Feb. 2, 1937. W. H. FRANK 2,069,305

AUTOMATIC RESET CIRCUIT BREAKER

Original Filed April 21, 1933 3 Sheets-Sheet 1

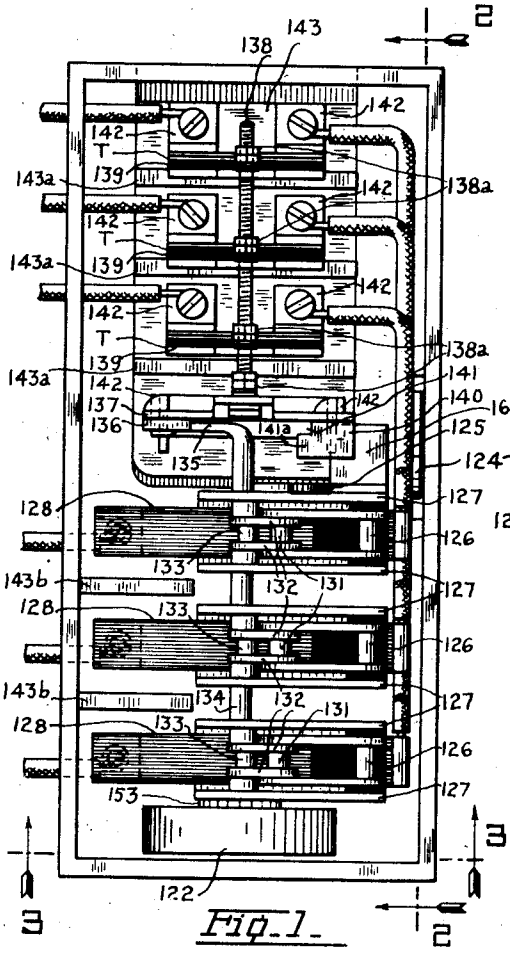


Fig. 1.

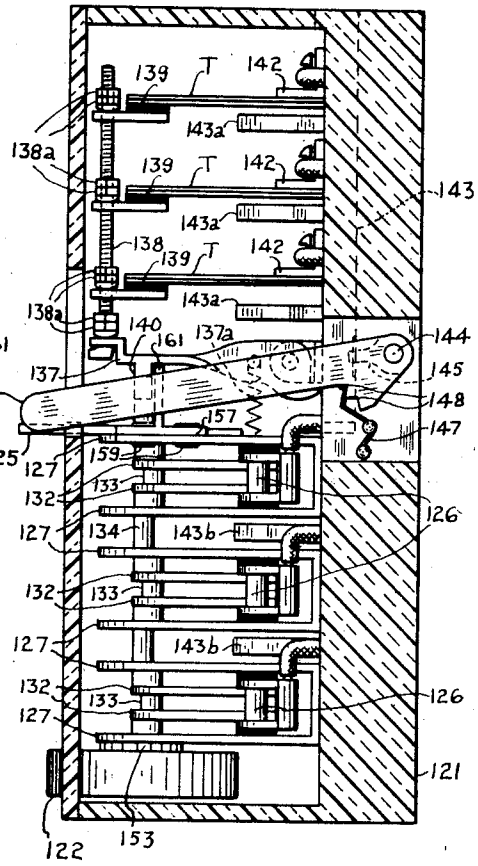


Fig. 2.

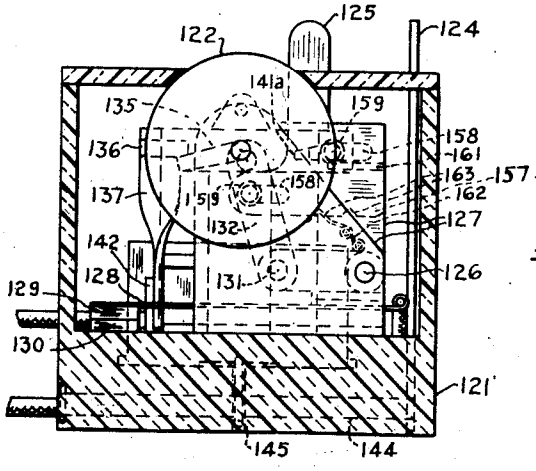


Fig. 3.

INVENTOR.
William H. Frank

BY
Daniel G. Fullem

ATTORNEY.

