

Feb. 18, 1958

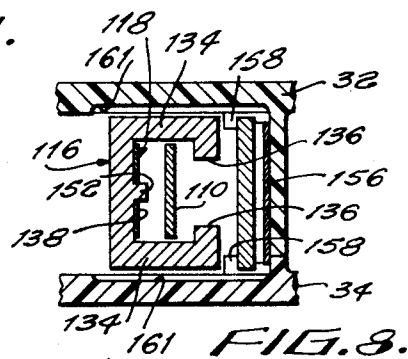
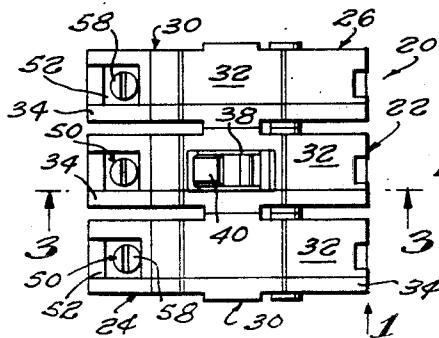
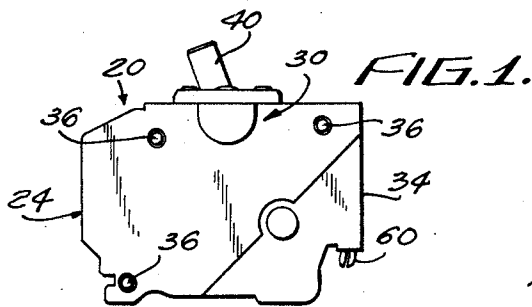
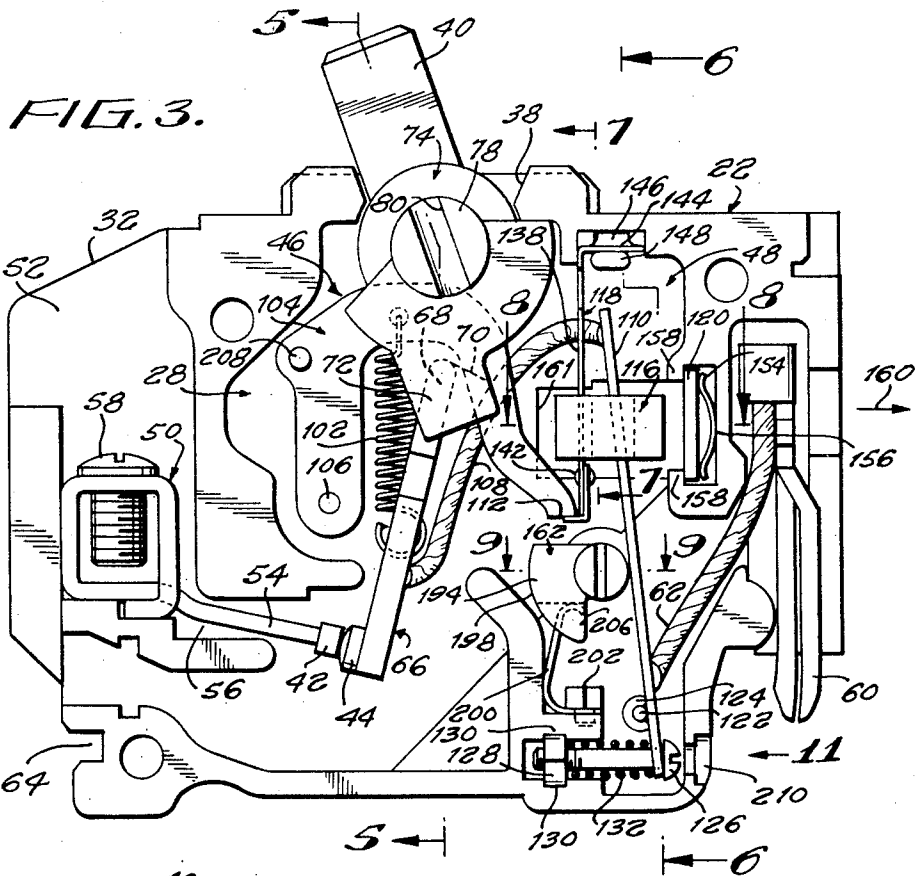
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2,824,191

CIRCUIT BREAKERS

Filed Feb. 5, 1953

4 Sheets-Sheet 1



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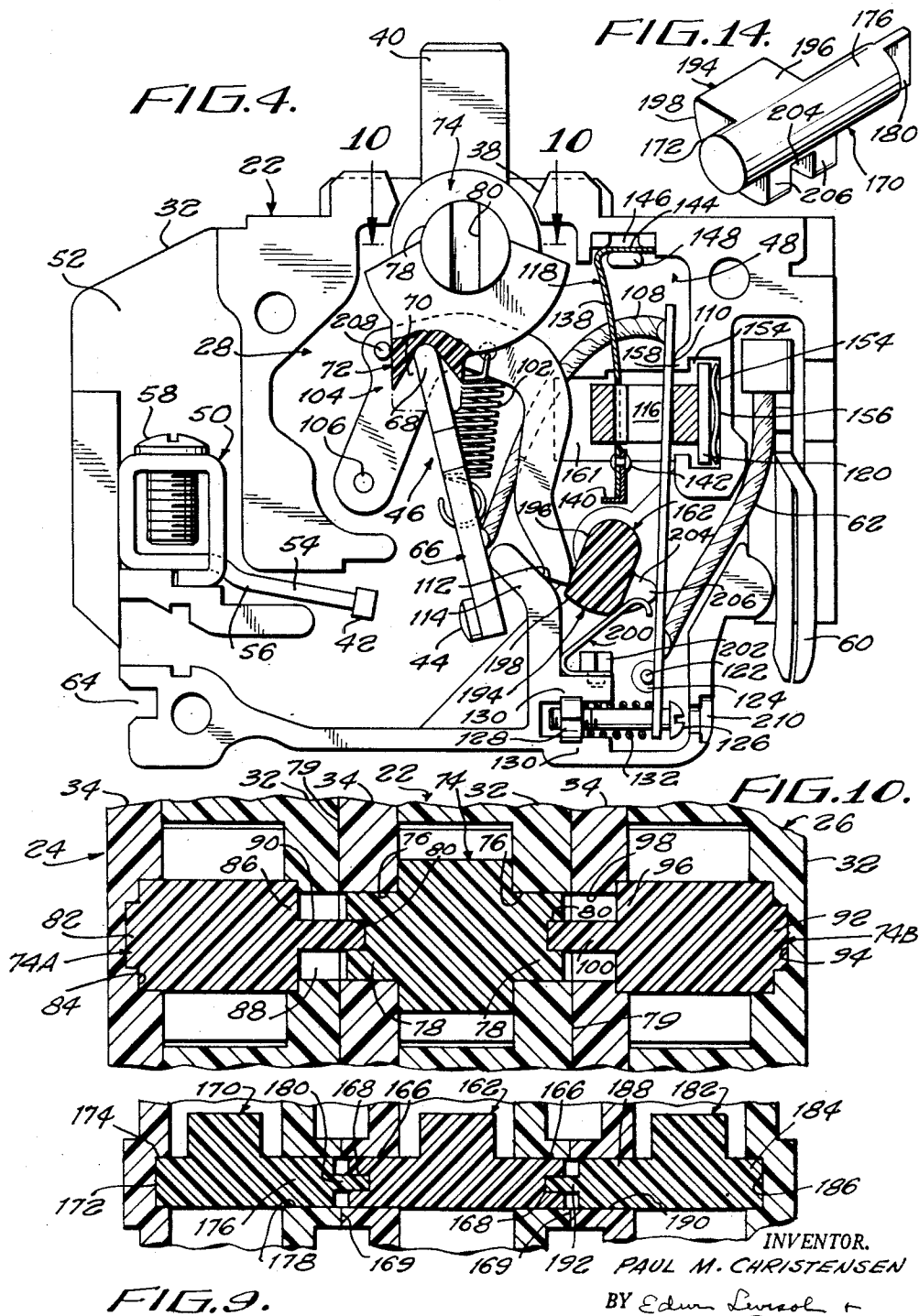
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CIRCUIT BREAKERS

