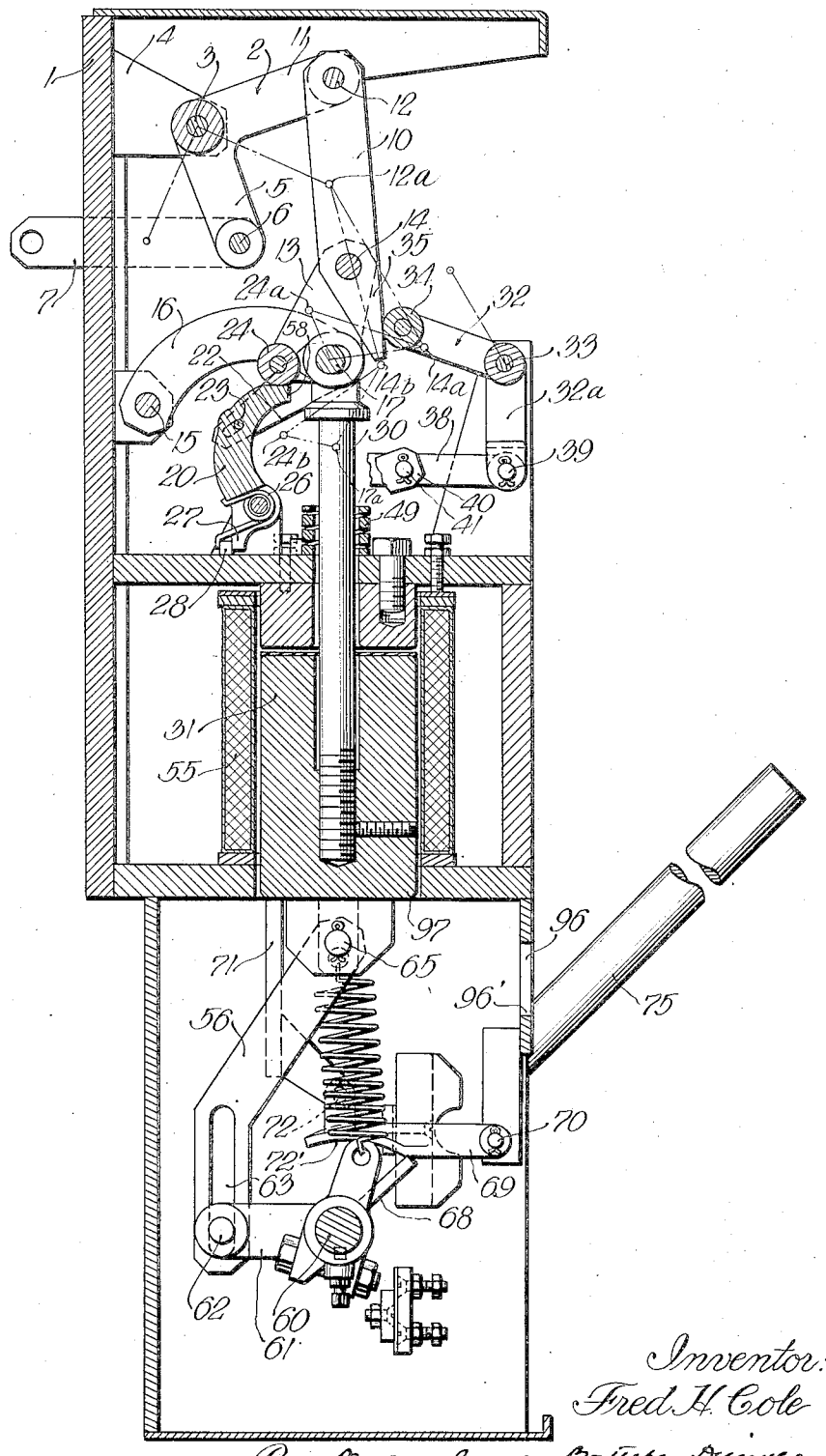
May 26, 1936. F. H. COLE 2,041,903

SWITCH OPERATING MECHANISM

Filed Feb. 5, 1934 4 Sheets-Sheet 1

Fig. 1.



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Fred H. Cole

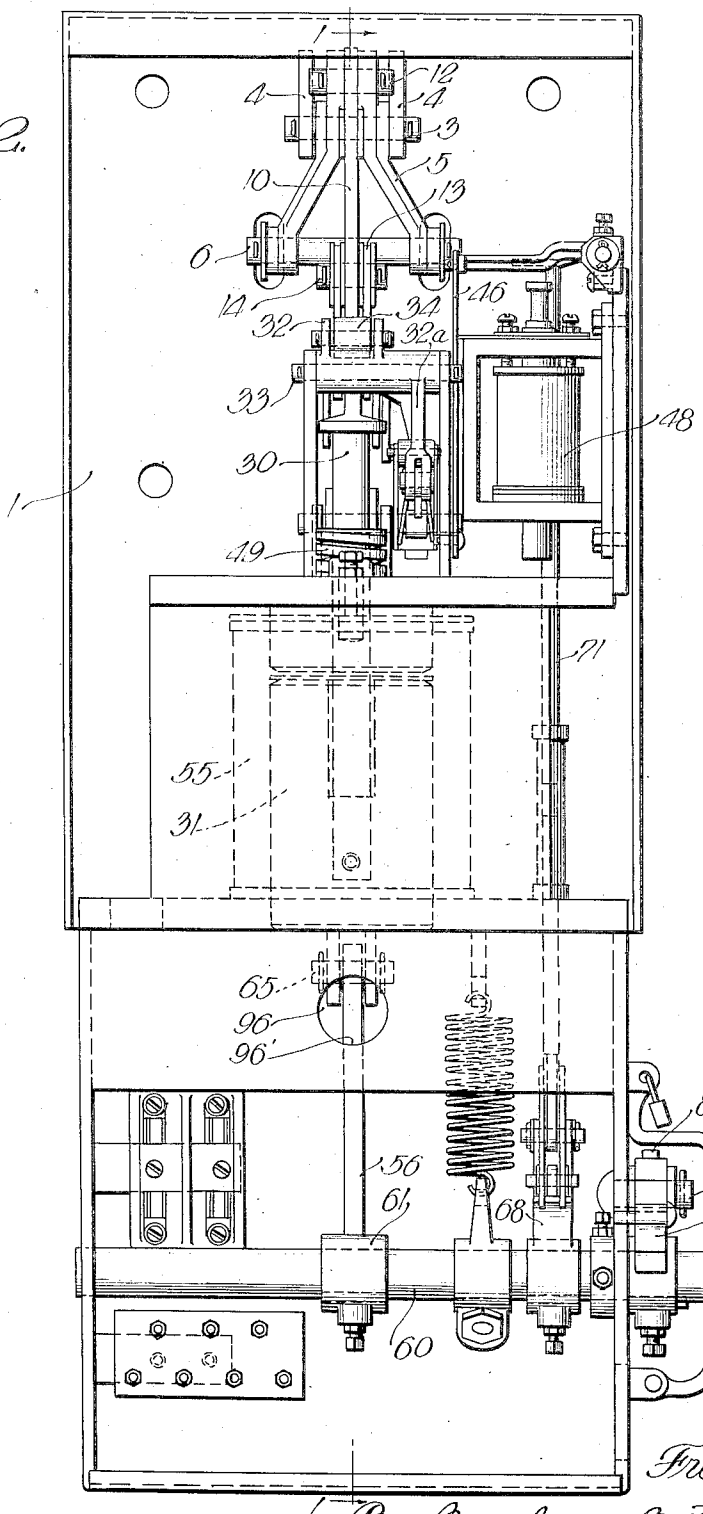
By Prawfranson Bottler & Dennis
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SWITCH OPERATING MECHANISM