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AUTOMATIC RESET CIRCUIT BREAKER

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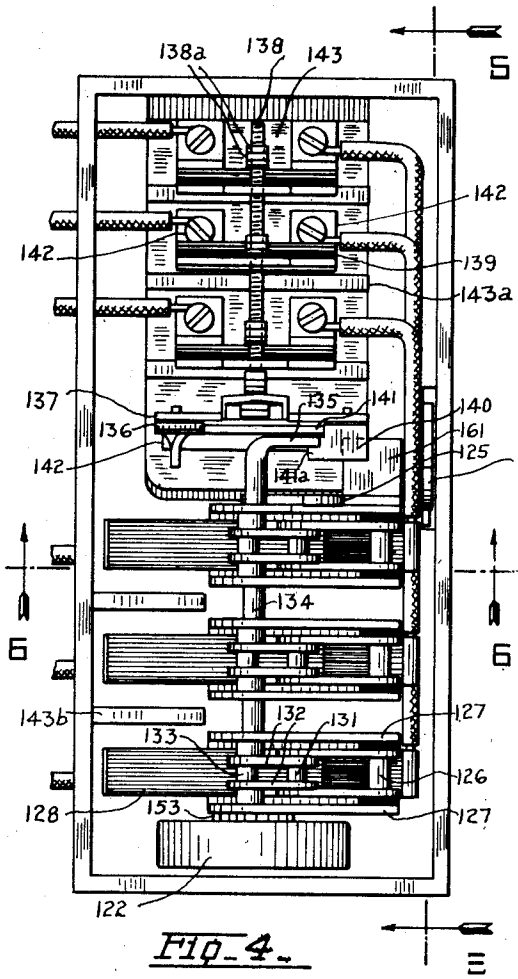


Fig. 4.

