July 20, 1943. W. M. SCOTT, JR 2,324,543

ENCLOSED CIRCUIT BREAKER OPERATING MECHANISM

Filed Feb. 6, 1941 6 Sheets-Sheet 1

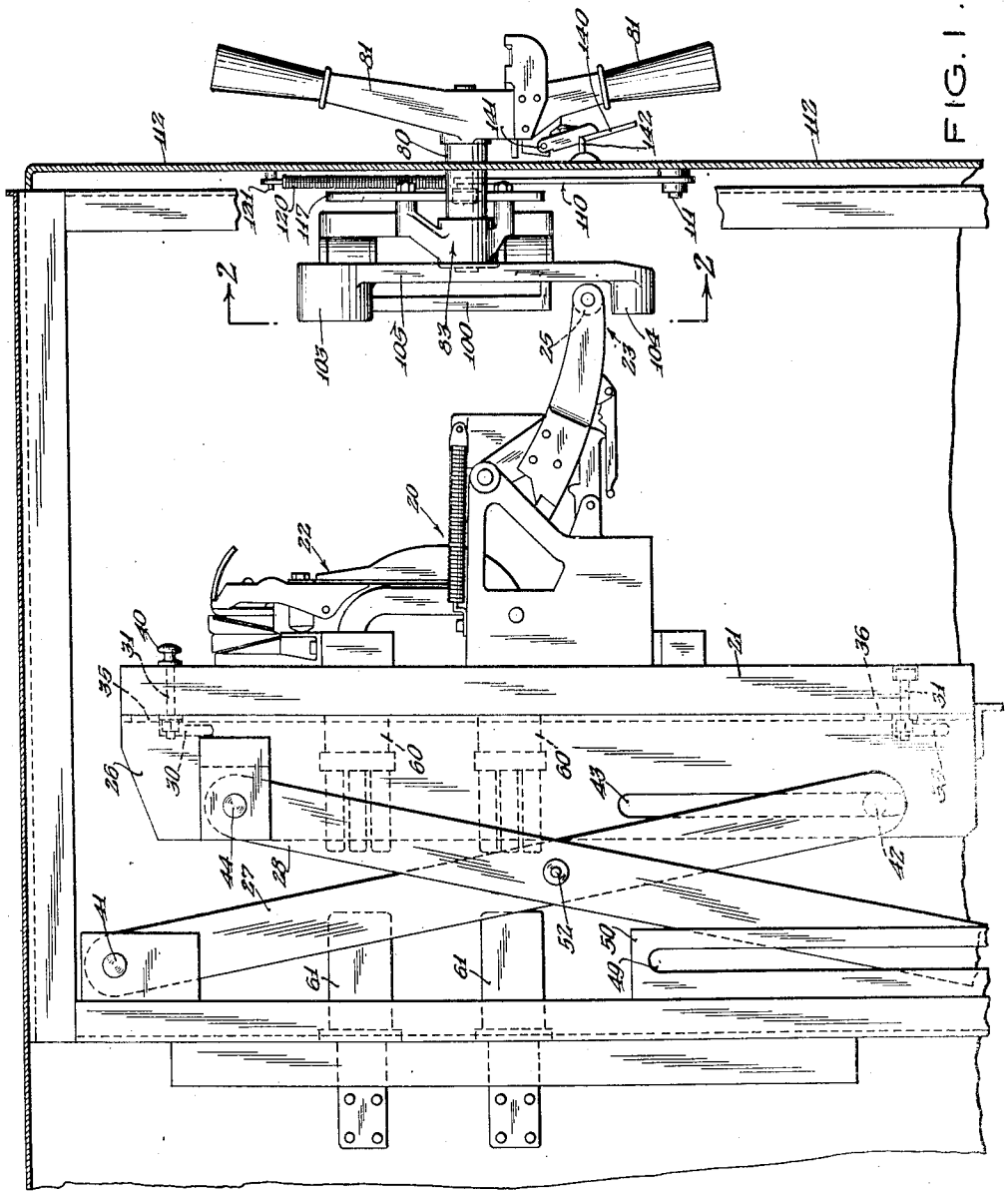


FIG. 1.

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ENCLOSED CIRCUIT BREAKER OPERATING MECHANISM

Filed Feb. 6, 1941 6 Sheets-Sheet 2

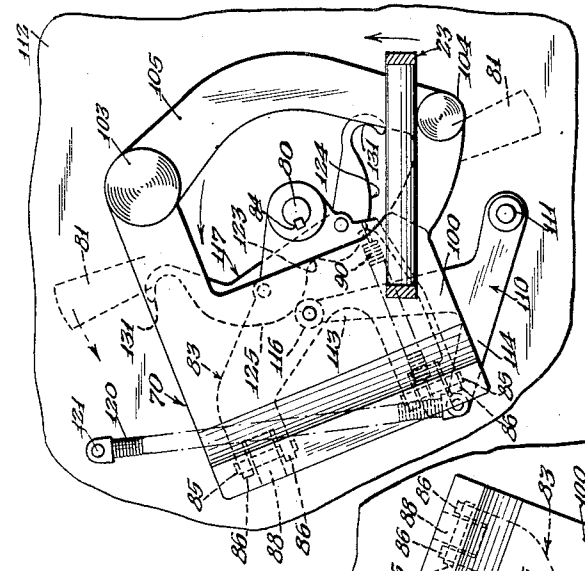


FIG. 3.

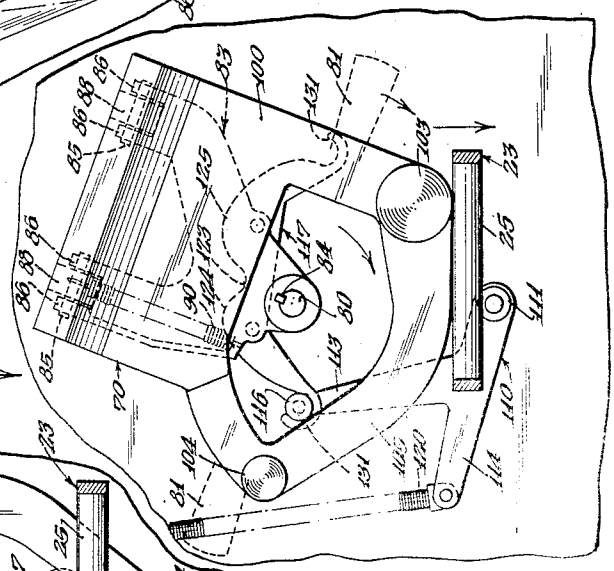


FIG. 4

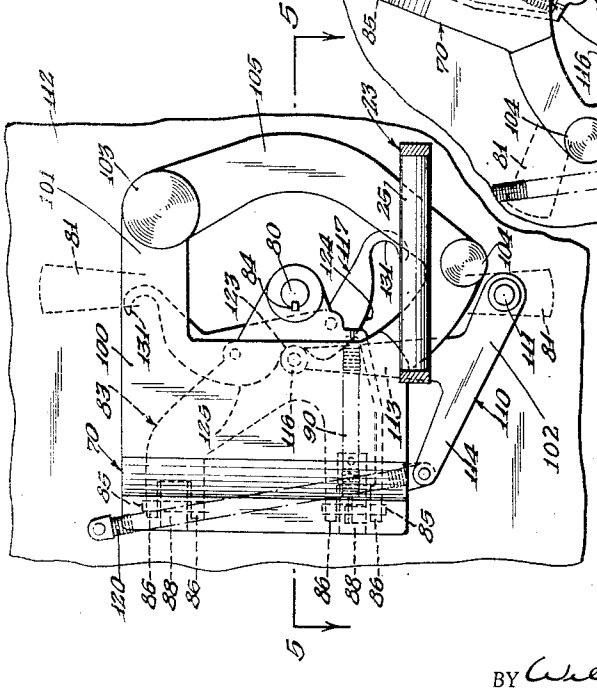


FIG. 2.