Filed Feb. 5, 1934 4 Sheets-Sheet 2

Fig. 2.



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SWITCH OPERATING MECHANISM

Filed Feb. 5, 1934 4 Sheets-Sheet 3

Fig. 3.

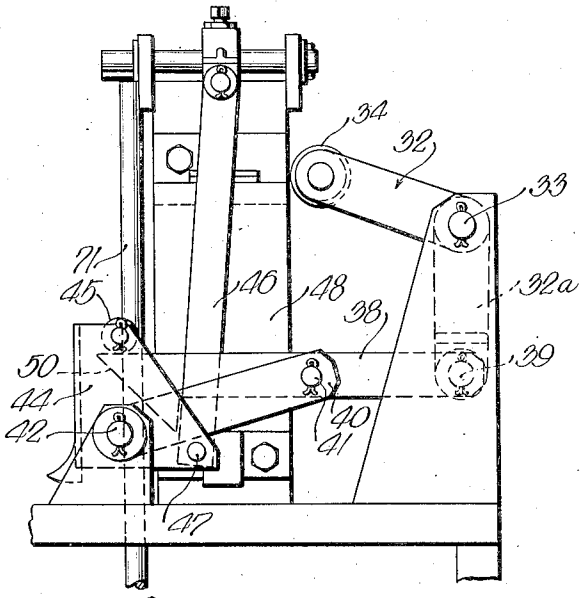


Fig. 5.

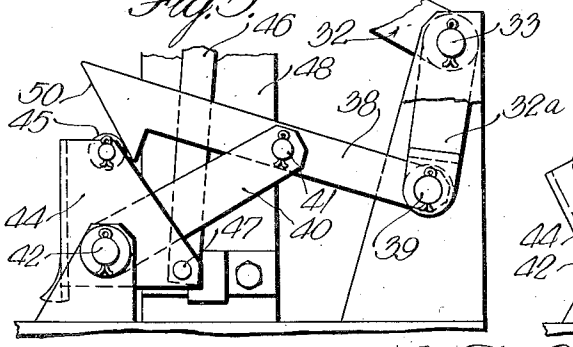


Fig. 4.

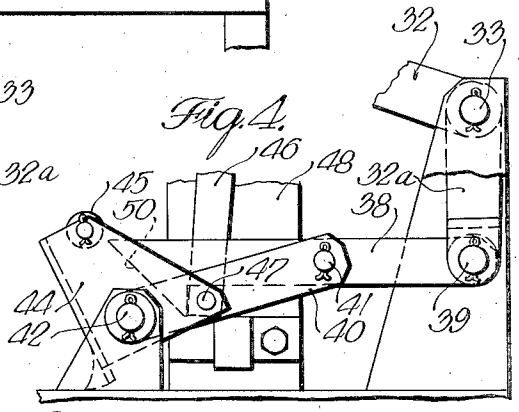
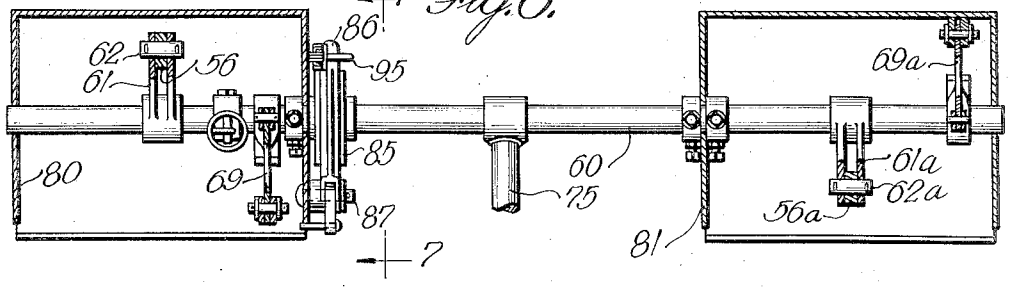


Fig. 6.



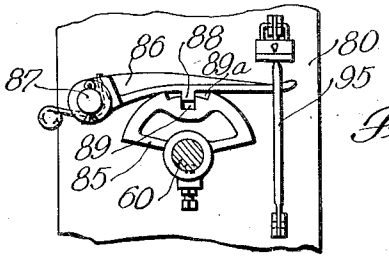


Fig. 7.

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SWITCH OPERATING MECHANISM

Filed Feb. 5, 1934 4 Sheets-Sheet 4

Fig. 8.