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4 Sheets-Sheet 2



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CIRCUIT BREAKERS

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4 Sheets-Sheet 3

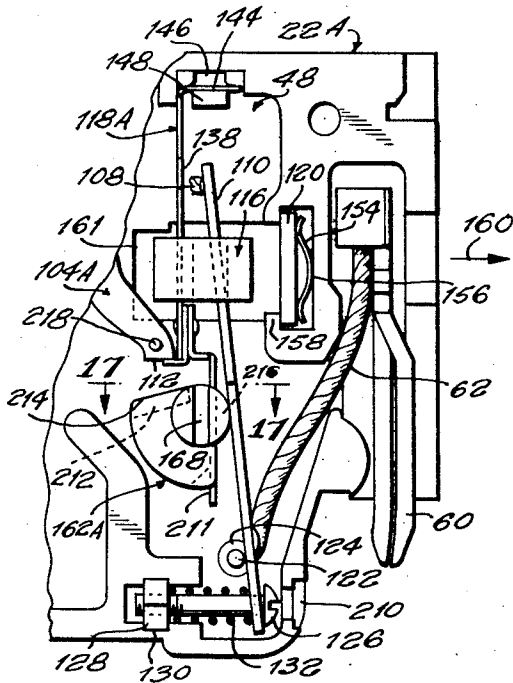


FIG. 15.

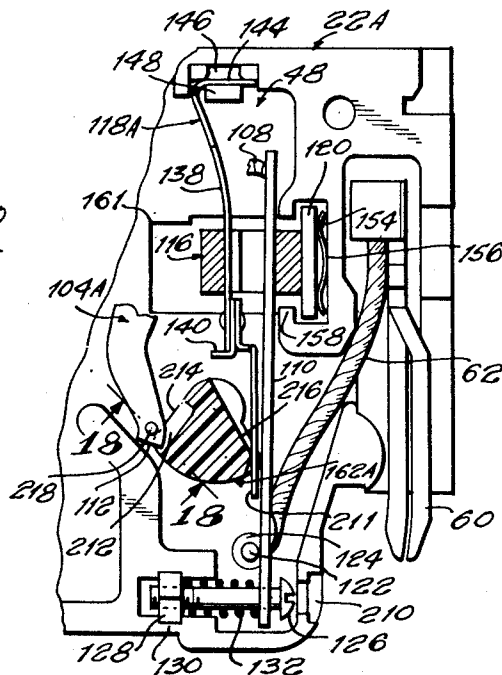


FIG. 16.

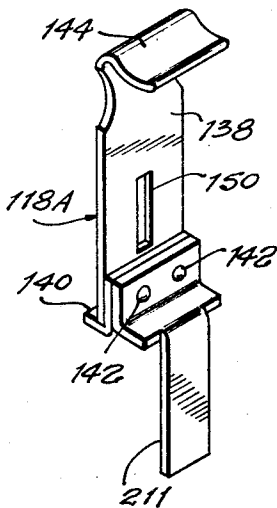


FIG. 19.

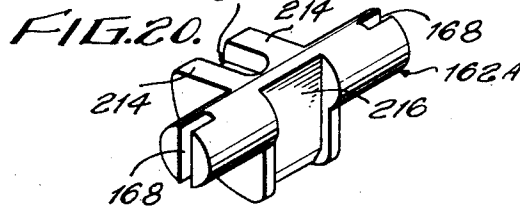
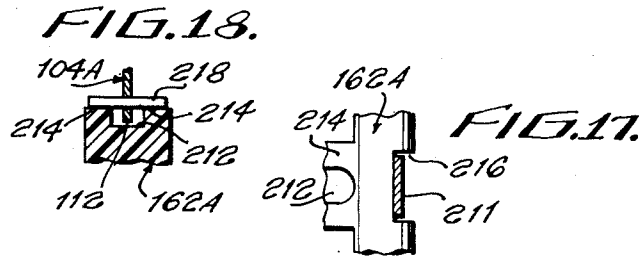


FIG. 20.

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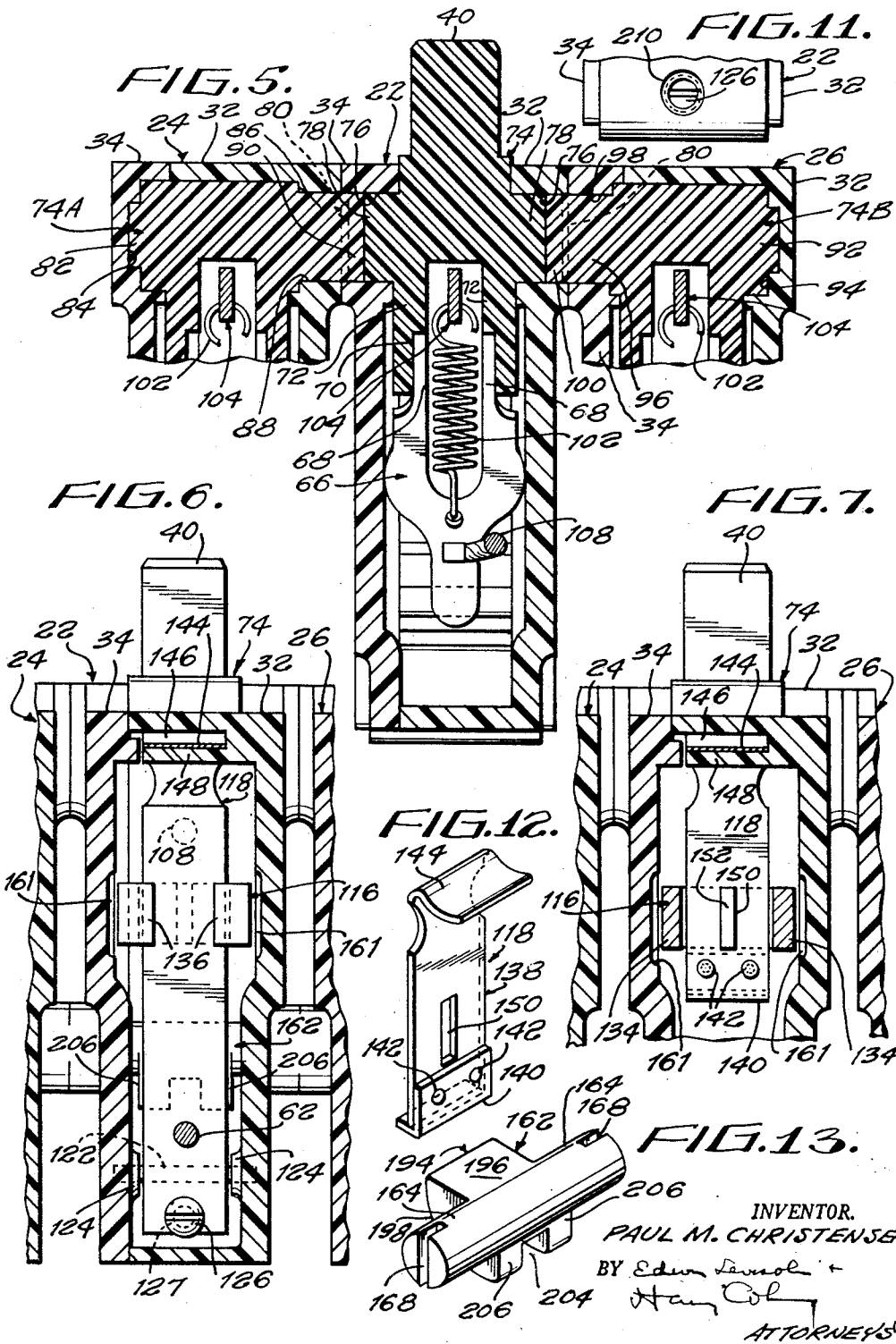
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4 Sheets-Sheet 4



