June 30, 1953 H. J. LINGAL ET AL 2,644,053

HIGH-SPEED CIRCUIT BREAKER OPERATING MECHANISM

Filed Feb. 10, 1951 4 Sheets-Sheet 1

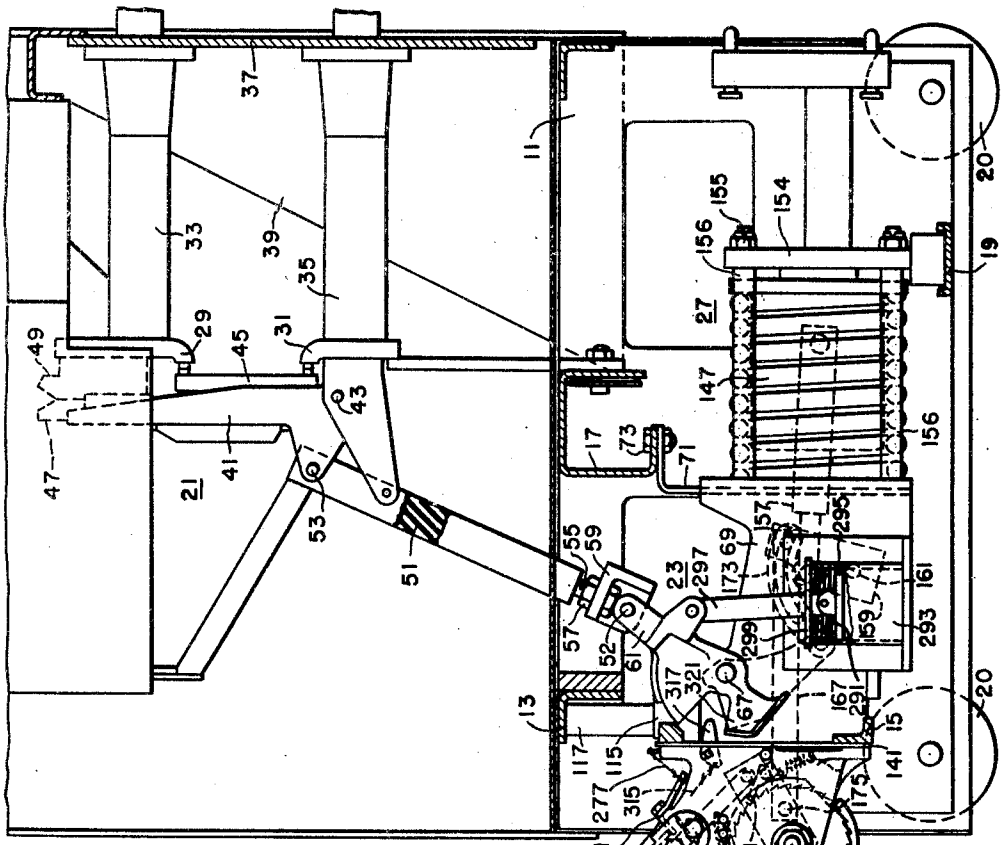


Fig. I.

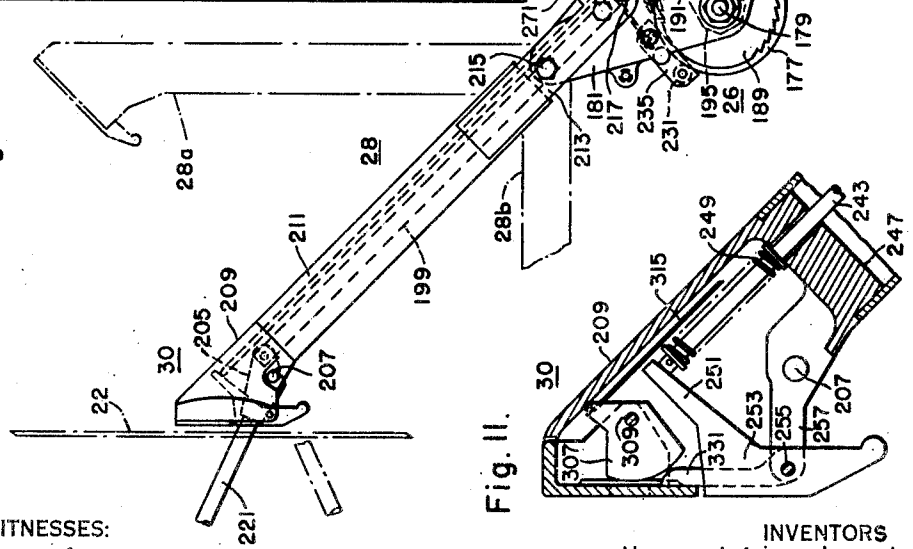


Fig. II.

WITNESSES:

Wm. B. Sellers.

Paul O. Harlow.

INVENTORS
Harry J. Lingal and
Joseph D. Findley, Jr.
BY
Ralph L. Swingle
ATTORNEY

June 30, 1953 H. J. LINGAL ET AL 2,644,053

HIGH-SPEED CIRCUIT BREAKER OPERATING MECHANISM

Filed Feb. 10, 1951 4 Sheets-Sheet 2

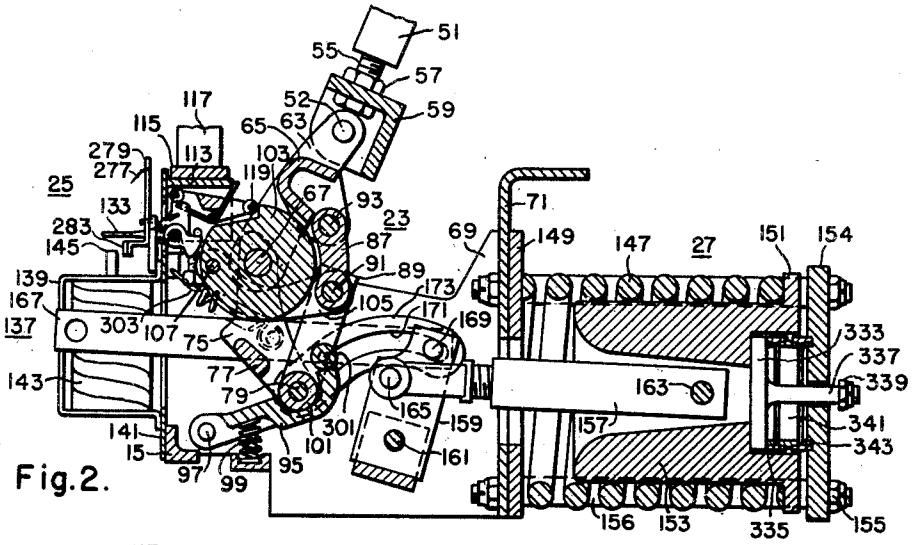


Fig.2.