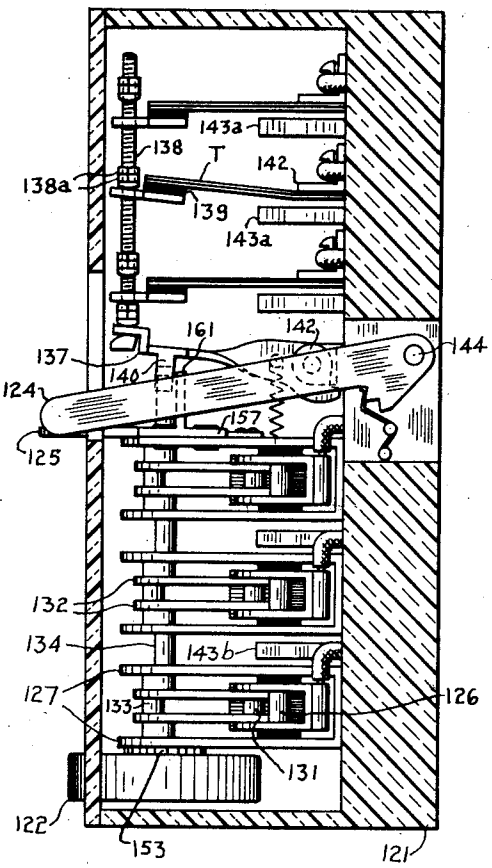


Fig. 5

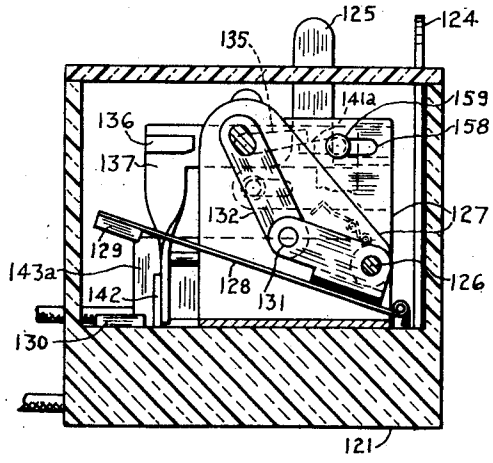


Fig. 6

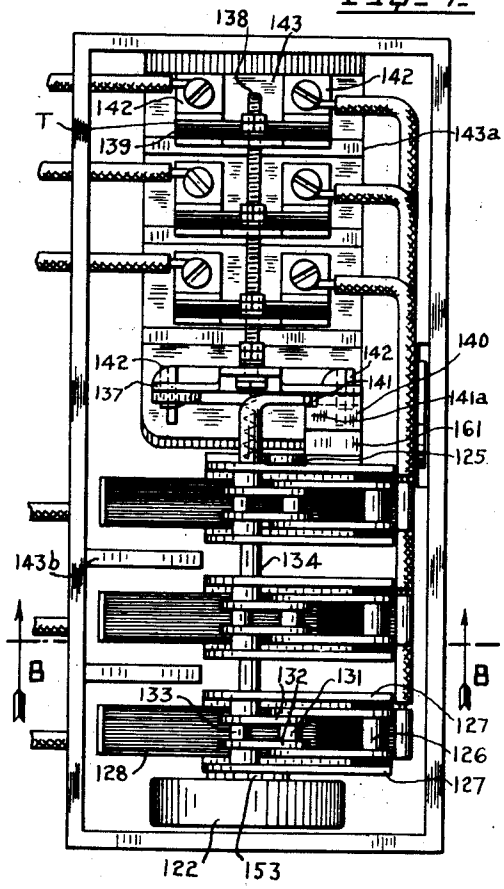
INVENTOR.
William H. Frank
BY
Daniel G. Fuller
ATTORNEY.

Feb. 2, 1937. W. H. FRANK 2,069,305

AUTOMATIC RESET CIRCUIT BREAKER

Original Filed April 21, 1933 3 Sheets-Sheet 3

Fig. 7.



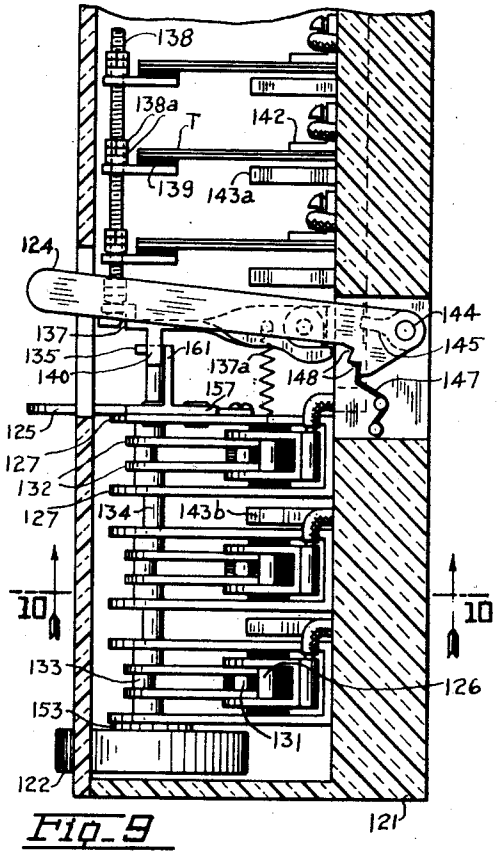
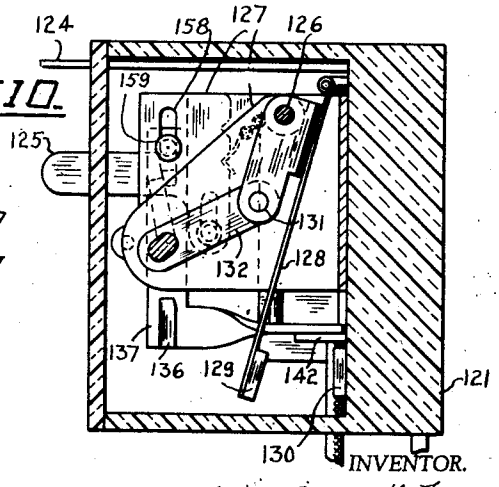


Fig. 9

Fig. 10.



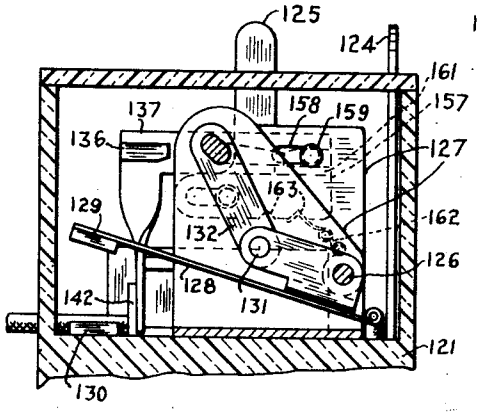


Fig. 8

INVENTOR.

