

Jan. 24, 1939.

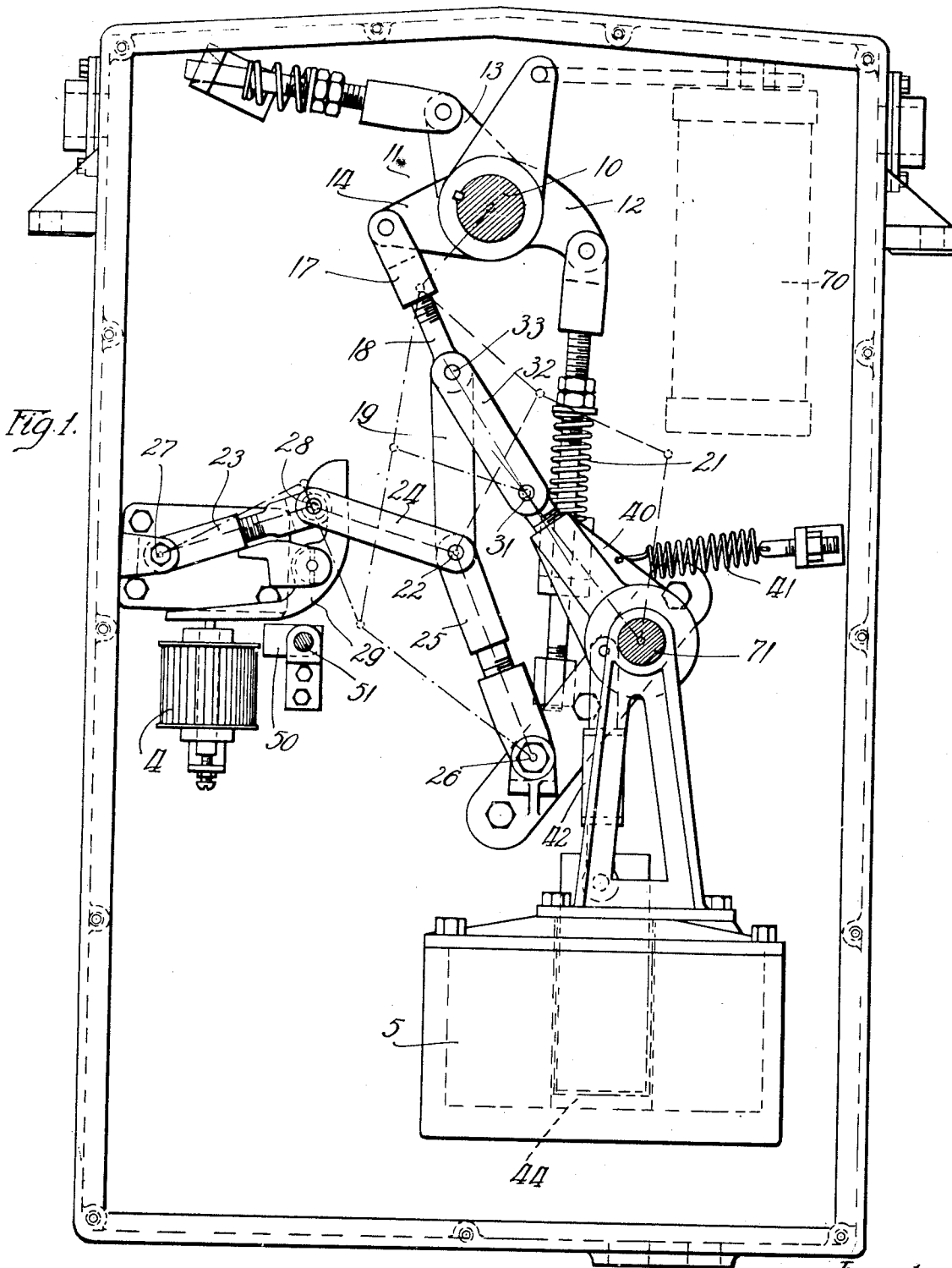
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2,145,141

TRIP MECHANISM FOR OIL SWITCHES

Original Filed Dec. 26, 1928

4 Sheets-Sheet 1



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TRIP MECHANISM FOR OIL SWITCHES

Original Filed Dec. 26, 1928 4 Sheets-Sheet 2

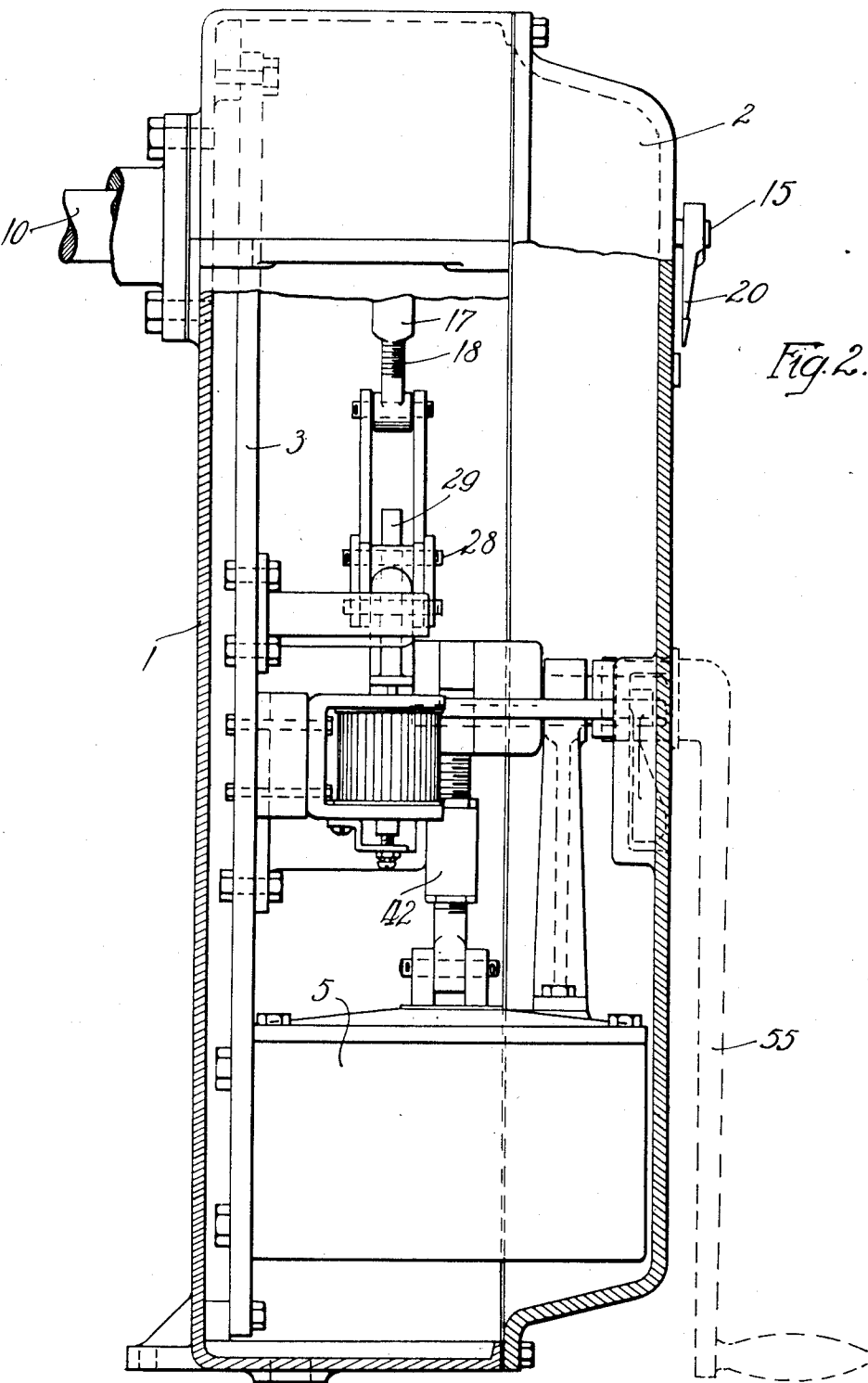


Fig. 2.

