Oct. 17, 1944. E. A. LINK 2,360,431

SWITCH CONSTRUCTION

Filed April 10, 1943 3 Sheets-Sheet 1

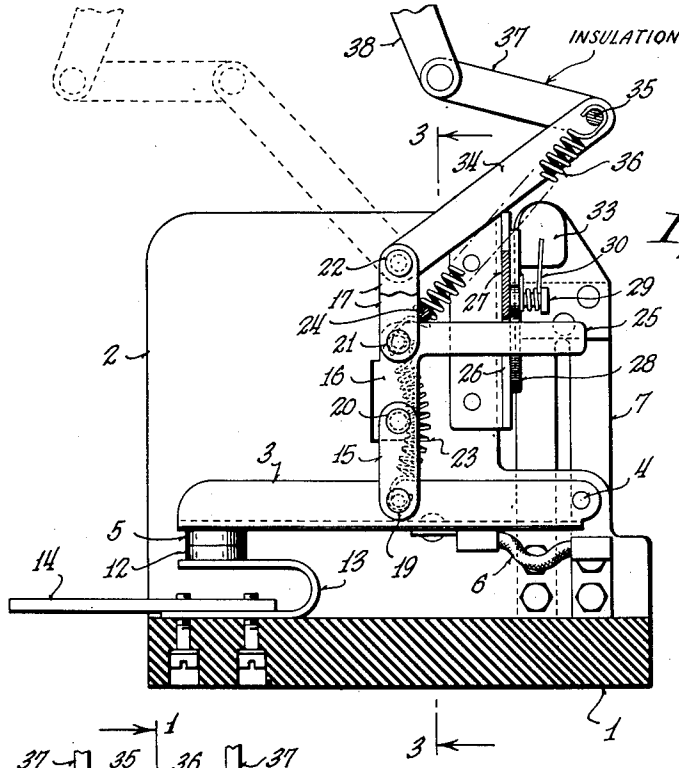


Fig. 1

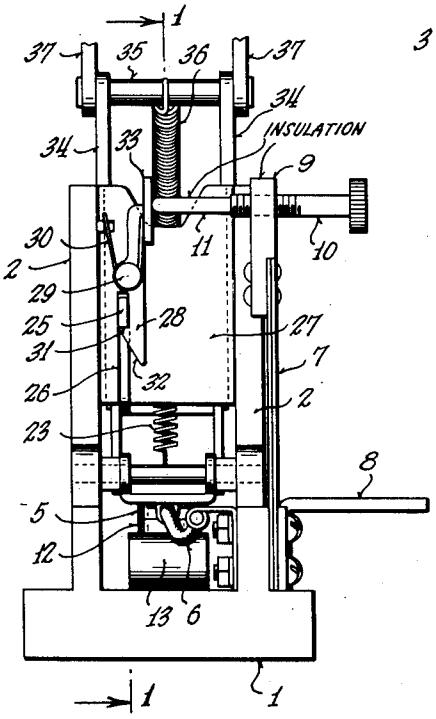


Fig. 2

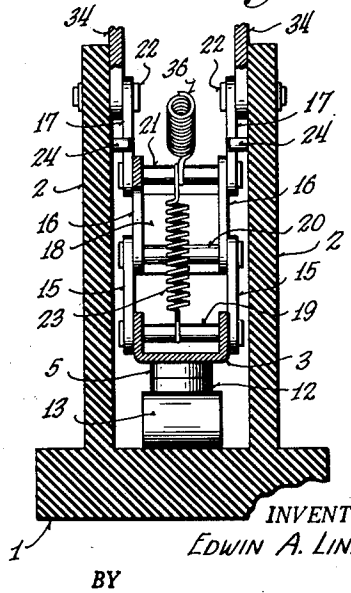


Fig. 3

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SWITCH CONSTRUCTION

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Fig. 4