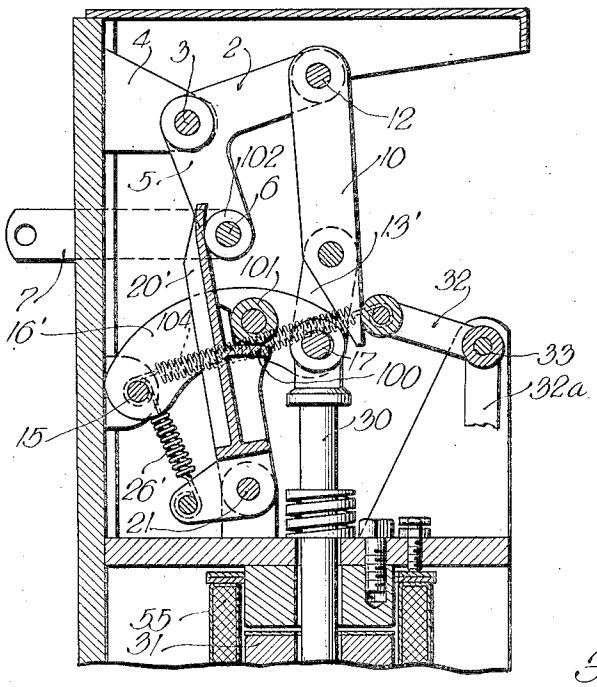


Fig. 9.

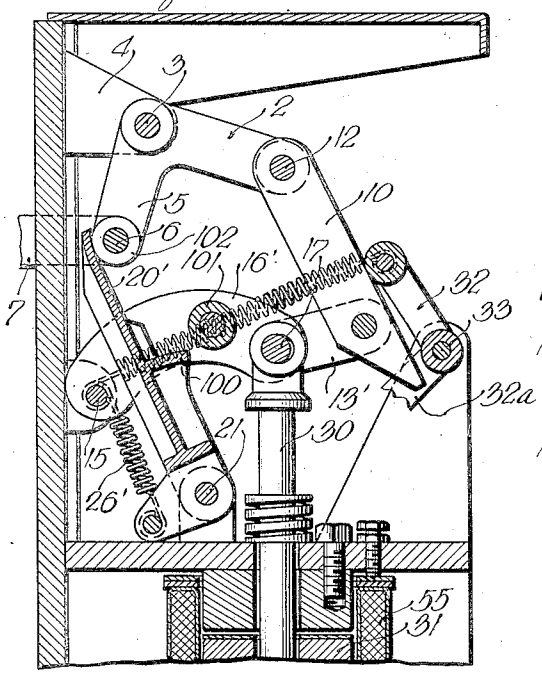
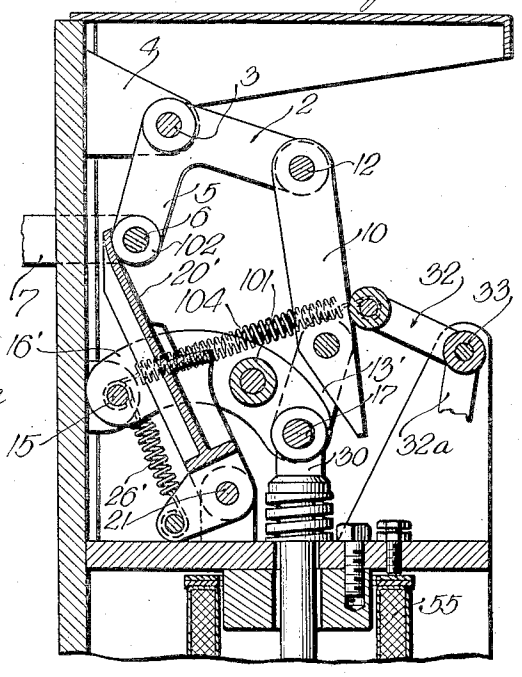


Fig. 10.



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Patented May 26, 1936

2,041,903

UNITED STATES PATENT OFFICE

2,041,903

SWITCH OPERATING MECHANISM

Fred H. Cole, Glendale, Calif., assignor to The Delta-Star Electric Company, Chicago, Ill., a corporation of Illinois

Application February 5, 1934, Serial No. 709,753

23 Claims. (Cl. 200—89)

The present application is a continuation in part of my copending application, Serial No. 625,429, filed July 28, 1932.

This invention relates to the operating mechanism and tripping means for circuit breakers in general and more particularly for circuit breakers of high voltage or high current interrupting capacity.

It is one of the objects of the present invention to provide a switch operating and tripping mechanism wherein a very rapid tripping action is obtained. In the particular embodiment of the invention herein illustrated this is accomplished by providing an improved tripping unit separate from the operating unit and arranged merely to bear against the operating unit to retain it in its operated condition. When the tripping mechanism is released it is not drawn with the operating unit; hence the delay incident to the inertia necessarily present in the various parts is avoided. The tripping unit is normally locked in its operative position and is arranged to be released by an electromagnet or other means. Upon release of the locking arrangement for the tripping means the operating mechanism forces the tripping means to its released position. The tripping magnet need only supply the energy necessary for unlocking the tripping means while the operating mechanism supplies the energy necessary for actually moving the tripping means to its released position. Thus, although the tripping means may be arranged to resist a comparatively great force tending to operate the switching mechanism to its open position, yet an almost negligible force is required to release the tripping means.

The circuit breaker operating mechanism of the present invention is provided with an operating handle for manually operating the same. The arrangement is such that the handle occupies the same position when the mechanism is in its switch closed position as it does when the mechanism is in its switch open position. This position of the operating handle is termed the "normal" position. To close the circuit breaker the operating handle is moved from its normal position to its switch closed position, which results in a closure of the switch, and is then returned to its normal position. The return movement to the normal position does not result in a release of the mechanism. Electromagnetic tripping means is provided for tripping a latch that holds the mechanism in its closed position, such tripping means being effective to trip the mechanism regardless of the instantaneous position of the operating handle. This is known in the art as a "trip free" switch operating mechanism. I provide additional means for tripping the circuit breaker mechanism responsive to a reverse movement of the operating handle from its normal position. Thus, when the operating handle is in its normal position, the mechanism may be in its switch closed position or in its switch open position. If the mechanism is in its switch open position, then a movement of the handle in one direction from the normal position will result in a closure of the mechanism. If the mechanism is already in its closed position then an initial reverse movement of the operating handle from its position will result in a tripping of the mechanism.