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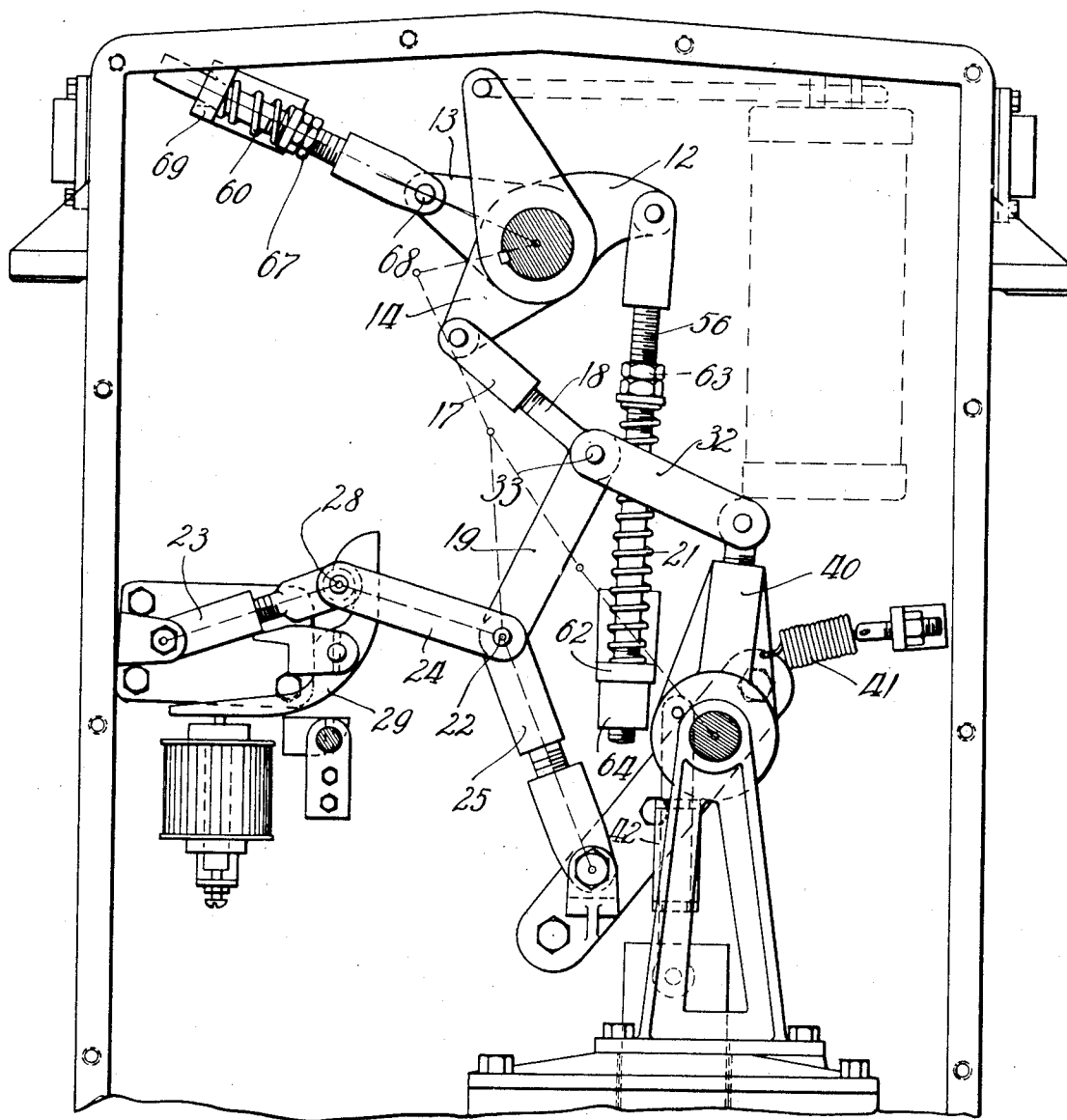
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TRIP MECHANISM FOR OIL SWITCHES

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Fig. 3.



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TRIP MECHANISM FOR OIL SWITCHES

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4 Sheets-Sheet 4

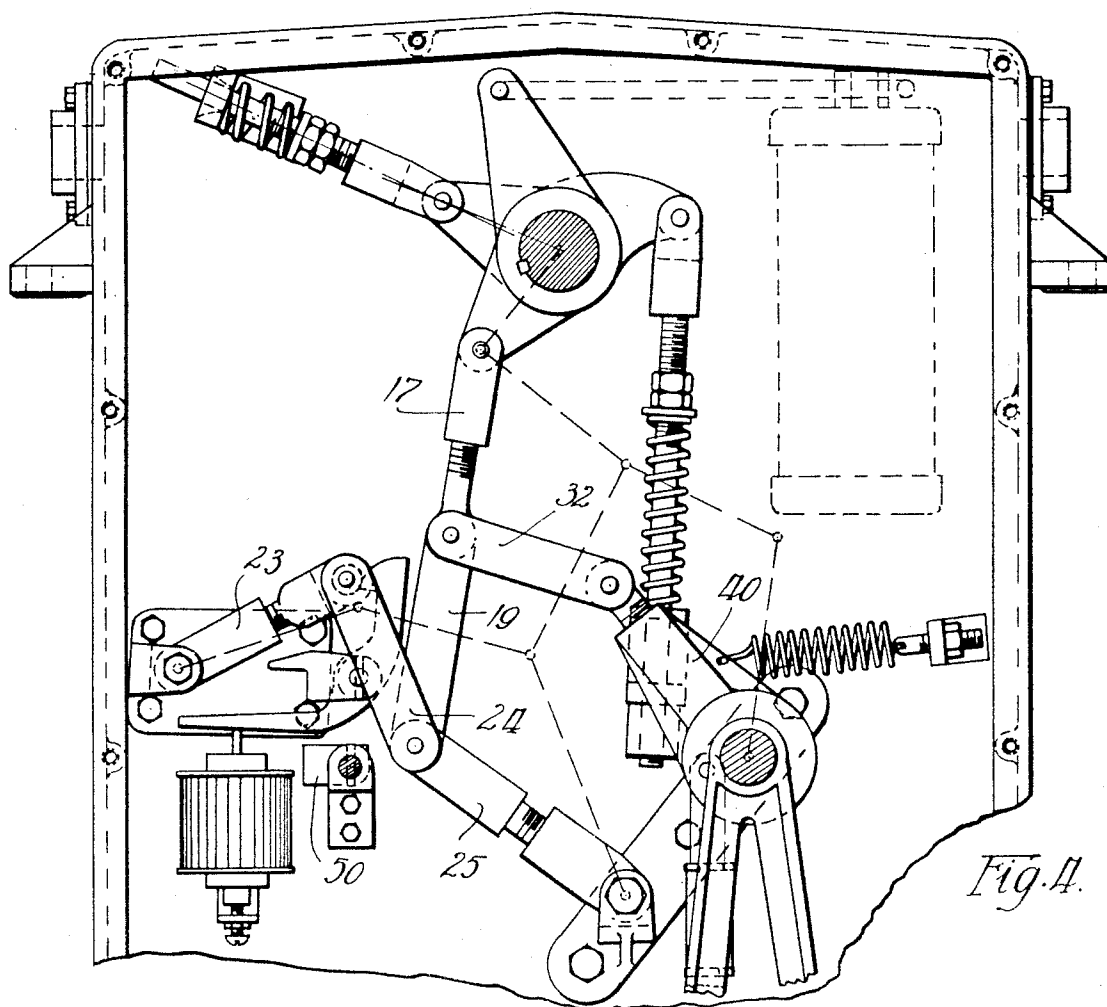


Fig. 4.