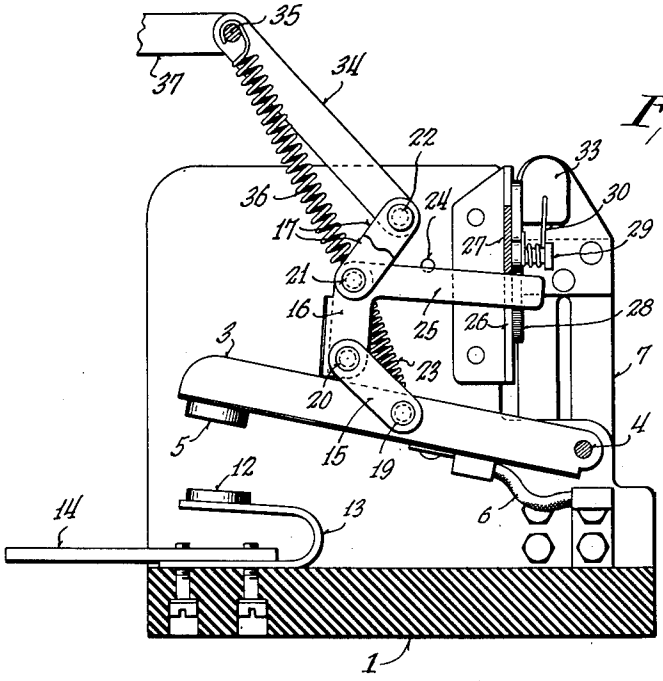
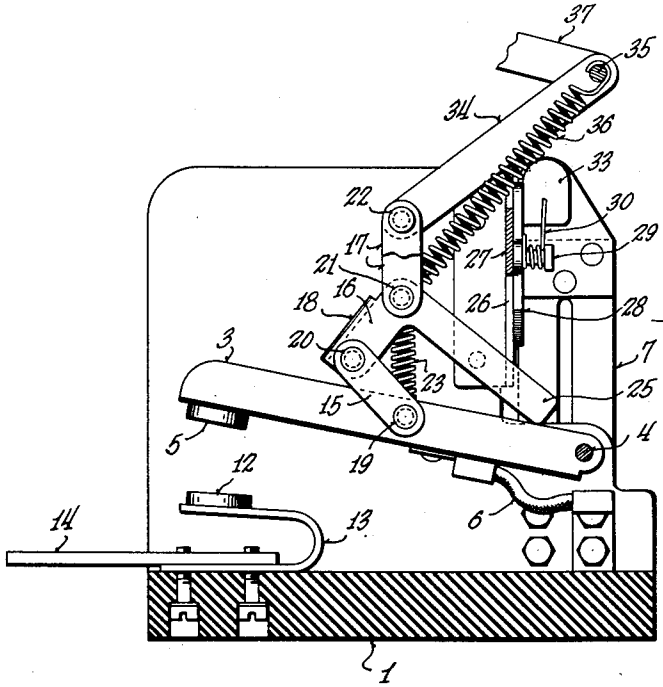


Fig. 5



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SWITCH CONSTRUCTION

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Fig. 6

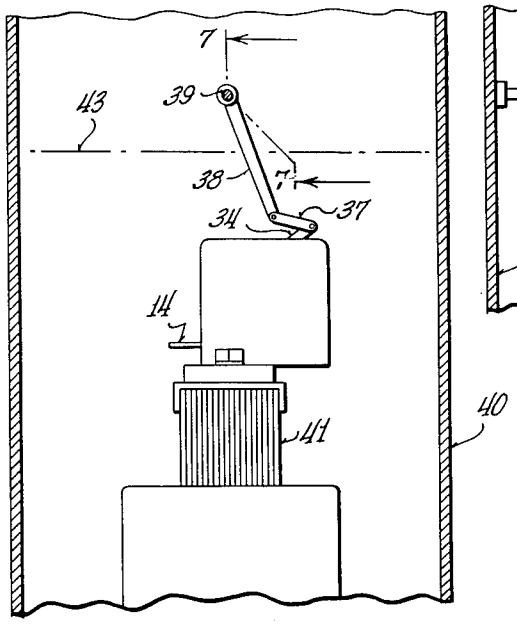


Fig. 7

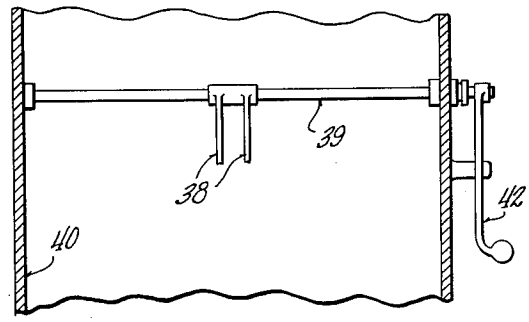
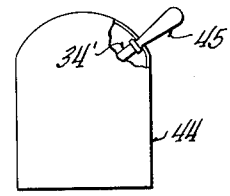