William H. Frank

BY Daniel G. Gullen.

ATTORNEY.

Patented Feb. 2, 1937 2,069,305

UNITED STATES PATENT OFFICE

2,069,305

AUTOMATIC RESET CIRCUIT BREAKER

William H. Frank, Detroit, Mich., assignor to Bulldog Electric Products Company, Detroit, Mich., a corporation of West Virginia

Original application April 21, 1933, Serial No. 667,149. Divided and this application August 24, 1935, Serial No. 37,728

18 Claims. (Cl. 200—116)

This application relates to circuit protective devices known as circuit breakers and is a divisional of application Serial No. 667,149, filed April 21, 1933.

This application discloses a number of automatically resetting circuit protective devices arranged in a multipole combination unit for protecting a multipole line, a characteristic of the unit being such that an overload or short circuit in any one phase of the line will cause the entire line to be opened in all phases.

Still further objects of the invention will presently appear upon reference to the following detailed description of the structures disclosed in the appended drawings. In these drawings,

Figs. 1–3 are top plan, end section and elevational section views of a three pole unit, the parts being shown in "on" position, the views of Figs. 2–3 being taken on lines 2—2, 3—3 of Fig. 1;

Figs. 4–6 inclusive are similar views of the same device with the parts shown in an "off" position, due to overload;

Figs. 7–8 are top plan and elevational sections of the device in an "off" position, due to operation of a manual reset latch;

Figs. 9 and 10 are sectional views of the device in an "off" position, due to a manual control operation, with Fig. 10 being a section as if on lines 10—10 of Fig. 9.

The multi-pole unit

There is here disclosed a multi-pole (three pole) unit, which includes three thermal elements, respectively controlled by the conditions of the three phases of the controlled line, the three elements being operatively connected to three contact arms through a single operating shaft. The three contact arms individually but simultaneously close or open the three phases, and the operation of the device is such that an overload in any one phase opens all of the phases. The unit is of the automatic resetting type and is shown as provided with a single manual control means and a single manual reset latch.

The unit is also characterized by the fact that while the thermal elements move in a direction parallel to the operating shaft they function through a separate release member to trip and reset the breakers. The units may be regarded as similar to breakers per se of Figures 1 to 10 inclusive, and Figures 11 to 18 inclusive of application Serial No. 667,149.

The breaker parts are mounted upon a base 121 of insulating material and are enclosed within a cover, also of insulating material, the cover having three slots through which project the three manually engageable parts of the unit, namely, the winding drum 122, the manual control lever or handle 124, and the manual reset latch 125. Pivotally mounted on three axle pins 126 to and between the three pairs of upstanding fixed frame plates 127 are three relatively isolated breaker contact arms 128 having three line contacts 129 for engaging the three fixed contacts 130 of the unit.

Pivotally connected by three axle pins 131 to upstanding parts of the breaker contact arms 128, are three pairs of connecting rod links 132 which at their upper ends are connected to three cranks 133, all of which are formed on the single breaker operating shaft 134, the latter being trunnioned in aligned holes of the upstanding frame plates 127. It is observed that rotation of the operating shaft 134 operates, through the medium of the cranks 133 and the connecting rod links 132, to move the three contact arms simultaneously to and from contact making and breaking position.

It is observed that while certain of the parts are shown in triplicate, single parts may be used, if desired, the device still remaining, in effect, a three pole crank type switch.

One end of the operating shaft is bent perpendicularly to the axis of the shaft to provide a holding crank 135 adapted to be held by one or another of the stops actuated by the three thermal elements referenced generally T. These three elements are respectively and individually connected at one end thereof to contact arms 128, and at the other, to the load.

The "on" holding stop, that is to say, the stop which holds the holding crank 135 in the "on" position, Figures 1 to 3, is referenced 136, and is in the nature of a lug provided on a plate 137 which is operatively connected to every one of the three thermal elements T, by an elongated bolt 138, there being adjusting and locking nuts 138a on this bolt, to provide suitable one way connections, it being observed that the bolt 138 is insulated from the thermal elements by insulating strips 139.

The other stop, that is to say, the stop which holds the crank 135 in the off position, Figures 4 to 6, is referenced 140 and is also in the nature of a lug provided on the plate 137. The stop 140 has a notch 141 directly in line with the stop 136 and has a tooth 141a somewhat out of line from the stop 136.