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ENCLOSED CIRCUIT BREAKER OPERATING MECHANISM

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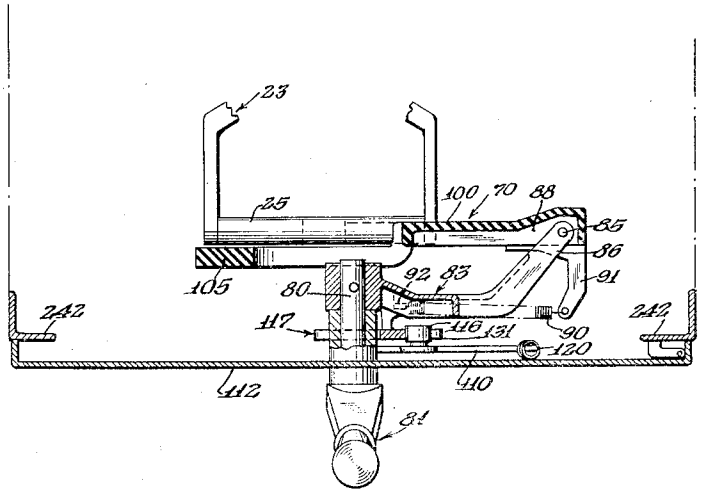


FIG. 5.

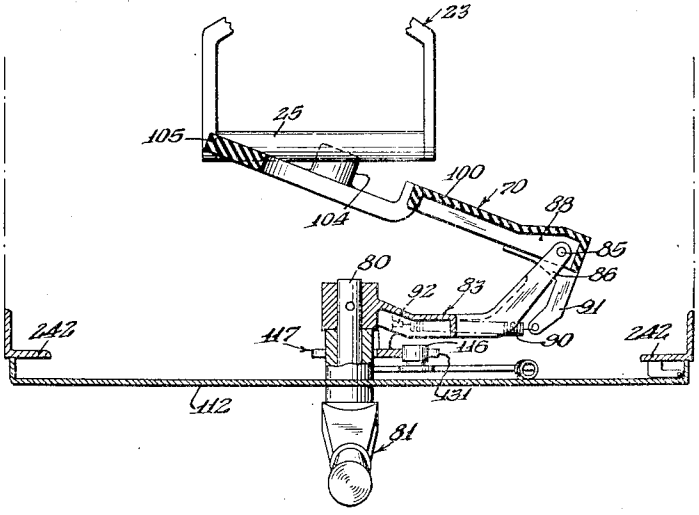


FIG. 6.

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ENCLOSED CIRCUIT BREAKER OPERATING MECHANISM

Filed Feb. 6, 1941 6 Sheets-Sheet 4

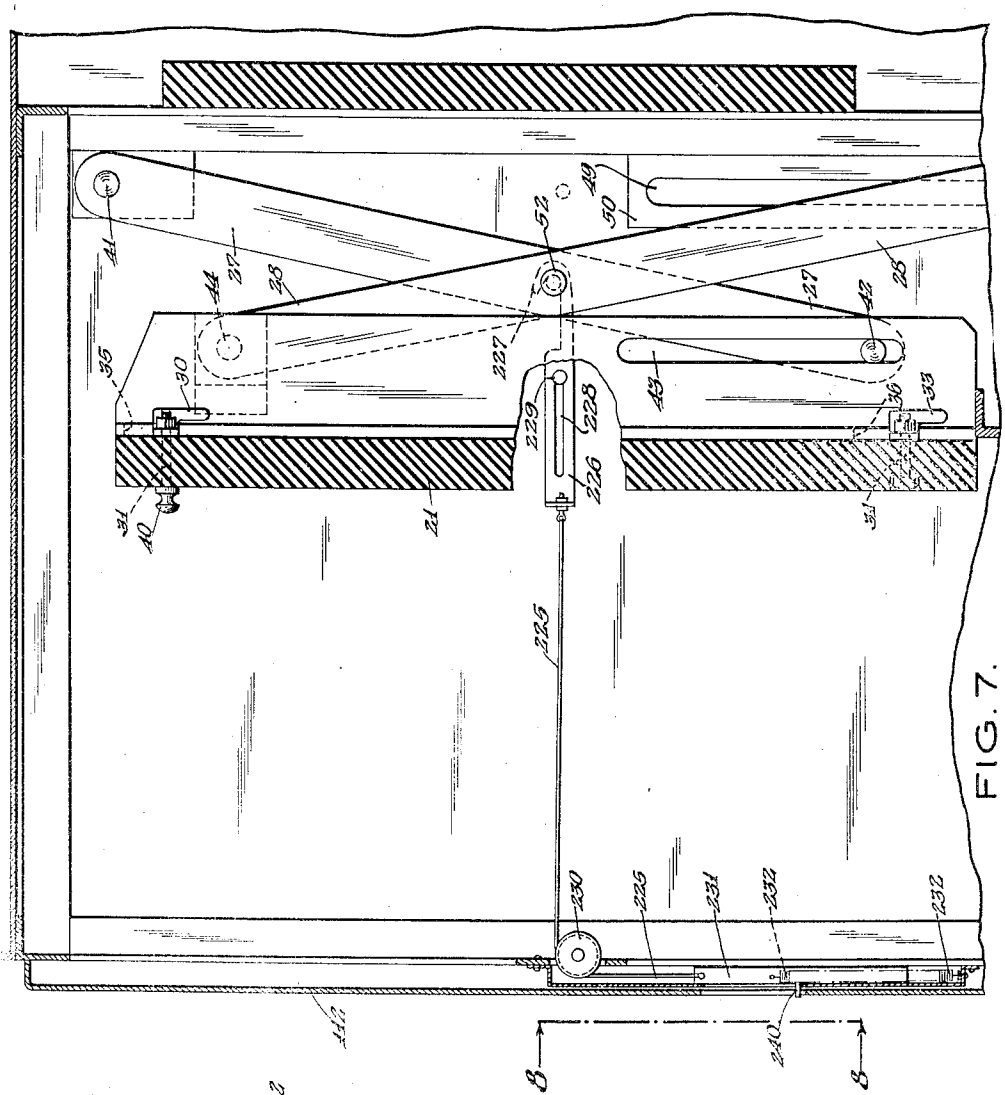


FIG. 7.

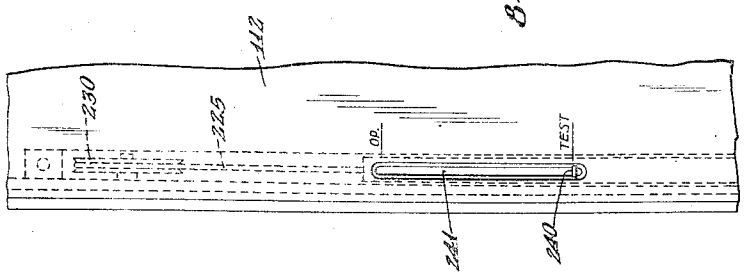


FIG. 8.