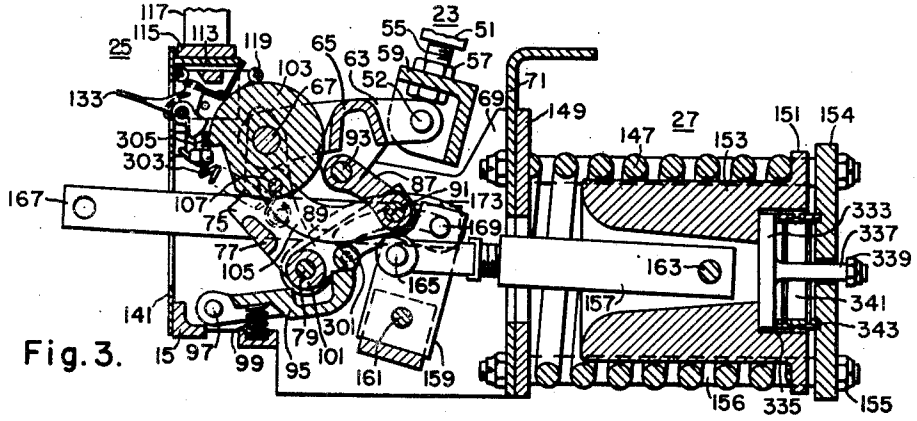


Fig.3.

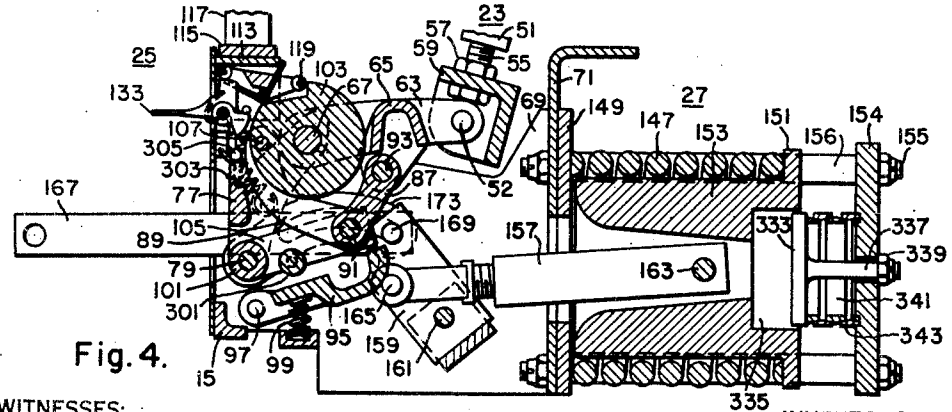


Fig.4.

WITNESSES:

Wm. B. Sellers.

Paul H. Harbers.

INVENTORS
Harry J. Lingal and
Joseph D. Findley, Jr.
BY
Ralph W. Swingle
ATTORNEY

June 30, 1953 H. J. LINGAL ET AL 2,644,053

HIGH-SPEED CIRCUIT BREAKER OPERATING MECHANISM

Filed Feb. 10, 1951 4 Sheets-Sheet 3

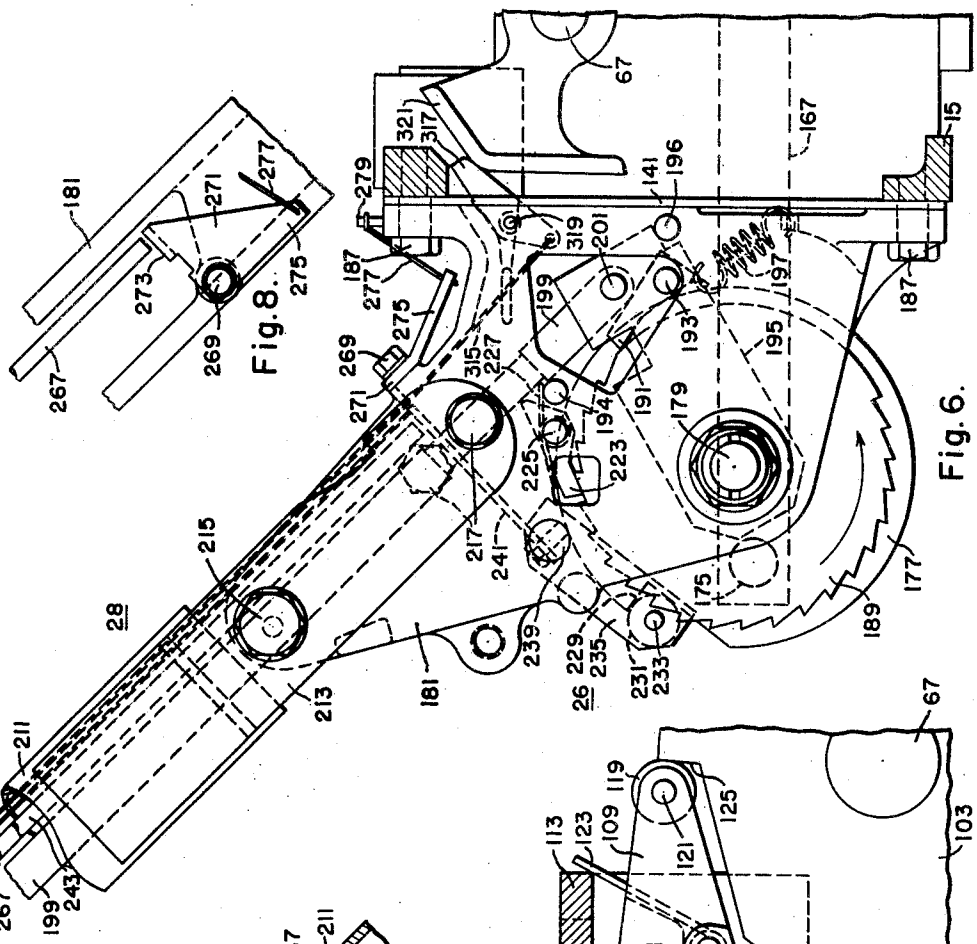


Fig. 6.

Fig. 8.

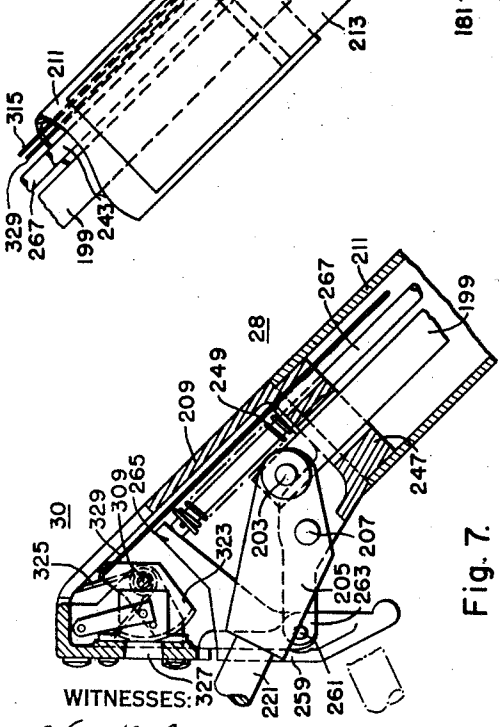


Fig. 7.