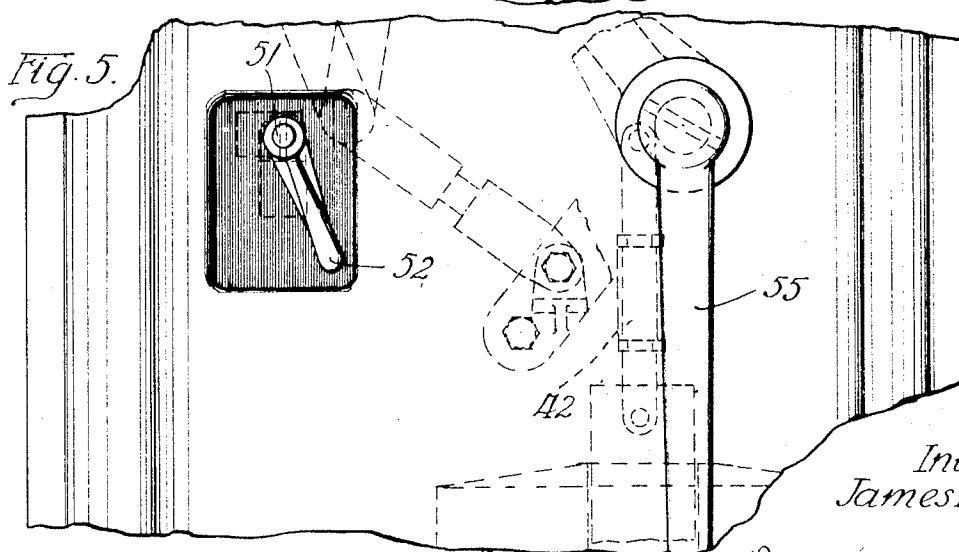


Fig. 5.

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UNITED STATES PATENT OFFICE

2,145,141

TRIP MECHANISM FOR OIL SWITCHES

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Application December 26, 1928, Serial No. 328,433
Renewed June 8, 1938

51 Claims. (Cl. 200—89)

This invention relates to control mechanism for electric switches, and more particularly to control mechanism for electric oil switches of the kind that may be actuated electromagnetically or manually to close or open the switch.

In the embodiment of the invention here illustrated, the mechanism shown is of the kind used for controlling oil circuit breakers and the like, such for instance as shown in my pending application, Serial No. 313,729, filed October 20, 1928. There is provided two actuating mechanisms operating through a common link work for opening and closing the switch, respectively. Each of the mechanisms may be operated electromagnetically or manually and the arrangement is such that the switch closing mechanism cannot be effective when the tripping mechanism is in the tripping position, that is, the operating mechanism cannot be effective to close the switch against a short circuit and maintain it.

The tripping mechanism is arranged to be effective to trip the switch at all times regardless of the position of the switch closing mechanism. The arrangement is such that a single latch pivoted about a stationary pivot retains the mechanism in its operated position against the action of a powerful spring tending to swing it to the open position. The latch is operated by the tripping magnet and upon the operation of the magnet the latch trips, thus permitting the spring to actuate the mechanism to trip the switch. To reclose the switch it is only necessary to operate the switch closing solenoid, and if the tripping solenoid has by this time been deenergized, the mechanism is effective to reclose the switch.

The attainment of the above and further objects of the present invention will be apparent from the following specification taken in conjunction with the accompanying drawings forming a part thereof. In the drawings:

Figure 1 is a front view of the operating mechanism with the casing cover removed, the parts being shown in the switch closed position, the position of the parts when the switch is open being shown in dotted lines;

Figure 2 is a side view of the mechanism with the casing wall partially broken away;

Figure 3 is a view similar to Figure 1 showing the link work in the switch open position, the dotted lines showing the position of the parts when the mechanism is in the switch closed position;

Figure 4 is a view showing the position that the parts assume when the mechanism is actuated

to the switch closed position at a time when there is a short circuit on the line; and

Figure 5 is a fragmentary view showing the position of the handles on the cover of the switch operating mechanism.

Referring now more particularly to Figure 1 of the drawings, the operating mechanism here shown is adapted to be connected to control a number of oil switches, circuit breakers, or the like, in any well known manner. A suitable connection between the operating mechanism and the controlled switches is shown in my pending application, Serial No. 313,729, filed October 20, 1928. Since this invention is concerned more particularly with the operating mechanism per se, the manner of connecting that mechanism to the switches is not shown.

The shaft 10 extends through the casing of the operating mechanism and upon rotation thereof in either direction opens or closes the oil switches. The main operating shaft 10 enters the housing 1 and has the crank plate 11 keyed thereto within the housing. The crank plate 11 includes three arms 12, 13 and 14, provided for a purpose which will be apparent as the description proceeds. An extension 15 of the shaft 10 extends through the cover 2 of the casing and has secured thereto an indicator 20 for indicating the position of the shaft. Suitably bolted to the rear wall of the casing 1 is the supporting frame 3 upon which the various operating parts are mounted.

The link mechanism for operating the shaft 10 is under the control of the tripping magnet 4 and of the switch closing magnet 5. When the shaft 10 is in the position shown in Figure 1, the switch is in the closed position. The link consisting of the members 17 and 18 together with the link 19 form a toggle which, when extended as shown, forces the circuit breaker to the closed position against the action of the spring 21 which exerts a force tending to rotate the shaft 10 in a counter clockwise direction, that is, to the switch open position. The lower end of the link 19, that is the pivot point 22, is held stationary by three links 23, 24 and 25. The link 25 is pivoted at its lower end at the stationary pivot point 26 while the link 23 is pivoted at one end at the stationary pivot point 27. The point 28 which is the pivot point between the links 23 and 24 is held against upward movement by the latch 29 pivoted at the point 30. As long as the pivot 28 is held against upward movement by the latch, the links 23, 24 and 25 constitute a rigid system, hence the point 22 is fixed. The force exerted upon the link 32 by the spring 21 acting

through the link 17—18 tends to rotate the link or operating crank 40 of the toggle 32—40 in a counter clockwise direction when the parts are in the position shown in Figure 1. The actuator 40 has a limited angular motion and, as seen in Figure 1, it is in its extreme position from which it can rotate only in a clockwise direction. The link 40 is, therefore, maintained in the switch closed position by the spring 21 and the reaction of the breaker contacts acting through the shaft 10. This fixes the point 31 and, since the point 22 is fixed as pointed out above, the position of the point 33 is also fixed. With the point 33 in a fixed position, it is apparent that the link comprising the members 17 and 18 will prevent further counter clockwise movement of the shaft 10 under the action of the spring 21.