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 longitudinal sectional view of the switch operating mechanism, said view being taken along the line 1—1 of Figure 2;

Figure 2 is a front view of the mechanism;

Figure 3 is a side view of the tripping mechanism, said view showing the mechanism in the locking position;

Figure 4 is a view similar to Figure 3 and showing the mechanism upon energization of the tripping magnet and before the release of the mechanism;

Figure 5 shows the tripping mechanism as it is being restored to its locking position;

Figure 6 is a fragmentary diagrammatic sectional view showing two circuit breaker operating mechanisms connected together for operation from the same operating shaft and interlocked to prevent simultaneous closing of both circuit breakers;

Figure 7 is a fragmentary sectional view taken along the lines 7—7 of Figure 6 and showing a locking arrangement for the operating shaft;

Figure 8 shows a portion of a modified form of mechanism;

Figure 9 shows the mechanism of Figure 8 in its tripped position when its operating magnet is energized; and

Figure 10 shows the mechanism of Figure 8 in its tripped position when its operating magnet is not energized.

Reference may now be had more particularly

to Figure 1 of the drawings, which shows the mechanism in its normal switch closed position. The mechanism is enclosed in a suitable metallic housing indicated in general by the reference numeral 1. A bell crank 2 is pivoted about a pivot pin 3 held by a pair of bracket arms 4—4 of the housing. The arm 5 of the bell crank 2 is pivotally connected at 6 with a switch operating link 7. When the switch is in its closed position the link 7 exerts a continuous pull to the left as seen in Figure 1 to urge the bell crank to its switch open position. A toggle link 10 is pivoted to the arm 11 of the bell crank 2 by means of a pivot pin 12 and is pivotally connected to a toggle link guide 13 by means of a pin 14. A guide link 16 is pivoted at one end about a stationary pivot 15 and at its other end is pivotally connected to the toggle link guide 13 by means of a pin 17. A holding latch 20 is pivoted about a stationary pivot 21 and has pivoted thereto a link 22 about a pivot 23. The opposite end of the link 22 is pivoted to the pin 17. The toggle link guide 13 carries a roller 24 at one end thereof, said roller resting upon the holding latch 20. The latch 20 is biased in a clockwise direction by a spring 26 and is held in the extreme position as shown in Figure 1 by a stop finger 27 abutting against a stationary stop 28. An eye bolt 30 that is secured to the core 31 of an operating solenoid is also pivoted about the pin 17, said eye bolt having an enlarged eye for receiving the pin and permitting a limited amount of side movement of the pin with respect to the eye bolt. A tripping bell crank 32 is pivoted about a stationary pivot 33 and carries at its end a roller 34 that bears against an extended portion 35 of the link 10, said portion 35 projecting beyond the knuckle 14 of the toggle formed by the toggle link 10 with the toggle link guide 13. Under normal conditions the tripping bell crank 32 is locked in the position shown in the drawings, being held against rotation about the stationary pivot 33 by suitable mechanism to be more fully set forth as this description proceeds. As long as the trip crank is locked in the position as shown it maintains the knuckle of the toggle comprising the members 10 and 13 against breaking, that is, it holds the toggle from collapsing under the downward force exerted on the pin 12 by the arm 11 of the bell crank, which arm is being urged in a clockwise direction by the pull on the switch operating link 7. The pin 17 is urged downwardly but is locked against downward movement by the holding latch 20 that supports the roller 24. The force of the roller 24 on the holding latch 20 is such as to tend to turn the same about the pin 21 in a clockwise direction, which movement is prevented by the stop 27—28. It is therefore apparent that as long as the tripping bell crank 32 is locked in position the toggle mechanism is also locked in position.

Reference may now be had more particularly to Figures 3 to 5 which show the tripping bell crank and the manner of releasably locking the same. The bell crank lever 32 includes an arm 32*a* integral with the portion 32 thereof so as to move as a unit therewith. A trip latch 38 is pivoted to the arm 32*a* by a pivot pin 39 and has a trip latch guide 40 pivoted thereto at 41. The opposite end of the trip latch guide 40 is pivoted to stationary pivot 42. A trip latch cam 44 is pivoted about the same pin 42 and carries at one end a roller 45 that lies over the end of the trip latch 38. As long as the trip latch cam 44 is in the position shown in Figure 3 the bell cranks 32—32*a* cannot rotate about the pin 33 in a clockwise direction as seen in Figures 1 and 3, since the roller 45 holds the end of the trip latch against upward movement. It is also apparent that no reasonable amount of force exerted on the trip latch 38 by the pin 39, tending to move the trip latch to the left as seen in Figure 3, will be effective to release the trip latch, since this force acts on the trip latch cam 44 radially with respect to its center of rotation 42, rather than tangentially. A trip link 46 is pivoted at its lower end to the trip latch cam 44 by means of a pin 47, said link being adapted to be actuated by a tripping electromagnet 48 which, upon energization, raises the trip link and rotates the trip latch cam 44 in a counterclockwise direction as seen in Figure 3 to move the roller 45 clear of the trip latch 38.

An explanation will now be given of the mode of operation of the apparatus thus far described. Assume that the tripping magnet 48 is energized to pull up on the trip link 46, thereby moving the trip latch cam 44 to its released position, as indicated in Figure 4. The tripping bell crank 32 is now free to rotate about the pin 33. The pull on the switch operating link 7 is transmitted through the bell crank 2 to the toggle link 10 which toggle link at its extended portion 35 exerts a force on the roller 34. This force has a small component tending to rotate the tripping bell crank 32 clockwise as seen in Figures 1 and 3. Since the bell crank member 32 is now not locked in position, this force moves the bell crank, thereby permitting the knuckle 14 of the toggle 10—13 to break. The center of the pin 14 therefore now moves to a position such as indicated at 14*a* and at the same time the center of the pin 12 moves to a position such as indicated at the point 12*a*, the switch operating link 7 moving towards the left to its open position. Attention is called to the fact that this operation is entirely independent of any movement of the pin 17. Once the tripping bell crank 32 is released it is necessary only for the toggle links 10 and 13 to move to their open position in order to permit opening of the switch. The link 13 rotates about the pin 17, bringing the axis of the roller 24 to the point 24*a*. If the operating magnet happens to be energized at this time, the solenoid core 31 remains in the position shown and therefore the guide link 16, the holding latch 20, and the holding latch guide 22 remain in the position shown in the drawings. The switch operating link 7 has, however, operated to trip the circuit breaker. When and if the electromagnet 55 is deenergized, the core 31 drops of its own weight to the switch open position. As the eye bolt 30 moves downwardly, the holding latch guide 22 moves the latch 20 in a counterclockwise direction, thus permitting the roller 24 to pass downward under the latch 20. At this time the pin 14 moves from the position 14*a* to the position 14*b* while the pin 17 moves to the position 17*a* and the pin 24 moves from the position 24*a* to the position 24*b*. A bumper spring 49 limits the extent of the downward movement of the eye bolt 30 and also acts to cushion the fall. This movement of the mechanism conditions the linkage for subsequent operation and is known as the resetting operation. The bell crank 32 drops back to the locking position shown in Figure 1, and the trip latch 38 (Figure 3) returns to the position shown in Figure 3. If the tripping magnet 48 is deenergized at this time the trip latch cam 44 is in the position shown in Fig. 3. If the trip latch cam 44 is returned to its initial position by the