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ENCLOSED CIRCUIT BREAKER OPERATING MECHANISM

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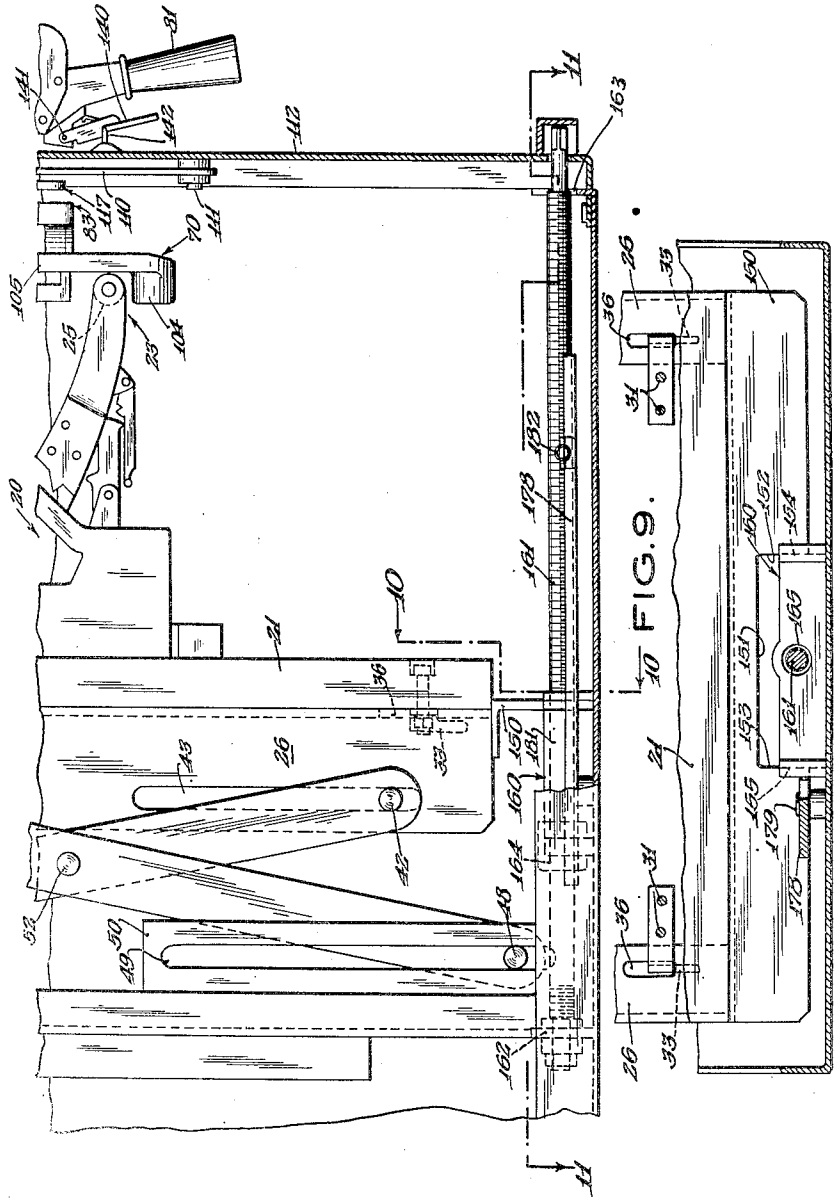


FIG. 9.

FIG. 10.

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ENCLOSED CIRCUIT BREAKER OPERATING MECHANISM

Filed Feb. 6, 1941 6 Sheets-Sheet 6

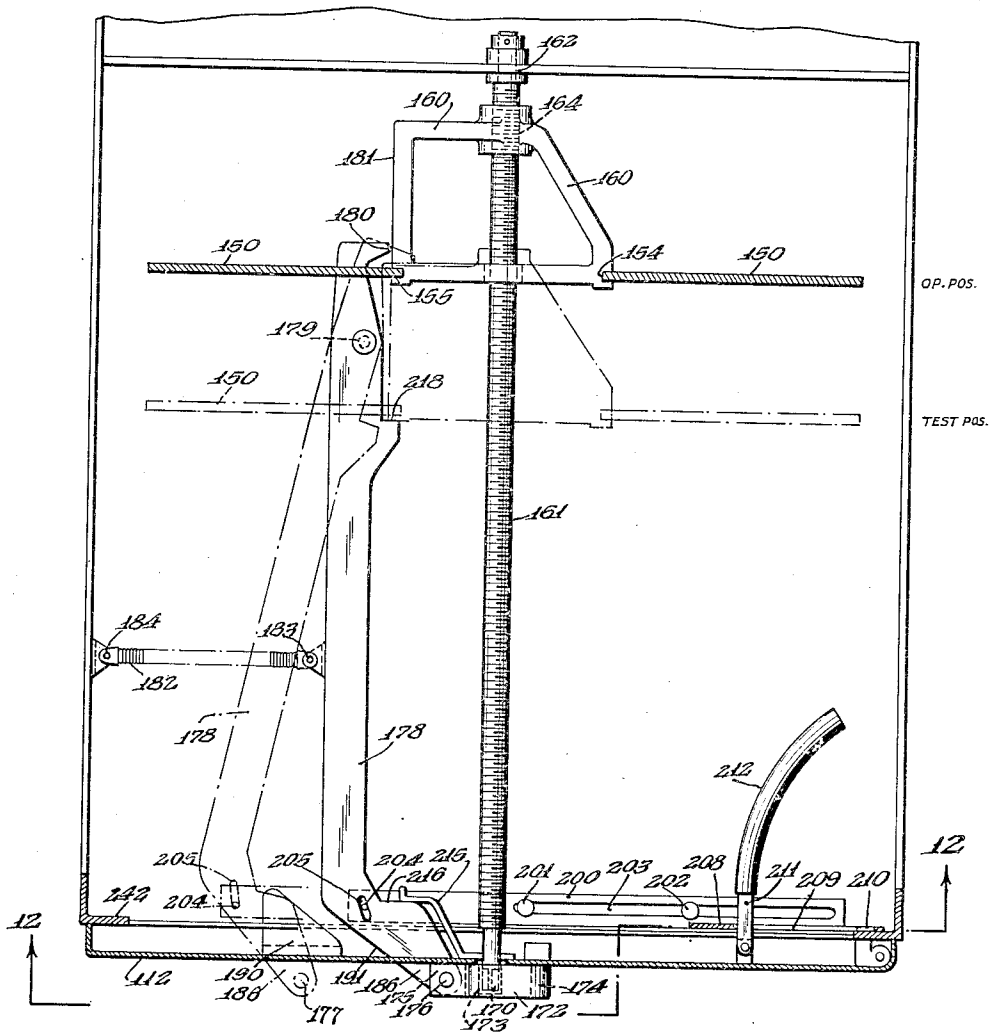


FIG. 11.

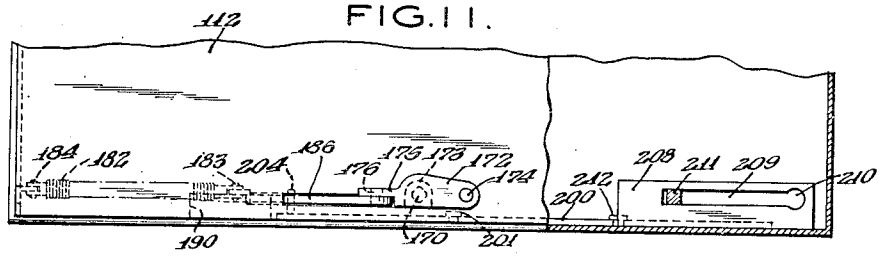


FIG. 12.

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Patented July 20, 1943 2,324,543

UNITED STATES PATENT OFFICE

2,324,543

ENCLOSED CIRCUIT BREAKER OPERATING MECHANISM

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Application February 6, 1941, Serial No. 377,605

25 Claims. (Cl. 200—168)

This invention relates to circuit interrupters of the withdrawal type and more particularly to housings therefor, and means accessible outside the housing for operating the circuit interrupter while it is enclosed within the housing whether it is in service position or in test position.