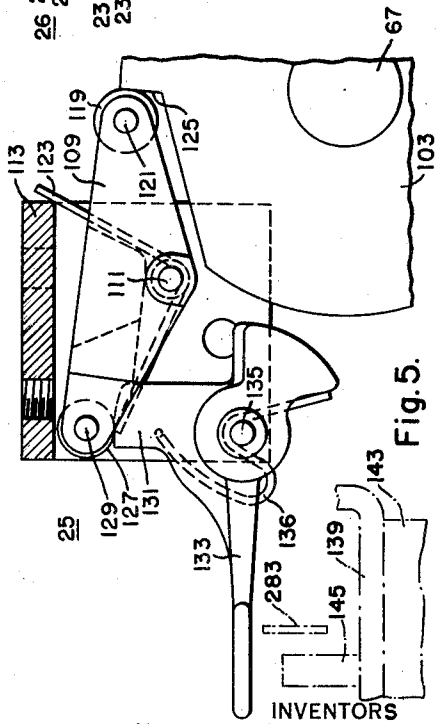


Fig. 5.

WITNESSES:

Wm. B. Sellers.

Paul O. Harlow.

INVENTORS

Harry J. Lingal and

Joseph D. Findley, Jr.

BY

Ralph H. Swingle

ATTORNEY

June 30, 1953 H. J. LINGAL ET AL 2,644,053

HIGH-SPEED CIRCUIT BREAKER OPERATING MECHANISM

Filed Feb. 10, 1951 4 Sheets-Sheet 4

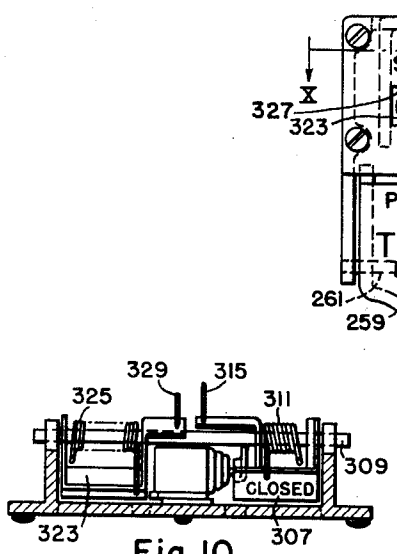


Fig. 10.

Fig. 9.

WITNESSES:
Wm. B. Sellers.
Paul O. Harlow.

INVENTORS
Harry J. Lingal and
Joseph D. Findley, Jr.
BY
Ralph W. Swingle
ATTORNEY

Patented June 30, 1953

2,644,053

UNITED STATES PATENT OFFICE

2,644,053

HIGH-SPEED CIRCUIT BREAKER OPERATING MECHANISM

Harry J. Lingal and Joseph D. Findley, Jr., Pittsburgh, Pa., assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application February 10, 1951, Serial No. 210,389

16 Claims. (Cl. 200—89)

1

This invention relates to circuit breakers and more particularly to high-speed operating mechanisms for power air circuit breakers.

Large air circuit breakers are required to close against fault currents of such magnitude that the blowout forces may stop the contacts before they reach full closed position or even blow the contacts open again if the closing speed is not maintained above a predetermined minimum. While such breakers can be closed by a solenoid operated mechanism, however, in small installations, using only one breaker, such as a breaker for supplying power to a small factory or an office building, the cost of an electric power source required to close the breaker by means of a solenoid mechanism is often not justified. For this and other reasons, it is desirable to provide manual closing means. However, the power needed to manually close a large air breaker at the required speed is greater than can be provided by an attendant.

It is accordingly an object of the invention to provide an operating mechanism for a circuit breaker utilizing stored energy means, in which energy is stored and releasably held, to effect high-speed closing of the breaker.

Another object of the invention is to provide an operating means for a circuit breaker comprising an energy storing device for closing the breaker and a trip-free thrust transmitting means for transmitting the energy stored in said device to the circuit breaker.

Another object of the invention is to provide an operating mechanism for a circuit breaker embodying an energy storing device comprising a power spring which is releasable to close the breaker.

Another object of the invention is to provide an operating mechanism for a circuit breaker embodying a stored energy device in which energy is manually stored and releasably held to close the breaker and having means for limiting the amount of energy that can be stored in said device.

Another object of the invention is to provide an operating mechanism for a circuit breaker embodying stored-energy means in which energy may be stored when the breaker is in closed position and releasably held to close the breaker having means for preventing release of said stored energy when the breaker is in the closed position.

Another object of the invention is to provide an operating mechanism for an enclosed circuit breaker having an enclosing housing provided

2

with an openable door and embodying stored-energy means in which energy is manually stored and releasably held to close the breaker with means operable externally of said enclosing housing to store energy in said stored-energy means and to control the breaker without having to open the door.

The novel features that are considered characteristic of the invention are set forth in particular in the appended claims. The invention itself, however, both as to structure and operation, together with additional objects and advantages thereof, will best be understood from the following detailed description thereof when read in connection with the accompanying drawings.

In said drawings:

Figure 1 is a side elevational view, partly in section, showing a circuit breaker embodying the principles of the invention.

Fig. 2 is a detailed sectional view taken through the operating mechanism showing the mechanism in the closed circuit position with the closing spring discharged or unloaded.

Fig. 3 is a sectional view similar to Fig. 2 but showing the operating mechanism in the tripped open position just before the mechanism is reset and with the closing spring unloaded.

Fig. 4 is a sectional view similar to Figs. 2 and 3 but showing the mechanism in the automatically reset position with the closing spring loaded in readiness to close the breaker.

Fig. 5 is an enlarged detail view of the latching mechanism.

Fig. 6 is an enlarged side elevational view of the closing spring loading mechanism showing a portion of the control column.

Fig. 7 is an enlarged sectional view of the control head of the control column showing the manual controls.

Fig. 8 is a fragmentary detail view of a portion of the trip means for manually tripping the breaker open.

Fig. 9 is an enlarged front elevational view, partly broken away of the spring loading mechanism and the control column.

Fig. 10 is a sectional view through the control head taken on line X—X of Fig. 9 and looking in the direction of the arrows.

Fig. 11 is an enlarged sectional view taken through the control head on line XI—XI of Fig. 9 showing the closing spring release lever.

The invention is illustrated as applied to a circuit breaker of the type disclosed and claimed in Patent No. 2,515,994, issued July 18, 1950, to

Joseph D. Findley, Jr., Alvin W. Ogg and Fritz E. Florschutz, and assigned to the assignee of the present invention.

Referring to Fig. 1 of the drawings, the circuit breaker is of the roll-out type and is mounted on a carriage comprising a pair of side plates 11 (only one being shown) which are rigidly joined by cross members 13, 15, 17 and 19 to form a rigid framework for supporting the breaker. The carriage is provided with wheels 20 to facilitate movement of the circuit breaker into and out of an enclosing cubicle in order to connect and disconnect the breaker in an electrical circuit and for purposes of inspection and repair. The cubicle is not shown in the drawings but a fragment of the door thereof is indicated by dot and dash lines at 22 (Fig. 1).

The circuit breaker is of the multi-pole type (only one pole being shown) and comprises generally, a plurality of pairs of separable contacts 21 (Fig. 1), a common operating mechanism indicated generally at 23 (Figs. 1, 2, 3 and 4) a latching and trip mechanism indicated generally at 25 (Figs. 2, 3, 4 and 5), spring closing means 27 (Figs. 1, 2, 3 and 4), closing spring loading mechanism indicated generally at 26 (Figs. 1, 6 and 9) a control column 28 (Figs. 1, 6, 7 and 9) and a control head 30.