deenergization of the tripping magnet 48 before the trip latch 38 has been returned to its original position, the tapered end portion 50 of the trip latch will exert a force on the roller 45 as the trip latch falls to its normal position, and will force the trip cam clockwise about the pin 42 until the trip latch reaches its normal position. Thereafter the trip latch cam resumes the position shown in Figure 3, due to the fact that its center of gravity is to the right of the axis of the pin 42 as seen in Figure 3. If desired, this return movement may be aided by a spring biasing the trip latch cam in a counterclockwise direction.

To reclose the circuit breaker it is only necessary to raise the solenoid core 31. This may be done manually, as through a link 56, or by energizing the solenoid 55. As the eye bolt is raised the holding latch guide 22 moves the holding latch 20 counterclockwise so that the latch is clear of the roller 24. As the roller 24 moves above the surface 58 of the latch 20 the spring 26 forces the latch clockwise to bring the latch holding portion directly under the roller 24. For this purpose the guiding link 22 is provided with an enlarged slot through which the pin 23 passes. Once the roller comes to rest on the latch 20 the mechanism is locked in position and cannot be withdrawn even though the operating magnet 55 is deenergized or the manual actuating force is released.

In Figure 1 there is shown the manual operating means. A rotatable operating shaft 60 has a crank 61 suitably secured thereto. The end of the crank 61 is provided with a pin 62 that rides in a slot 63 in the link 56, which is shown in its normal switch closed position. When the switch mechanism is in its normal open position and the core 31 of the operating magnet has dropped, the link 56 is also dropped until the upper portion of the slot 63 lies over the pin 62. To close the switch the shaft 60 is rotated in a clockwise direction. The pin 62 forces the lever 56 upwardly, thereby forcing the solenoid core upwardly, to move the mechanism to the position shown in Figure 1. If the shaft 60 is then permitted to remain in the switch closed position the link 56 will be in a position turned a few degrees counterclockwise about the pin 65. If the shaft is returned to its initial normal position as shown in Figure 1, the link 56 pivots about the pin 65 as it moves to the position shown, while the pin 62 rides the slot 63. When the switch mechanism trips and the eye bolt 30 drops to its switch open position, the link 56 drops, said link being guided by the pin 62 riding in the slot 63.

It is to be noted that when the switch mechanism is in its closed position the pin 62 is somewhat above the bottom of the slot 63. This permits a limited counterclockwise movement of the crank 62 when the mechanism is in its switch closed position. A tripping lever 68 is keyed to the shaft 60 and cooperates with a trip cam 69 which is pivoted about a stationary pivot 70 and is pivotally connected, by a pin 72, with a trip rod 71. When the shaft 60 is in its normal position the trip cam 69 is in the position shown. Upon counterclockwise rotation of the shaft 60, the lever 68 engages the cam surface 72' and forces the trip cam 69 upward about the pin 70 as a center. As the trip cam 69 rises it raises the trip rod 71. The trip rod 71 extends upwardly to the movable armature of the tripping magnet 48, and actuates this armature to actuate the trip link 46 in the same manner as this link is actuated by the energization of the tripping magnet 48, thereby releasing the trip latch cam 44 to trip the circuit breaker. It is thus seen that upon clockwise rotation of the shaft 60 from its normal position the switch mechanism will be operated to a closed position, whereas upon the initial counterclockwise rotation of the shaft from its normal position the switch mechanism will be tripped.

In Figure 6 I have illustrated, diagrammatically, an arrangement whereby two switch operating mechanisms of the type above described may be selectively operated by the same shaft 60. The unit 80 represents the mechanism previously described, the mechanism 61 being arranged so that upon downward movement of the handle 75, into the plane of the paper, the shaft 60 is rotated clockwise as seen in Figure 1 to operate the crank 61 and actuate the mechanism to its closed position. The switching unit 81 may be identical to the unit 80, differing only in that the crank 61*a*, which corresponds to the crank 61, is on the opposite side of the shaft, hence the shaft 60 must be rotated in the opposite direction, that is, counterclockwise as seen in Figure 1, to raise the pin 62*a*, which corresponds to the pin 62 of Figure 1, to operate the mechanism. In such an arrangement it is, of course, obvious that the link 56*a* corresponds to the link 56 of Figure 1 but extends from the pivot 65 on the right hand side of the mechanism rather than on the left hand side as shown in Fig. 1. In the unit 81 the trip cam 69*a*, which corresponds to the trip cam 69 of the unit 80, is located on the opposite side of the shaft. In other words, the unit 81 differs from the unit 80, as illustrated in Figure 1, only in that the position of the link 56*a* and the cam 69*a* have been reversed with respect to the positions of the corresponding members as shown in Figure 1.

From the description thus far given it is apparent that when the shaft 60 is rotated to close the mechanism 81 the initial rotation of the shaft 60 brings the pin 62 to the bottom of the slot 63 of the mechanism 80, and at the same time the lever 68 operates the cam 69 to bring about a tripping of the switch mechanism 80. Thereafter the link 56 drops downward to permit continued rotation of the shaft 60 to close the switch unit 81. After the switch unit 81 has been closed, the shaft 60 is returned to the position shown in Figure 1. If it is later desired to operate the switch mechanism 80, the shaft 60 is rotated in a clockwise direction as seen in Figure 1. Upon the initial rotation of the shaft 60 the pin 62*a* travels downward in the corresponding slot in the member 56*a* and, at the same time, the lever corresponding to the lever 68 brings about the operation of the trip cam 69*a* to trip the switching mechanism 81. In this same connection it should be noted that if the tripping mechanism of either unit 80 or 81 should fail to operate to release the unit from its switch closed position it will not be possible to pull downward upon the corresponding link 56 or 56*a*, and therefore this link, acting through the pin 62, will lock the corresponding crank 61 or 61*a* against rotation and thereby positively prevent the closing of either circuit breaker while the other breaker is in its closed position. By the present arrangement there is provided a simple and effective locking arrangement for insuring against the mechanical closure of one circuit breaker while the other is closed. Electrical closure of the two circuit breakers may be prevented by providing electrical interlocks in the circuits of the two operating magnets so that a closure of one breaker introduces a gap in the

operating circuit of the operating magnet of the other breaker.