Fig. 8



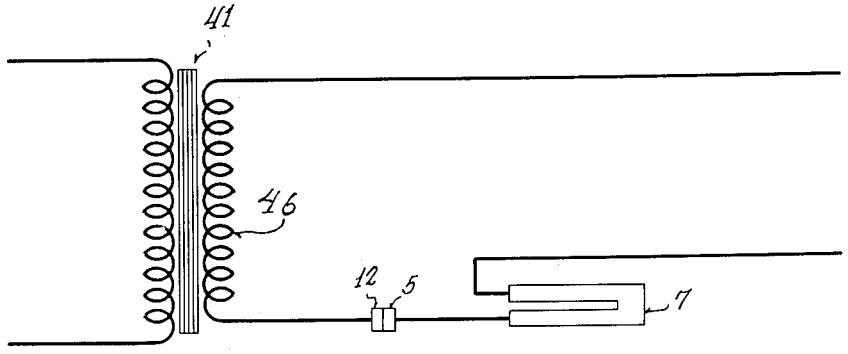


Fig. 9

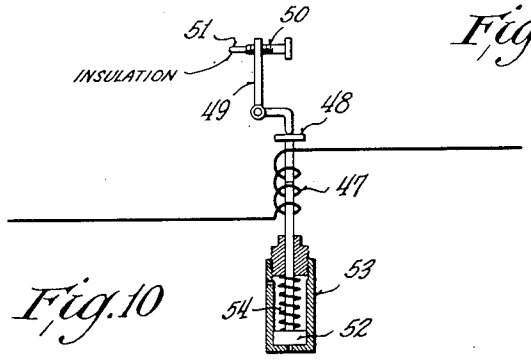


Fig. 10

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Patented Oct. 17, 1944 2,360,431

UNITED STATES PATENT OFFICE

2,360,431

SWITCH CONSTRUCTION

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Application April 10, 1943, Serial No. 482,522

13 Claims. (Cl. 200—116)

This invention relates to a switch construction.

In greater detail, this invention relates primarily to a switch construction of the circuit breaker type.

Objects of this invention are to provide a circuit breaker which has a quick make and a quick break, which has condition responsive means of the trip type, which is so constructed that it releases the circuit breaker so that the circuit breaker will open under predetermined conditions, and which is provided with a handle or other operating means for normally opening and closing the circuit breaker and for resetting the trip means, the trip means and the operating means being so related that the trip means will operate to release the circuit breaker irrespective of the position of the operating means and irrespective of any motion that the operating means may be executing at the time the trip means operates so that the trip means is trip free and will operate no matter whether the operating means is forcibly held in closed position or is being moved from one position to another.

Further objects are to provide a circuit breaker which is so constructed that the circuit breaker cannot be closed until the trip means has moved back to normal position, and in which the resetting of the trip means is accomplished by moving the operating means towards open position, such motion being followed by movement to closed position after the resetting of the trip means when it is desired to again close the circuit breaker after the occurrence of the predetermined condition.

Further objects are to provide a construction in which the trip means may be either thermostatically or magnetically or otherwise operated and which has either a quick action or a delayed action and which is adjustable so that the condition to which it will respond may be predetermined.

Further objects are to provide a circuit breaker which has a heavy contact pressure when it is closed, in which this heavy contact pressure is maintained during the operation of the circuit breaker until the instant at which the contacts are suddenly separated, thereby avoiding burning of the contacts under overload conditions.

Further objects are to provide a circuit breaker in which the mechanism is so arranged that it is easy to operate in opening and closing the circuit breaker and in resetting the trip means, and which is so made that there is no great wear on the parts during the opening and closing of the circuit breaker or during the resetting of the trip means as the mechanism is so arranged that during resetting, for example, relatively small forces or pressures are exerted between the cooperating parts, thereby minimizing wear.

Further objects are to provide a circuit breaker in which the trip means is required to exert only a very small force in order to cause automatic operation, the relation of the parts insuring relatching without any chance of wedging or jamming either the trip mechanism as a whole or any portion of the latch means.

Further objects are to provide a circuit breaker which is so constructed that toggle link mechanism is employed to secure a high contact pressure but in which, when the circuit breaker is closed, no force due to the high contact pressure is transmitted to the latch mechanism of the automatic release so that the latch mechanism is free of a considerable amount of friction which it would otherwise have if the force due to the heavy contact pressure were transmitted to the latch mechanism.