The contact means 21 comprises stationary contacts 29 and 31 (Fig. 1) mounted respectively on terminal members 33 and 35 which are rigidly supported on a back plate 37. The back plate 37 is rigidly supported by angular brackets 39 (only one being shown) rigidly secured to the side plates 11 of the carriage. A switch arm 41 pivotally mounted at 43 on the terminal member 35 carries a bridging contact member 45 for cooperating with the stationary contacts 29 and 31 to open and close the circuit. The switch arm 41 also carries a movable arcing contact 47 which cooperates with a stationary arcing contact 49 mounted on the terminal 33 for drawing an arc upon opening movement of the switch arm.

The switch arm 41 for each pole of the breaker is operatively connected by means of an insulating operating rod 51 to the operating mechanism 23. The upper end of the rod 51 is pivotally connected by means of a pivot pin 53 to the switch arm 41 and the lower end of the rod 51 is connected by means of a screw 55 and a lock nut 57 to an angular cross bar 59 common to all of the poles of the breaker. The cross bar 59 is pivotally connected by means of pivot pins 52 at its ends to an operating lever comprising a pair of spaced levers 61 (Fig. 1) and 63 (Figs. 2, 3 and 4). The operating levers 61 and 63 are rigidly connected by an integral U-shaped cross member 65 (Figs. 2, 3 and 4) and are pivotally supported on a shaft 67. The shaft 67 is mounted in the side members of a generally U-shaped frame 69 secured to a bracket 71 which is secured by means of bolts 73 to the cross member 17.

The operating mechanism also includes a closing lever 75 pivotally amounted on the shaft 67 and comprising a pair of spaced levers (only one being shown) rigidly connected by an integral cross bar 77. The operating lever 63 and the closing lever 75 are operatively connected by means of a collapsible thrust-transmitting toggle comprising toggle links 87 and 89 pivotally connected together by means of a knee pivot pin 91. The toggle link 87 is pivotally connected by means of a pivot pin 93 to the operating lever 63 and the toggle link 89 is connected by means of a pivot pin 79 to the closing lever 75. The closing lever 75 is held in the closed position (Fig. 2) by means of a latch 95 pivotally mounted on a pin 97 supported in the side members of the frame 69. The latch 95 is biased by means of a spring 99 to latching position wherein a shoulder formed by a recess in the latch engages a roller 101 mounted on the pin 79.

The toggle 87—89 is normally held in its extended but slightly underset position by means of a latch member 103 pivoted on the shaft 67 and connected by means of a link 105 to the knee pin 91 of the toggle. The link 105 has one end pivotally connected by means of a pivot pin 107 to the latch member 103 and the other end connected to the knee pin 91 of the toggle 87—89. The latch member 103 is normally releasably held in latching position by means of the latching and tripping mechanism 25 which is more clearly shown in Fig. 5.

The latching and tripping mechanism comprises a trip lever 109 pivoted on a pivot pin 111 mounted in the side members (only one being shown) of a generally U-shaped bracket 113. The bracket 113 is rigidly secured to a bracket 115 (Fig. 1) which, in turn, is rigidly secured to the side members of the frame 69. The bracket 115 is also secured to the cross member 13 (Fig. 1) by means of spacers 117. The trip member 109 carries a latch roller 119 pivoted on a pin 121 carried by the trip member which roller is normally biased by means of a spring 123 into engagement with a shoulder 125 on the latch member 103 to restrain the latter and the toggle 87—89 in the closed or thrust transmitting position.

The latching arrangement of the roller 119 and the shoulder 125 is such that it will not, of itself, restrain the latch member 103 against releasing movement. For this reason there is provided a latch roller 127 mounted on a pin 129 in the opposite end of the trip lever 109 from the roller 119. The latch roller 127 is engaged and releasably held in latching position by a latching portion 131 of a secondary latch 133 which is pivoted on a pin 135 in the side members of the bracket 113 and biased in a counterclockwise direction to latching position by means of a spring 136. The latch 133 is adapted to be operated to unlatching position either manually or automatically to effect release of the operating mechanism and automatic opening of the breaker.

The latch 133 is automatically operated to unlatching position by means of a tripping electromagnet 137 comprising a yoke member 139 (Fig. 2) secured to a plate 141 rigidly mounted on the left-hand end of the U-shaped frame 69, an energizing coil 143 and a movable armature (not shown) which is attached to a trip rod 145.

The closing means 27 comprises a powerful spring 147 (Figs. 1, 2, 3, 4) compressed between the cross member 149 of the U-shaped frame 69 and a flange 151 of a cylindrical member or weight 153. The closing spring 147 and the weight 153 are supported between the frame 69 and an end plate 154 which is secured to the frame 69 by means of bolts 155 and spacers 156. The weight 153 is connected by means of an adjustable link 157 to a lever 159 pivotally supported on a pivot pin 161 mounted in the side member of the frame 69. The link 157 is pivotally connected to the member 153 by means of a pivot pin 163 and to the lever 159 by a pin 165. The lever 159 is connected to the spring loading means 26 (Figs. 1, 6 and 9) by means of a link 167 which is pivotally connected to the lever 159 by means of a pin 169. The pin 169 also extends through an elongated

arcuate slot 171 in a link 173 pivotally connected to the closing lever 75 by the pin 79. The other end of the link 167 is pivotally connected by means of a pin 175 (Figs. 1, 6 and 9) to a cam member 177 rigidly mounted on a shaft 179 for rotation therewith. The shaft 179 is mounted for rotation in a frame 181 (Figs. 1, 6 and 9) comprising a pair of spaced side members rigidly connected by integral cross members 183 and 185 (Fig. 9) and secured to the plate 141 and to the frame 69 by means of bolts 187. Rigidly fixed to the shaft 179 and disposed between the side members of the frame 181 is a ratchet wheel 189 which is adapted to be rotated in a counterclockwise direction to load the closing spring 147 and releasably hold the spring in its loaded or compressed condition. The ratchet wheel 189 is manually rotated step by step by means of a pawl 191 pivotally mounted on a pin 193 carried by an operating lever 195 and biased by means of a spring 197 into engagement with the periphery of the ratchet wheel 189. The operating lever 195 is mounted on the shaft 179 (Fig. 6) for rotation relative thereto and is pivotally connected at its free end to an operating rod 199 by means of a pin 201. The operating rod 199 extends outwardly through the control column 28 and at its outer end is pivotally connected by means of a pin 203 (Fig. 7) to a lever 205 which is pivoted on a pin 207 supported in the side members of a casting 209 secured to the outer end of the control column 28.

The control column 28 comprises a tube 211 having members 213 disposed one on each side thereof rigidly secured thereto by welding or other suitable means. The members 213 are disposed on the outside of the side members of the frame 181 and are rigidly secured thereto by means of a pair of upper bolts 215 and a pair of lower bolts 217.

In order to actuate the lever 195 (Fig. 6) and the pawl 191 to advance the ratchet wheel 189 the lever 205 (Fig. 7) is provided with an opening 219 (Fig. 9) for receiving an operating bar or handle 221 (Figs. 1 and 7).