It may be desirable to lock the mechanism against unauthorized closure and for this purpose I have provided an arrangement such as is shown in Figure 7. In this connection it should be noted that the apparatus must always be in such a condition as to permit prompt manual tripping, since the preservation of life or property may be dependent upon the prompt tripping of the circuit breaker. Therefore, although the mechanism may safely be locked against re-closure without the use of a key, it is inadvisable to lock it to prevent tripping of the same without a key. This end is obtained by providing a locking arrangement which permits only a limited rotation of the shaft 60, that is, sufficient to operate the cam 69 or the cam 69*a*. For this purpose the shaft 60 is provided with a locking cam 85 keyed thereto and cooperating with a latch 86 pivoted about a pivot 87. The latch is provided with a tongue 88 that extends into a slot 89 in the member 85 and prevents rotation of the shaft 60. If the latch 86 is slightly elevated, the tongue 88 clears the slot 89 and rides in a slot 89*a* in the member 85. When the tongue 88 is in the slot 89*a* it permits a limited amount of rotation of the shaft 60 in either direction from its normal position, an amount sufficient to trip either cam 69 or 69*a* (Figures 1 and 6). For the continued operation of the shaft 60 it is necessary to raise the latch 86 further. This may be prevented by any suitable locking arrangement, as by means of a hinged bolt 95 that is adapted to be padlocked to a cooperating lug spaced above the latch 86. The locking bolt 95, when padlocked, is spaced from the latch 86 an amount sufficient to permit movement of the latch to cause the tongue 88 to clear the slot 89, but insufficient to clear the slot 89*a*. To permit a further movement of the latch 86 it is necessary to release the hinge bolt, an operation that requires the unlocking of the padlock. It is, of course, to be understood that any other desirable locking arrangement may be provided.

If an operating unit such as shown in Figure 1 is to be used alone, without an interlock to an adjacent unit, the lever 68 and the trip cam 69 may be retained, since they provide for manual tripping of the breaker by an overtravel of the operating handle 15 in the reverse direction from its switch closing direction. However, if desired, the lever 68 and the trip cam 69 may be omitted if this feature is not desired, or is taken care of by other means. Also, in such an installation, the operating shaft 60, the crank 61, and the link 56, may be entirely omitted. Where this is the case manual operation may be had by inserting a lever through an opening 96 in the lower part of the mechanism housing and, with the lever fulcrumed at the surface 96', cause the other end thereof to engage the bottom 97 of the magnet core and thus raise the magnet core 31 to its normal switch closed position. Movement of the operating magnet 31, and the eye-bolt 30, to the normal switch closed position in this manner will have no different effect than that had by movement of these parts to the same position by energization of the operating magnet 55 or by rotation of the shaft 60, as previously described. If the bell crank 32 is in its closed position, as illustrated in full lines in Figure 1, such upward movement of the magnet core 31 causes a closing movement of the operating mechanism. If the tripping bell crank 32 is not in its normal locking position, upward movement of the core 31 merely moves the members 10, 13, 16 and 22 from the positions indicated by the dash-double-dot lines to the dash-dot lines, that is, the point 14 moves from its position 14*b* to its position 14*a* and the point 24 moves from its position 24*b* to its position 24*a*, while the crank 2 and the switch operating member 7 remain in their switch open position.

Reference may now be had more particularly to Figures 8, 9 and 10, wherein I show a modified form of my invention. Insofar as the structure shown in these figures is the same as that shown in Figure 1, the same reference numerals have been used. Figures 8, 9 and 10 show only the upper part of a mechanism, the lower part of which is the same as that shown in Figure 1. The mechanism shown in Figure 8 differs from that of Figure 1 only in that here the latch 20 and the link 22 have been omitted, the links 13 and 16 have been changed somewhat, and an additional link, 20' has been provided in lieu of the latch 20 and the link 22. The link 20' comprises a latch pivoted about the pin 21 and biased in a clockwise direction as seen in Figure 8 by a spring 26'. The link 20' has a curved shoulder 100 upon which moves a roller 101 mounted on the guide link 16'. The upper portion of the link 20' bears against a roller 102 on the pivot 6 between the arm 5 of the bell crank 2 and the switch operating link 7. A toggle guide link 13' replaces the triangular toggle guide link 13 of Figure 1. A spring 104 biases the bell crank 32 to its normal switch locking position.

When the switch of Figure 8 is in its closed position, the roller 101 rests upon the shoulder 100 and is held against downward movement thereby. The guide link 16' is thus held in its elevated position and holds the operating electromagnet in the position to which it is movable by energization of the magnet. The mechanism is therefore locked in position shown in Figure 8 even though the operating electromagnet is deenergized. When the switch is tripped, by release of the bell crank 32, the force on the link 7 causes the operating mechanism to move into the position shown in Figure 9 or the position shown in Figure 10, depending upon whether or not the operating electromagnet 55 happens to be energized at the time. If the operating magnet is energized at the time of release of the tripping bell crank 32, the eye-bolt 30 will not drop since it is held in position by the electromagnet. The links of the switch operating mechanism will therefore assume the position shown in Figure 9, the switch operating link 7 moving to its switch open position. Later, when the electromagnet 55 is deenergized, the mechanism will be reset by the dropping of the core 31 and the associated parts. The mechanism therefore assumes the position shown in Figure 10. During the initial movement of the link 7 in its switch open position the shoulder 100 of the latch 20' holds the guide link 16', the pin 17, and the eye-bolt 30 against downward movement and takes the downward thrust of the toggle guide link 13'. As the opening movement of the circuit breaker continues, and the roller 102 forces the latch 20' further and further counterclockwise, the curved surface 100 finally comes free of the roller 102 and permits dropping of the eye-bolt 30. This does not, however, occur until a substantial amount of the opening movement of the link 7 has taken place and the tog-

gle links 10—13' are at a substantial angle to one another, so that no violent downward impact is imparted to the pin 17 and the eye-bolt. This effects a reduction in the jarring and wear and tear on the apparatus.