Further objects are to provide a circuit breaker in which the switch means is operated through the medium of a compound toggle link mechanism having three links so associated with the other portions of the apparatus that during normal operation in opening and closing the circuit breaker, the outer links coact and the center link merely acts as a guide or connector, a true toggle action taking place between the outer links, and being so arranged that during automatic operation the center link and one of the outer links coact and have a true toggle action, in both instances controlling the action of the switch means.

In greater detail further objects are to provide a circuit breaker having three links forming a compound toggle mechanism for controlling the motion of the switch means in which the center link normally acts merely as a connector when the circuit breaker is opened and closed by the main operating means, and in which the center link is controlled by condition responsive means, the condition responsive means holding the center link from substantial rocking motion under normal conditions and under abnormal conditions releasing the center link and allowing it to rock and form a true toggle with one of the outer links to thus open the switch means upon the occurrence of a predetermined condition, the center link being so associated with the condition responsive means it it is free to slide but is not

free to execute substantial rocking motion until the occurrence of a predetermined condition.

Further objects are to provide a circuit breaker construction which is sturdy and is reliable in operation, which may be installed in a transformer case and submerged in the oil in the transformer case if desired, and which if a thermostatic trip means is employed, may be arranged to have the thermostatic means respond solely to the heat generated by current passing through the thermostatic means or to the combined action of the heat in the oil from the transformer or other device as well as from the heat due to the current passing through the thermostatic means, or may be arranged to respond solely to the heat of the oil.

Embodiments of this invention are shown in the accompanying drawings, in which:

Figure 1 is a sectional view through the circuit breaker with parts broken away, such view corresponding approximately to a section on the line 1—1 of Figure 2 and showing the circuit breaker in closed position.

Figure 2 is an end view of the circuit breaker.

Figure 3 is a sectional view on the line 3—3 of Figure 1 with parts broken away.

Figure 4 is a view corresponding to Figure 1 showing the circuit breaker after it has been manually opened.

Figure 5 is a view corresponding to Figure 1 showing the circuit breaker after it has been automatically opened.

Figure 6 is a sectional view showing the circuit breaker mounted in a transformer casing.

Figure 7 is a fragmentary sectional view on the line 7—7 of Figure 6.

Figure 8 shows another manner in which the circuit breaker may be mounted.

Figure 9 is a wiring diagram.

Figure 10 is a view of a further form of condition responsive means.

Before proceeding with the detailed description of this invention it is to be understood that the circuit breaker may have either a single switch means or a plurality of switch means, a circuit breaker with a single switch means having been chosen for the sake of illustration.

Referring to the drawings, it will be seen that the circuit breaker comprises an insulating base portion 1 provided with a pair of insulating walls 2 extending upwardly therefrom. Switch means in the form of a channel member 3 is pivotally mounted on the pin 4 carried by the side walls 2 and is provided with a movable contact 5 at its outer end. The switch member 3 is connected by means of a flexible leader 6 with one arm of the inverted U-shaped bimetallic thermostatic member 7, the other arm of such member being connected to the terminal 8, see Figure 2. The upper end of the thermostatic member 7 is provided with an insulating head portion 9 through which an adjusting screw 10 is threaded, such screw being provided with an insulating pin 11 for a purpose hereinafter to appear. The stationary contact is indicated by the reference character 12 in Figure 1 and is carried by a relatively stiff resilient metal member 13 which is connected to the other terminal 14. When the circuit breaker is in closed position, as shown in Figure 1, the resilient member 13 is compressed.

The switch means 3 is operated by means of a compound toggle link mechanism which is composed of three links—a lower link 15, a center link 16, and an upper link 17. As a matter of fact, the links 15 and 17 are formed of two separate links and are joined to the side walls of the channel-shaped center link 16. Such center link is provided with a connecting web portion 18 integrally joining the side walls, as shown in Figure 3, and constituting a stop coacting with the switch member 3 when the circuit breaker is in open position, as shown in Figure 4, to thus limit the motion of all of the links. The lower link members 15 are pivoted on the pin 19 to the switch member 3 and the center link 16 is pivotally joined to the lower link members 15 by means of the pivot pin 20. The upper link members 17 are pivotally joined to the center link 16 by means of the pivot pin 21 and the upper link members 17 are pivoted at their upper ends at fixed points on the side frames 2 by means of the pivot pins 22.