With the operating crank 40 held against the stop 44 and thus held against counter clockwise rotation and the point 31 therefore held fixed, the link comprising the members 17 and 18 together with the link 32 constitutes a toggle, the knuckle 33 of which tends to break in a direction towards the left as seen in Figure 1. This is opposed by the link 19. The links 19 and 25 form a toggle resulting in a reaction in link 24 materially less than the force acting on either 19 or 25. Again links 23 and 24 form a toggle resulting in a reaction on the latch 29 materially less than the force acting on either link 24 or 23. Thus the force acting on the latch is a small fraction of the force on the link 17—18 holding the shaft 10 in the closed position against the cumulative action of the spring 21, the spring and contact pressure of the switch and the electro mechanical forces which may be developed in the switch by large short circuit currents. Accordingly the energy required by the trip coil 4 to release the latch 29 is many times smaller than would be required if no such mechanical advantage were present in the mechanism. This factor is of very real value in many cases where it is desired to operate the trip coil 4 directly from a current transformer in the circuit controlled by the switch as the energy output of a current transformer is of necessity limited by commercial considerations.

Energization of the trip coil 4 releases the latch 29 and permits the toggle comprising the links 23 and 24 to break upwards, that is in a counter clockwise direction about the stationary point 27. This permits the pin 22 which is the pivot point of the toggles comprising the links 19 and 25 to move to the left, as seen in Figure 1. This permits the counter clockwise rotation of the point 33 about the pin 31 as a center, this motion being brought about by the spring 21. The link 32 rotates about the point 31 as a center and when the center line of this link passes the center line of the link 40 thus breaking the toggle formed by the links 32 and 40, the spring 41 rotates the toggle 40 in a clockwise direction. This is of no particular consequence at this time, this action being merely preparatory for the subsequent closing operation of the switch. The mechanism now moves under the action of the accelerating spring 21 until the parts reach the position shown in Figure 3, which is the full open position.

Thus during the switch opening movement the links 23 and 25 are rotated in a counter clockwise direction about their respective centers 27 and 26 for a very short distance, that is, until the link 32 has rotated in a counter clockwise direction sufficiently to permit the spring 41 and the spring 21 to rotate the link 40 in a clockwise direction. When this amount of motion has taken place the

links 23, 24 and 25 are brought back to their initial position, and at this time the links 19, 32 and the link formed by the members 17 and 18 are in the position shown in Figure 3. If, on the other hand, during the switch opening operation the link 40 were held stationary as by the magnet 5 so that the spring 41 could not rotate that link in a clockwise direction, the switch opening operation would still take place, and under those conditions the links would operate to the position shown in Figure 4. If subsequent to the switch opening movement the solenoid 5 were deenergized so that the spring 41 could be effective, the links would be rotated from the positions shown in full lines in Figure 4 to the position shown in the dotted lines which is the position shown in Figure 3. It is thus apparent that the switch opening operation is accomplished even though the crank 40 is held in the closed position at the time the latch 29 trips.

To reclose the circuit breaker, the crank arm 40 is rotated in a counter clockwise direction from the position shown in Figure 3 to the position shown in Figure 1. If at this time the latch 29 is being held in the tripped position by the solenoid 4, that is, if there is a short circuit on the line, the rotation of the crank arm 40 is of no avail, for under these conditions the rotation of the crank arm 40 merely moves the links from the position shown in Figure 3 to the position shown in Figure 4, the shaft 10 remaining stationary. This feature prevents pumping of the mechanism if an attempt is made to close the switch against a short circuit which would automatically trip the mechanism as soon as the switch contacts touch. If there is no fault on the line and the latch 29 is in its normal position, the pivot point 28 is held against upward movement by the latch and upon rotation of the crank arm 40 to the position shown in Figure 1 the switch is moved to the closed position. As the crank arm 40 is rotated the link 32 is forced to the left, the point 33 moving about the point 22 as a center. As the crank 40 rotates into line with the link 32 it forms a powerful toggle, which through the link 17—18 exerts a heavy closing torque on the crank 14. Near the end of the closing stroke, the toggle comprising the crank arm 40 and the link 32 passes over the center and is thereby held against clockwise rotation by the force transmitted through the link 32 by the spring 21. This toggle is not broken until, during the releasing action, the link 32 rotates about the pin 31 as a center in the manner previously described.

The crank 40 is rotated in a counter clockwise direction by the solenoid 5 acting through the link 42. When the switch is in its closed position the solenoid armature 43 is in actual contact with the pole piece 44 (except for a thin non-magnetic washer). It may, therefore, be seen that with the switch in the closed position further counter clockwise rotation of the crank arm 40 by the force transmitted through the link 32 is not possible. The link 42 is adjustable as to length so as to permit an adjustment of the extent of movement of links 32 and 40 when the switch is moved to the closed position. The energization of the solenoid 5 may be controlled from a remote point in any desired manner. It is to be noted that should the operator maintain the solenoid 5 energized while the mechanism is being tripped automatically, the magnetic action of the solenoid 5 holds the armature against the pole piece and the spring 41 is unable to rotate the 75

crank 40 clockwise to reset the link mechanism beneath the latch 29. This, however, does not prevent the tripping of the switch operating mechanism since under such conditions the link work is moved from the position shown in Figure 1 to that shown in Figure 4, the switch operating shaft rotating in the same manner as before. As soon as the solenoid is deenergized the crank 40 may be rotated by the spring 41. It may thus be seen that I have provided an arrangement which prevents cutting of the mechanism if an attempt is made to close against a short circuit which would automatically trip the mechanism as soon as the contacts touch, and, at the same time, it prevents the operator from holding the breaker closed against a fault, as the mechanism is permitted to trip free of the solenoid 5 under all conditions.

The solenoid armature is held firmly against the stop 44 when the switch is closed. If then an operator, by mistake, energizes the coil 5 while the switch is closed, no movement of the armature results. In some mechanisms the armature is released when the closing operation is completed and returns to the position occupied before the operation. If the operator energizes the coil when the switch is closed and the armature is not in contact with the stop the armature moves against the stop with a powerful impact. The mechanical forces produced are of such magnitude as to be dangerous and in some such devices electrical interlocks are provided to prevent energizing the coil when the switch is closed. Such devices are costly and complicate the control wiring. The mechanism here offered is not subject to such dangerous impacts and requires no such interlocks for the reasons previously set forth.

Provision is made for manually tripping the latch 29 independent of the trip coil 4, if desired. A lever 50 is fixed upon a rotatable shaft 51 which may be turned by means of the handle 52 on the outside of the cover of the mechanism. The lever 51 trips the latch 29 in the same manner that the trip coil does.

An operating handle 55 is provided for manually rotating the crank 40, if desired. This may be necessary at times due to the possible failure of the source of direct current for operating the solenoid 5, or for mechanical convenience at times. The handle 55 may rotate the shaft 71 carrying the crank 40 in the same manner that the solenoid controlled link 42 operates that shaft.

