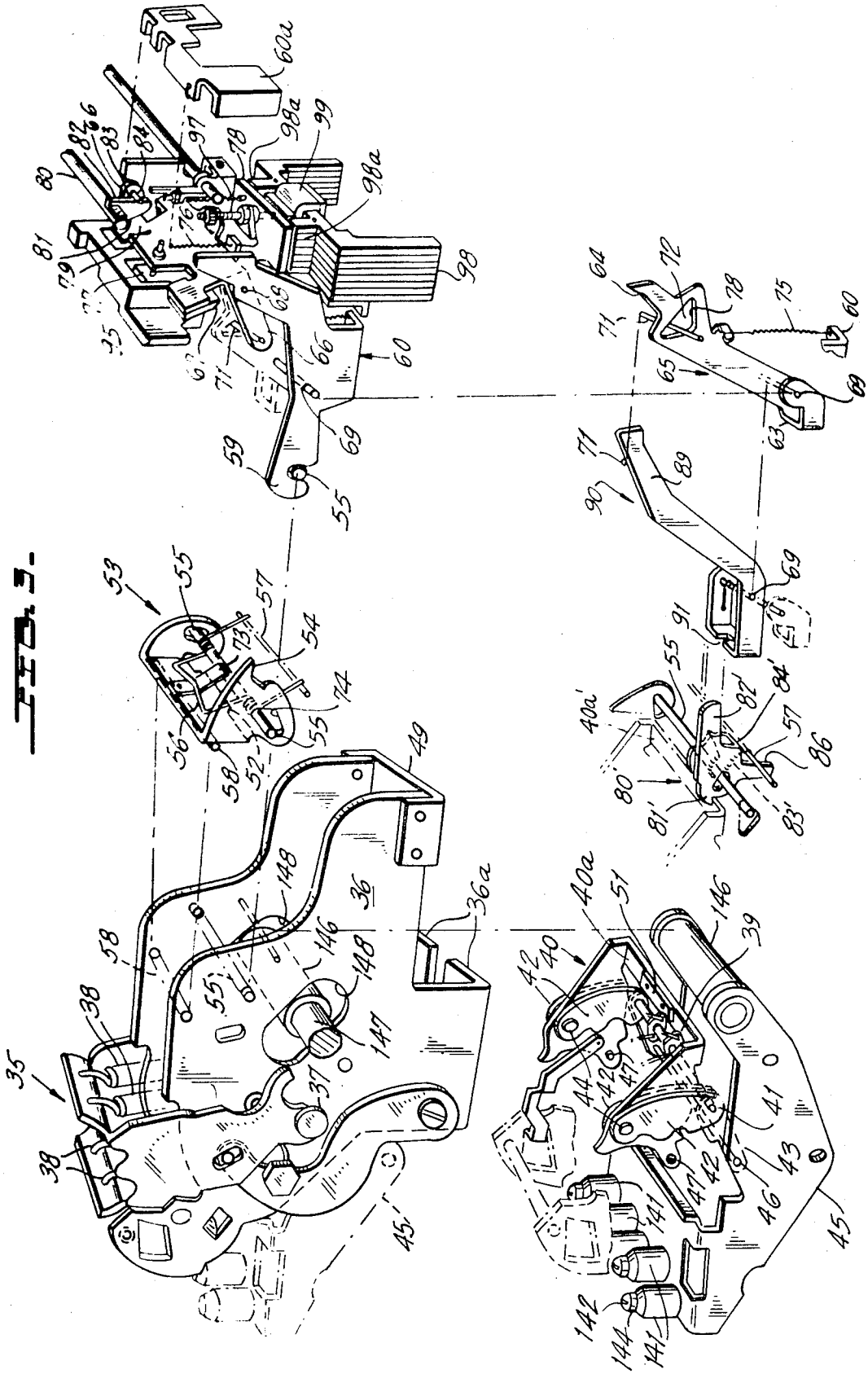