The lower ends of the thermal elements and the lower end of the plate 137 (the latter

through a pivotal connection) are mounted on brackets 142, in turn positioned upon a single large block of insulating material 143, disposed in a depression in the upper surface of the base and so proportioned as to be able to slide in such depression, in a direction parallel to the axis of the operating shaft 134. A light coil spring 137a connected to plate 137 and a frame part tends to resist any pull that the elements T might exercise on plate 137, as the elements warp, and tends to maintain the plate 137 to the on position.

Further, formed on block 143 are barriers 143a which isolate one thermal element from its neighbor so that one is not affected by a thermal condition of the other. Similar barriers 143b isolate the contact arms 128 from one another to prevent over-arcing.

For manually sliding the block 143 in this depression, there is provided an actuating device whose handle was previously referred to as a manual control lever or handle 124. This handle is journalled in the base on the end of a cross shaft 144, which shaft is provided with an upstanding finger 145 engaging in a notch in the lower surface of the block 143, and it will be observed that movement of the actuating handle 124 rotates shaft 144 and slides the block 143 in its depression. For latching the handle 124 in the on position of Figure 2 or in the off position of Fig. 9, there is provided a spring 147 adapted to engage one or another of a pair of notches 148, formed in that part of the handle near the shaft 144.

On the end of the operating shaft, opposite that end thereof, which is formed as a holding crank 135 is a drum previously referenced 122 and containing a clock spring (not shown) wound upon the end of the operating shaft and having one end fixed to the shaft and the other end fixed to the drum. This spring tends to rotate the operating shaft clockwise, Figure 3, and its influence is opposed by the stops 136 and 141a previously mentioned.

For winding the spring, the operator rotates the drum, which is rotatably journalled on the shaft and is held against reverse rotation by a ratchet wheel 153, fixed to the drum and disposed between a frame plate 127 and the drum, as indicated in Figure 1. A clock work pawl (not shown) cooperates with the ratchet to prevent movement of the drum in the counter-clockwise direction as the drum is being rotated clockwise to wind the spring, it being observed that the drum can be wound by moving it with the thumb.

In order to provide a manual reset latch which maintains the circuit open and prevents any or all phases of the line from being closed unintentionally, there is slidably mounted on one of the upstanding frame plates 127, a plate 157, guided on the upstanding frame plate through the medium of the slots 158 receiving pins 159 projecting from the frame. The latching plate is formed with an extension 161 adapted to be moved with the plate, to underlie the notch 141, and when so moved, to prevent rotation of the holding crank 135 from the off position to the on position. The spring 162 cooperates with notches 163 in the lower edge of the plate 157 to define positions of the latter.

The operations of the multi-pole unit will now be described in complete detail. Assume the parts to be in on position. At this time the holding crank 125 engages and is disposed under the on stop 136 and the operating shaft and its associated parts are held in the on position, with the contact arms 128 in horizontal position, so that contacts 129 engage contacts 130, the parts being held against the influence of the spring in drum 122 which tends to rotate the operating shaft clockwise. It is observed that plate 137 occupies such a position on normal load that the stop 136 is directly in line with holding crank 135.

Upon the arising of an overload in any phase, the thermal element T connected to that phase will warp in the direction of the axis of the operating shaft 134, that is to say, away from the crank 135, sufficiently to pull on bolt 138, and accordingly on plate 137 to move stop 136 away from the holding crank. The spring in drum 122 consequently rotates the operating shaft clockwise with an extremely rapid movement, causing an upward pull on the connecting rod links 132 and pivoting the contact arms 128 from the closed circuit positions of Figure 3 to the open circuit positions of Figure 6. When plate 137 moved away from crank 135, it placed the tooth 141a of stop 140 in the path of crank 135, consequently, the crank rotated upon overload but one-half turn, being engaged by the stop of tooth 141a to restrain further rotation of the parts.

When the circuit has been opened sufficiently long for the previously warped thermal element, (or elements, if such be the case) to cool or warp back to its original position, the pull on bolt 138 will be relieved and the coil spring 137a connected to plate 137 will move the latter back to its original position. The stop tooth 141a will move away from crank 135 and notch 141 will be placed in line with this crank. Accordingly, the operating shaft will be free to rotate and the drum spring will rapidly rotate the shaft another one-half turn clockwise to close the circuit and to bring holding crank 135 once more under and against stop 136.