The accelerating spring 21 and the decelerating spring 60 act upon the shaft in the same manner as do the accelerating and decelerating springs shown in my pending application, above referred to, to which reference may be had for a more complete description. The rod 56 is pivoted to swing about a pin in the crank arm 12 and passes freely through an opening in a stationary plate 62. With the apparatus in the closed position, as shown in Figure 1, the spring 21 is under compression and exerts a powerful tangential force tending to rotate the shaft 10 in a counter clockwise direction, that is, to the open position. The latch 29 acting through the link work previously described prevents the rotation of the shaft.

The compression of the spring 21 may be adjusted at the lock nut 63, and the length of the stroke of the rod 56 may be adjusted at the lock nuts 64. When the switch is in the closed position the decelerating spring 60 is not stressed. As the shaft 10 rotates to the open position, the spring 60 comes into action near the end of the

opening movement, is compressed and exerts a force on the crank plate 13 which has a powerful tangential component. The force exerted by this spring may be adjusted by means of lock nuts 67, and can be set to reduce the velocity of moving parts to a low value, which is just sufficient to carry the point 68 across a line drawn from the center of the shaft through the center of the decelerating spring rod guide support 69. The component of the force exerted by the spring 60 tangent to the crank disc is reversed in direction as the pin 68 passes dead center near the end of the stroke, and it then tends to force the mechanism slightly further open. Actually this force carries the mechanism a very short distance further until the stop 64 engages the stationary plate 62. The mechanism is thus brought to rest at the end of the stroke without shock and the rebounding of the parts is thus effectively prevented. The stop 64 being adjustable, the location of the switch parts in the open position may be accurately fixed. A suitable auxiliary switch 70 is controlled by the shaft 10 and in turn it controls suitable signaling or indicating means for indicating the closed or open position of the switch operating mechanism at some remote point.

In compliance with the requirements of the patent statutes, I have herein shown and described a preferred embodiment of my invention. I do not wish to be limited to the precise structure here shown, the same being shown for illustrative purposes only. What is believed to be new and desired to be secured by Letters Patent is:

1. In a switch operating mechanism the parts of which are in certain relative positions when the mechanism is in the normal closed position and in certain other relative positions when the mechanism is in the normal open position, a latch mounted independently of the hereinafter mentioned operating member for retaining the mechanism in the closed position, means for moving the mechanism to the normal open position upon the release of the latch, an operating member operable by a continuous motion in one direction from the normal closed position to the normal open position and in the opposite direction from the normal switch open position of the mechanism to move the mechanism to the closed position, said operating member being retainable in its closed position without preventing switch opening movement of the mechanism upon release of the latch, and urged to its normal switch open position upon opening movement of the mechanism to condition the mechanism for reclosure, and electromagnetic means for imparting said continuous motion to the operating member to move the mechanism to the closed position, movement of said operating member being ineffective if or when the latch is released, and said mechanism including means controlled by the latch for rendering the movement of the operating means ineffective.

2. In a switch operating mechanism the parts of which are in certain relative positions when the mechanism is in the normal closed position and in certain other relative positions when the mechanism is in the normal open position, a latch mounted independently of the hereinafter mentioned operating member for retaining the mechanism in the closed position, means for moving the mechanism to the normal open position upon the release of the latch, an operating member operable by a continuous motion in one direction from the normal closed position to the

normal open position and in the opposite direction from the normal switch open position of the mechanism to move the mechanism to the closed position, said operating member being retainable in its closed position without preventing switch opening movement of the mechanism upon release of the latch, and urged to its normal switch open position upon opening movement of the mechanism to condition the mechanism for reclosure, and electromagnetic means for imparting said continuous motion to the operating member to move the mechanism to the closed position, said mechanism including means controlled by the latch for rendering the electromagnetic means ineffective to maintain the mechanism in the operated position or to operate the mechanism when the latch is tripped.

3. In a switch operating mechanism, means for holding the mechanism in the closed position, means for releasing the holding means, spring means for moving the mechanism to the open position, switch closing means held by said spring in the switch closed position when the switch is closed, said mechanism including means for releasing the closing means upon the initial opening movement of the switch mechanism, means independent of the holding means for biasing the closing means to the open position, and electromagnetic means for actuating the closing means to reclose the switch.

4. In a switch operating mechanism, a spring urging the mechanism to the open position, a latch for retaining the mechanism in the closed position against the action of the spring, an operating member movable between extreme limits for operating the mechanism to the closed position, said mechanism including means for reversing the opposing force on the operating member near the end of the switch closing movement whereby the operating member is retained in the switch closing position, the force on the operating member being again reversed as the mechanism moves to the open position upon the release of the latch, whereby the operating member is permitted to return to its other extreme position, and means urging the return movement.

5. In a switch operating mechanism, a spring urging the mechanism to the open position, a latch for retaining the mechanism in the closed position against the action of the spring, an operating member movable between extreme limits for operating the mechanism to the closed position, said mechanism including means for reversing the opposing force on the operating member near the end of the switch closing movement whereby the operating member is retained in the switch closing position, the force on the operating member being again reversed as the mechanism moves to the open position upon the release of the latch, whereby the operating member is permitted to return to its other extreme position, means urging the return movement, and electromagnetic means for actuating the operating member to operate the mechanism to the switch closed position.

6. A switch operating member biased to the open position, an operating crank, a toggle between the member and the crank whereby, when the knuckle of the toggle is free, actuation of the crank is ineffective to transmit power through the toggle for actuating the member, a second toggle extending between the first toggle and a fixed point, and means for releasably retaining the knuckle of the second toggle against breaking whereby upon actuation of the crank, the knuckle

of the first toggle is guided by the second toggle thereby actuating the member to its closed position, said last means comprising a third toggle extending between the second toggle and a fixed point, and a latch for holding the third toggle to hold the second toggle.

7. A switch operating shaft biased to the open position, an operating crank, a toggle between the shaft and the crank whereby, when the knuckle of the toggle is free, actuation of the crank is ineffective to transmit power through the toggle for actuating the shaft, a second toggle extending between the first toggle and a fixed point, means for releasably retaining the knuckle of the second toggle against breaking whereby upon actuation of the crank, the knuckle of the first toggle is guided by the second toggle thereby actuating the shaft to its closed position, said last means comprising a third toggle extending between the second toggle and a fixed point, and a latch for holding the third toggle to hold the second toggle; and a stop for limiting the motion of the crank in the switch closing direction, said first mentioned toggle urging the crank against the stop when the switch is closed thereby maintaining the toggle system in equilibrium.

8. A switch operating member biased to the open position, an operating crank biased to its switch open position, a toggle between the member and the crank whereby, when the knuckle of the toggle is free, actuation of the crank is ineffective to transmit power through the toggle for actuating the member, a second toggle extending between the first toggle and a fixed point, means for releasably retaining the knuckle of the second toggle against breaking whereby upon actuation of the crank the knuckle of the first toggle is guided by the second toggle thereby actuating the member to its closed position, and a stop for limiting the motion of the crank in the switch closing direction, said first mentioned toggle urging the crank against the stop when the switch is closed thereby maintaining the toggle system in equilibrium.

9. A rotatable switch operating member biased to the open position, an operating crank, a toggle between the member and the crank whereby, when the knuckle of the toggle is free, actuation of the crank is ineffective to transmit power through the toggle for actuating the member, a second toggle extending between the first toggle and a fixed point, means for releasably retaining the knuckle of the second toggle against breaking whereby upon actuation of the crank the knuckle of the first toggle is guided by the second toggle thereby actuating the member to its closed position, and a stop for limiting the motion of the crank in the switch closing direction, said first mentioned toggle urging the crank against the stop when the switch is closed thereby maintaining the toggle system in equilibrium, the knuckle of the first mentioned toggle breaking, upon release thereof by the second mentioned toggle, in a direction to urge the crank away from the stop during the switch opening operation of the member.