The pins 19 and 21 are connected by means of a helical spring 23 and such helical spring always applies tension between the pivot pins 19 and 21 and when the circuit breaker is in closed position, as shown in Figure 1, is bowed to the right, thereby exerting a force in the left-hand direction on the pin 20 tending to break the toggle formed of the links 15 and 16. It is to be noted that stop pins 24 are provided, as shown most clearly in Figure 3, for limiting the rocking motion of the links 17 towards the right as viewed in Figure 1.

The center link 16 is controlled by condition responsive means, for example the thermostatic member 7, and is formed in the shape of a bell crank lever having an arm 25 extending approximately at right angles to the axis of the link 16. The arm 25 loosely extends through a slot 26 formed in a guiding plate 27 carried by the side walls 2, as shown most clearly in Figure 2. The arm 25 is normally retained in the position shown in Figures 1, 2 and 4 by means of the latch lever 28 pivoted on the pin 29 and urged in a clockwise direction by means of the spring 30. This latch lever is provided with a latching lip 31, see Figure 2, and has a bevelled cam-shaped lower portion 32. The latch lever is provided with an outwardly extending ear or pad 33 against which the insulating pin 11 of the adjusting screw 10 is adapted to bear. It is apparent that when the thermostatic member 7 warps to the left, which is its direction of motion upon overload, the pin 11 of the adjusting screw 10 will unlatch the latching lever 28. The description of the automatic releasing operation will be given in greater detail hereinafter.

Main operating means in the form of a pair of levers 34 are pivotally mounted on the pins 22 and are provided with a transverse pin 35 at their outer ends which is connected by means of a spring 36 with the pin 21. The main operating means 34 is adapted to be rocked from the full line position shown in Figure 1 to the full line position shown in Figure 4 in opening and closing the circuit breaker and in resetting the circuit breaker. The main operating means 34 may be operated in any suitable manner, as by means of a pair of insulating links 37 pivoted on the pin 35 and pivoted to rock arms 38. The rock arms 38 are rigidly carried by a rock shaft 39, see Figure 6, which may extend through the casing 40 of the transformer 41 and may be provided with an externally located manipulating handle 42, see Figure 7.

The operation of the circuit breaker is as follows: When it is desired to open the circuit breaker, the main operating means 34 is rocked from the full line position shown in Figure 1 to the dotted line position shown in Figure 1, which latter is the full line position shown in Figure 4.

The line of pull of the spring 36 passes to the left of the line joining the center of the pins 21 and 22 and consequently pulls the toggle link mechanism towards the left to the position shown in Figure 4. During this motion, the arm 25 of the center link 16 slides on the lip of the latch lever 28 and the center link 16 merely acts as a connecter or crosshead joining the inner ends of the links 15 and 17. The links 15 and 17 have a true toggle action and open the circuit breaker with a quick motion.

When it is desired to close the circuit breaker, the main operating means 34 is rocked from the full line position shown in Figure 4 to the full line position shown in Figure 1 and the line of pull of the spring 36 passes to the right of a line joining the center of the pins 22 and 21 and suddenly pulls the compound toggle link mechanism from the position shown in Figure 4 to that shown in Figure 1, thus closing the circuit breaker with a quick motion.

In automatic operation of the circuit breaker the parts initially in the position shown in Figure 1 move to the position shown in Figure 5. During automatic action the condition responsive means 7 warps to the left as viewed in Figure 2 and moves the latch lever 28 so that it releases the arm 25 of the center link 16. The spring 23, see Figure 1, bears against the pin 20 and tends to break the toggle formed of the links 15 and 16 towards the left as viewed in Figure 1 and the pull of the spring 23 between the pins 21 and 19 causes complete collapse of the toggle formed of the center link 16 and the lower link 15 to the position shown in Figure 5 and thus opens the circuit breaker with a quick motion. The links 17 are held against the stop 24 by means of the spring 36 and do not execute any motion during the automatic operation.

In resetting the circuit breaker the main operating means 34 is rocked from the position shown in Figure 5 to the circuit breaker open position shown in Figure 4 and during this motion the compound toggle link mechanism is pulled by means of the spring 36 from the position of its parts shown in Figure 5 to the position shown in Figure 4, thus causing the center link to rotate about the pin 21 and again raise the arm 25 of such center link into a position to be latched by the latching lever 28. It is to be noted that the spring 36 overpowers the spring 23.