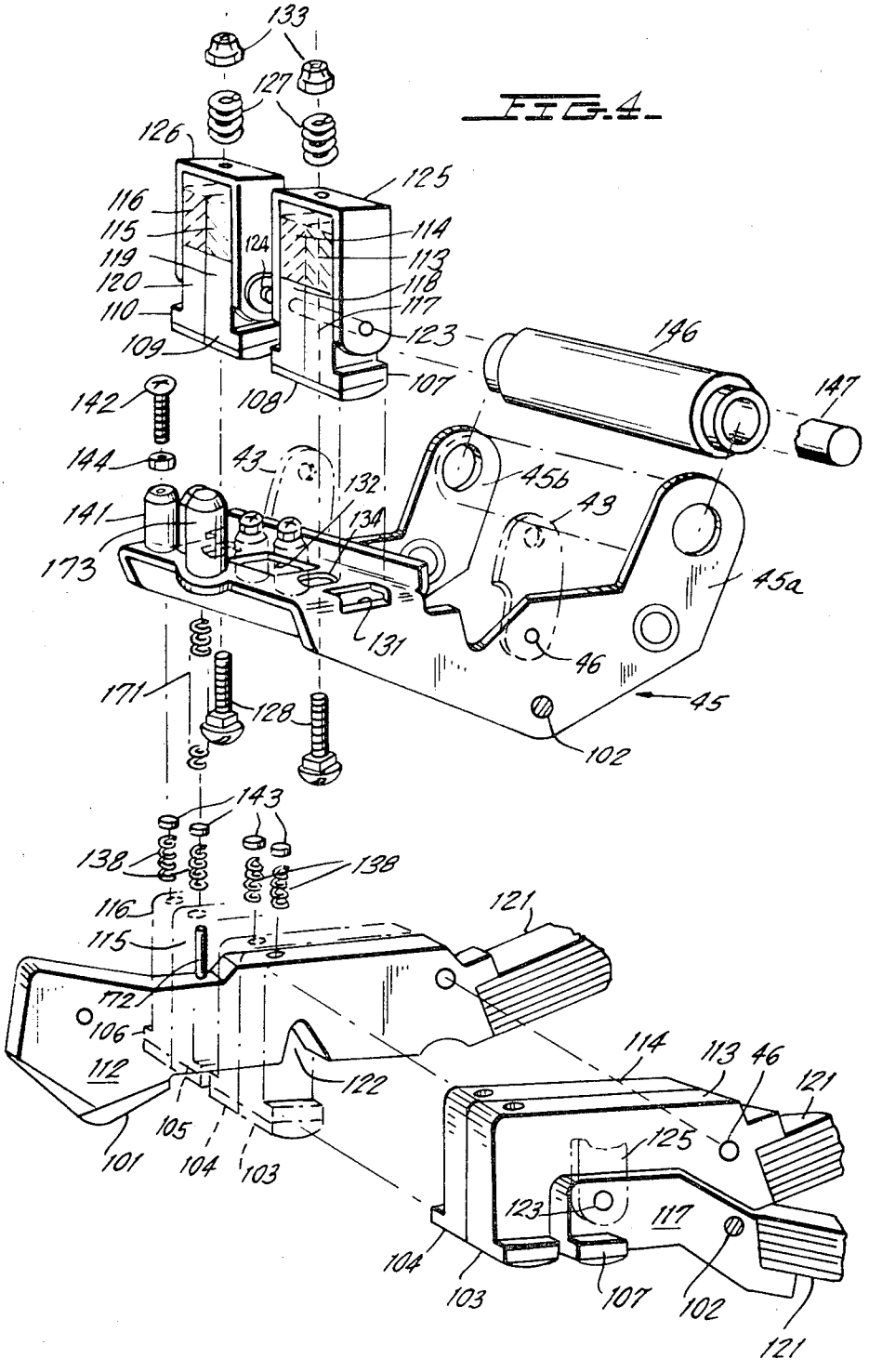