10. A rotatable switch operating member biased to the open position, an operating crank, a toggle between the member and the crank whereby, when the knuckle of the toggle is free, actuation of the crank is ineffective to transmit power through the toggle for actuating the member, a second toggle extending between the first toggle and a fixed point, means for releasably retaining the knuckle of the second toggle against breaking

whereby upon actuation of the crank the knuckle of the first toggle is guided by the second toggle thereby actuating the member to its closed position, a stop for limiting the motion of the crank in the switch closing direction, said first mentioned toggle urging the crank against the stop when the switch is closed thereby maintaining the toggle system in equilibrium, and means for moving the crank away from the stop during the switch opening movement.

11. A switch operating member biased to the open position, an operating crank biased to its switch open position, a toggle between the member and the crank whereby, when the knuckle of the toggle is free, actuation of the crank is ineffective to transmit power through the toggle for actuating the member, a second toggle extending between the knuckle of the first toggle and a fixed point, means for releasably retaining the knuckle of the second toggle against breaking whereby upon actuation of the crank the knuckle of the first toggle is guided by the second toggle thereby actuating the member to its closed position, a stop for limiting the motion of the crank in the switch closing direction, said first mentioned toggle urging the crank against the stop when the switch is closed thereby maintaining the toggle system in equilibrium, and electromagnetic means for moving the crank from its released position to the stop for reclosing the switch.

12. A switch operating member biased to the open position, an operating crank biased to the open switch position, a toggle between the member and the crank whereby, when the knuckle of the toggle is free, actuation of the crank is ineffective to transmit power through the toggle for actuating the member, a second toggle extending between the first toggle and a fixed point, means for releasably retaining the knuckle of the second toggle against breaking whereby upon actuation of the crank the knuckle of the first toggle is guided by the second toggle thereby actuating the member to its closed position, a stop, and electromagnetic means for moving the crank from its released position to the stop for reclosing the switch.

13. A switch operating shaft biased to the open position, an operating crank, a toggle between the shaft and the crank whereby, when the knuckle of the toggle is free, actuation of the crank is ineffective to transmit power through the toggle for actuating the shaft, a second toggle extending between the first toggle and a fixed point, means for releasably retaining the knuckle of the second toggle against breaking whereby upon actuation of the crank the knuckle of the first toggle is guided by the second toggle thereby actuating the shaft to its closed position, said last means comprising a third toggle extending between the second toggle and a fixed point and a latch for holding the third toggle to hold the second toggle, electromagnetic means for releasing the latch thereby rendering the toggle system unstable whereby the operating shaft moves from the closed position to the open position under the action of its bias.

14. In combination, a switch operating member, an operating crank, an unstable toggle connecting both, a second unstable toggle one end of which is attached to first toggle and the other end to a fixed pivot, a third toggle having one end attached to the second toggle and other end to a fixed pivot, and latching means mounted on a fixed pivot and engaging said third toggle

to lock the same in position, thereby locking said second toggle in position and stabilizing said first toggle whereby upon operation of the crank the first toggle operates said switch operating member to a closed position.

15. In combination, a switch operating shaft, an operating crank, an unstable toggle connecting both, a second unstable toggle one end of which is attached to first toggle and the other end to a fixed pivot, a third toggle having one end attached to the second toggle and other end to a fixed pivot, latching means mounted on a fixed pivot and engaging said third toggle to lock the same in position, thereby locking said second toggle in position and stabilizing said first toggle whereby upon operation of the crank the first toggle operates said switch operating shaft to a closed position, and electromagnetic means for tripping the latching means to render said three toggles unstable.

16. A switch operating member biased to the open position, an operating crank, an actuating toggle between the two, a second toggle guiding the first toggle, means for releasably retaining the knuckle of the second toggle against breaking, said last means comprising a third toggle extending between the second toggle and a fixed point, and a latch for holding the third toggle to hold the second toggle, and a stop for limiting the motion of the crank, said first mentioned toggle urging the crank toward the stop limiting position when the switch is closed thereby maintaining the toggle system in equilibrium, the knuckle of the first mentioned toggle breaking, upon release thereof by the second mentioned toggle, in a direction to urge the crank away from the stop during the switch opening operation of the member.

17. A switch operating shaft biased to the open position, an operating crank, a shaft actuating toggle between the two, a second toggle guiding the first toggle and extending between it and a fixed point, means for releasably retaining the second toggle against breaking, said last means comprising a third toggle extending between the second toggle and a fixed point and a latch for holding the third toggle to hold the second toggle; a stop for limiting the motion of the crank, said first mentioned toggle urging the crank towards its stop limiting position when the switch is closed thereby maintaining the toggle system in equilibrium, the knuckle of the first mentioned toggle breaking, upon release thereof by the second mentioned toggle, in a direction to urge the crank away from the stop during the switch opening operation of the shaft, and means for moving the crank away from the stop during the switch shaft opening movement.

18. A switch operating shaft biased to the open position, an operating crank, a shaft actuating toggle between the two, a second toggle guiding the first toggle, means for releasably retaining the second toggle against breaking, said last means comprising a third toggle extending between the second toggle and a fixed point and a latch for holding the third toggle to hold the second toggle; a stop for limiting the motion of the crank, said first mentioned toggle urging the crank against the stop when the switch is closed thereby maintaining the toggle system in equilibrium, the knuckle of the first mentioned toggle breaking, upon release thereof by the second mentioned toggle, in a direction to urge the crank away from the stop during the switch opening operation of the shaft, and means for mov-

ing the crank away from the stop during the switch shaft opening movement and returning the knuckle of the second toggle to its initial position for conditioning the mechanism for reclosure operation.

19. A switch operating shaft biased to the open position, an operating crank, a shaft actuating toggle between the two, a second toggle guiding the first toggle, means for releasably retaining the second toggle against breaking, said last means comprising a third toggle extending between the second toggle and a fixed point and a latch for holding the third toggle to hold the second toggle; a stop for limiting the motion of the crank, said first mentioned toggle urging the crank towards its stop limiting position when the switch is closed thereby maintaining the toggle system in equilibrium, the knuckle of the first mentioned toggle breaking, upon release thereof, in a direction to urge the crank away from the stop during the switch opening operation of the shaft, means for moving the crank away from the stop during the switch shaft opening movement and returning the knuckle of the second toggle to its initial position and also the third toggle to its position under the latch for conditioning the mechanism for the reclosure operation.

20. A switch operating shaft biased to the open position, an operating crank, a shaft actuating toggle between the two, a second toggle guiding the first toggle, means for releasably retaining the second toggle against breaking, said last means comprising a third toggle and a latch for holding the third toggle to hold the second toggle; a stop for limiting the motion of the crank, said first mentioned toggle urging the crank towards its stop limiting position when the switch is closed thereby maintaining the toggle system in equilibrium, the first mentioned toggle breaking, upon release thereof, in a direction to urge the crank away from the stop during the switch opening operation of the shaft, means for moving the crank away from the stop limiting position during the switch shaft opening movement and returning the knuckle of the second toggle to its initial position and also the third toggle to its position under the latch for conditioning the mechanism for the reclosure operation, and electromagnetic means for releasing the latch thereby rendering the toggle system unstable and permitting the shaft to move to the open position under the action of its bias.