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1

2,824,191

CIRCUIT BREAKERS

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Application February 5, 1953, Serial No. 335,217

25 Claims. (Cl. 200—116)

The present invention relates to multi-pole circuit breakers and to tripping devices and manual operating members therefor. More particularly the invention is concerned with a multi-pole circuit breaker which can be manually opened and closed and which is also opened automatically at all of the poles thereof upon the occurrence of an overload in the circuit at any one of the poles.

The primary object of the present invention is the provision of a single pole circuit breaker unit which is provided with a handle for the manual operation thereof and which unit has provision for use with one or two other circuit breaker units which are not provided with handles but which are manually operable by said handle whereby said single pole unit may be used by itself or in conjunction with one or both of the other units to form a multi-pole circuit breaker of the double pole or triple pole type, as the case may be, means being provided to trip all the poles of the multi-pole circuit breaker upon the occurrence of an overload or other abnormal condition in the circuit of one of the poles thereof.

Another object is the provision in a circuit breaker of a generally improved thermal and magnetic tripping device.

In accordance with the foregoing object, it is a further object to provide a bi-metallic current-responsive control device which is mounted for pivotal movement whereby to obviate the necessity for the bending or mechanical flexing thereof upon overload.

Further in accordance with said foregoing object, it is a further object to provide such a tripping device wherein a spring latch element is mounted separately from the bi-metallic control device.

A still further object is the provision of a generally improved calibration arrangement for a circuit breaker.

The above and other objects, features and advantages of the present invention will be more fully understood from the following description considered in connection with the accompanying illustrative drawings.

In the drawings:

Fig. 1 is a side view of a multi-pole circuit breaker pursuant to the present invention;

Fig. 2 is a top plan view thereof;

Fig. 3 is a sectional view, on an enlarged scale, taken on the line 3—3 of Fig. 2, the circuit breaker mechanism being illustrated in the closed or circuit making condition thereof;

Fig. 4 is a view similar to Fig. 3, with parts broken away and parts sectioned for purposes of illustration, and illustrates the tripped condition of the circuit breaker mechanism;

Fig. 5 is a fragmentary sectional view taken on the line 5—5 of Fig. 3;

Fig. 6 is a fragmentary sectional view taken on the line 6—6 of Fig. 3;

Fig. 7 is a fragmentary sectional view taken on the line 7—7 of Fig. 3;

2

Fig. 8 is a fragmentary sectional view through a single circuit breaker unit taken on the line 8—8 of Fig. 3;

Fig. 9 is a fragmentary sectional view taken on the line 9—9 of Fig. 3;

Fig. 10 is a fragmentary sectional view taken on the line 10—10 of Fig. 4;

Fig. 11 is a fragmentary end view of a single circuit breaker unit taken in the direction of the arrow 11 in Fig. 3 and illustrates a calibration opening for the circuit breaker unit;

Fig. 12 is a perspective view of a spring latch member pursuant to the present invention;

Fig. 13 is a perspective view of the tripping element in the circuit breaker unit which is provided with the handle;

Fig. 14 is a perspective view of the tripping element in one of the other circuit breaker units,

Fig. 15 is a fragmentary view similar to Fig. 3 and illustrates a modification;

Fig. 16 is a fragmentary view similar to Fig. 15, with parts in section, and illustrates the tripped condition of the circuit breaker mechanism;

Fig. 17 is a fragmentary sectional view taken on the line 17—17 in Fig. 15;

Fig. 18 is a fragmentary sectional view taken on the line 18—18 in Fig. 16;

Fig. 19 is a perspective view of a modified spring latch member; and

Fig. 20 is a perspective view of a modified tripping element in the circuit breaker unit which is provided with the handle.

The present invention is illustrated as applied to a circuit breaker of the type described in application Serial No. 186,013, filed September 21, 1950, by Louis W. Cole, now abandoned, and the subject matter thereof being contained in a continuation application Serial Number 308,235, filed September 6, 1952, which issued as Patent Number 2,692,926, dated October 26, 1954, and assigned to the assignee of this invention.

Referring now to the drawings in detail, the multi-pole circuit breaker 20 of the present invention is here shown in Fig. 2 as comprising the intermediate single pole circuit breaker unit 22 and the outer single pole circuit breaker units 24 and 26, said units being disposed in side-by-side relation and interconnected, as hereinafter described in detail, to provide for the concomitant manual operation thereof, as well as to provide for the automatic tripping of all of said units in response to the tripping of one of said units upon occurrence of an overload. The circuit breaker mechanism for each of said single pole circuit breaker units is generally indicated by the reference numeral 28 in Figs. 3 and 4. Said mechanisms are similar and each is enclosed within a casing or housing 30 which is formed by a body part 32 and a cover or closure part 34 therefor. Each of said parts is formed, preferably by a molding operation, from a suitable insulation material such as, for example, "Bakelite" and said parts are mutually secured together in housing defining relation in a suitable manner, as by means of the rivets 36. It will be noted that the body part 32 for the intermediate circuit breaker unit 22 differs from the similar body parts of the other circuit breaker units by being provided with an openings 38 (Figs. 2, 3 and 4) for the handle 40.

The circuit breaker mechanism 28 for each unit comprises a stationary contact 42, a companion movable contact 44, an operating mechanism, generally indicated by the reference numeral 46, and a trip device 48. The stationary contact 42 is carried at the inner end of a terminal member 50 which is seated within an open recess 52 provided in the housing 30. It will be noted that the inner end 54 of the terminal member 50 extends through a slot 56 formed in the housing in

order to position the stationary contact 42 for engagement by the companion movable contact 44. At its outer end, the terminal member 50 is provided with suitable connecting means 58 for connecting the terminal 50 in an electric circuit. At the opposite end of the housing 30, provision is made for a prong terminal member 60 which is preferably of the type illustrated and described in the copending application of Thomas M. Cole and Paul M. Christensen, Serial No. 127,432, filed November 15, 1949, now Patent No. 2,647,225, and assigned to the assignee hereof. Said prong terminal is adapted to engage in a suitable line terminal to complete the electric circuit in which the circuit breaker unit is connected. A flexible conductor 62 connects the prong terminal 60 to the circuit breaker mechanism, as hereinafter described in detail, for completing a circuit through the circuit breaker when the contacts are engaged. In order to securely and releasably mount the circuit breaker unit on a panelboard, a recess 64 is defined therein for engagement by a companion retaining element on the panelboard, in the manner fully illustrated and described in said last mentioned application. Thus the circuit breaker unit is releasably locked in position at opposite ends thereof by engagement of the prong in a companion terminal on the panelboard and by the engagement of a panelboard securing element in the recess 64. However, it will be understood that the line terminal need not be in the form of a prong but may be of other suitable type.