In the arrangement and installation of circuit interrupters or circuit breakers which are intended to carry a relatively high load, it is customary and desirable that each circuit breaker be enclosed in an individual steel housing which fully surrounds the same. In such cases, the circuit breaker unit is accessible for replacement, readjustment and repair through a door placed in the front of the housing. The circuit breaker may, however, be operated by manual or other control means which project through the door of the housing and which are connected in operable condition when the door of the housing is closed.

Ordinarily installations where a multiplicity of circuit breakers are used, it is desired that the front panel which is made up of a plurality of doors covering the front of each of the housings be uniform and unmarred by doors standing open and apparatus exposed. No means, however, has previously been provided in connection with enclosed circuit breakers operated directly by closing mechanism on the door for permitting the removal of the circuit breaker to test position or the positioning of the circuit breaker within the housing in test position so that it is disconnected from the contacts at the rear of the housing while at the same time the front door of the housing may remain closed in order to maintain the desired uniform condition. This is particularly so where the handle shaft is normal to the front door or panel.

An object of this invention, therefore, is the formation and construction of the housing and operating members for a circuit breaker or circuit interrupter so that the same may be withdrawn from in service position to test position while the front door of the housing remains closed and locked.

Another object of the present invention is the provision of means in circuit breaker or circuit interrupter housings which will permit the placement of the circuit breaker in test position in a housing while the front door of the housing is completely closed so that the circuit breaker together with its auxiliary equipment may be properly tested under the exact conditions and in the exact environment in which it is to be used.

To this extent, the present invention relates to an improved and simplified form of the devices disclosed in Patent No. 1,955,287 to Graves and Krips which is owned by the assignee of the present invention.

Still a further object of the present invention is the provision of means accessible from outside the housing for operating the circuit breaker within the housing while the front door of the housing is closed, the said means being in operative relation with the circuit breaker whether or not the circuit breaker is in in service position or in test position.

Other objects of the present invention include means for preventing opening of the door of the housing while the circuit breaker is in in service position and the provision of means associated with the operating mechanism for preventing any possible flashes from the circuit breaker arm to the grounded front panel or door.

These and many other objects of the present invention will in part be pointed out and in part be apparent from the following description and drawings in which:

Figure 1 is a side elevation partly in cross-section showing a circuit breaker in test position within its housing.

Figure 2 is a view of the operating mechanism taken along line 2—2 of Figure 1 and looking in the direction of the arrows, showing the position of the operating members in the closed position of the circuit breaker.

Figure 3 is a view corresponding to that of Figure 2 showing the movement of the operating members for tripping the circuit breaker.

Figure 4 is a view corresponding to that of Figures 2 and 3 showing the position of the members thereof for closing the circuit breaker.

Figure 5 is a top view partly in cross section taken along line 5—5 of Figure 2 looking in the direction of the arrows and showing the position of the operating members when the circuit breaker is in test position.

Figure 6 is a view corresponding to that of Figure 5 showing the position of the members thereof when the circuit breaker is in in service position.

Figure 7 is a side view of the circuit breaker mounting frame within the housing corresponding to a portion of Figure 1 and showing the mechanically operated indicator mechanism.

Figure 8 is a view taken along line 8—8 of Figure 7 looking in the direction of the arrows.

Figure 9 is a side elevation of the lower portion of the circuit breaker housing of Figure 1

showing the circuit breaker withdrawal mechanism.

Figure 10 is a view taken along line 10—10 of Figure 9 looking in the direction of the arrows.

Figure 11 is a plan view partly in cross section of the bottom of the circuit breaker housing taken along line 11—11 of Figure 9 looking in the direction of the arrows.

Figure 12 is an elevation partly in cross-section of the front end of the bottom wall of the housing taken along line 12—12 of Figure 11 looking in the direction of the arrows.

Referring now to Figure 1, there is here shown a circuit breaker 20 secured to an insulating panel 21 having a set of contacts 22 and an operating arm 23. The circuit breaker or circuit interrupter here shown may be of any desired type and may operate for any required purpose. However, the operating arm 23 thereof should, for the purposes of the present description, be one which should move in a downward direction for closing and in an upward direction for tripping. Obviously, a mere reversal of the parts of the operating mechanism hereinafter described will permit the adaptation of these parts to a circuit breaker which has a different type of movement.

Preferably also, as seen in Figures 1, 2 and 5, the operating arm 23 of the circuit breaker should be bifurcated and the handle thereof should preferably constitute a roller 25 which may cooperate more readily with the parts hereinafter described.

The panel 21 is secured to the movable frame 26 which is supported on pantograph members 27 and 28 within the housing, a similar set of members being preferably used on each side of the frame 26. The connection between the panel 21 and the frame may be by removable bolts or hooks as the particular installation may require. I have here shown one means which consists of a pair of hooks 30 secured by bolts 31, 31 to the upper portion of the panel 21 and a similar pair of hooks 33 also secured by bolts to the lower portion of the panel 21.

The upper hooks 30 may slide down into appropriate notches 35 in the upper portion of the frame 26 and the lower pair of hooks 33 may slide down into appropriate slots 36 in the lower portions of said frame. One of the bolts 31 which secure each of the hooks 30 to the panel 21 may be provided with an extension button 40 which provides a simple means for attaching the end of a crane, cable or chain for purposes of lifting the circuit breaker out of the housing and transporting the same after it has been moved clear of the housing door.

Pantograph member 27 is pivotally supported at 41 at the rear of the housing and carries at the free end thereof a pin 42 which slides in a vertical slot 43 in the lower portion of the frame 26. The other of the pantograph members 28 is hingedly supported at 44 at the top of the frame 26 and likewise carries at the other end thereof a pin 48 (see also Figure 9) which slides in a vertical slot 49 in a flanged member 50 secured to the rear wall of the housing.

The pantograph members 27 and 28 on each side of the frame are pivotally connected at 52 in order to complete the pantograph supporting structure. These pantograph members, by reason of their extensibility, provide a support for the frame 26 whatever its position in the housing may be.

The panel 21 of the circuit breaker is also provided with back connection studs and contacts 60, 60 which, when the circuit breaker is moved back into in service position, engage the contacts 61, 61 mounted on the back of the housing. As will be seen in Figure 1, the movement of the circuit breaker to the test position has disengaged the contacts 60 from the contacts 61 so that the circuit breaker carries no current.

As will be seen in Figures 1, 5 and 6, the operating mechanism which includes the cam 70 is in engagement with the handle 25 of the circuit breaker operating arm 23 whether or not the circuit breaker is in in service position or in test position. This result is achieved by the mounting of the cam member 70 in such a manner that it is spring biased into engagement with the handle 25 and remains in engagement therewith as the circuit breaker is moved from one position to the other within the housing and while the door is closed.

The operating mechanism as a whole consists of a shaft 80 which projects through the door of the housing and which carries at the outer end thereof a double ended handle member 81 which may be manually operated in order to rotate the shaft. The bifurcated cam carrying member 83 is a casting which at 84 is keyed to the inner end of the shaft 80 and rotatable therewith so that rotation of the handle 81 will result in rotation of the casting 83. The cam 70 is hingedly mounted on the free ends of the bifurcated member 83 by means of the hinge pin 85 which is supported in appropriate openings in the extensions 86, 86 of the ends of the forked casting and which pass through suitable lugs 88 of the cam 70.

As will thus be seen in Figures 5 and 6, the cam 70 may swing outwardly away from or towards the bifurcated rotatable supporting member 83. The cam 70 is biased so that it will tend to swing away from its supporting member 83 into the position shown in Figure 6 by means of the tension spring 90, one end of which engages the arm 91 secured to the cam 70 and the other end of which engages a lug 92 at the base of the bifurcated member 83.