If any phase, at this moment, has an overload on it, this cycle of operations will be repeated, and will continue so long as the overload is in existence or until the drum spring has been run down to such an extent that it can no longer rotate the parts or until the operator manually controls the circuit breaker. Consequently, it will be seen that the circuit breaker automatically resets itself after having been opened on overload in any phase, provided all of the thermal elements have assumed, or are in, the unwarped position.

For manual control operation the actuating handle 124 is utilized to move the slide block and consequently the thermal elements and the plate 137 away from the crank 135, thus freeing the crank and permitting the operating shaft to be rotated to off position. Reverse movement of the handle 124 will restore the parts to the position they occupy in Figures 1 to 3, freeing the crank which then rotates to its on position against stop 136.

In the event it is desired to latch the breaker in the off position, the manual reset latch 125 is moved from the position of Figures 1 to 3, to the position of Figures 7 and 8, placing the extension stop 161 under the notch 141 for manual reset latching.

I claim:

1. A multipole automatically resetting circuit breaker unit for a multipole line, including a plurality of operated members, one for each phase, means providing each member with a constant tendency to move to and from on and

off positions, successively and repeatedly, and a plurality of elements, one for each phase, each of which is arranged to be energized on an abnormality in its phase, and thereafter to be de-energized automatically, each element being arranged to control the movements of all the members, so that all of the latter will go through successive and repeated cycles of movement, stopping in each of their two positions momentarily, at least, so long as there exists an abnormality on any one or more phases of the line.

2. A multipole automatically resetting circuit breaker unit for a multipole line, including a multipole operated member, means providing the member with a constant tendency to move to and from on and off positions, successively and repeatedly, and a plurality of elements, one for each phase, each of which is arranged to be energized on an abnormality in its phase, and thereafter to be de-energized automatically, each element being arranged to control the movements of the member, so that the latter will go through successive and repeated cycles of movement, stopping in each of its two positions, momentarily, at least, so long as there exists an abnormality on any one or more phases of the line.

3. A multipole automatically resetting circuit breaker for a multipole line, including a multipole operated member, and means arranged to move the member to open circuit position on an overload or short circuit in any phase, and automatically to closed circuit position thereafter.

4. A multipole automatically resetting circuit breaker unit for a multipole line, including a plurality of operated members, one for each phase, means providing each member with a constant tendency to move to and from on and off positions, successively and repeatedly, and a plurality of elements, one for each phase, each of which is arranged to be energized on an abnormality in its phase, and thereafter to be de-energized automatically, each element being arranged to control the movements of all the members, so that all of the latter will go through successive and repeated cycles of movement, stopping in each of their two positions momentarily, at least, so long as there exists an abnormality on any one or more phases of the line, and manually controllable means for latching all of said members in off position.

5. A multipole automatically resetting circuit breaker unit for a multipole line, including a plurality of operated members, one for each phase, means providing each member with a constant tendency to move to and from on and off positions, successively and repeatedly, and a plurality of elements, one for each phase, each of which is arranged to be energized on an abnormality in its phase, and thereafter to be de-energized automatically, each element being arranged to control the movements of all the members, so that all of the latter will go through successive and repeated cycles of movement, stopping in each of their two positions momentarily, at least, so long as there exists an abnormality on any one or more phases of the line, and manually controllable means operating on said controlling elements for manually causing them to cause movement of said members to and from on and off positions, as desired.

6. A multipole automatically resetting circuit breaker unit for a multipole line, including a plurality of operated members, one for each phase, means providing each member with a constant tendency to move to and from on and off positions, successively and repeatedly, and a plurality of elements, one for each phase, each of which is arranged to be energized on an abnormality in its phase, and thereafter to be de-energized automatically, each element being arranged to control the movements of all the members, so that all of the latter will go through successive and repeated cycles of movement, stopping in each of their two positions momentarily, at least, so long as there exists an abnormality on any one or more phases of the line, and manually controllable means for latching all of said members in off position, and manually controllable means operating on said controlling elements for manually causing them to cause movement of said members to and from on and off positions, as desired.