If the thermostatic member 7 has cooled sufficiently, latching will occur as the arm 25 rides along the cam surface 32 of the latching lever, see Figure 2, until the latching lever snaps into latching position. If the thermostatic member has not cooled sufficiently, no damage is done to any of the parts. It is to be noted that when the circuit breaker is in closed position shown in Figure 1, the center point of the pins 19, 20, 21 and 22 are in substantial alignment and consequently there is no pressure transmitted to the latching lever due to the pressure between the stationary and movable contacts and thus no increase in friction is imparted to the latching lever.

If desired the circuit breaker may be mounted directly on the transformer 41, as shown in Figure 6, and may be mounted below the oil level 43. Under these conditions the thermostatic member may be heated not only by the current passing therethrough but also by the general heat of the oil. The purpose of this is to allow the thermostatic element to respond not only to a relatively sudden overload but to allow it to respond to the gradual rise of temperature of the oil which would result from a small and prolonged overload due to the heating of the transformer itself. Thus there may be afforded the double protection of opening the circuit breaker under the influence of an overload of reasonable magnitude or the opening of the circuit breaker from a prolonged small overload due to the heating of the transformer. It is obvious also that if desired the main current need not pass through the thermal member and the thermal member could then respond merely to the heat of the oil or the oil level could be so regulated that it is below the thermal member and then the thermal member would respond merely to the heat of the current passing therethrough.

The circuit breaker is adapted for wall mounting. For example it may be mounted in a casing 44 having a rounded, slotted top through which an insulating handle 45 projects, such handle being directly joined to the main operating means 34' corresponding to the main operating means 34 hereinbefore described.

Figure 9 shows the wiring diagram in which the circuit breaker is connected in series with a secondary 46 of the transformer 41.

Obviously other forms of condition responsive means could be employed. For instance, a solenoid type of condition responsive means is shown in Figure 10 in which the solenoid is indicated at 47 and is adapted to raise the plunger 48 to thereby rock the bell crank lever 49, such lever being provided with an adjusting screw 50 equipped with an insulating tip 51 adapted to bear against the ear or pad 33 of the latching lever in the same manner as that shown in Figure 2.

Any suitable form of time delay means may be employed. For example, the plunger 48 may be provided with a piston 52 cooperating with the cylinder 53, such cylinder being provided with apertures to accommodate the flow of fluid. A spring 54 is preferably employed to return the plunger to its initial position. Obviously the amount of time delay can be determined by properly designing the time delay means. The purpose of the time delay is to prevent the circuit breaker from suddenly opening for any sudden or extremely transitory overload for instance but to allow the circuit breaker to open as promptly as desired for an overload for a period longer than that for which the time delay is designed.

It is apparent that the value of the condition to which the circiut breaker may respond may be determined by the setting of the adjusting screw 50 of Figure 10 or 10 of Figure 2.

Other time delay means of course could be employed and it is to be distinctly understood that the circuit breaker could be made to respond to over or under voltage, overload, phase reversal, or any other desired condition.

It is to be noted that a circuit breaker has been provided by this invention in which a compound toggle link mechanism is employed for controlling the switch means, such toggle link mechanism being composed of upper and lower links and a center link, the center link acting merely as a connector or crosshead and sliding in and out and having no toggle action with the other two links when the circuit breaker is manually opened or closed, such mechanism, however, allowing the center link to coact with the lower link to open the circuit breaker when the center link is released and allowed to execute a toggle action

with the lower link on the occurrence of a predetermined condition.

The circuit breaker chosen for illustration is a single switch unit type but obviously, as hereinbefore stated, the circuit breaker may be either a single or multiple switch type without departing from the spirit of this invention.

It is to be understood that the expressions "upper" and "lower" in defining certain of the parts, particularly the links 17 and 15, are not intended as limiting as obviously the circuit breaker can be mounted in any position desired.

Although this invention has been described in considerable detail, it is to be understood that such description is intended as illustrative rather than limiting, as the invention may be variously embodied and is to be interpreted as claimed.

I claim:

1. A circuit breaker comprising switch means, compound toggle link mechanism for opening and closing said switch means, said compound toggle link mechanism including a center link and two outer links, one of said outer links being operatively connected to said switch means and the other outer link being pivoted at a spaced point, main operating means for causing toggle action between said outer links to open and close said switch means, and condition responsive means normally restraining said center link against substantial rocking motion and adapted to release said center link upon the occurrence of a predetermined condition, said center link and one of said outer links being biased towards toggle action to open said switch means and having toggle action when said center link is released.