Although the cam is hingedly mounted so that it can swing away from its supporting member 83, or towards the supporting member in a vertical plane only, it is nevertheless, by reason of the arrangement of the hinges herein described so connected to the supporting member that it is rotatable therewith. Therefore, whatever rotative motion is imparted to the manual operating handle 81 will be communicated through the shaft 80 to the supporting member 83 and thence to the cam 70. The function of a hinged support for the cam and the spring bias thereof which tends to drive it away from the supporting member and into the housing is to ensure that a connection between the operating members and the circuit breaker operating handle will exist whether the circuit breaker is in service position or in test position within the housing.

The cam 70 has a solid or continuous web 100 and an arm 101 which projects therefrom above the roller 25 of the operating handle of the circuit breaker and an arm 102 which projects therefrom beneath the said roller. Arm 101 is provided with a boss 103 and arm 102 is provided with a boss 104 for engaging the horizontal roller 25 at the forked end of the circuit breaker operating arm so that it may alternately be lifted or depressed to control the contact position.

A bow shaped tie member 105 extends between the bosses 103 and 104 serving to reinforce the cam 70 and at the same time serving as a stop

for the cam against the roller 25; that is, the bow 105 is pressed against the roller 25 by the action of the tension spring 90 and serves accurately to position the bosses 103 and 104 so that whatever the position of the circuit breaker within the housing, the roller on the handle thereof will always be captured between the two bosses and in engagement with the tie or bow member.

The entire operating mechanism is biased towards a midposition by means of a centering arm 110 pivotally connected at 111 to the door 112 of the housing and having two extensions 113 and 114. Extension 113 carries a roller 116 which bears against the surface of a cam 117 which is likewise keyed to the shaft 80. The other extension 114 is secured to an end of a tension spring 120, the opposite end of which is at 121 likewise secured to the door 112 of the housing. The tensioning spring thus serves to bias the roller 116 on the arm 110 against the surface of the cam 117. The cam 117 has a central depression 123 and a pair of curved surfaces 124 and 125 extending on either side thereof and so curved that the pressure of the roller 116 against the surfaces tends to move the cam so that the roller will seek normally to come to rest in the depression 123.

Consequently, when the operating arm 81 is released from any manual operating pressure, the pressure of the roller 116 against the cam 117 will serve to rotate the mechanism so that it will assume the position shown in Figure 2.

In Figure 2 there is shown the position of the operating members when the circuit breaker is closed. The circuit breaker is so arranged that on automatic tripping or on a slight upward movement of roller 25, the breaker latch trips free of the lever 23. It will here be noted that the roller 25 on the operating arm of the circuit breaker is close to the boss 104 which operates to trip the circuit breaker. When the handle 81 is then rotated in a counterclockwise direction with respect to Figure 2, to the position shown in Figure 3, the tripping boss 104 will come into contact with the under side of the roller 25 and move the same upwardly in order to trip the circuit breaker.

Rotating the handle so that the boss 104 moves to the top of its stroke re-engages the latches and leaves the roller 25 in a position where it is just beneath the boss 103 of Figure 2. At that time, the rotation of the handle 81 in a clockwise direction with respect to Figure 2 will move the members into the position shown in Figure 4 where the circuit breaker is once more closed. Thereafter upon release of manual pressure from the operating handle 81, the spring pressed engagement of the roller 116 against the surface of cam 117 will serve to swing the mechanism back to the position shown in Figure 2 where all of the mechanism is once more in its normal position.

In order to prevent excessive and unnecessary rotation of the handle 81 and in order to prevent the roller 116 from leaving the surface of the cam 117, any suitable means may be provided to halt the rotation of the shaft 80 when the closing or tripping operation has been completed.

The cam 117 may be provided with hooks 131 at each end thereof which will engage the roller 116 at the completion of rotation in either direction in order to halt such rotation. By this means, therefore, the cam and the operating members cannot accidently be moved to such a position that they will cease to be operative.

The web 100 of the cam 70 which is made of insulating material is always interposed between the roller 25 of the handle of the circuit breaker and the supporting member 83 which is connected to the operating shaft 80, thus preventing any possible flash-over from the circuit breaker operating arm through the operating member to the grounded front panel.

A latch 140 may, if desired, be pivotally mounted at 141 on one of the arms of the handle 81 to engage beneath the lug 142 extending from the front of the door 112. Since the latch 140 must be manually disengaged before the handle 81 may be rotated, it serves to prevent an accidental tripping of the circuit breaker.

Various means may be provided to mount the circuit breaker within the housing or to move the circuit breaker into the housing once the panel thereof has been mounted on the frame 26 and the operating mechanism hereinabove described may be utilized in connection with various types of housing to permit the circuit breaker to be moved from in service to test position without opening the door of the housing.

It is preferred, however, to utilize the circuit breaker operating mechanism in connection with the housing construction shown particularly in Figures 1, and 9 to 12 inclusive. Thus, as is seen in Figures 9 and 10, a flanged member 150 may be secured to the bottom of the frame 26 which supports the circuit breaker panel 21, the said flanged member being cut out at 151 in order that the edges 152 and 153 thereof may slide into the notches 154 and 155 in each side of the sliding block 160 (see also Figure 11).

Any longitudinal movement of the sliding block 160 along the floor of the housing will result in a corresponding movement of the flange 150 and hence of the frame 26 to which the circuit breaker panel is secured—the pantograph members hereinbefore described serving properly, however, to support and position the frame within the housing regardless of the movement thereof. A longitudinal screw 161 extends along the floor of the housing and rotates in bearing 162 in the rear wall of the housing and in bearing 163 at the front thereof.

Openings 164 and 165 in the sliding block 160 are threaded so that rotation of the screw will result in movement of the sliding block along the screw and hence along the bottom wall of the housing. The front end of the shaft of the screw 161 is extended as is seen in Figures 9 and 11, through an opening in the front door 112 of the housing and the projecting portion thereof, 170, is squared so that a suitable crank may be connected thereto in order to rotate the same. By this means, therefore, the circuit breaker may be moved from service position to test position, without opening the door or front panel of the housing and therefore without subjecting the operator to any of the dangers which may arise should a fault occur at the moment that the circuit breaker is being disconnected. Automatic tripping means may be provided as shown in Patent 1,955,287 to ensure that the circuit breaker contacts are open during engagement or disengagement of the back contacts.

A protective casting 172 having a blind notch 173 therein may be swingingly supported on a pin 174 extending from the door of the housing so that the casting may be placed in position to cover the end 170 of the screw 161 and thus prevent operation thereof. A lug 175 extending from the casting may be provided with a perfora-

tion 176 registering with a similar perforation 177 in the end of the blocking bar 178. Passing a padlock hasp through perforations 176 and 177 will serve to lock the blocking bar and the end of the screw from unauthorized movement or tampering.

If it is now desired to inspect the circuit breaker, it is necessary to remove the padlock and rotate the locking arm or casting 172 in order to clear the end 170 of the screw shaft. A wrench or crank is then applied to the end 170 in order to withdraw the circuit breaker.

Suitable means may be provided so that the initial movement of the circuit breaker panel towards the front door will serve to trip the circuit breaker. Thus a cam or roller may, if desired, be mounted on the frame to abut against the automatic tripping arm or the plunger of the automatic tripping solenoid or any suitable lever connected to latch mechanism of the circuit breaker.

The blocking bar 178 which is pivotally mounted at 179 on the floor of the housing is arranged in the manner shown by the solid lines of Figure 11 when the circuit breaker is in in service position within the housing. The inner end 180 of the blocking bar 178 bears against the side 181 of the sliding block 160, thus counteracting the tendency of the tension spring 182, one end of which is connected at 183 to the blocking bar and the other end of which is connected at 184 to the floor of the housing, to cause the blocking bar to rotate to the position shown by the dotted lines of Figure 11.