The circuit breaker is shown in Figure 1 in the closed position with the closing spring 147 in its unloaded condition. In order to load or compress the spring 147 the handle 221 is moved up and down after the fashion of a pump handle. On the downward stroke of the handle 221, the lever 205 is rotated counterclockwise drawing the operating rod outwardly and moving the lever 195 also counterclockwise. During this movement the pawl 191 engages a tooth of the ratchet wheel 189 and rotates the ratchet wheel one step or the distance of one ratchet tooth. Upward movement of the handle 221 reverses the movement of the lever 195 and retracts the pawl 191 causing it to drop in back of the next following tooth of the ratchet wheel 189. The ratchet wheel 189 is prevented from retrograde movement during the retracting movement of the lever 195 and pawl 191 by means of a retaining pawl 223 (Fig. 6) pivoted on a pin 225 and biased by a spring 227 into engagement with the teeth of the ratchet wheel 189.

Since both the ratchet wheel 189 and the cam 177 are rigidly fixed to the shaft 179, the counterclockwise rotation of the ratchet wheel causes the cam 177 to rotate in the same direction. The rotation of the cam 177 draws the link 167 step by step toward the left or front of the breaker and acting through the lever 159 (Figs. 1, 2 and 3) and link 157 draws the member 153 toward

the left from the Fig. 1 position to the position shown in Figs. 4 and 6 compressing the closing spring 147. As the pin 175 (Fig. 6) which connects the link 167 to the cam 177, passes below the horizontal center line of the shaft 179 the closing spring 147 acts through the weight 153, the link 157, lever 159 and link 167 to advance the cam 177 until a shoulder 229 (Fig. 6) thereon engages a latch roller 231 which releasably holds the mechanism and the closing spring in condition for a closing operation.

The latch roller 231 is mounted on a pin 233 carried between the free ends of a pair of spaced latch levers 235 rigidly secured to a hub 237 which, in turn, is rigidly fixed to a shaft 239 pivotally mounted in the side members of the frame 181. Rigidly secured to the shaft 239 between the sides of the frame 181 is an arm 241 (Fig. 6) which extends to a point between the side member 213 to be engaged by a rod 243 extending outwardly through the control column 28. The lower ends of rod 243 and the operating rod 199 extend through openings in a guide member 245 (Fig. 9) rigidly mounted in the lower end of the control column tube 211. At their outer ends the rods 199 and 243 are guided by openings in an integral portion 247 of the casting 209. The outer end of the rod 243 is biased by means of a spring 249 into engagement with one arm 251 of a closing spring release lever 253 (Figs. 9 and 11). The lever 253 is pivotally supported on a pin 255 mounted in one side of the casting 209 and in a bracket 257 integral with the casting 209. Clockwise movement of the lever 253 (Fig. 11) thrusts the rod 243 downwardly causing the lower end thereof to engage the arm 241 and actuate the arm, the shaft 239 and the latch levers 235 to disengage the latch roller 231 from the shoulder 229 thus releasing the closing spring to effect closing of the breaker in a manner hereinafter described.

In addition to the tripping magnet 137 (Figs. 2 and 9) the breaker is manually tripped open from outside the cubicle and without opening the door 22 (Fig. 1) by operation of a manual trip lever 259 (Figs. 7 and 9). The manual trip lever 259 is pivoted on a pin 261 supported between the left-hand side (Fig. 4) of the casting 209 and a bracket 263 integral with the casting 209. An arm 265 of the lever 259 extends into the hollow casting 209 and is adapted to engage the outer end of a rod 267 guided for sliding movement in the portion 247 of the casting 209 and in the guide members 245 (Fig. 9) in the lower end of the control tube 211. Pivoted on a stud bolt 269 (Figs. 6 and 8) in the frame 181 is a lever 271 having an arm 273 extending downwardly between the side member of the frame 181 and disposed to be engaged by the lower end of the rod 267. The other arm 275 of the lever 271 has attached to the free end thereof a rod or wire 277 the other end of which is attached to the free end of one arm 279 (Fig. 9) of a bell crank lever 281 the other arm 283 of which is disposed beneath the secondary latch member 133 (see also Figs. 2 and 5) of the latching and tripping mechanism. The bell crank 281 is pivoted on a pin 285 supported in a bracket 287 secured by means of bolts 289 to the plate 141, the bolts 289 also serving to secure the upper end of the yoke 139 to the plate 141.

It will thus be seen that the secondary latch 133 is operated to unlatching position to effect opening of the circuit breaker either by energization of the tripping electromagnet 137 or man-

ually by operation of the lever 259 (Figs. 7 and 9). Clockwise movement of the lever 259 (Fig. 7) thrusts the rod 267 downwardly causing the lower end thereof to engage the lever 271 (Fig. 8) and move the lever in a clockwise direction (Fig. 8) or counterclockwise as shown in Fig. 9. This movement of the lever 271 through the rod 277 moves the bell crank 281 clockwise causing the arm 283 thereof to engage and move the secondary latch 133 to unlatching position.

Referring to Fig. 2 of the drawings, the operating mechanism 23 is shown in the closed and latched position. In the closed position, the operating lever 61—63 (Figs. 1 and 2) is biased in a clockwise or opening direction by means of a coiled spring 291 (Fig. 1) disposed in a cylinder 293 rigidly mounted on the frame 69. A piston 295 disposed for reciprocal movement in the cylinder 293 is connected oy means of a link 297 to the arm 61 of the operating lever and the spring 291 is compressed between the piston 295 and a closure plate 299 suitably secured to the upper end of the cylinder 293. The cylinder 293 and piston 295 also serve as a dash pot to absorb the final opening movement of the breaker and operating mechanism. The spring 291 acting through the piston 295 and the link 297 biases the operating lever 61—63 in a clockwise or breaker opening direction. The biasing force of the spring 291 is transmitted by means of the toggle 87—89 to the closing lever 75 which is normally restrained in the position shown in Fig. 2 by the latch 95. The force of the spring 291, therefore, tends to force the toggle 87—89 to collapse toward the right (Fig. 2) which is prevented by the link 105 and the latching mechanism. A component of the force tending to collapse the toggle 87—89 is applied through the link 105 to the latch member 103 tending to rotate the latter in a counterclockwise direction, the latch member 103 being restrained by the slip-off latch 119—125, and this latch, in turn, is restrained by the latch 127—131 (Fig. 5).

When the secondary latch 133 is operated, either by energization of the tripping magnet 137 or by manipulation of the manual lever 259 (Figs. 7 and 9) and rod 267, the latching portion 131 thereof is moved in a clockwise direction out from under the roller 127 (Fig. 5). When this occurs the force tending to collapse the toggle 87—89, a component of which is applied to the latch member 103, forces the roller latch 119 out of the path of the shoulder 125 whereupon the latch member 103 is free to rotate in tripping direction and no longer maintains the toggle 87—89 in its extended underset position. Upon release of the latch member 103 the toggle 87—89 immediately collapses under the influence of the spring 291 which immediately rotates the operating lever 61—63 to the position in which it appears in Fig. 3 to effect opening of the circuit breaker contacts.

If the closing spring 147 has been previously loaded or compressed moving the pin 169 to a point adjacent the left-hand end of the slot 171 in the link 173, the toggle 87—89 will be immediately reset to the position shown in Fig. 4. However, if the closing spring 147 is in its discharged condition as shown in Fig. 3, the pin 169 remains in the right-hand end of the slot 171 and the operating mechanism will be held in this position until the spring 147 is compressed.