If the operating magnet is later energized, to raise its core, the linkage will be moved to the position shown in Figure 8 or to the position shown in Figure 9, depending upon whether or not the tripping bell crank 32 is held locked by the mechanism previously described. If the tripping bell crank is not locked against movement, an upward movement of the eye-bolt 30 will merely cause the toggle comprising the links 10 and 13' to break to the right, into the position shown in Figure 9. The operating bell crank 2 and the switch operating link 7 are not moved. However, if the eye-bolt 30 is raised while the tripping bell crank 32 is locked against movement, the link 13 forces the link 10 upwardly to rotate the bell crank 2 and move the switch to its closed position. As the roller 102 is moved to the right as seen in Figure 10, it permits the spring 26' to rotate the link 20' clockwise, to the position shown in Figure 8. At this same time the link 16' carries the roller 101 to the position shown in Figure 1, where, upon deenergization of the operating magnet, the link 20', at its shoulder 100, holds the guide link 16'. The link 20' thus sustains the weight of the operating core 31 and the thrust on the pin 17 by the toggle 10—13' under the action of the biasing force which tends to move the link 7 to its normal switch open position.

In compliance with the requirements of the patent statutes I have herein shown and described a preferred embodiment of my invention. It is, however, to be understood that the invention is not limited to the precise arrangement herein shown, the same being merely illustrative of the general principles of the invention. What I consider new and desire to secure by Letters Patent is:—

1. A circuit-interrupter operating mechanism comprising an operating member, an operated member, means including an underset toggle connecting the said members, a latch pivoted to a fixed support for maintaining the operating member against retraction from its switch closed position, a trip member pivoted to a fixed support and having locked abutting contact with the toggle for maintaining the toggle against breaking, and means for unlocking said trip member whereby said toggle urges said trip member to toggle-releasing position, said trip member being normally biased toward toggle locking position.

2. A circuit-interrupter operating mechanism comprising an operating member, an operated member, means including a toggle connecting the said members and, when in its circuit closing position, extending substantially in alignment with the direction of movement of the operating member, a latch pivoted to a fixed support for maintaining the operating member against retraction from its switch closed position, a trip member pivoted to a fixed support and having abutting contact with the toggle for maintaining the toggle against breaking, means for releasing the trip member, means responsive to a predetermined switch opening movement of the toggle for permitting a limited retraction of the operating member from the latch, and means for thereafter releasing the latch to permit full retraction of the operating member.

3. A circuit-interrupter operating mechanism comprising an operating member, an operated member, means including an underset toggle connecting the said members, one of the links of the toggle being extended beyond the knuckle of the toggle, a latch pivoted to a fixed support for maintaining the operating member against retraction from its switch closed position, a trip member pivoted to a fixed support and having roller means at its end making abutting contact with the extended portion of the link of the toggle for maintaining the toggle against breaking, means for releasably locking the trip member in position, means for releasing said last named means, and means operable upon predetermined movement of said mechanism after said release for releasing said latch to permit full retraction of said operating member.

4. A circuit-interrupter operating mechanism comprising an operating member, an operated member, means including a toggle connecting the said members, a latch pivoted to a fixed support for maintaining the operating member against retraction from its switch closed position, a trip member pivoted to a fixed support and having abutting contact with the toggle for maintaining the toggle against breaking, means for releasably locking the trip member in position, means for releasing said last named means, and means interconnected between said operating member and said latch for releasing said latch after predetermined breaking movement of said toggle.

5. A circuit-interrupter operating mechanism comprising an operating member, an operated member, means including a toggle connecting the said members, a latch pivoted to a fixed support for maintaining the operating member against retraction from its switch closed position, a trip member pivoted to a fixed support and having abutting contact with the toggle for maintaining the toggle against breaking, means for releasably locking the trip member in position, and means for releasing said last named means, said toggle being underset for urging the trip member to its release position whereby upon release of the locking means the trip member is moved to its release position by the toggle.

6. In a circuit-interrupter operating mechanism, an operating member, an operated member, means including a toggle connecting the said members, a latch pivoted to a fixed support for maintaining the operating member against retraction from its switch closed position, a trip member pivoted to a fixed support and having abutting contact with the toggle for maintaining the toggle against breaking, means for releasably locking the trip member in position, and means for releasing said last named means, said toggle urging the trip member to its release position whereby upon release of the locking means the trip member is moved to its release position by the toggle, said trip member being biased to its holding position and said locking means being biased to the locking position, whereby the trip member is restored to its holding position upon release of the toggle and is locked in its holding position upon deactuation of the lock releasing means.

7. In combination, a switch actuating member biased to its open position, means for operating the member, a toggle pivoted at one end to the member and at its other end to the operating means, means for locking the operating means against retraction subsequent to the switch operation, a trip link mechanically unconnected with the toggle and bearing against the same for preventing breaking of the knuckle of the toggle,

means for releasably locking the trip link, means for releasing the locking means, said toggle urging the trip link to its release position whereby upon release of the locking means the trip link is moved to its release position by the force transmitted by the switch actuating member through the toggle, and means carried by the toggle and effective upon tripping of the same for unlocking the operating means to permit retraction of the same.

8. In combination, a switch actuating member biased to its open position, means for operating the member, a toggle pivoted at one end to the member and at its other end to the operating means, means for locking the operating means against retraction subsequent to the switch operation, a trip link mechanically unconnected with the toggle and bearing against the same for preventing breaking of the knuckle of the toggle, means for releasably locking the trip link, means for releasing the locking means, said toggle urging the trip link to its release position whereby upon release of the locking means the trip link is moved to its release position by the force transmitted by the switch actuating member through the toggle, and means carried by the toggle and effective upon tripping of the same for unlocking the operating means to permit retraction of the same, said toggle being moved to its switch open position upon retraction of the operating means and permitting the trip link to be restored to its locked position.

9. The combination with a switch operating mechanism of the type including means for actuating it and means for tripping it, said actuating means having a normal position and movable therefrom in one direction to close the switch and in the reverse direction to the normal position while the mechanism is retained in its closed position, of means responsive to an overtravel in the said reverse direction beyond the said normal position for tripping the mechanism.