7. A multipole circuit breaker unit for a multipole multiphase line including a plurality of circuit responsive elements arranged one for each phase, a plurality of circuit making elements arranged one for each phase, a common actuator for all the circuit making elements, a common controlling element operatively connected to all the circuit responsive elements so as to be moved by movement of any one of the circuit responsive elements, and so operatively connected to the actuator as to cause movement thereof and with it movement of all of the circuit making elements simultaneously when it is moved.

8. A multipole circuit breaker unit for a multipole multiphase line including a plurality of circuit responsive elements arranged one for each phase, a plurality of circuit making elements arranged one for each phase, a common actuator for all the circuit making elements, a common controlling element operatively connected to all the circuit responsive elements so as to be moved by movement of any one of the circuit responsive elements, and so operatively connected to the actuator as to cause movement thereof and with it movement of all of the circuit making elements simultaneously when it is moved, there being a lost motion connection between the controlling element and each of the circuit responsive elements arranged to permit the controlling element to be moved by any one of the circuit responsive elements without requiring movement of the other circuit responsive elements.

9. A multipole circuit breaker unit for a multipole multiphase line including a plurality of circuit responsive elements arranged one for each phase, a plurality of circuit making elements arranged one for each phase, a common actuator for all the circuit making elements, a common controlling element operatively connected to all the circuit responsive elements so as to be moved by movement of any one of the circuit responsive elements, and so operatively connected to the actuator as to cause movement thereof and with it movement of all of the circuit making elements simultaneously when it is moved, the actuator being provided with means constantly tending to cause the circuit making elements to go through successive and repeated cycles of movement, stopping in each of two positions at least momentarily, the influence of the means on the circuit making elements being controlled by the moving controlling element.

10. A multipole circuit breaker unit for a multipole multiphase line including a plurality of cir-

cuit responsive elements arranged one for each phase, a plurality of circuit making elements arranged one for each phase, a common actuator for all the circuit making elements, a common controlling element operatively connected to all the circuit responsive elements so as to be moved by movement of any one of the circuit responsive elements, and so operatively connected to the actuator as to cause movement thereof and with it movement of all of the circuit making elements simultaneously when it is moved, the actuator being provided with means constantly tending to cause the circuit making elements to go through successive and repeated cycles of movement, stopping in each of two positions at least momentarily, the influence of the means on the circuit making elements being controlled by the moving controlling element, and manually operable means for causing movements of the controlling element.

11. A multipole circuit breaker unit for a multipole multiphase line including a plurality of circuit responsive elements arranged one for each phase, a plurality of circuit making elements arranged one for each phase, a common actuator for all the circuit making elements, a common controlling element operatively connected to all the circuit responsive elements so as to be moved by movement of any one of the circuit responsive elements, and so operatively connected to the actuator as to cause movement thereof and with it movement of all of the circuit making elements simultaneously when it is moved, the actuator being provided with means constantly tending to cause the circuit making elements to go through successive and repeated cycles of movement, stopping in each of two positions at least momentarily, the influence of the means on the circuit making elements being controlled by the moving controlling element, and manually operable means for causing movements of the controlling element, there being a lost motion connection between the controlling element and each of the circuit responsive elements arranged to permit the controlling element to be moved by any one of the circuit responsive elements without requiring movement of the other circuit responsive elements, the lost motion connection aforesaid permitting the controlling element to be moved manually without requiring movement of any of the circuit responsive elements.

12. A multipole circuit breaker unit for a multipole multiphase line including a plurality of circuit responsive elements arranged one for each phase, a plurality of circuit making elements arranged one for each phase, a common actuator for all the circuit making elements, a common controlling element operatively connected to all the circuit responsive elements so as to be moved by movement of any one of the circuit responsive elements, and so operatively connected to the actuator as to cause movement thereof and with it movement of all of the circuit making elements simultaneously when it is moved, the actuator being provided with means constantly tending to cause the circuit making elements to go through successive and repeated cycles of movement, stopping in each of two positions at least momentarily, the influence of the means on the circuit making elements being controlled by the moving controlling element, and a manually operable latch for preventing movement of the actuator out of one position after it has been moved to that position by the means aforesaid and operable for that purpose at any time and without itself causing movement of the actuator out of that position.

13. A multipole circuit breaker unit for a multipole multiphase line including a plurality of parallel circuit responsive elements arranged one for each phase, a plurality of parallel circuit making elements arranged one for each phase, a common actuator for all the circuit making elements and arranged transverse to them, and comprising a rod having a crank end, a common controlling element operatively connected to all the circuit responsive elements by means transverse thereof so as to be moved by movement of any one of the circuit responsive elements, and having stops for engagement by the crank end of the actuator rod to control movement of the rod, and with it movement of all the circuit making elements simultaneously.