The movable contact 44 is carried on the free end of a generally U-shaped switch member 66 (Figs. 3-5) having the spaced legs 68-68 thereof supported in recesses 70-70, respectively, defined in the legs 72-72 of a U-shaped operating member 74. Pursuant to one feature of the present invention, only the operating member 74 of the intermediate circuit breaker unit 22 is provided with the aforementioned handle 40. Referring to Figs. 5 and 10, the handled operating member for the intermediate unit 22 is therein designated by the reference numeral 74, and the handleless operating member for the circuit breaker unit 24, which may be considered as the left hand unit as viewed in said figures, is designated by the reference numeral 74A, and the circuit breaker unit 26, which may be considered as the right hand unit, is provided with the handleless operating member which is designated by the reference numeral 74B. The housing for the intermediate circuit breaker unit 22 is provided with aligned opposing bearing openings 76-76 defined therein for pivotally mounting the laterally extending pivot portions 78-78 of the operating member 74. It will be noted that each of said pivot portions is provided with a groove 80 defined therein, and further that said pivot portions terminate inwardly of the outer surfaces 79-79 of the companion casing, as best illustrated in Fig. 10. The operating member 74A for the left hand circuit breaker 24 is provided with a laterally extending pivot portion 82 which is preferably mounted in a bearing recess 84 defined in the companion cover part 34 and is also provided with the opposing pivot portion 86 which is preferably mounted in a bearing aperture 88 defined in the companion casing body 32 opposite the recess 82. Said pivot portion 86 is provided with a projection or tongue 90 which extends outwardly of the companion casing for releasable engagement in the adjacent groove 80 defined in the operating member 74. In the same manner, the operating member 74B for the right hand circuit breaker unit 26 is provided with a pivot portion 92 which is pivotally mounted in a bearing recess 94 defined in the companion casing body 32, and is also provided with an opposing pivot portion 96 which is mounted in an opposing bearing opening 98 defined in the companion casing cover 34. A projection or tongue 100 provided on the pivot portion 96 extends outwardly

of the companion casing for engagement in the adjacent groove 80 provided in the operating member 74. From the foregoing, it will be apparent that when the operating member 74 of the circuit breaker unit 24 is interlocked with either or both of the operating members of the left and right circuit breaker units, an articulated operating unit is provided and the handle 40 may be manually operated to concomitantly operate the various interlocked segments thereof.

In each circuit breaker mechanism, an operating spring 102 is connected under tension between the switch member 66 and a releasable carrier or actuator 104 which is pivoted on a pivot pin 106 supported in opposing openings provided in the companion housing. The switch member 66 is connected by means of a flexible conductor 108 to the free end of a bi-metallic current-responsive control element 110 which forms a part of the previously mentioned trip device 48, said control element, as previously indicated being connected by the flexible conductor 62 to the terminal 60 to complete a circuit between the terminal 60 and the terminal 50 when the contacts are engaged.

The switch member 66 of the intermediate circuit breaker unit 22 is operated to manually open and close the contacts by manipulation of the handle 40. More specifically, movement of the handle in a clockwise direction from the circuit making position thereof illustrated in Fig. 3, carries the legs 68-68 of the switch member across to the left of the line of action of the operating spring 102 which then biases the switch member to the open position thereof, and causes movement of the switch member to open position with a snap action. It will be readily apparent that when the operating members 74A and 74B, of the companion circuit breakers, are interlocked with the operating member 74 for concomitant movement therewith, the previously described movement of the handle 40 will also result in the movement of the switch members thereof to the open position thereof.

From said manual open position, each of the interlocked circuit breaker units are manually closed by reverse operation of the handle 40. Counter-clockwise movement of the handle 40 from the "open" to the "closed" position thereof moves the legs 68-68 of each of the switch members across to the right of the line of action of the companion spring 102 which thereupon acts to close the companion contacts with a snap action.

Each circuit breaker unit is adapted to be tripped open instantaneously, to the position thereof illustrated in Fig. 4, in response to overloads above a predetermined value, or upon the occurrence of a short circuit, and after a time delay, in the case of lesser overloads, by means of the trip device 48. Operation of the trip device 48, releases the companion actuator 104 whereupon the overcenter spring 102 moves the actuator clockwise, moving the line of action of said overcenter spring to the right of the centerline of the companion switch member 66. Thereafter the spring 102 acts to move the switch member 66 to open position with a snap action, said switch member, actuator 104 and the spring 102 therebetween comprising releasably restrained mechanism released by said operation of the trip device 48. The movement of the actuator 104 is limited by the engagement of the free latching end 112 thereof with the portion 114 of the casing, as illustrated in Fig. 4.

The trip device 48 comprises the previously mentioned bi-metal element 110, an electro magnet which comprises a movable core element 116 carried by a resilient latch member 118, and a companion spring biased armature 120 mounted for limited movement. Pursuant to another feature of the present invention, as will hereinafter appear in detail, the trip device also includes a latch piece for engaging the actuator, which latch piece is mounted separately from the bi-metal element, being mounted on said resilient latch member.

Pursuant to a further feature of the present invention, the bi-metallic control element 110 is not fixed but is mounted for pivotal or bodily movement. Said element is provided adjacent the lower end thereof with a pivot pin 122 which is pivotally mounted in opposing bearing portions 124 formed in the casing, as best illustrated in Fig. 6. At the lower end thereof, the unthreaded shank of a screw member 126 extends through an opening 127 in the bi-metal for threaded engagement in a companion nut 128 which is retained against rotation by suitably formed portions 130—130 of the casing. A spring 132 is coiled about the screw 126, being disposed between the nut 128 and the bi-metal 110, as best illustrated in Fig. 3, for biasing the bi-metal in a counter-clockwise direction. It will be noted from Fig. 8 that the core member 116 is a channel or U-shaped yoke and that the bi-metal 110 extends between the opposing arms 134—134 thereof. Said arms are provided with the inturned flange portions 136—136, the function of which will presently appear. The core member 116, as previously indicated, is carried by the latch member 118. More specifically, as best illustrated in Fig. 12, said latch member comprises the leaf spring 138 which is provided at the lower end thereof with the angled latch piece 140 secured thereto, as by the rivets 142, and is provided at the upper end thereof with the reversed arcuate portion 144. When said arcuate portion 144 is inserted into a slot defined by the companion housing portions 146 and 148, said arcuate portion is straightened, the spring is placed under tension and also biases the electro-magnetic member 116 to the left, viewing Fig. 3. The spring 138 is slotted, as at 150, to receive a projection or tongue 152 provided on the bight of the electro-magnetic core member 116 for mounting the latter upon the latch member 118, as best illustrated in Fig. 8. The previously mentioned armature 120 is disposed within a recess 154 defined in the housing and a leaf spring 156 biases said armature against the inturned portions 158—158 provided in the housing for retaining said armature in position, the spring 156 permitting limited movement of the armature away from said portions 158—158, as will presently appear.

The latch piece 140 provided on the latch member 118 normally engages and restrains the actuator in the operative position thereof, in the closed condition of the circuit breaker, as illustrated in Fig. 3. Upon the occurrence of an overload current below a predetermined magnitude or value thereof, the bi-metallic control device 110 in the overloaded circuit is heated and flexes away from the companion actuator 104. During said flexing thereof, the bi-metal will engage the inturned flange portions 136—136 of the electro-magnetic core 116 and move said core in the direction of the arrow 160 in Fig. 3 against the bias of spring 138 to disengage the latch piece 140 from the end 112 of the actuator 104. The casing parts are recessed at 161—161 to allow for said movements of the member 116. If said movement of the core 116 is sufficient to cause the latter to engage the armature 120 the latter will be moved thereby in the same direction against the bias of the spring 156 to prevent damage to the bi-metal. Upon release of the actuator 104 by the latch piece 140, the operating mechanism 46 functions in the previously described manner to automatically open the contacts.