Assuming that the closing spring has been compressed, upon collapse of the toggle 87—89, a pin 301 on the toggle link 89 engages the latch

95 and moves it to unlatching position thus freeing the closing lever 75 whereupon a spring 303 tensioned between the plate 141 and the lever 75 moves the latter clockwise from the Figure 3 position to the position shown in Fig. 4. This movement of the lever 75 straightens the toggle 87—89 and through the link 105 rotates the latch member 103 clockwise to a position wherein the latch roller 119 is re-engaged with the shoulder 125. The operating mechanism is now in the reset and relatched position shown in Fig. 4 and in condition for a closing operation. The reset position of the closing lever 75 is adjustably determined by an adjustable stop 305 (Figs. 2, 3 and 4) against which a shoulder on the lever 75 rests in the reset position of the parts.

With the closing spring 147 in the discharged position as shown in Fig. 3, the right-hand end of the slot 171 in the hub 173 is biased by the spring 303 against the pin 169 connecting the lever 159 to the link 167. This prevents immediate resetting of the operating mechanism, however, upon operation of the spring charging mechanism 25 (Figs. 1 and 6) in the previously described manner, the link 167 is drawn toward the left to the position shown in Fig. 4 in order to compress the spring 147. During this movement of the link 167, the spring 303 rotates the closing lever in clockwise or resetting direction maintaining the end of the slot 171 against the pin 169 until the movement of the lever 75 is arrested by the shoulder thereon striking the stop 305. The operating mechanism is now in the reset and relatched position and the closing spring in its loaded or charged condition.

In order to close the breaker following an opening and resetting operation, the attendant operates the lever 253 (Figs. 9 and 11) in a clockwise direction which thrusts the rod 243 downwardly causing the lower end thereof to engage the arm 241 (Fig. 6) and rock this arm, the shaft 239 and the latch levers 235 clockwise to withdraw the latch roller 231 from in front of the shoulder 229 on the cam 177, thus releasing the cam and the closing spring. The cam 177 is now free to rotate and, since the point of connection 175 of the link 167 to the cam is below the center line of the shaft 179, the closing spring 147 now quickly expands rotating the cam 177 counterclockwise as indicated by the arrow (Fig. 6). Referring to Fig. 4, as the spring 147 expands, it thrusts the member 153 toward the right and through the link 157 rotates the lever 159 in a clockwise direction at high speed. This movement of the lever 159 is transmitted through the pin 169 and link 173 to the closing lever 75 moving this lever counterclockwise. Since the toggle 87—89 is now latched in its thrust transmitting position, the counterclockwise movement of the closing lever 75 is transmitted therethrough to the lever 61—63 which, in turn, transmits this movement through the rod 51 to the switch arm 41 to close the breaker contacts.

Indicating means is provided in the control head 30 (Fig. 9) to indicate the "open" or "closed" position of the circuit breaker. The indicating means comprises an indicator 307 (Figs. 9, 10 and 11) pivoted on a pin 309 supported in the sides of the casting 209. The indicator 307 is biased by means of a spring 311 coiled about the pin 309 to position a legend "closed" in alignment with a sight opening 313 in the face of the control head. The indicator 307 is connected by means of a wire or small rod 315 to a lever 317 (Figs. 1 and 6) pivoted on a pin 319 supported in the

frame 181. When the breaker is tripped open and the lever 61 (Figs. 1 and 6) moves to the open position, a projection 321 of the lever 61 engages the lever 317 and moves it counterclockwise as shown in Fig. 6. This movement of the lever 317 pulls downward on the rod 315 and operates the indicator 307 to position an "open" legend in alignment with the sight opening 313 (Fig. 9).

When the breaker is actuated to the closed position, the lever 61 is moved counterclockwise freeing the lever 317 whereupon the spring 311 actuates the indicator 307 counterclockwise (Fig. 11) to again position the "closed" legend in alignment with the sight opening 313 (Fig. 9).

Indicating means is also provided for indicating the condition of the closing spring. This means comprises an indicator 323 (Figs. 7, 9 and 10) pivoted on the pin 309 and biased by means of a spring 325 to a position to present a legend "loaded" in alignment with a sight opening 327 in the face of the control head 30 (Fig. 9). The indicator 323 is connected by means of a rod or wire 329 to the arm 241 (Fig. 6) which operates the latch lever 235. When the closing spring 147 is in a charged or loaded condition, the latch roller 231 (Fig. 6) occupies a position in the path of the shoulder 229 on the cam 177 in which position the spring 325 maintains the indicator in the position wherein the legend "loaded" is displayed through the sight opening 327. When the lever 259 (Figs. 7 and 9) is operated to disengage the latch roller 231 (Fig. 6) from the cam 177 the arm 241 pulls down in the rod 329 actuating the indicator 323 to present a legend "unloaded" through the sight opening 323. As long as the closing spring 147 is in the discharged or unloaded condition, the shoulder 229 is out of alignment with the latch roller 235 which is then in engagement with the periphery of the cam 177 thus holding the indicator 323 in position to indicate the unloaded condition of the spring. When the spring charging mechanism 26 is operated to compress or load the spring 147, the roller will again drop into position in the path of the shoulder 229 permitting the spring 325 (Fig. 10) to move the indicator 323 to the position in which it indicates that the spring is loaded.

The spring loading means 26 is so constructed that the spring 147 cannot be overloaded and also cannot be discharged until it is fully loaded. When the pin 175 (Fig. 6) which connects the link 167 to the cam 177 moves over center below the center line of the shaft 179, the closing spring 147 is effective to slightly advance the cam to bring the shoulder 229 into latching engagement with the roller 231. This movement of the cam 177 is sufficient to advance the last tooth of the ratchet wheel 189 beyond the reach of the pawl 191 in its fully advanced position consequently any operations of the handle 221 after the parts are in the positions shown in Fig. 6 are idle and without effect to engage or advance the ratchet wheel 189. This limits the compression or loading of the spring 147 to a predetermined compression. The oscillatory movement of the lever 195 (Fig. 6) is limited by stop studs 194 and 196 on the frame 181.

When the closing spring 147 is discharged or in a partially loaded condition, the latch roller 231 (Fig. 6) rides on the periphery of the cam 177, and does not drop into the recess formed by the shoulder 229 until the spring 147 is fully loaded, hence, the spring cannot be tripped or discharged from a partially loaded condition.

As previously set forth, the closing spring may be compressed or loaded either while the breaker is in the closed position or after it has been tripped open. Release of the powerful closing spring when the breaker is in the closed position and the spring has no work to do would result in unnecessary slamming and possible damage to the parts. To avoid this, means is provided to prevent release of the closing spring in the closed position of the breaker. Referring to Fig. 11 of the drawings, the indicator 307, which indicates the "open" and "closed" positions of the breaker, is shown in the "closed" position. In this position, the indicator lies in the path of travel of an arm 331 of the lever 253 which is manually actuated to effect release of the closing spring thus effectually blocking releasing movement of the lever 253. When the breaker is tripped open the indicator 307 is moved clockwise out of the path of the arm 331 after which the lever 253 may be operated at will to release the closing opening and effect closing of the breaker.