FIG. 3.

FIG. 4


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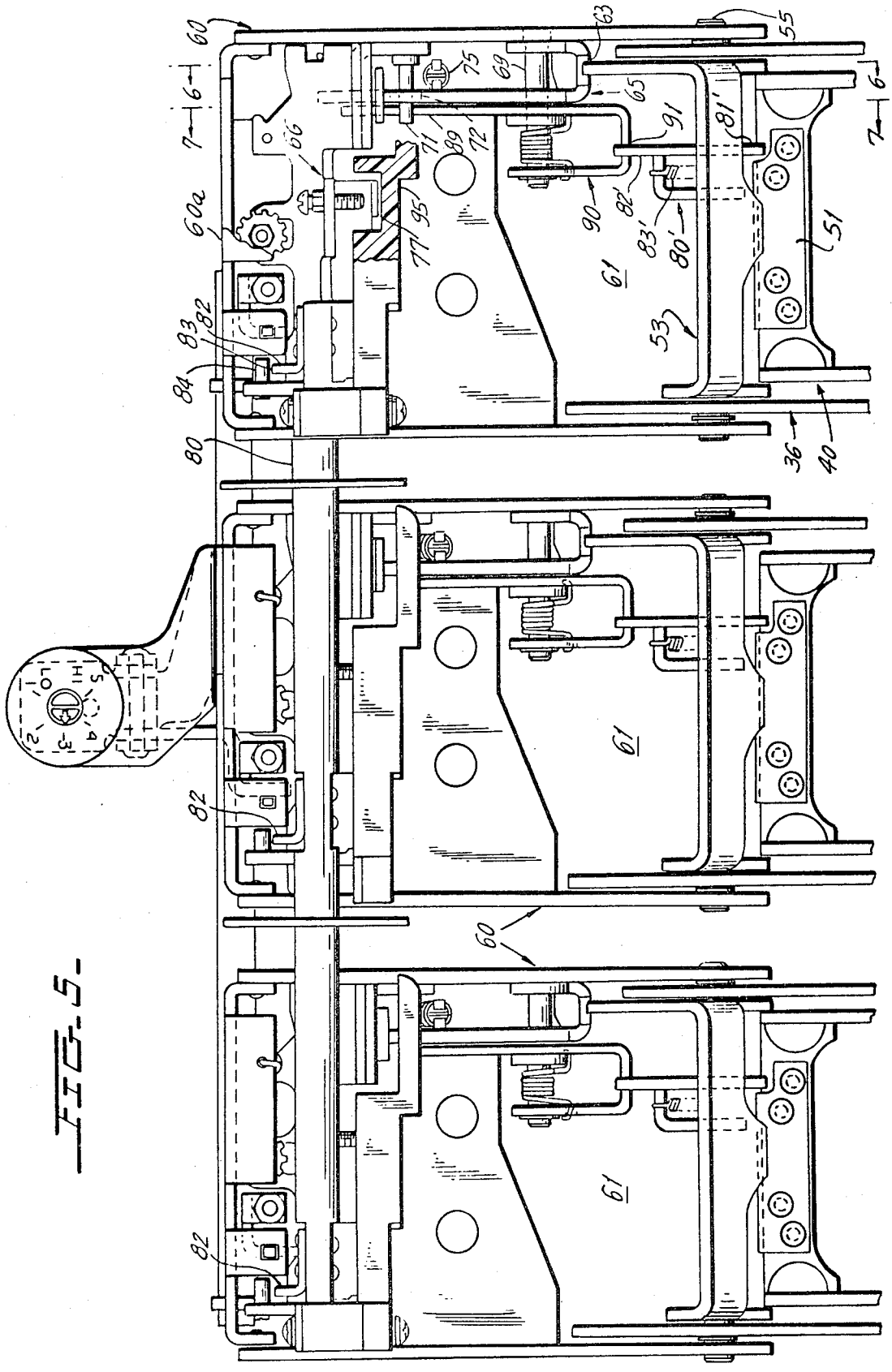

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FIG. 5.