Upon the occurrence of a heavy overload or short circuit above the previously mentioned predetermined current magnitude, the current flowing through the bi-metallic element 110 will energize the electro-magnet core member 116 a sufficient amount to attract the companion magnetic armature 120. However, since said armature is retained against movement toward the core member, by the casing portions 158—158, the core member 116 will move toward the armature to flex the spring 138 in said direction whereby to release the latch piece 140 from the latched engagement with the end 112 of the

actuator 104, thereby releasing the actuator and effecting instantaneous opening of the contacts.

Pursuant to another feature of the present invention, provision is made for automatically opening or tripping all of the circuit breaker units upon the occurrence of an overload or short circuit in the circuit of any one of said units. In this connection, the intermediate circuit breaker unit 22 is provided with a tripping element 162, best illustrated in Fig. 13. Said element is provided with the laterally extending pivot portions 164—164 which are pivotally mounted in opposing bearing apertures 166—166 (Fig. 9) formed in the companion casing. Said pivot portions are provided with the grooves 168—168 and, as noted from Fig. 9, terminate inwardly of the outer surfaces 169—169 of the companion casing. The left hand circuit breaker unit 24 is provided with a tripping element 170, best illustrated in Fig. 14. Said tripping element is provided with the laterally extending pivot portion 172 which is pivotally mounted in a bearing recess 174 provided in the companion casing and with the opposing pivot portion 176 which is pivotally mounted in an opposing bearing aperture 178 provided in said casing. Said latter pivot portion is provided with a projection or tongue 180 which engages in the adjacent groove 168 provided in the tripping element 162. The right hand circuit breaker unit 26 is provided with a similar tripping element except that the projection is provided on the opposite pivot portion thereof. More specifically, the tripping element 182 of said right hand circuit breaker is provided with the pivot portion 184 which is mounted in a bearing recess 186 defined in the companion casing and with an opposing pivot portion 188 which is pivotally mounted in an opposing bearing aperture 190 defined in the casing. Said portion 188 is provided with a projection or tongue 192 which extends outwardly from the casing for engagement in the adjacent groove 168 defined in the tripping element of the intermediate unit. From the foregoing, it will be apparent that the various tripping elements are interlocked for concomitant movement in the same manner as the previously described operating members, said tripping elements forming an articulated trip means or member. Each of the tripping elements is provided with a laterally extending portion 194 having a flat surface 196 and an arcuate surface 198. A spring member 200 (Figs. 3 and 4), is secured at one end thereof to the casing, as by the securing element 202, and the free end of the spring is disposed in a recess 204 defined in the companion tripping element. It will be noted that in the closed condition of each circuit breaker unit, the spring 200 resiliently disposes the companion tripping element in the position thereof illustrated in Fig. 3 so that the flat portion 196 thereof is disposed below the free end 112 of the actuator and in the path of movement thereof.

Upon the automatic tripping of any one of the circuit breaker units, each of which has a circuit breaker mechanism independently operable upon overload in the circuit thereof to open said circuit, the actuator of the tripped unit will be released from the companion latch piece 140 and will be moved by the operating spring 102 as previously described, to the position thereof illustrated in Fig. 4 to open the breaker. During such movement, the free end 112 of the actuator strikes the flat surface 196 of the underlying tripping element, which is one segment of the articulated trip member, causing said segment, and therefore, the articulated trip member to rotate in a counter-clockwise direction, as illustrated in Fig. 4. During said rotation of the articulated trip means or member, the depending portions 206—206, of the segments in the other circuit breakers, are rotated into engagement with the companion bi-metallic elements 110, as illustrated in Fig. 4, and will pivot the latter, as illustrated in said figure, against the bias of springs 132, in a clockwise direction to engage and move the companion electro-magnetic members 116 in the direction of the arrow 160,

whereby to release the companion actuators for tripping the companion circuit breakers. It will be apparent that the depending portions 206—206 at each pole constitute means independent of the control member at each pole and are operated by the articulated trip means at the non-overloaded poles for opening the circuits at the non-overloaded poles. Due to the pivotal mounting of the various bi-metallic elements to effect the bodily movement thereof the latter need not be bent or flexed mechanically, when engaged by the segments of the articulated trip member, as heretofore, in order to trip the companion circuit breakers. Consequently, a smaller amount of force is required to move the bi-metal, since the bi-metal is pivoted rather than having one end thereof fixed, as heretofore, it being also noted that the bi-metal is engaged adjacent the pivot thereof to minimize the required force. In this connection, it will be understood that the spring 132 is comparatively weak and will not interfere with said pivotal movement of the companion bimetal. This arrangement permits the overcentering spring 102, of the circuit breaker which trips in response to the overload or short in the circuit thereof, to trip all of the circuit breaker units without requiring the necessity for a heavy overcentering spring which, if required, would materially increase the size of the spring and therefore increase the size of each circuit breaker. In addition, a heavy spring 102 would increase the pressure of the latch end 112 of the actuator 104 against the companion latch piece 140 and this is undesirable due to the fact that excessive latch pressure tends to cause unreliable or non-uniform calibration of the circuit breaker mechanism. Further, said increased force applied at the latching end of the actuator would require increased force on the part of the bi-metal to trip the circuit breaker upon overload. These various disadvantages are overcome through the use of the pivotally mounted bodily movable bi-metallic element 110. Further in this connection, as previously indicated, in order to decrease the force required on the part of the bi-metal to unlatch the companion actuator upon overload, the spring 133 of the latching member is made in the form of a thin leaf spring to provide as light a spring action as possible when pressing the latch piece against the actuator, said spring being in the form of a straight bar which is maintained under tension and which will not interfere with the movement of the bi-metal in the tripping direction thereof. Further in this connection it will be noted that the latch piece is hardened and polished to eliminate any burrs which may be formed thereon and to provide for good wear, and since the latch piece forms only a small part of the latching member 118, most of which is formed by the comparatively light spring member 133, the force required on the part of the bi-metal to unlatch the actuator is kept to a minimum.

Before the contacts can be closed following an automatic tripping or opening of the circuit breakers, it is necessary to reset and relatch each circuit breaker mechanism. This is accomplished by moving the handle 40 clockwise from the tripped position thereof illustrated in Fig. 4. During said movement of the handle, each of the interlocked operating members 74, 74A and 74B forming the articulated operating member, will rotate in the same direction, as previously described, so that a leg 72 of each of said operating members, which is in abutment with a pin 208 carried by the companion actuator, in the tripped condition of the circuit breaker, will move the actuator in a counter-clockwise direction about its pivot 106. During said counter-clockwise movement, the free end 112 of the actuator wipes past the companion tripping element of the articulated trip member whereupon the spring 200 returns the tripping element to the position thereof illustrated in Fig. 3. Upon disengagement of said elements from the companion bi-metals, the flexed spring 138 returns the latch piece 140 and the electro-magnetic member 116 to the position thereof il-

lustrated in Fig. 3. Said return movement of the electro-magnetic member 116 pivots the companion bi-metallic element in a counter-clockwise direction, and the expansion of the compressed spring 132 properly positions the bi-metal relative to the member 116, at the end of said return movement of the latter illustrated in Fig. 3. The latching pieces 140 are now in position to be engaged by the companion actuators 104 at the end of said counter-clockwise movement of said actuators. Thereafter, the handle 40 is moved in a counter-clockwise direction to the position thereof illustrated in Fig. 3, as previously described, to close the companion contacts in each of the circuit breakers.