The closing spring 147 must be capable of storing sufficient energy to effect high-speed closing of the circuit breaker against the blowout effect of a fault current. Since most of the closing operations are against normal rated currents, means is provided to absorb the excess energy of the closing spring on normal closing operations. The energy absorbing means includes an abutment 333 (Figs. 2, 3 and 4) disposed in a counterbore 335 in the member 153. The abutment 333 is provided with an integral stem 337 which extends through a guide opening in the end plate 155 and has a stop nut 339 threaded thereon to limit the inward movement of the abutment. Disposed between the abutment 333 and the end plate 154 is a series of inner and outer spring friction rings 341 and 343. The contacting surfaces of the rings 341—343 are angular with respect to each other so that when the member 153 strikes the abutment 333 near the end of a closing operation the friction generated by the spring rings 341—343 sliding over each other dissipates the excess energy of the closing spring 147 and prevents excessive slamming of the parts.

In certain testing procedures it is desirable to move the breaker to a test position near the door 22 (Fig. 1) with the door in the closed position. By removing the lower bolts 217 (Figs. 1, 6 and 9) the control column 28 may be pivoted about the upper bolts 215 to the vertical position indicated by dot and dash lines at 28*a* (Fig. 1) without disconnecting any of the control connections extending through the control column. With the lower bolts 217 removed, the control column 28 may also be lowered about the bolts 215 as a pivot to the horizontal position indicated by the dot and dash lines at 28*b* also without disconnecting any of the controls. In order to effect this pivotal movement of the control column the ratchet wheel operating rod or bar 199 is made in two parts that are pivotally connected by means of a pin 345 (Fig. 9) normally in axial alignment with the bolts 215. When the control column 28 is swung about the bolts 215 either to the vertical or horizontal positions, the operating rod 199 pivots about the pin 345. During such movement of the control column the control wires 315 and 329 flex to permit the movement of the control column and

the lower ends of the control rods 243 and 267 swing in a radius to clear their respective levers 241 and 271. With the control column in its vertical position, the circuit breaker may be rolled out to a position just inside the door and the door closed for test purposes.

Having described the invention in accordance with the patent statutes, it is to be understood that various changes and modifications may be made in the structural details thereof without departing from some of the essential features of the invention.

We claim as our invention:

1. A controlling and operating mechanism for an enclosed circuit breaker, an enclosing housing for said circuit breaker having an openable door therein, operating mechanism releasable to effect opening of said circuit breaker, closing means for said circuit breaker comprising a stored energy device, energy storing mechanism operable to store energy in said stored energy device, holding means releasably holding said stored energy in said stored energy device, control means supported on said breaker terminating adjacent to said housing and accessible from outside said housing, means on said control means for manually operating said energy storing mechanism to store energy in said stored energy device, means on said control means operable to release said operating mechanism to effect opening of said breaker free of said closing means, and means on said control means manually operable to release said stored energy device to effect closing of said breaker, said energy storing mechanism, said operating mechanism release means, and said stored energy release means all being operable from outside said housing while said openable door remains closed.

2. A controlling and operating mechanism for an enclosed circuit breaker, an enclosing housing for said circuit breaker having an openable door therein, operating mechanism releasable to effect opening of said circuit breaker, closing means for said circuit breaker comprising a compression spring, means operable to compress said spring, holding means releasably holding said spring in compressed condition, control means supported on said breaker extending outwardly therefrom and terminating adjacent to said housing, means on said control means for manually operating said spring compressing means, means on said control means operable to release said operating mechanism to effect opening of said breaker free of said closing means, and means on said control means manually operable to release said spring to effect closing of said breaker, said spring compressing means, said operating mechanism release means, and said spring release means all being operable from outside of said housing while said openable door remains closed.

3. A controlling and operating mechanism for an enclosed circuit breaker, an enclosing housing for said circuit breaker having an openable door therein, operating mechanism releasable to effect opening of said circuit breaker, electroresponsive means operable to release said operating mechanism to effect automatic opening of said breaker, closing means for said circuit breaker comprising a stored energy device, energy storing mechanism operable to store energy in said stored energy device, holding means releasably holding said stored energy in said stored energy device, control means supported on said breaker terminating adjacent to said housing and accessible from outside said housing, means on said control means for manually operating said energy storing mechanism to store energy in said stored energy device, manually operable means on said control means operable to release said operating mechanism to effect opening of said breaker free of said closing means, and means on said control means manually operable to release said stored energy device to effect closing of said breaker, said energy storing mechanism, said operating mechanism release means, and said stored energy release means all being operable from outside said housing while said openable door remains closed.

4. A controlling and operating mechanism for an enclosed circuit breaker, an enclosing housing for said circuit breaker having an openable door therein, operating mechanism releasable to effect opening of said circuit breaker, closing means for said circuit breaker comprising a stored energy device, energy storing mechanism operable to store energy in said stored energy device, holding means releasably holding said stored energy in said stored energy device, control means supported on said breaker terminating adjacent to said housing and accessible from outside said housing, means on said control means for manually operating said energy storing mechanism to store energy in said stored energy device, means on said control means operable to release said operating mechanism to effect opening of said breaker, and means on said control means manually operable to release said stored energy device to effect closing of said breaker, electroresponsive means operable to release said operating mechanism to effect opening of said breaker trip free of said closing means, said energy storing mechanism, said operating mechanism release means, and said stored energy release means all being operable from outside said housing while said openable door remains closed.

5. A controlling and operating mechanism for an enclosed circuit breaker, an enclosing housing for said circuit breaker having an openable door therein, operating mechanism releasable to effect opening of said circuit breaker, electroresponsive trip means responsive to overload currents to release said operating mechanism and opening of said breaker, closing means for said circuit breaker comprising a compression spring, means operable to compress said spring, holding means releasably holding said spring in compressed condition, control means supported on said breaker extending outwardly therefrom and terminating adjacent to said housing, means on said control means for manually operating said spring compressing means, means on said control means operable to release said operating mechanism to effect opening of said breaker, and means on said control means manually operable to release said spring to effect closing of said breaker, said spring compressing means, said operating mechanism release means, and said spring release means all being operable from outside of said housing while said openable door remains closed, said operating mechanism being releasable to effect opening of said breaker free of said closing spring.

6. In a circuit breaker comprising relatively movable contacts biased open, operating means for said contacts comprising an operating lever operable to effect opening of said contacts, a closing lever for operating said operating lever to close said contacts, thrust transmitting means connecting said levers, releasable means nor-

mally restraining said thrust transmitting means in thrust transmitting position, said operating lever, said closing lever and said releasable means being pivoted about a common axis, trip means for releasing said releasable means to effect opening of said contacts free of said closing lever, closing means comprising a spring, means operable to compress said spring, a linkage connecting said spring compressing means to said spring, connecting means connecting said linkage to said closing lever, latch means normally restraining said spring in compression and operable to release said spring, said spring when released acting through said linkage and said connecting means to actuate said closing lever to close said contacts, and manual means operable to release said latch means.