The outer hook shaped end 186 of the blocking bar 178 which projects through a slot in the front door of the housing is connected to locking means hereinafter described, which serves to prevent the opening of the front door until the blocking bar has been moved to the position shown by the dotted lines of Figure 11. It is thus impossible to open the front door of the housing until the sliding block and its associated members which carry the circuit breaker have been completely moved to the test position.

When the circuit breaker is moved to test position, the sliding block 160 is in such position that the end 180 of the blocking bar 178 may move in behind the rear end of the sliding block and the rotation of the blocking bar 178 is no longer prevented by the contact of the end 180 with the sliding block. This now permits the door 112 to be swung on its hinges and opened.

A triangular member 190 attached to the inner side of the door is so arranged, that as the door closes, it presses against the surface 191 of the hook shaped end 186 of the blocking bar, causing it to move toward locking position. The end of the bar may then be moved completely over by hand in order to bring it to full locking position.

The initial opening movement of the door serves to remove this member 190 from behind the hook shaped end 186 and thus releases the blocking bar 178 so that it may freely swing in response to the bias of the tension spring 182.

A locking slat 200 is slidably positioned on the floor of the housing by means of the studs 201 and 202 which project through the slot 203 thereof. A pin 204 on one end of the sliding slat 200 engages a slot 205 in the hook shaped end 186 of the blocking bar 178. The movement of the blocking bar 178 causes the slat 200 to move correspondingly. The slat 200 carries at the opposite end thereof a vertical flange 208 having a slot 209 therein (see also Figure 12) terminating in a circular opening, 210.

A squared bar 211 (Figures 11 and 12) extends from the inner side of the door through the slot 209 and is integral with a round curved bar 212. The curved bar 212 has a diameter greater than that of the width of the slot 209 and hence cannot pass therethrough and thus does not permit an opening of the door unless the slat 200 and its flange 208 have been moved completely to the left with respect to Figures 11 and 12; at this time the circular opening 210 of the flange 208 comes into registry with the round section 212 of the bar and is sufficiently large to permit the passage of the round section therethrough.

The square section 211 of the bar is sufficiently long so that the door 112 may be swung open a sufficient distance to clear the member 190 attached to the door from the surface 191 of the locking bar 178. At this time, if the sliding block 160 is in the position shown by the dotted lines of Figure 11, then the blocking bar 178 may be swung by the spring 182 to the position shown by the dotted lines of Figure 11, thus bringing the round opening 210 of the flange 208 into registry with the round section 212 of the bar and thus permitting the door to be fully opened.

A hook 215 is also provided on the inner side of the door 112 so that it may engage the inner surface 216 of the hook shaped extension 186 of the blocking bar to interlock the door 112 with the said hook shaped extension 186 to prevent an opening of the door until the blocking bar has moved out of the way. The fact that the triangular member 190 does not engage the surface of bar 178 when the bar is in fully locked position, permits the hook 186 to move out of engagement with hook 215 before the door is opened.

Even while the circuit breaker is in the test or disconnected position, shown by the dotted lines of Figure 11, the blocking bar 178 may be swung into the position shown by the solid lines of Figure 11 and a padlock may be passed through the holes 176 and 177 to lock the door closed during test. The circuit breaker may thus be moved from the test position into the in service position while the door or front panel thereof is held closed. And when the door or front panel of the circuit breaker is thus held, the circuit breaker may be moved up to the test position but may not be moved beyond it, owing to the interposition in the path of movement of the sliding block of the surface 218 of the blocking bar 178.

Thus a positive stop 52 is provided which will determine the test position of the circuit breaker without the necessity of actually viewing the same. And the circuit breaker, after it has been moved to test position and padlocked in place, cannot be moved beyond test position toward the front of the housing or toward the rear thereof. Nor can the circuit breaker, when in test position, be moved to service position until after the door is closed.

When desired, however, the circuit breaker may, when the door is opened, be moved to the very front of the housing where it may be removed from the frame by lifting the panel to disengage hooks 30 and 33 from their respective slots 35 and 36. The knobs 40 provide means for readily attaching the panel to a crane or other device for lifting and removing the circuit breaker from the housing.

While the definite stops hereinbefore described accurately indicate the position of the circuit

breaker whether in test or in in service position, various indicating means may, if desired, be utilized in connection with the housing in order to give a visual indication while the door is closed, of the actual position of the circuit breaker.

Referring to Figures 7 and 8, there is here shown a simple indicating means which depends on the movement of the hinge pin **52** of the pantograph which pin is located at one side of the housing. A cable **225** is connected at one end to a slide **226** having the hook **227**. The slide is appropriately positioned in the housing by means of the slot **228** therein, which engages the button **229** mounted on the side wall of the housing. The cable **225** is led over the roller **230** mounted in suitable bearings at a front side flange of the housing and is connected at its opposite end to one end of the indicator plate **231**. The opposite end of the indicator plate is connected to the tension spring **232** which is anchored to the housing at **233**. The tension spring thus serves to exert tension on the cable **225** to draw the same away from the rear of the housing. The indicator plate **231** has an indicator stud **240** projecting therefrom through a slot **241** in the front panel. When the hinge pin **52** of the pantograph is moved away from the rear of the housing in accordance with the movement of the circuit breaker to test position, then the spring **232** is permitted to draw the cable downwardly so that the stud **240** on the indicator plate **231** moves down to the bottom of slot **241** to indicate the members are in test position.

When the hinge pin **52** is moved backwardly towards the rear of the housing as when the circuit breaker is moved into in service position, then the tension on the cable **225** extends the spring **232** and moves the stud **240** to the top of the slot **241** thus indicating that the circuit breaker is in operative or service position.

By this means, therefore, a simple indication is provided of the exact position of the circuit breaker without making it necessary to open the door or front panel or without making other tests. When the pantograph is extended beyond test position towards the position where the circuit breaker may be removed from the housing, the hinge pin thereof swings upward on an arc having a radius equal to the distance between the hinged connection **41** and the pin **52** and thus swings out of engagement with the hook **27** of the sliding plate **226**.

In this case, however, the abutment of the end of the slot **228** against the button **229** serves to support the cable and indicator mechanism and the hook **227** in such position that when the pantograph is moved backwardly once more, the pin **52** thereof will be able to reengage the hook and thus operate the indicator.

In the foregoing I have described and illustrated the elements of my invention which permit four different positions of the circuit breaker within the housing: first, the service position, in which the main disconnect contacts are engaged and any auxiliary contacts are engaged. In this position, the circuit breaker may be opened and closed and perform its normal function in the circuit. The second position is that used for test, in which the main separable contacts are disconnected and any auxiliary contacts remain in circuit. The special operating cam, disclosed herein, permits manual control of the circuit breaker at this point. If auxiliary switches or other devices connected to auxiliary contacts are used, the operations of these units may be tested without the energization of the feeder. The third position, which may be identical with the second position, is that used for positively preventing energization of the feeder. There have been here described interlocks particularly suitable to this last condition so that the door and panel operating mechanism may be padlocked definitely to prevent operation. The fourth position represents the complete withdrawal to the front of the cell so that the circuit breaker panel can be lifted from its frame and removed from the structure.

As a practical matter, the third, or disconnect position, may be more important to the industry than the test position. The fact that particular design of cam herein set forth, permits manual operation in the disconnect position, while it is of real importance, is somewhat secondary. The important item, therefore, which is achieved in the third position, is to definitely kill the feeder circuit and, at the same time, to be able to have the front panel closed to provide a smooth, uniform face for the switchboard. The position indicator is an essential part of this mechanism.