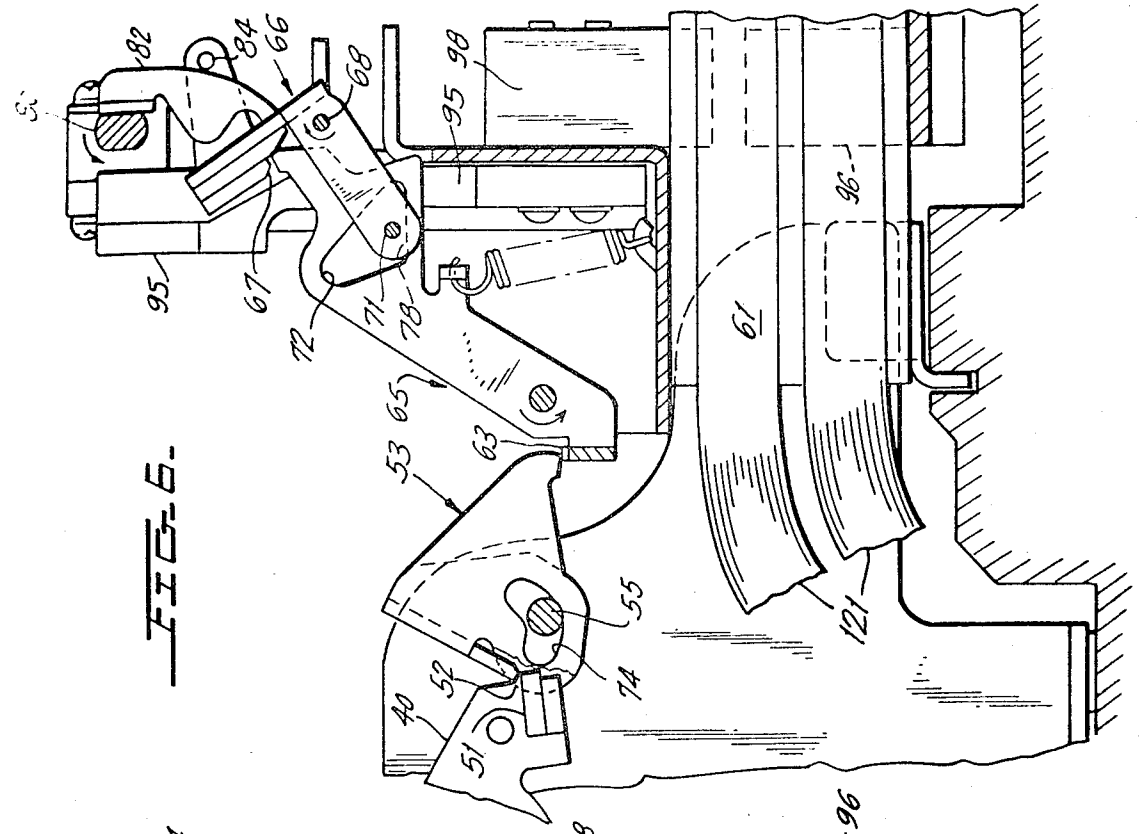

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FIG. 6.