21. A switch operating shaft biased to the open position, an operating crank, a shaft actuating toggle between the two, a second toggle guiding the first toggle, means for releasably retaining the second toggle against breaking, whereby upon actuation of the crank the first toggle is guided by the second toggle to actuate the shaft to its closed position, said last means comprising a third toggle and a latch for holding the third toggle to hold the second toggle; a stop for limiting the motion of the crank, said first mentioned toggle urging the crank towards its stop limiting position when the switch is closed thereby maintaining the toggle system in equilibrium, the first mentioned toggle breaking, upon release thereof, in a direction to urge the crank away from the stop limiting position during the switch opening operation of the shaft, means for moving the crank away from the stop during the switch shaft opening movement and returning the knuckle of the second toggle to its initial position and also the third toggle to its position under the latch

for conditioning the mechanism for the reclosure operation, electromagnetic means for releasing the latch thereby rendering the toggle system unstable and permitting the shaft to move to the open position under the action of its bias, and electromagnetic means for moving the crank from its released position towards the stop limiting position for reclosing the switch.

22. A switch operating mechanism including a switch operating member biased to its open position, an actuator for the mechanism, a link pivoted to the operating member, a second link pivoted to the first link and substantially in alignment therewith and also pivoted to the actuator, a second toggle guiding the movement of the pivot between the two links, one of the members of the second toggle and the first mentioned link being in substantial alignment when the switch is closed whereby the second mentioned toggle and the second mentioned link take a substantial portion of the thrust of the bias on the operating member, and means for releasably retaining the knuckle of the second toggle against breaking.

23. A switch operating mechanism including a switch operating member biased to its open position, a toggle extending between said member and a movable point, actuating means connected to the knuckle of said toggle and holding said knuckle against breaking when the mechanism is in its switch closed position and including a link approximately in toggle position with one of the members of the first mentioned toggle when the mechanism is in its switch closed position, said actuating means being biased to the switch open position and held in its switch closed position against its bias by the force of the bias of the switch operating member transmitted through said link, and releasable means for holding said movable point fixed, thereby maintaining the toggle system in equilibrium.

24. A switch operating mechanism including a switch operating member biased to its open position, a toggle extending between said member and a movable point, actuating means connected to the knuckle of said toggle and holding said knuckle against breaking when the mechanism is in its switch closed position and including a link approximately in toggle position with one of the members of the first mentioned toggle when the mechanism is in its switch closed position, said actuating means being biased to the switch open position and held in its switch closed position against its bias by the force of the bias of the switch operating member transmitted through said link, electro-magnetic means for operating the actuating means from its biased position, and releasable means for holding said movable point fixed, thereby maintaining the toggle system in equilibrium, said releasable means including a toggle holding said movable point and a latch holding said last named toggle, whereby actuation of the actuating means is ineffective when the last named means is released.

25. A switch operating mechanism including a switch operating member biased to its open position, an actuator for the mechanism, a link pivoted to the operating member, a second link pivoted to the first link and pivoted to the actuator, a toggle guiding the movement of the pivot between the two links, one of the members of the toggle and the first mentioned link being in position of toggle when the switch is closed whereby the toggle takes a substantial portion of the thrust of the bias on the operating member, means for releasably retaining the knuckle

of the toggle against breaking, and means for biasing the actuator to its switch open position whereby upon movement of the switch operating member to its open position the actuator is positioned for its closing operation.

26. A switch operating mechanism including a switch operating member, an actuating link pivoted thereto, a pair of links pivotally connected in V-formation with the apex of the V pivotally connected to the first mentioned link, both of the V-connected links being in substantial toggle with the first mentioned link when the mechanism is in the switch closed position, floating supports for the two opposite ends of the V-connected links, one of the supports comprising an actuating member, the other support comprising latch held means adapted to be tripped, and electromagnetic means for tripping the latch held means.

27. A circuit breaker mechanism comprising a solenoid, a main closing lever actuated by said solenoid, a pivoted element, said main closing lever being pivotally mounted on said pivoted element and rotated thereon as its fulcrum during the closing movement, a latch for retaining said pivoted element in fixed position during the closing movement, and means for tripping said latch upon the occurrence of an abnormal condition.

28. A circuit breaker mechanism comprising a solenoid, a main closing lever actuated by said solenoid, a pivoted element, said main closing lever being pivotally mounted on said pivoted element and rotated thereon as its fulcrum during the closing movement, a latch for retaining said pivoted element in fixed position during the closing movement, and means for tripping said latch during the closing stroke of the breaker upon the occurrence of an abnormal condition.

29. A circuit breaker mechanism comprising a main closing lever, a pivoted element, said main closing lever being pivotally mounted on said pivoted element and rotated thereon as its fulcrum during the closing movement, means for restraining said pivoted element in fixed position during the closing movement and for automatically controlling the release thereof, and guiding means for controlling the movement of said main closing lever.

30. A circuit breaker mechanism comprising a main closing element, a pivoted element, said main closing element being pivotally mounted on said pivoted element, means for restraining said pivoted element and for automatically controlling the release thereof, a pivoted guide for controlling the movement of said main closing element, and a retrieving spring secured to said guide.

31. A circuit breaker mechanism comprising a main closing lever, a pivoted element, said main closing lever being pivotally mounted on said pivoted element and rotated thereon as its fulcrum during the closing movement, a latch for restraining said pivoted element in fixed position during the closing movement, and electromagnetic means for tripping said latch.

32. A circuit breaker mechanism comprising a main closing lever, a pivoted element, said main closing lever being pivotally mounted on said pivoted element and rotated thereon as its fulcrum during the closing movement, a latch for restraining said pivoted element in fixed position during the closing movement, electromagnetic means for tripping said latch, and guiding means controlling the movement of said main closing element.

33. A circuit breaker mechanism comprising a supporting frame, a main closing element, a movable support for said main closing element carried by said frame, a retaining device for holding said support in fixed position during the closing movement of the breaker, and means for automatically releasing said device during the closing stroke of said closing element.

34. A circuit breaker mechanism comprising a supporting frame, a main closing element, a releasable support for said main closing element carried by said frame, a guiding element pivotally mounted on said frame and connected to said closing element, and means for automatically releasing said releasable support upon the occurrence of an abnormal condition.

35. A circuit breaker mechanism comprising a supporting frame, a main closing element, a releasable support for said main closing element carried by said frame; a guiding element pivotally mounted on said frame and connected to said closing element, a latch pivotally mounted on said frame for engaging said releasable support, and means carried by said frame for tripping said latch upon the occurrence of an abnormal condition.

36. A circuit breaker mechanism comprising a supporting frame, a main closing element, a releasable support for said main closing element carried by said frame, a guiding element pivotally mounted on said frame and connected to said closing element, a retrieving spring secured to said frame and connected to said guiding element, and means for automatically releasing said release support upon the occurrence of an abnormal condition.

37. A circuit breaker mechanism comprising a solenoid, a main closing element actuated by said device, a supporting frame, a pivoted element thereon, said main closing element being operatively connected to said pivoted element, a latch mounted on said frame for restraining said pivoted element, a guiding element pivotally mounted on said frame connected to the core of said solenoid and to said closing element, a retrieving spring connected to said guiding element and to said frame, and means for tripping said latch when the breaker is being closed.