In the foregoing I have described specific embodiments illustrating the various principles of my invention. The operation of each of the portions of the mechanism has been described in connection with the specific description thereof. Many variations and modifications of each of the members hereinabove described should now be obvious to those skilled in the art. I prefer therefore to be bound, not by the specific disclosure herein, but only by the appended claims.

I claim:

1. A circuit breaker and an enclosure therefor, a front panel on said enclosure, operating mechanism carried on said front panel and operable from outside said enclosure; said circuit breaker being movable between two limiting positions toward and away from said panel, said operating mechanism being in operative engagement with said circuit breaker at each of said limiting positions.

2. A circuit breaker enclosed in a housing, a movable panel forming a wall of said housing, means for securing said panel in fixed relation to said housing, said circuit breaker being movable to a plurality of positions at different distances from the face of said panel, means mounted on said panel movable toward and away from said panel, effective when said panel is closed, for operating said circuit breaker when in any of said positions.

3. A circuit breaker and an enclosure therefor, a front panel on said enclosure, operating mechanism carried on said front panel and operable from outside said enclosure to actuate the contacts of said circuit breaker; said circuit breaker being movable between two limiting positions toward and away from said panel, said operating mechanism being in operative engagement with said circuit breaker at each of said limiting positions, and at every position between said limiting positions.

4. A circuit breaker and an enclosure therefor, a front panel on said enclosure, operating mechanism carried on said front panel and operable from outside said enclosure to actuate the contacts of said circuit breaker; said circuit breaker being movable between two limiting positions toward and away from said panel, while said front panel is closed, said operating mechanism being in operative engagement with said circuit breaker

at each of said limiting positions, and at every position between said limiting positions.

5. A circuit breaker and an enclosure therefor, a front panel on said enclosure, operating mechanism carried on said front panel and operable from outside said enclosure; said circuit breaker being movable between two limiting positions within said housing, said operating mechanism being in operative engagement with said circuit breaker at each of said limiting positions, said operating mechanism comprising a rotatable shaft mounted in said front panel and normal thereto, means on the outside of said panel for rotating said shaft, a cam mounted on said shaft on the inside of the panel and resilient means urging a portion of said cam inwardly into said housing into operative engagement with the circuit breaker.

6. A circuit breaker and an enclosure therefor; a front panel on said enclosure, operating mechanism carried on said front panel and operable from outside said enclosure; said circuit breaker being movable between two limiting positions within said housing, said operating mechanism being in operative engagement with said circuit breaker at each of said limiting positions, said operating mechanism comprising a rotatable shaft mounted in said front panel and normal thereto, means on the outside of said panel for rotating said shaft, a plate secured to said shaft on the inside of said panel and rotatable with said shaft, a cam hingedly secured at one end to an end of said plate, the free end of said cam being swingable away from said panel into said enclosure, resilient means biasing said free end of said cam toward a position furthest from said panel, means on said cam engageable with an operating element of said circuit breaker and positioning said cam in operative relation with said circuit breaker.

7. A circuit breaker and an enclosure therefor; a front panel on said enclosure, operating mechanism carried on said front panel and operable from outside said enclosure; said circuit breaker being movable between two limiting positions within said housing, said operating mechanism being in operative engagement with said circuit breaker at each of said limiting positions, said operating mechanism comprising a rotatable shaft mounted in said front panel and normal thereto, means on the outside of said panel for rotating said shaft, a plate secured to said shaft on the inside of said panel and rotatable with said shaft, a cam hingedly secured at one end to an end of said plate, the free end of said cam being swingable away from said panel into said enclosure, resilient means biasing said free end of said cam toward a position furthest from said panel, means on said cam engageable with an operating element of said circuit breaker and positioning said cam in operative relation with said circuit breaker, and a plurality of operative elements on said cam selectively engageable with said operating element of said circuit breaker upon rotation of said shaft.

8. A circuit breaker and an enclosure therefor; a front panel on said enclosure, operating mechanism carried on said front panel and operable from outside said enclosure; said circuit breaker being movable between two limiting positions within said housing, said operating mechanism being in operative engagement with said circuit breaker at each of said limiting positions, said operating mechanism comprising a rotatable shaft mounted in said front panel and normal thereto, means on the outside of said panel for rotating said shaft, a plate secured to said shaft on the inside of said panel and rotatable with said shaft, a cam hingedly secured at one end to an end of said plate, the free end of said cam being swingable away from said panel into said enclosure, resilient means biasing said free end of said cam toward a position furthest from said panel, means on said cam engageable with an operating element of said circuit breaker and positioning said cam in operative relation with said circuit-breaker, and an insulating web on said cam interposed between said plate and said operating element of said circuit breaker.

9. A circuit breaker and an enclosure therefor; a front panel on said enclosure, operating mechanism carried on said front panel and operable from outside said enclosure; said circuit breaker being movable between two limiting positions within said housing, said operating mechanism being in operative engagement with said circuit breaker at each of said limiting positions, said operating mechanism comprising a rotatable shaft mounted in said front panel and normal thereto, means on the outside of said panel for rotating said shaft, a plate secured to said shaft on the inside of said panel and rotatable with said shaft, a cam hingedly secured at one end to an end of said plate, the free end of said cam being swingable away from said panel into said enclosure, resilient means biasing said free end of said cam toward a position furthest from said panel, means on said cam engageable with an operating element of said circuit breaker and positioning said cam in operative relation with said circuit breaker, and a plurality of operative elements on said cam selectively engageable with said operating element of said circuit breaker upon rotation of said shaft, and means for centering said shaft for moving said operative elements of said cam in a plane parallel to the front panel to a position where each such element may selectively be engageable with the said operating element of the circuit breaker.

10. A circuit breaker and an enclosure therefor; a front panel on said enclosure, operating mechanism carried on said front panel and operable from outside said enclosure; said circuit breaker being movable between two limiting positions within said housing, said operating mechanism being in operative engagement with said circuit breaker at each of said limiting positions, said operating mechanism comprising a rotatable shaft mounted in said front panel and normal thereto, means on the outside of said panel for rotating said shaft, a plate secured to said shaft on the inside of said panel and rotatable with said shaft, a cam hingedly secured at one end to an end of said plate, the free end of said cam being swingable away from said panel into said enclosure, a plurality of operative elements on the free end of said cam selectively engageable with an operating element of said circuit breaker, means for causing the free end of said cam to swing in a plane normal to said front panel into engagement with said operating element of said circuit breaker, means for automatically rotating said shaft to rotate said cam in a plane substantially parallel to said front panel for positioning the operative elements of the cam with respect to the operating element of said circuit breaker, said operative elements of said cam being selectively engageable with the operating element of said circuit breaker in accordance with the direction of rotation of said shaft.

11. In circuit breaker operating mechanism a cam of insulating material, said cam having a substantially broad and flat web, lugs adjacent one edge of said web, a pair of arms extending from the opposite edge of said web, said arms being spaced from each other, a boss on the end of each arm, and a bow connecting the said ends of said arms.

12. In circuit breaker operating mechanism a cam of insulating material, said cam having a substantially broad and flat web, lugs adjacent one edge of said web, a pair of arms extending from the opposite edge of said web, said arms being spaced from each other, a boss on the end of each arm, said bosses extending from the surface of said cam opposite the surface from which the lugs extend, and a bow connecting the said ends of said arms.

13. A circuit breaker enclosure having a front panel, rear contacts, a vertical frame movable horizontally, means on the frame for supporting a circuit breaker panel and means for maintaining the circuit breaker panel in a vertical position during movement of the frame, means for moving said frame between a first limiting position and a second limiting position only when said front panel is closed and for thereafter moving said frame between said second limiting position and a third limiting position.