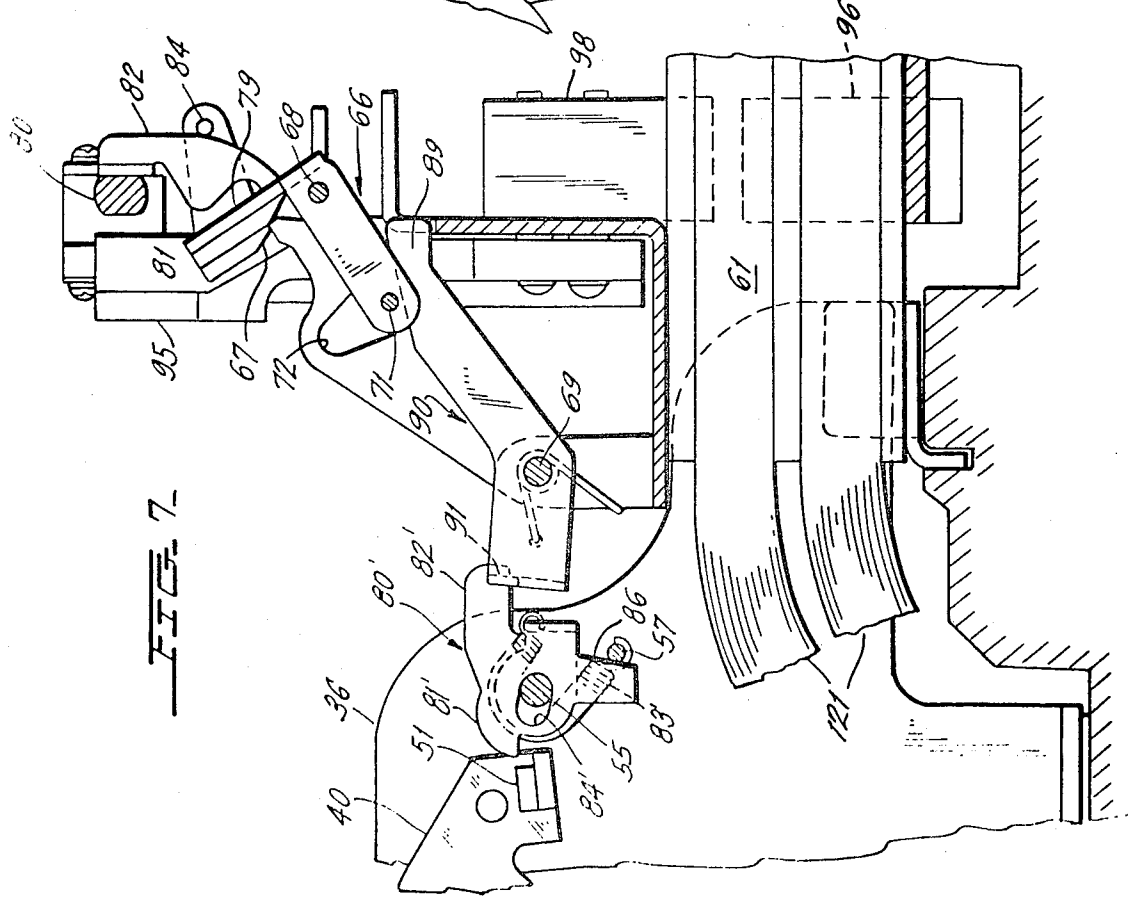

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FIG. 7.

MULTI-POLE LATCH SYSTEM HAVING MEANS TO DEFEAT SINGLE POLE LATCHING

This invention relates to multi-pole molded case circuit breakers having very high continuous current ratings, and more particularly relates to a circuit breaker of this type having individual contact operating mechanisms for each pole and a system to prevent contact closing prior to latching of all the operating mechanisms.

For the most part, a multi-pole molded case circuit breaker is provided with a single operating mechanism which operates the contact structures of all poles simultaneously. This contact operating mechanism includes a latch member which extends into an overload sensing unit where the latch member is locked against a latch plate on a tripper bar that extends into all poles of the circuit breaker. Magnetic and/or thermal actuated devices in each pole may independently pivot the tripper bar responsive to predetermined overload conditions and upon pivoting of the tripper bar the latch of the operating mechanism becomes disengaged and the contacts of all poles open simultaneously.

When continuous current carrying capability of a compact circuit breaker becomes very high, it may become necessary to use more than one contact operating mechanism to generate sufficient forces for adequate contact pressure and contact operation. Even though multi-pole operating mechanism circuit breakers may be provided with means to assure simultaneous tripping of all poles in the event a fault condition develops in any of the poles, because of some malfunction in one of the mechanisms, or because of misalignment or adverse accumulation of tolerances, when the mechanisms are being reset the releasable cradle of one of these mechanisms may not engage its latch even though the cradles in the other mechanisms engage their respective latches. If this condition should occur, closing motion of the circuit breaker handle will result in the closing of the contacts only in those poles having latched cradles.

Under these conditions the movable contact of the pole that has not relatched will move towards its closed position, since the movable contact carriers of all poles are connected by a tie bar. However, the movable contacts of the pole without a latched cradle may or may not engage the stationary contacts in this pole, depending on the rigidity of the tie bar and the movable contact structures. In fact, the unlatched mechanism will exert substantial forces which oppose closing of the contacts in the unlatched pole. Therefore, at best, contacts in the unlatched pole may appear to be closed properly, but they will not have the necessary contact pressure to carry current without overheating. More likely, the contacts in the unlatched pole will be slightly open, so that arcing may occur on a continuous or intermittent basis.

Accordingly, a primary object of the instant invention is to provide a novel defeater means to prevent contact closing of a multiple mechanism type circuit breaker unless the cradles of all mechanisms are latched.