38. A circuit breaker mechanism comprising a main closing lever, a releasable element forming a movable fulcrum for said lever, a device for holding said element in fixed position during the closing movement of the breaker, and means for automatically controlling said device to release said releasable element during the closing stroke of said closing lever.

39. A circuit breaker mechanism normally urged to the open position and including a solenoid, a movable element, an actuating connection between said element and said solenoid for moving said mechanism to its closed position, a pivoted element, said movable element being pivotally mounted on said pivoted element and rotated thereon as its fulcrum during the closing movement, a latch for retaining said pivoted element in fixed position during the closing movement, means for tripping said latch upon the occurrence of an abnormal condition to permit movement of the first mentioned element to a switch open position, and means for restoring the pivoted element to its latched position responsive to the release of the solenoid and the movement of the first mentioned element to a switch open position upon tripping of the latch.

40. A circuit breaker mechanism normally

urged to the open position and including a solenoid, a link, an actuating connection between said link and said solenoid for moving said mechanism to its closed position, a pivoted element, said link being pivotally mounted on said pivoted element and rotated thereon as its fulcrum during the closing movement, a latch pivoted about a stationary pivot for retaining said pivoted element in fixed position during the closing movement, means for tripping said latch during the closing stroke of the breaker upon the occurrence of an abnormal condition to permit movement of the first mentioned element to a switch open position, and means for restoring the pivoted element to its latched position responsive to the release of the solenoid and the movement of the first mentioned element to a switch open position upon tripping of the latch.

41. A circuit breaker mechanism comprising a link, a pivoted element, said link being pivotally mounted on said pivoted element and rotated thereon as its fulcrum during the closing movement, means for restraining said pivoted element in fixed position during the closing movement and for automatically controlling the release thereof, guiding means for controlling the movement of said link, electromagnetic actuating means for the guiding means, the link being moved to one open position upon release thereof when the guiding means is held by the electromagnetic means and to another open position when the guiding means is not held by the electromagnetic means, and means for restoring the pivoted element to its restrained position and moving the link to its second mentioned position responsive to the release of the guiding means by the electromagnetic means when the link is in its first mentioned position.

42. A circuit breaker mechanism comprising a link, a pivoted element, said link being pivotally mounted on said pivoted element, means for restraining said pivoted element and for automatically controlling the release thereof, pivoted guiding means for controlling the movement of said link, and a retrieving spring secured to said guiding means.

43. A circuit breaker mechanism comprising a link, a pivoted element, said link being pivotally mounted on said pivoted element and rotated thereon as its fulcrum during the closing movement, a magnetically actuated switch closing member, a latch for restraining said pivoted element in fixed position during the closing movement, electromagnetic means for tripping said latch to permit release of the link independently of the position of the closing member, and means for biasing the closing member to its switch open position responsive to the release of the link and for restoring the pivoted element to its latched position upon movement of the switch closing member to its open position.

44. A circuit breaker mechanism comprising a link, a pivoted element, said link being pivotally mounted on said pivoted element and rotated thereon as its fulcrum during the closing movement, a magnetically-actuated switch closing member, a latch for restraining said pivoted element in fixed position during the closing movement, electromagnetic means for tripping said latch, to permit release of the link independently of the position of the closing member, means for biasing the closing member to its switch open position responsive to the release of the link and for restoring the pivoted element to its latched position upon movement of the switch closing

member to its open position, and guiding means controlling the movement of said link.

45. A circuit breaker mechanism comprising a supporting frame, a link for retaining the mechanism in the breaker closed position, a releasable support for said link carried by said frame, a guiding element pivotally mounted on said frame and connected to said link, a latch pivotally mounted about a fixed pivot on said frame for engaging said releasable support to hold the link, means carried by said frame for tripping said latch upon the occurrence of an abnormal condition whereby the link is released to permit breaker opening movement of the mechanism, and means for restoring the releasable support to its latched position responsive to the release of the link under predetermined conditions.

46. A circuit breaker mechanism comprising a supporting frame, a link for retaining the mechanism in the breaker closed position, a releasable support for said link carried by said frame, means latching the releasable support, a guiding element pivotally mounted on said frame and connected to said link, a retrieving spring secured to said frame and connected to said guiding element, means for automatically releasing said releasable support upon the occurrence of an abnormal condition, and means including said guiding element and said retrieving spring for relatching the releasable support responsive to the release of the link under predetermined conditions.

47. A circuit breaker mechanism comprising a solenoid device, a link actuated by said device and retaining the mechanism in the breaker closed position, a supporting frame, a pivoted element thereon, said link being operatively connected to said pivoted element, a latch mounted on said frame for restraining said pivoted element and thus hold the link, guiding means pivotally mounted on said frame connected to the core of said solenoid and to said closing element, a retrieving spring connected to said guiding means and to said frame, means for tripping said latch and releasing the link even when the breaker is being closed, and means including said guiding means and said retrieving spring for resetting the pivoted element to the latched position responsive to the release of the link under predetermined conditions.

48. A switch operating mechanism having two degrees of mechanical freedom, comprising a lever, restraining means therefor limiting the mechanism to one degree of mechanical freedom, an electromagnetic operator connected to said lever capable when energized of rotating said lever and urging the operating mechanism to the switch closed position, mechanical means for retaining the operator in the position assumed upon completion of the closing operation, means effective under predetermined conditions for releasing the restraining means to permit movement of the lever allowing the switch to assume the switch open position regardless of the position of the electromagnetic operator, and restoring means effective upon the release of the restraining means and movement of said lever to return the electromagnetic operator to the switch open position, said restoring means remaining effective until restoration is accomplished and simultaneously effecting the reengagement of the restraining means.

49. A switch operating mechanism having two degrees of mechanical freedom, comprising a lever, toggle restraining means for one end of the lever limiting the mechanism to one degree of

mechanical freedom, an electromagnetic operator connected to said lever capable when energized of urging the mechanism to switch-closed position, means operable upon movement of said operator to closing position for retaining said operator in said position, means responsive to predetermined conditions for releasing the restraining means to permit the mechanism to assume switch-open position independently of movement of said operator, and means operable upon release of said restraining means providing for return of said operator to switch-open position to thereby automatically reengage said lever with said restraining means.

50. A switch operating mechanism having two degrees of mechanical freedom, comprising a lever, restraining means including a toggle joint for restraining one end of said lever and providing a fulcrum support therefor, an electromagnetic operator capable when energized of rotating said lever about said fulcrum support to move the mechanism into switch-closed position, means effective under certain conditions for releasing the restraining means, spring means operable upon release of said restraining means for moving said mechanism to switch-open position independently of the position of said operator, and means operable upon said movement of said mechanism to

switch-open position providing for return of said operator to switch-open position, thereby moving said lever into engagement with said restraining means.

51. In circuit breaker operating mechanism having two degrees of mechanical freedom, an electromagnetic operator, a leverage system connected to said operator including an element having a free end, restraining means providing a fulcrum support for said end to limit the mechanism to one degree of mechanical freedom, said operator when energized moving said system to breaker-closing position and rotating said element around said end as a pivot, means in said system for holding said operator in switch-closed position upon completion of switch-closing movement, means operable under predetermined conditions for releasing said restraining means, spring means operable upon said release for moving said system to switch-open position independently of the position of said operator, and means effective upon said movement to switch-open position providing for return of said operator to switch open position for thereby returning said element into position to reengage said end with said restraining means.

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