7. In a circuit breaker comprising relatively movable contacts biased open, operating means for said contacts comprising an operating lever operable to effect opening of said contacts, a closing lever for operating said operating lever to close said contacts, thrust transmitting means connecting said levers, releasable means normally restraining said thrust transmitting means in thrust transmitting position, said operating lever, said closing lever and said releasable means being pivoted about a common axis, trip means for releasing said releasable means to effect opening of said contacts free of said closing lever, closing means comprising a spring disposed on one side of said operating mechanism, means disposed on the opposite side of said operating mechanism from said spring and operable to compress said spring, a linkage connecting said spring compressing means to said spring, connecting means connecting said linkage to said closing lever, latch means normally restraining said spring in compression and operable to release said spring, said spring when released acting through said linkage and said connecting means to actuate said closing lever to close said contacts, and manual means operable to release said latch means.

8. In a circuit breaker comprising relatively movable contacts biased open, operating means for said contacts comprising an operating lever operable to effect opening of said contacts, a closing lever for operating said operating lever to close said contacts, thrust transmitting means connecting said levers, releasable means normally restraining said thrust transmitting means in thrust transmitting position, said operating lever, said closing lever and said releasable means being pivoted about a common axis, trip means for releasing said releasable means to permit collapse of said thrust transmitting means and effect opening of said contacts free of said closing lever, closing means comprising a spring, means operable to compress said spring, a linkage connecting said spring compressing means to said spring, connecting means connecting said linkage to said closing lever, latch means normally restraining said spring in compression and operable to release said spring, said spring when released acting through said linkage and said connecting means to actuate said closing lever to close said contacts, and manual means operable to release said latch means, said connecting means being pivotally connected to said closing lever and having a pin and slot connection with said linkage to permit compression of said spring while said breaker is in the closed position.

9. In a circuit breaker comprising relatively movable contact means and releasable operating mechanism for said contact means including, an enclosing housing for said circuit breaker having an openable door therein, closing means for said circuit breaker comprising a stored energy device, energy storing mechanism mounted on said circuit breaker and operable to store energy in said stored energy device, holding means releasably holding said stored energy in said stored energy device, control means comprising a control tube having one end mounted on said operating energy storing mechanism, a control head mounted on the other end of said control tube adjacent said openable door and accessible from outside said door, actuating means in said control head operable to actuate said energy storing mechanism, a first trip means in said control head operable to cause an opening operation of said operating mechanism free of said closing means, and a second trip means in said control head operable to release said stored energy device to effect a closing operation of said operating mechanism, said actuating means, said first trip means and said second trip means all being operable from outside of said housing while said openable door remains closed.

10. In an enclosed circuit breaker comprising relatively movable contact means and releasable operating mechanism therefor, an enclosing housing for said circuit breaker having an openable door thereon, closing means comprising a spring for operating said operating mechanism to close said breaker, means operable to compress said spring, holding means releasably holding said spring in compressed condition, control means supported on said breaker extending outwardly therefrom and terminating adjacent to said openable door, means on said control means for manually operating said spring compressing means, means on said control means manually operable to release said spring to close said breaker, and means operable according to the position of said operating mechanism to prevent release of said spring when said operating mechanism is in the closed position.

11. In an enclosed circuit breaker comprising a releasable operating mechanism for said breaker, an enclosing housing for said circuit breaker having an openable door thereon, trip mechanism operable to release said operating mechanism to effect opening operation of said operating mechanism, spring means for actuating said operating mechanism to close said breaker, a spring charging means operable to store energy in said spring, means releasably holding said spring means in charged condition, a linkage connecting said spring means to said spring charging device and to said operating mechanism, a control device for said circuit breaker accessible from outside said openable door while said door remains closed, actuating means in said control device for actuating said spring charging means, a first indicating means on said control device operated by said spring charging means to indicate the condition of said spring, means on said control device for actuating said trip mechanism to effect opening of said circuit breaker, means on said control device operable to actuate said spring holding means to release said spring and effect closing of said breaker, a second indicating means on said control device operated by said operating mechanism to indicate the condition of said circuit breaker, and said second indicating means preventing release of said spring means in the closed position of said circuit breaker.

12. A circuit breaker comprising a frame, oper-

ating mechanism for said breaker, a trip device operable to effect opening of said breaker, spring closing means for said breaker, a spring charging device operable to store energy in said spring, means releasably holding said spring in charged condition and operable to release said spring to effect closing of said breaker, a control device mounted on said frame and extending outwardly therefrom, control means on said control device for actuating said trip device, said spring charging means and said spring holding means, connections for said control means extending through said control device connecting said control means to the elements actuated thereby, and means pivotally mounting said control device on said frame to permit movement of said control device to a plurality of positions without disconnecting any of said connections.

13. A circuit breaker comprising operating mechanism operable to effect opening and closing of said breaker, an enclosing housing for said breaker having an openable door, spring means for actuating said operating mechanism to close the breaker, spring charging means operable to store energy in said spring, means releasably holding said spring in charged condition, a linkage connecting said spring to said spring charging means and to said operating mechanism, a control device comprising a tube mounted on said breaker having a normal operating position extending outwardly therefrom and movable to a plurality of other positions, a control element mounted on said control tube adjacent to said openable door when said control device is in said normal position, and a lever mounted in said control element operable from outside of said door to actuate said spring charging means while said door remains closed.

14. A circuit breaker comprising operating mechanism operable to effect opening and closing of said breaker, an enclosing housing for said breaker having an openable door, spring means for actuating said operating mechanism to close the breaker, spring charging means operable to store energy in said spring, means releasably holding said spring in charged condition, a linkage connecting said spring to said spring charging means and to said operating mechanism, a control device comprising a tube mounted on said breaker and having a normal operating position extending outwardly therefrom, a control element mounted on said tube adjacent to said openable door, and a lever mounted in said control element operable from outside said door to actuate said spring charging means while said door remains closed, and means pivotally mounting said control device for movement to a position other than said normal position.

15. In a circuit breaker comprising relatively movable contact means and releasable operating mechanism for said contact means including closing means for said circuit breaker comprising a stored energy device, energy storing mechanism mounted on said circuit breaker and operable to store energy in said stored energy device, holding means releasably holding said stored energy in said stored energy device, control means comprising a control tube having one end mounted on said operating mechanism, a control head mounted on the other end of said control tube, actuating means in said control head operable to actuate said energy storing mechanism, a first trip means in said control head operable to cause an opening operation of said operating mechanism and opening of said contacts free of said closing means, and a second trip means in said control head operable to release said stored energy device to effect a closing operation of said operating mechanism.

16. In a circuit breaker comprising relatively movable contact means and releasable operating mechanism for said contact means including closing means for said circuit breaker comprising a stored energy device, energy storing mechanism mounted on said circuit breaker and operable to store energy in said stored energy device, control means including a control head mounted on said operating mechanism, actuating means in said control head operable to actuate said energy storing mechanism, a first trip means in said control head operable to cause an opening operation of said operating mechanism and opening of said contacts free of said closing means, a second trip means in said control head operable to release said stored energy device to effect a closing operation of said operating mechanism, and said control head being movable relative to said circuit breaker.

HARRY J. LINGAL.
JOSEPH D. FINDLEY, JR.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,318,342	Thompson	May 4, 1943
2,388,934	Pearson	Nov. 13, 1945
2,449,820	Seaman	Sept. 21, 1948
2,458,800	Schultz	Jan. 11, 1949