Pursuant to another feature of the present invention, each circuit breaker unit can be calibrated externally of the casing. In this connection, an opening 210 (Figs. 3, 4, 11) is provided in each housing for access to the previously mentioned adjusting screw 126. It will be apparent that by threading the screw further into the nut 128 the bi-metal 110 will be pivoted in a clockwise direction and thus move closer to the flanges of the electro-magnetic member 116. This will decrease the amount of flexing of the bi-metal in the overloaded circuit breaker before it begins to move the member 116 in the direction of the arrow 169 to disengage latch piece 140 from the actuator 104. Conversely, rotation of the screw 126 in a direction to withdraw the same from the nut 128 results in the expansion of the spring 132 to pivot the bi-metal 110 in a counter-clockwise direction and requires a greater amount of flexing of the bi-metal before it is effective to cause the release of the companion actuator.

From the foregoing, it will be apparent that the circuit breaker unit 22 is available for use, by itself as a single pole circuit breaker, or with either a left or a right hand circuit breaker unit to form a double pole circuit breaker, and with both a left and a right hand unit to form a triple pole circuit breaker. Due to the novel trip device, which includes a pivoted bimetallic control element and a latch piece mounted separately therefrom, an overcenter spring which is sufficient for use in a single pole circuit breaker is also strong enough to trip a double-pole or a triple-pole circuit breaker.

Referring now to Figs. 15 through 20 in detail, there is illustrated a modification of the previously described construction, pursuant to which the force that is necessary to rotate the articulated trip member for tripping all of the circuit breakers is greatly decreased, elements similar to those previously described having the same reference numerals. More particularly, the resilient latch member 118A comprises both the leaf spring 138 and the angled latch piece 140, as previously described, and, in addition, is provided with the depending tongue or element 211, the rivets 142—142 securing the spring member 138, the latch piece 140 and said tongue 211 together. The tripping element in each circuit breaker unit is modified to cooperate with said tongue 211. More specifically, a modified tripping element 162A for the intermediate circuit breaker unit 22A, is illustrated in Fig. 20. As therein shown, said element is recessed, as at 212, to provide the laterally spaced portions or arms 214—214, and is also recessed, as at 216, to provide a seat for the tongue 211. The actuator 104A is similar to the previously described actuator 104, except for the provision of the transversely extending pin 218 adjacent the free end 112 thereof. With the circuit breaker mechanism in the closed condition thereof, as illustrated in Fig. 15, it will be noted from Fig. 17 that the tongue 211 is disposed in the seat 216 of the tripping element and that the spring 138 is tensioned and effective to bias said tripping element to the position thereof illustrated in said figure. In said position, the seat 212 underlies the end 112 of the actuator 104A, the trip element 162A being disposed in the path of movement thereof. Assuming now that the circuit breaker trips in

response to an overload, the bimetal 110 will operate, as previously described, to move the core member 116 in the direction of the arrow 160 in Fig. 16, for effecting disengagement of the latch piece 140 from the actuating member 104A. Upon said release thereof the actuating member is moved, as previously described, to the position thereof illustrated in Fig. 16 to open the breaker. During said movement, the actuator end 112 enters the recess 212, the pin 218 straddling the latter and the opposite ends thereof engaging the spaced arms 214—214, as best illustrated in Fig. 18, to rotate the tripping element to the position thereof illustrated in Fig. 16.

It will be understood that in the present modification, the tripping elements in the right and left hand circuit breakers, are substantially the same as the tripping element 162A, except for the provision of the grooved portions 168—168 at each side of the latter. As previously described in connection with Fig. 9, the right and left hand circuit breakers have tripping elements which interlock with the intermediate tripping element to form an articulated tripping member. However, it will be understood that the tripping elements in each of the right and left hand circuit breaker units are also each provided with a recess 212 for engagement by a companion pin 218 carried by the associated actuator and with a recess 216 for seating a companion tongue 211 carried by the resilient latch member 118A thereof. Therefore, it will be understood that upon the occurrence of an overload at any one pole of the multi-pole circuit breaker, the tripping element at said pole will be moved to the position thereof illustrated in Fig. 16, and the companion tripping elements at other poles, which rotate as a unit therewith, in a counter-clockwise direction viewing Fig. 15, to also move to the position thereof illustrated in Fig. 16. It will be noted that at each of the poles which were not overloaded, the effect of said movement of the companion tripping element is to carry the companion latch member 118A thereof away from the companion actuator 104A to the position thereof illustrated in Fig. 16, for disengaging the companion latch piece 140 from the companion actuator 104A to release the latter for tripping the mechanism thereof. Therefore, it will be readily apparent that, insofar as the circuit breaker mechanisms at the poles which were not overloaded are concerned, they will trip as a result of the movement of the latch elements 118A thereof by the companion tripping elements thereof, and they do not depend on the mechanical flexing of the bimetal 110, for said tripping, as in the previously described embodiment.

Upon resetting of the various circuit breaker mechanisms, as previously described, the resilient latch 118A returns to the position thereof illustrated in Fig. 15 and thereby rotates the companion tripping element, in a clockwise direction, viewing Fig. 16, from the position thereof illustrated in Fig. 16, to the position thereof illustrated in Fig. 15. In this connection, it will be noted that the tripping element is automatically repositioned in the operative disposition thereof by its associated resilient latch member whereby to obviate the necessity for the spring members 200 of the previously described embodiment.

While I have shown and described the preferred embodiments of my invention, it will be understood that various changes may be made in the present invention without departing from the underlying idea or principles of the invention within the scope of the appended claims.

Having thus described my invention, what I claim and desire to secure by Letters Patent, is:

1. In a circuit breaker having a stationary contact, a movable contact engageable with and disengageable therefrom, releasably restrained mechanism operable upon release thereof to effect disengagement of said contacts, and trip means for effecting release of said

mechanism upon overload, said trip means comprising a latch member in latch engagement with said mechanism, a part carried by said latch member, and a current-responsive control element operable upon said part for disengaging said latch member from said mechanism, said part being U-shaped and said control element being disposed between the arms thereof, said arms being oppositely flanged for engagement of said element.

2. In a circuit breaker having a stationary contact, a movable contact engageable with and disengageable therefrom, releasably restrained mechanism operable upon release thereof to effect disengagement of said contacts, and trip means for effecting release of said mechanism upon overload, said trip means comprising a latch member in latched engagement with said mechanism, a part carried by said latch member, and a current-responsive control element operable upon said part for disengaging said latch member from said mechanism, said part being an electro-magnetic element energized by current flow through said control element, and a companion magnetic member to which said part is attracted upon said energization thereof for disengaging said latch member from said mechanism, said electro-magnetic member being U-shaped and said control element being disposed between the arms thereof, said arms being oppositely flanged for engagement of said element.

3. In a multi-pole circuit breaker having at each pole thereof a circuit breaker mechanism independently operable upon overload in the circuit thereof to open said circuit, said circuit breaker mechanism comprising a movable contact member, an operating mechanism therefor and a trip device operable to latch said operating mechanism in circuit-closed condition, said trip device including a current responsive control member operable to unlatch said trip device from said operating mechanism for operating said movable member to circuit-open condition upon said overload, and trip means extending between said poles and energized at the overloaded pole for operating the control members at the other poles to open the circuits thereof, that improvement which comprises mounting said control members for bodily movement, whereby to reduce the force required at the overloaded pole to trip all of said poles.