10. A circuit-interrupter operating mechanism comprising an operating member, an operated member, means including a toggle connecting said members, a latch pivoted to a fixed support for maintaining the operating member against retraction from its switch closed position, means for actuating the operating member, said actuating means having a normal position and movable therefrom in one direction to close the switch and in the reverse direction back to the normal position while the mechanism is retained in its closed position by the latch, a trip member pivoted to a fixed support and having abutting contact with the toggle for maintaining the toggle against breaking, means for releasably locking the trip member in position, and means responsive to an overtravel of the actuator in its reverse direction beyond its normal position for releasing the trip member locking means.

11. A circuit-interrupter operating mechanism comprising an operating member, an operated member, means including a toggle connecting said members, a latch pivoted to a fixed support for maintaining the operating member against retraction from its switch closed position, an actuator for the operating member, said actuator having a normal position, an operating connection between the actuator and the operating member, said actuator being movable from its normal position for actuating the operating member, the operating connection including a pin and slot to permit restoration of the actuator to its normal position while the latch maintains the operating member in its switch closed position, a trip member pivoted to a fixed support and having abutting contact with the toggle for maintaining the toggle against breaking, and means releasably locking the trip member in position.

12. A circuit-interrupter operating mechanism comprising an operating member, an operated member, means including a toggle connecting said members, a latch pivoted to a fixed support for maintaining the operating member against retraction from its switch closed position, an actuator for the operating member, said actuator having a normal position, an operating connection between the actuator and the operating member, said actuator being movable from its normal position for actuating the operating member, the operating connection including a pin and slot to permit restoration of the actuator to its normal position while the latch maintains the operating member in its switch closed position, a trip member pivoted to a fixed support and having abutting contact with the toggle for maintaining the toggle against breaking, means releasably locking the trip member in position, and means controlled by the actuator for releasing the trip member.

13. The combination with a switch operating mechanism of the type including means for actuating it and means for tripping it, said actuating means having a normal position and movable therefrom in one direction to close the switch and in the reverse direction to the normal position while the mechanism is retained in its closed position, of means responsive to an overtravel in the said reverse direction beyond the said normal position for tripping the mechanism, and means for locking the actuating means against effective operation in the switch closing direction while permitting operation in the tripping direction.

14. A circuit-interrupter operating mechanism comprising an operating member, an operated member, means including a toggle connecting the said members, a latch pivoted to a fixed support for maintaining the operating member against retraction from its switch closed position, manual means for actuating the operating member, said manual means being retractible while the mechanism is retained against retraction from its switch closed position, a trip member pivoted to a fixed support and having abutting contact with the toggle for maintaining the toggle against breaking, means for releasably locking the trip member in position, and means for releasing said last named means, including means actuated by a predetermined movement of the manual means.

15. A circuit-interrupter operating mechanism comprising an operating member, an operated member, means including a toggle connecting said members, a releasable trip member pivoted to a fixed support for maintaining the toggle against breaking, means for releasing the trip member to effect tripping of the mechanism, means for latching the operating member in its circuit closing position, and means for releasing said latch responsive to the completion of a substantial part of the tripping movement of the operated member.

16. A circuit-interrupter operating mechanism comprising an operating member biased to its switch open position, an operated member biased to its switch open position and moved to its switch closed position by means including the operating member, a trip member holding the operated member in its switch closed position, the operated

member being released and moved to its switch open position responsive to the release of the trip member, latching means holding the operating member in its switch closed position, and means effective responsive to the completion of a substantial portion of the opening movement of the operated member for releasing the latching means and permitting the initiation of the movement of the operating member to its switch open position.

17. In a circuit-interrupter operating mechanism comprising an operating member, an operated member biased to its switch open position and moved to its switch closed position by means including the operating member, electromagnetic means for tripping the mechanism from its switch closed position and effective when moved to its tripping position for preventing switch closing operation of the mechanism responsive to switch closing movement of the operating mechanism, the combination of means for inhibiting the transmission of a shock through the operating member by release of the operated member in the event of the operation of the electromagnetic tripping means as the operated member is being moved towards its switch closed position, comprising means responsive to a predetermined switch closing movement of the operating member for latching the operating member against retraction and for holding it latched against retraction until the operated member has moved substantially to its normal switch open position.

18. A circuit-interrupter operating mechanism comprising an operating member, an operated member, means including a toggle connecting said members, a trip member pivoted to a fixed support and having abutting engagement with the toggle for maintaining the toggle against breaking, means for manually moving said operating member into switch closed position, and means operable upon initial reverse movement of said manual closing means for resetting said trip member in locked position.

19. A circuit-interrupter operating mechanism comprising an operating member, an operated member, means including a toggle connecting said members, a latch pivoted to a fixed pivot for maintaining the operating member against retraction from its switch closed position, a trip member normally having abutting engagement with the toggle for maintaining it against breaking, means for tripping said trip member, and means connected between said latch and said operating member for moving said latch out of operative position upon retraction of said operating member subsequent to tripping of said trip member.

20. A circuit-interrupter operating mechanism comprising an operating member, an operated member, means including a toggle connecting said members, a latch pivoted to a fixed pivot for maintaining the operating member against retraction from its switch-closed position, a trip member normally having abutting engagement with the toggle for maintaining it against breaking, means for tripping said trip member, and means actuated by breaking of said toggle upon tripping of said trip member for moving said latch out of operative position.

21. A circuit-interrupter operating mechanism comprising an operating member, an operated member, means comprising a toggle connecting said members, a trip member pivoted to a fixed pivot and having abutting engagement with the toggle to maintain the same against breaking, a latch pivoted to a fixed pivot for maintaining the operating member in switch-closed position, and means carried by said operated member for moving said latch out of operative position upon breaking of said toggle.

22. A circuit-interrupter operating mechanism comprising an operating member, an operated member, means comprising a toggle connecting said members, a trip member having abutting engagement with the toggle to maintain the same against breaking, a latch for maintaining the operating member in switch-closed position, and means carried by said operated member for moving said latch out of operative position upon breaking of said toggle, said means holding said latch in inoperative position until said trip member is reset and said operated member is moved to switch-closed position.

23. A circuit-interrupter operating mechanism comprising an operating member, an operated member, a pair of links forming a toggle connecting said members, a trip member pivoted on a fixed pivot and having abutting engagement with one of said links for maintaining said toggle against breaking, means for releasing said trip member for rotation to provide for breaking of said toggle, said links being moved into toggle position by switch-opening movement of said operating member, and a camming surface formed on one of said links and engaged by said trip member for maintaining said toggle against breaking during switch-closing movement of said operating member after resetting of said trip member.

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