14. A circuit breaker enclosure having a front panel, rear contacts, a vertical frame movable horizontally, means on the frame for supporting a circuit breaker panel and means for maintaining the circuit breaker panel in a vertical position during movement of the frame, means for moving said frame between a first limiting position and a second limiting position only when said front panel is closed and for thereafter moving said frame between said second limiting position and a third limiting position, said means comprising a sliding block engaging a portion of said frame, a rotatable screw passing through a threaded portion of said block, rotation of said screw moving said block horizontally.

15. A circuit breaker enclosure having a front panel, rear contacts, a vertical frame movable horizontally, means on the frame for supporting a circuit breaker panel and means for maintaining the circuit breaker panel in a vertical position during movement of the frame, means for moving said frame between a first limiting position and a second limiting position only when said front panel is closed and for thereafter moving said frame between said second limiting position and a third limiting position, said means comprising a sliding block engaging portion of said frame, a rotatable screw passing through a threaded portion of said block, rotation of said screw moving said block horizontally, and a blocking bar having a lug interposable in the path of the forward edge of said block at said second limiting position.

16. A circuit breaker enclosure having a front panel, rear contacts, a vertical frame movable horizontally, means on the frame for supporting a circuit breaker panel and means for maintaining the circuit breaker panel in a vertical position during movement of the frame, means for moving said frame between a first limiting position and a second limiting position only when said front panel is closed and for thereafter moving said frame between said second limiting position and a third limiting position, said means comprising a sliding block engaging a portion of said frame, a rotatable screw passing through a threaded portion of said block, rotation of said screw moving said block horizontally, and a blocking bar having a lug interposable in the path of the forward edge of said block at said second limiting position, said blocking bar having an additional lug engageable with a portion of said sliding block while the forward edge of said sliding block is between said first and second limiting position; said blocking bar being movable to non-blocking position only when said sliding block has been moved to said second limiting position; and means interengaging said blocking bar and said front panel for locking said panel closed while said blocking bar is in blocking position.

17. A circuit breaker enclosure having a front panel, rear contacts, a vertical frame movable horizontally, means on the frame for supporting a circuit breaker panel and means for maintaining the circuit breaker panel in a vertical position during movement of the frame, and means for moving said frame between a first limiting position and a second limiting position only when said front panel is closed and for thereafter moving said frame between said second limiting position and a third limiting position, said means comprising a sliding block engaging a portion of said frame, a rotatable screw passing through a threaded portion of said block, rotation of said screw moving said block horizontally, and a blocking bar having a lug interposable in the path of the forward edge of said block at said second limiting position, said blocking bar having an additional lug engageable with a portion of said sliding block while the forward edge of said sliding block is between said first and second limiting position; said blocking bar being movable to non-blocking position only when said sliding block has been moved to said second limiting position; and means interengaging said blocking bar and said front panel for locking said panel closed while said blocking bar is in blocking position, said additional lug being interposed in the path of movement of the rear edge of said sliding block when said panel is open and preventing movement of said sliding block from the second limiting position toward the first limiting position while the front panel is open.

18. A circuit breaker enclosure having a front panel, rear contacts, a vertical frame movable horizontally, means on the frame for supporting a circuit breaker panel and means for maintaining the circuit breaker panel in a vertical position during movement of the frame, means for moving said frame between a first limiting position and a second limiting position only when said front panel is closed and for thereafter moving said frame between said second limiting position and a third limiting position, said means comprising a sliding block engaging a portion of said frame, a rotatable screw passing through a threaded portion of said block, rotation of said screw moving said block horizontally, and a blocking bar having a lug interposable in the path of the forward edge of said block at said second limiting position, said blocking bar having an additional lug engageable with a portion of said sliding block while the forward edge of said sliding block is between said first and second limiting position; said blocking bar being movable to non-blocking position only when said sliding block has been moved to said second limiting position; and means interengaging said blocking bar and said front panel for locking said panel closed while said blocking bar is in blocking position, said last mentioned means comprising a slide interengaged with the end of said blocking bar, a flange on said slide and a slot therein, a mem-

ber on said front panel passing through said slot; said slot having an enlarged area of limited extent; said enlarged area registering with said member only when said blocking bar is moved to non-blocking position; said member having a section of enlarged thickness, said latter section being movable only through said enlarged area of said lot.

19. A circuit breaker enclosure having a front panel, rear contacts, a vertical frame movable horizontally, means on the frame for supporting a circuit breaker panel and means for maintaining the circuit breaker panel in a vertical position during movement of the frame, means for moving said frame between a first limiting position and a second limiting position only when said front panel is closed and for thereafter moving said frame between said second limiting position and a third limiting position, and means for indicating the position of said frame between said first limiting position and said second limiting position while said front panel is closed.

20. A circuit breaker enclosure having a front panel, rear contacts, a vertical frame movable horizontally, means on the frame for supporting a circuit breaker panel and an extensible support for said frame, means for moving said frame between a first limiting position and a second limiting position only when said front panel is closed and for thereafter moving said frame between said second limiting position and a third limiting position, and means for indicating the position of said frame between said first limiting position and said second limiting position while said front panel is closed, said last mentioned means comprising a cable engageable at one end with a portion of said extensible support, said cable passing over a guide and engageable at the other end with a member slidably mounted in the front of said enclosure; a spring attached to said member biasing the same to one indicating position, movement of said extensible support causing said cable to move said member against the bias of said spring to another indicating position.

21. A circuit breaker enclosure having a front panel, rear contacts, a frame movable toward and away from said panel, means on the frame for supporting a circuit breaker panel and means for supporting the said frame during movement thereof, means operative while said front panel is closed for moving said frame between a first limiting position and a second limiting position, and means for preventing opening of the front panel when said frame is in said first limiting position and when said frame is at any point between said first limiting position and said second limiting position, said last mentioned means becoming ineffective when said frame reaches said second limiting position.

22. A circuit breaker enclosure having a front panel, rear contacts, a frame movable toward and away from said panel, means on the frame for supporting a circuit breaker panel and means for supporting the said frame during movement thereof, means operative from the front of said front panel while it is closed for moving said frame between a first limiting position and a second limiting position, and means for opening said circuit breaker upon the initial movement of the frame from the first limiting position to the second limiting position.

23. A circuit breaker enclosure having a front panel, rear contacts, a vertical frame movable horizontally, means on the frame for supporting a circuit breaker panel and means for maintaining the circuit breaker panel in a vertical position during movement of the frame, means operative from the front of said front panel while it is closed for moving said frame between a first limiting position and a second limiting position, and means operative while said front panel is closed for engaging the frame and halting the same when the second limiting position is reached.

24. A circuit breaker enclosure having a front panel, rear contacts, a vertical frame movable horizontally, means on the frame for supporting a circuit breaker panel and means for maintaining the circuit breaker panel in a vertical position during movement of the frame, means operative from the front of said front panel while it is closed for moving said frame between a first limiting position and a second limiting position, and means operative while said front panel is closed for engaging the frame and halting the same when the second limiting position is reached, said last mentioned means being rendered ineffective when said front panel is opened; said frame being thereafter movable to a third limiting position.

25. A circuit breaker enclosure having a front panel, rear contacts, a vertical frame movable horizontally, means on the frame for supporting a circuit breaker panel and means for maintaining the circuit breaker panel in a vertical position during movement of the frame, means for moving frame between a first limiting position and a second limiting position only when said front panel is closed and for thereafter moving said frame between said second limiting position and a third limiting position, said means comprising a sliding block engaging a portion of said frame, a rotatable screw passing through a threaded portion of said block, rotation of said screw moving said block horizontally and means for locking said screw in position when said front panel is closed.

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