14. A multipole circuit breaker unit for a multipole multiphase line including a plurality of parallel circuit responsive elements arranged one for each phase, a plurality of parallel circuit making elements arranged one for each phase, a common actuator for all the circuit making elements and arranged transverse to them, and comprising a rod having a crank end, a common controlling element operatively connected to all the circuit responsive elements by means transverse thereof so as to be moved by movement of any one of the circuit responsive elements, and having stops for engagement by the crank end of the actuator rod to control movement of the rod, and with it movement of all the circuit making elements simultaneously, the controlling element being positively connected to the means transverse of the circuit responsive elements, which means in turn is connected to each of the circuit responsive elements by a lost motion connection so arranged as to permit the means and the controlling element to be moved by any one of the circuit responsive elements without requiring movement of the other of the circuit responsive elements.

15. A multipole circuit breaker unit for a multipole multiphase line including a plurality of parallel circuit responsive elements arranged one for each phase, a plurality of parallel circuit making elements arranged one for each phase, a common actuator for all the circuit making elements and arranged transverse to them, and comprising a rod having a crank end, a common controlling element operatively connected to all the circuit responsive elements by means transverse thereof so as to be moved by movement of any one of the circuit responsive elements and having stops for engagement by the crank end of the actuator rod to control movement of the rod, and with it movement of all the circuit making elements simultaneously, the actuator being positively connected to the circuit making elements and being provided with means constantly tending to rotate the actuator on its axis, with such rotation being controlled by the controlling element whose stops are engaged by the actuator crank end.

16. A multipole circuit breaker unit for a multipole multiphase line including a plurality of parallel circuit responsive elements arranged one for each phase, a plurality of parallel circuit making elements arranged one for each phase, a common actuator for all the circuit making elements and arranged transverse to them, and comprising a rod having a crank end, a common controlling element operatively connected to all the circuit responsive elements by means transverse thereof so as to be moved by movement of any

one of the circuit responsive elements and having stops for engagement by the crank end of the actuator rod to control movement of the rod, and with it movement of all the circuit making elements simultaneously, the actuator being positively connected to the circuit making elements and being provided with means constantly tending to rotate the actuator on its axis, with such rotation being controlled by the controlling element whose stops are engaged by the actuator crank end, and manually operable means for causing movements of the controlling element.

17. A multipole circuit breaker unit for a multipole multiphase line including a plurality of parallel circuit responsive elements arranged one for each phase, a plurality of parallel circuit making elements arranged one for each phase, a common actuator for all the circuit making elements and arranged transverse to them, and comprising a rod having a crank end, a common controlling element operatively connected to all the circuit responsive elements by means transverse thereof so as to be moved by movement of any one of the circuit responsive elements and having stops for engagement by the crank end of the actuator rod to control movement of the rod, and with it movement of all the circuit making elements simultaneously, the actuator being positively connected to the circuit making elements and being provided with means constantly tending to rotate the actuator on its axis, with such rotation being controlled by the controlling element whose stops are engaged by the actuator crank end, and manually operable means for causing movements of the controlling element, the lost motion connection aforesaid permitting the controlling element to be moved manually without requiring movement of any of the circuit responsive elements.

18. A multipole circuit breaker unit for a multipole multiphase line including a plurality of parallel circuit responsive elements arranged one for each phase, a plurality of parallel circuit making elements arranged one for each phase, a common actuator for all the circuit making elements and arranged transverse to them, and comprising a rod having a crank end, a common controlling element operatively connected to all the circuit responsive elements by means transverse thereof so as to be moved by movement of any one of the circuit responsive elements and having stops for engagement by the crank end of the actuator rod to control movement of the rod, and with it movement of all the circuit making elements simultaneously, the actuator being positively connected to the circuit making elements and being provided with means constantly tending to rotate the actuator on its axis, with such rotation being controlled by the controlling element whose stops are engaged by the actuator crank end, and a manually operable latch for preventing movement of the actuator out of one position after it has been moved to that position by the means aforesaid and operable for that purpose at any time and without itself causing movement of the actuator out of that position.

WILLIAM H. FRANK.