4. In a multi-pole circuit breaker having at each pole thereof a circuit breaker mechanism independently operable upon overload in the circuit thereof to open said circuit, said circuit breaker mechanism comprising a movable contact member, an operating mechanism therefor and a trip device operable to latch said operating mechanism in circuit-closed condition, said trip device including a current-responsive control member operable to unlatch said trip device from said operating mechanism for operating said movable member to circuit-open condition upon said overload, and trip means extending between said poles and energized at the overloaded pole for operating the control members at the other poles to open the circuits thereof, that improvement which comprises the pivotal mounting of said control members, whereby to reduce the force required at the overloaded pole to trip all of said poles.

5. In a multi-pole circuit breaker having at each pole thereof a circuit breaker mechanism independently operable upon overload in the circuit thereof to open said circuit, said circuit breaker mechanism comprising a movable contact member, an operating mechanism therefor and a trip device operable to latch said operating mechanism in circuit-closed condition, said trip device including a current responsive control member operable to unlatch said trip device from said operating mechanism for operating said movable member to circuit-open condition upon said overload, and trip means extending between said poles and energized at the overloaded pole for operating the control members at the other poles to open the circuits thereof, that improvement which comprises mounting said control members for bodily movement,

whereby to reduce the force required at the overloaded pole to trip all of said poles, said control members being thermal-responsive bimetallic strips each mounted for pivotal movement.

6. In a multi-pole circuit breaker having at each pole thereof a circuit breaker mechanism independently operable upon overload in the circuit thereof to open said circuit, said circuit breaker mechanism comprising a movable contact member, an operating mechanism therefor and a trip device operable to latch said operating mechanism in circuit-closed condition, said trip device including a current responsive control member operable to unlatch said trip device from said operating mechanism for operating said movable member to circuit-open condition upon said overload, and trip means extending between said poles and energized at the overloaded pole for operating the control members at the other poles to open the circuits thereof, that improvement which comprises mounting said control members for bodily movement, whereby to reduce the force required at the overloaded pole to trip all of said poles, said trip device having a part mounted separately from the control member thereof, said part being in latched engagement with the companion operating mechanism.

7. In a multi-pole circuit breaker having at each pole thereof a circuit breaker mechanism independently operable upon overload in the circuit thereof to open said circuit, said circuit breaker mechanism comprising a movable contact member, an operating mechanism therefor and a trip device operable to latch said operating mechanism in circuit-closed condition, said trip device including a current responsive control member operable to unlatch said trip device from said operating mechanism for operating said movable member to circuit-open condition upon said overload, and trip means extending between said poles and energized at the overloaded pole for operating the control members at the other poles to open the circuits thereof, that improvement which comprises mounting said control members for bodily movement, whereby to reduce the force required at the overloaded pole to trip all of said poles, said trip device having a part mounted separately from the control member thereof, said part being in latched engagement with the companion operating mechanism, said part being an electro-magnetic element energized by current flow through the companion control element, and a companion magnetic member to which said part is attracted upon said energization thereof for disengaging said part from the companion operating mechanism.

8. In a circuit breaker having a stationary contact, a movable contact engageable with and disengageable therefrom, releasably restrained mechanism operable upon release thereof to effect disengagement of said contacts, and trip means for effecting release of said mechanism upon overload, said trip means comprising a latch member in latched engagement with said mechanism, a part carried by said latch member, and a current-responsive control element spaced from said part and operable thereon upon overload for disengaging said latch member from said mechanism, and means for adjustably varying the space between said control element and said part for calibrating the circuit breaker.

9. In a circuit breaker having a stationary contact, a movable contact engageable with and disengageable therefrom, releasably restrained mechanism operable upon release thereof to effect disengagement of said contacts, and trip means for effecting release of said mechanism upon overload, said trip means comprising a latch member in latched engagement with said mechanism, a part carried by said latch member, and a current-responsive control element spaced from said part and operable thereon upon overload for disengaging said latch member from said mechanism and means for adjustably varying the space between said control element and said part for calibrating the circuit breaker, and a housing for said

circuit breaker, said housing having provision for access externally thereof to said varying means for operating the latter.

10. In a circuit breaker having a stationary contact, a movable contact engageable with and disengageable therefrom, releasably restrained mechanism operable upon release thereof to effect disengagement of said contacts, and trip means for effecting release of said mechanism upon overload, said trip means comprising means in latching engagement with said mechanism, current responsive control means spaced from said latching means and operable thereon upon overload for effecting release of said mechanism by said latching means, and means for adjustably varying the relative disposition of said control means and said latching means for calibrating the circuit breaker, said control means being mounted for pivotal movement, and said varying means being operable to adjustably pivot said control means.

11. In a circuit breaker having a stationary contact, a movable contact engageable with and disengageable therefrom, releasably restrained mechanism operable upon release thereof to effect disengagement of said contacts, and trip means for effecting release of said mechanism upon overload, said trip means comprising means in latching engagement with said mechanism, current responsive control means spaced from said latching means and operable thereon upon overload for effecting release of said mechanism by said latching means, and means for adjustably varying the relative disposition of said control means and said latching means for calibrating the circuit breaker, said control means being mounted for pivotal movement, and said varying means being operable to adjustably pivot said control means, and resilient means biasing said control means for pivotal movement in opposition to movement thereof by said varying means.

12. In a circuit breaker having a stationary contact, a movable contact engageable with and disengageable therefrom and mechanism for effecting automatic disengagement thereof upon overload, a trip mechanism comprising a latch member having uniform initial latched engagement with said first mentioned mechanism and a bodily movable pivotally mounted current-responsive control element normally spaced from said latch member and operable upon said latch member for bodily disengaging said latch member from said latched engagement thereof upon overload, a pair of magnetic members supported separate from and extending about said control element, said members being spaced from each other by a gap and including one member carried by said latch member, and means for adjusting said control element relative to said latch member without disturbing said initial latched engagement or said gap for calibrating the circuit breaker.

13. In a circuit breaker having a stationary contact, a movable contact engageable with and disengageable therefrom and mechanism for effecting automatic disengagement thereof upon overload, a trip mechanism comprising a latch member having uniform initial latched engagement with said first mentioned mechanism and a bodily movable pivotally mounted current-responsive control element normally spaced from said latch member and operable upon said latch member for bodily disengaging said latch member from said latched engagement thereof upon overload, a pair of magnetic members supported separate from and extending about said control element, said members being spaced from each other by a gap and including one member carried by said latch member, and means for adjusting said control element relative to said latch member without disturbing said initial latched engagement or said gap for calibrating the circuit breaker, said control element being normally spaced from said latch member, and said calibration means being operable to vary said spacing.

14. In a circuit breaker having a stationary contact, a movable contact engageable with and disengageable there-

from and mechanism for effecting automatic disengagement thereof upon overload, a trip mechanism comprising a latch member having uniform initial latched engagement with said first mentioned mechanism and a bodily movable pivotally mounted current-responsive control element normally spaced from said latch member and operable upon said latch member for bodily disengaging said latch member from said latched engagement thereof upon overload, a pair of magnetic members supported separate from and extending about said control element, said members being spaced from each other by a gap and including one member carried by said latch member, and means for adjusting said control element relative to said latch member without disturbing said initial latched engagement or said gap for calibrating the circuit breaker, said control element being normally spaced from said latch member, and said calibration means being operable to vary said spacing, said circuit breaker having a housing and said calibration means being accessible externally thereof.

15. A multi-pole circuit breaker having at each pole thereof a circuit breaker mechanism independently operable upon overload in the circuit thereof to open said circuit, said circuit breaker mechanism comprising a movable contact member, an operating mechanism therefor and a trip device operable to latch said operating mechanism in circuit-closed condition, said trip device including a current responsive control member operable to unlatch said trip device from said operating mechanism for operating said movable member to circuit-open condition upon said overload, and trip means extending between said poles and energized at the overloaded pole upon operation of the trip device thereof, and means independent of the control member at each pole and operable by said trip means at the non-overloaded poles for opening the circuits of the latter, said trip device having a part releasably latched to said operating mechanism, and said independent means being a part on said trip device positioned for operation by said trip means for disengaging said latching part from said operating mechanism.