Another object is to provide a defeater means of this type that is independent of the primary latch system for the contact operating mechanism.

Still another object is to provide a defeater means of this type in which part tolerances as well as alignment of parts from pole to pole are not critical.

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 phase.

FIG. 5 is an enlarged plan view showing a fragmentary portion of the circuit breaker operating mechanisms including elements of the interpole trip system and system to prevent contact closing prior to latching of all operating mechanisms.

FIG. 6 is a cross-section taken through line 6—6 of FIG. 5 looking in the direction of arrows 6—6, showing the elements of the interpole trip system with other elements eliminated for the sake of brevity.

FIG. 7 is a cross-section taken through lines 7—7 of FIG. 5 looking in the direction of arrows 7—7, showing the elements of the system to prevent contact closing prior to latching the contact operating mechanisms of all poles, eliminated for the sake of brevity.

Now referring to the figures. Three phase molded case circuit breaker 25 of FIGS. 1 and 2 includes an individual overcenter 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 spirngs 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 40*a* 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 50 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 memeber 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 phases 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 downwardly 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, 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.

It is noted that because of high magnitude current flow in circuit breaker 25, the magnetic fields generated are very strong. In order to reduce adverse effects of these magnetic fields, many of the frame parts and operating mechanism parts are constructed of nonmagnetic stainless steel.

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; 275,466; 275,578; 275,507; 275,454; 275,508; 275,621; 275,624; 275,569; 275,522; 275,521; 275,523; and 275,622, 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 lim-

ited 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 multi-pole circuit breaker including first, second, and third mechanisms, each comprising associated contact operating means, latch means and overload trip means; said operating means including a main spring means to provide contact operating power and contact pressure, and a latchable cradle movable by said spring means from a normally latched position wherein said operating means is effective for contact closing to a tripped position wherein said operating means is ineffective for contact closing when said cradle is released; said latch means including a latch unit normally maintaining the cradle of its associated operating means in its said latched position; said overload trip means when subjected to predetermined current overload conditions operating its associated latch means to release the cradle of its associated operating mechanism; common trip bar means for operating and for being operated by said latch units; each of said latch units being connected to the cradle of its associated operating means such that after releasing the last recited cradle the force of its associated spring means is transmitted through this last recited cradle and its associated latch unit to operate said trip bar means which in turn operates the other latch units to release their associated cradles; each of said mechanisms also including link means to prevent contact closing if all of the cradles are not in their said latched positions; said link means extending between the cradle and the latch unit of its associated mechanism; each of said link means being operatively positioned for actuation by the spring means of its associated mechanism acting through its associated cradle after an unsuccessful attempt has been made to latch its associated cradle; each of said link means upon actuation thereof operating its associated latch unit which in turn operates said trip bar means to operate the other latch units to release their associated cradles.

2. A circuit breaker as set forth in claim 1 in which the link means of each of said mechanisms comprises a first and second cooperatively engaging link pivotally mounted on laterally spaced parallel axes, with the axis for said first link being closer to said trip unit than the axis for said second link; said trip bar means extending parallel to and being pivotable about another axis parallel to said parallel axes.

3. A circuit breaker as set forth in claim 2 in which the latch means of each of said mechanisms includes an individual latch train interposed between the cradle and the latch unit thereof.

4. A circuit breaker as set forth in claim 3 in which each of said latch trains includes cooperatively engaging primary and auxiliary latches mounted on laterally spaced axes parallel to the axis for the trip bar means.

5. A circuit breaker as set forth in claim 4 in which for each of said mechanism the first link and the primary latch are mounted on a common axis.

6. A circuit breaker as set forth in claim 4 in which for each of said mechanisms the second link and the auxiliary latch are mounted on a common axis.

7. A circuit breaker as set forth in claim 6 in which for each of said mechanism the first link and the primary latch are mounted on another common axis.

8. A circuit breaker as set forth in claim 1 also including individual separable contact means connected for operation to open and closed positions directly by the operating means of the respective associated operating means; a transverse tie bar mechanically interconnecting said separable contact means of all of said mechanisms.

* * * * *