16. A multi-pole circuit breaker having at each pole thereof a circuit breaker mechanism independently operable upon overload in the circuit thereof to open said circuit, said circuit breaker mechanism comprising a movable contact member, an operating mechanism therefor and a trip device operable to latch said operating mechanism in circuit-closed condition, said trip device including a current responsive control member operable to unlatch said trip device from said operating mechanism for operating said movable member to circuit-open condition upon said overload, and trip means extending between said poles and energized at the overloaded pole upon operation of the trip device thereof, and means independent of the control member at each pole and operable by said trip means at the non-overloaded poles for opening the circuits of the latter, said trip device having a part releasably latched to said operating mechanism, and said independent means being a part on said trip device positioned for operation by said trip means for disengaging said latching part from said operating mechanism, and said trip device having a resilient part for biasing said trip means to the operative disposition thereof.

17. A multi-pole circuit breaker having at each pole thereof a circuit breaker mechanism independently operable upon overload in the circuit thereof to open said circuit, said circuit breaker mechanism comprising a movable contact member, an operating mechanism therefor and a trip device operable to latch said operating mechanism in circuit-closed condition, said trip device including a current responsive control member operable to unlatch said trip device from said operating mechanism for operating said movable member to circuit-open condition upon said overload, and an articulated trip member

extending between said poles and having a segment at each pole energized at the overloaded pole for operating said trip member, and means at each pole operable by the associated segment for operating the trip device thereof independently of the control member thereof.

18. A multi-pole circuit breaker having at each pole thereof a circuit breaker mechanism independently operable upon overload in the circuit thereof to open said circuit, said circuit breaker mechanism comprising a movable contact member, an operating mechanism therefor and a trip device operable to latch said operating mechanism in circuit-closed condition, said trip device including a current responsive control member operable to unlatch said trip device from said operating mechanism for operating said movable member to circuit-open condition upon said overload, and an articulated trip member extending between said poles and having a segment at each pole energized at the overloaded pole for operating said trip member, and means at each pole operable by the associated segment for operating the trip device thereof independently of the control member thereof, said trip device having an element engaged by the associated segment for operating said trip device to unlatch its associated operating mechanism.

19. A multi-pole circuit breaker having at each pole thereof a circuit breaker mechanism independently operable upon overload in the circuit thereof to open said circuit, said circuit breaker mechanism comprising a movable contact member, an operating mechanism therefor and a trip device operable to latch said operating mechanism in circuit-closed condition, said trip device including a current responsive control member operable to unlatch said trip device from said operating mechanism for operating said movable member to circuit-open condition upon said overload, and an articulated trip member extending between said poles and having a segment at each pole energized at the overloaded pole for operating said trip member, and means at each pole operable by the associated segment for operating the trip device thereof independently of the control member thereof, said trip device having an element engaged by the associated segment for operating said trip device to unlatch its associated operating mechanism, and means biasing said element for disposing said associated segment in operative disposition thereof.

20. A multi-pole circuit breaker including multiple pairs of contacts and corresponding operating mechanisms and overload release means for said contacts, each of said operating mechanisms including a rockable operating element, the operating elements of said mechanisms being axially aligned, said circuit breaker comprising an insulating casing comprising a plurality of stacked casing walls generally disposed in parallel planes transverse to said coaxial operating members, each of said mechanisms being contained in a cavity provided between a respective confronting pair of said walls, each of said operating elements being supported by bearings formed in the respective confronting walls containing the related contact operating mechanism, said operating elements being keyed together internally of the casing for conjoint operation, and only one of said operating elements including an integral handle projecting externally of the casing through an opening therein.

21. A multi-pole circuit breaker including multiple pairs of contacts and corresponding operating mechanisms and overload release means for said contacts, each of said operating mechanisms including a rockable operating element, the operating elements of said mechanisms being axially aligned, said circuit breaker comprising an insulating casing comprising a plurality of stacked casing walls generally disposed in parallel planes transverse to said coaxial operating members, each of said mechanisms being contained in a cavity provided between a respective confronting pair of said walls, each of said operating elements being supported by bearings formed in the respec-

tive confronting walls containing the related contact operating mechanism, said operating elements having inter-engaging tongue and groove end portions extending through openings in their bearing walls enforcing conjoint operation, and only one of said operating elements including an integral handle projecting externally of the casing through an opening therein.

22. A circuit breaker having a stationary contact, an operating means, a movable contact member pivoted on said operating means to engage and to disengage the stationary contact for closing and opening the circuit, respectively, an actuator member mounted for movement between circuit-closed and circuit-open positions, respectively, thereof, and an overcentering spring interconnected between said members for effecting opening and closing movements of said movable contact member; means for latching said actuator in the circuit closed condition thereof, electro-magnetic control means for releasing said actuator in response to predetermined overload conditions comprising a magnetic member carried by said latching means and a cooperating magnetic member mounted adjacent said first magnetic member, and a current-responsive control element spaced from said magnetic member and operable thereon upon overload for disengaging said latch means from said actuator, and means for adjustably varying a space between said control element and said magnetic member for calibrating the circuit breaker.

23. In a multi-pole circuit breaker having at each pole thereof a circuit breaker mechanism comprising a movable contact member, an operating mechanism therefor and a trip device operable to latch said operating mechanism in circuit-closed condition, said trip device including a current-responsive control member operable to unlatch said trip device from said operating mechanism for operating said movable member to circuit-open condition upon said overload, and trip means extending between said poles and energized at the overloaded pole for operating the control members at the other poles to open the circuits thereof, each of said control members being mounted on a pivot for movement as an entity whereby to reduce the force required at the overload pole to trip all of said poles.

24. A multi-pole circuit breaker having at each pole thereof a circuit breaker mechanism operable upon the occurrence of predetermined current in the circuit thereof to open said circuit, each of said mechanisms comprising a movable contact member, an actuator means operatively connected to said movable contact member and a latching means for latching its associated actuator means in circuit-closed disposition thereof and for releasing the same for operating said movable member to circuit-open condition upon said occurrence, and means operatively common to all poles of said circuit breaker and disposed for operation by a released actuator means upon said occurrence in the associated circuit of said released actuator means for operating the circuit-breaker mechanism at a companion pole to the circuit-open condition thereof, said mechanism including a current responsive control element operable upon said latching means in response to predetermined current to release its associated actuator, and said means common to all of said poles being operable upon the control elements at the other poles to release the actuators thereof.

25. A multi-pole circuit breaker having at each pole

thereof a circuit breaker mechanism operable upon the occurrence of predetermined current in the circuit thereof to open said circuit, each of said mechanisms comprising a movable contact member, an actuator means operatively connected to said movable contact member and a latching means for latching its associated actuator means in circuit-closed disposition thereof and for releasing the same for operating said movable member to circuit-open condition upon said occurrence, and means operatively common to all poles of said circuit breaker and disposed for operation by a released actuator means upon said occurrence in the associated circuit of said released actuator means for operating the circuit-breaker mechanism at a companion pole to the circuit-open condition thereof, said mechanism including a current responsive control element operable upon said latching means in response to predetermined current to release its associated actuator, and said means common to all of said poles being operable upon the control elements at the other poles to release the actuators thereof, each latching means having an electro-magnetic member energized by the associated control means and a companion electro-magnetic member mounted adjacent thereto, and said control means being operable on the associated first mentioned electro-magnetic member to release the associated actuator.

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