2. A switch construction comprising switch means, compound toggle link mechanism for opening and closing said switch means, said compound toggle link mechanism including a center link and two outer links, one of said outer links being operatively connected to said switch means and the other outer link being pivoted at a spaced point, means for causing toggle action between said outer links to operate said switch means, and means for causing toggle action between the center link and an outer link to operate said switch means.

3. A switch construction comprising switch means, compound toggle link mechanism for opening and closing said switch means, said compound toggle link mechanism including a center link and two outer links, one of said outer links being operatively connected to said switch means and the other outer link being pivoted at a spaced point, means for causing toggle action between said outer links to open and close said switch means, and means for causing toggle action between the center link and an outer link to open said switch means.

4. A circuit breaker comprising switch means, compound toggle link mechanism for opening and closing said switch means, said compound toggle link mechanism including a center link and two outer links, said center link being arranged for rocking and sliding motion, one of said outer links being operatively connected to said switch means and the other outer link being pivoted at a spaced point, main operating means for causing toggle action between said outer links to open and close said switch means, and condition responsive means normally restraining said center link against substantial rocking motion and allowing sliding motion and adapted to release said center link upon the occurrence of a predetermined condition for rocking motion, said center link and one of said outer links being biased towards toggle action to open said switch means and having toggle action when said center link is released.

5. A circuit breaker comprising switch means, compound toggle link mechanism for opening and closing said switch means, said compound toggle link mechanism including a center link and two outer links, said center link being arranged for rocking and sliding motion and having a laterally extending arm, one of said outer links being operatively connected to said switch means and the other outer link being pivoted at a spaced point, main operating means for causing toggle action between said outer links to open and close said switch means, and condition responsive means normally engaging said laterally extending arm and restraining said center link against substantial rocking motion and allowing sliding motion and adapted to release the arm of said center link upon the occurrence of a predetermined condition to allow said center link to rock, said center link and one of said outer links being biased towards toggle action to open said switch means and having toggle action when said center link is released.

6. A circuit breaker comprising switch means, compound toggle link mechanism for opening and closing said switch means, said compound toggle link mechanism including a center link and two outer links, one of said outer links being operatively connected to said switch means and the other outer link being pivoted at a spaced point, main operating means for causing toggle action between said outer links to open and close said switch means, and condition responsive means normally restraining said center link against substantial rocking motion and adapted to release said center link upon the occurrence of a predetermined condition, said center link and one of said outer links being biased towards toggle action to open said switch means and having toggle action when said center link is released without requiring any motion of said main operating means.

7. A circuit breaker comprising switch means, compound toggle link mechanism for opening and closing said switch means, said compound toggle link mechanism including a center link and two outer links, said center link being arranged for rocking and sliding motion, one of said outer links being operatively connected to said switch means and the other outer link being pivoted at a spaced point, main operating means for causing toggle action between said outer links to open and close said switch means, and condition responsive means normally restraining said center link against substantial rocking motion and allowing sliding motion and adapted to release said center link upon the occurrence of a predetermined condition for rocking motion, said center link and one of said outer links being biased towards toggle action to open said switch means and having toggle action when said center link is released without requiring any motion of said main operating means.

8. A circuit breaker comprising switch means, a three link toggle mechanism for operating said switch means, a first spring means for extending the three link toggle mechanism when moved in one direction to close said switch means and for collapsing the three link toggle mechanism when moved in the reverse direction for opening said switch means, main operating means for moving said first spring means, a second spring means

acting between two links of the toggle to open said switch means, and condition responsive means controlling the action of said second spring means.

9. A circuit breaker comprising switch means, a three link toggle mechanism for operating said switch means, a first spring means for extending the three link toggle mechanism when moved in one direction to close said switch means and for collapsing the three link toggle mechanism when moved in the reverse direction for opening said switch means, main operating means for moving said first spring means, a second spring means acting between two links of the toggle and permanently biasing said two links towards collapsing motion to open said switch means, and condition responsive means controlling the action of said second spring means.

10. A circuit breaker comprising switch means, a three link toggle mechanism for operating said switch means, a first spring means for extending the three link toggle mechanism when moved in one direction to close said switch means and for collapsing the three link toggle mechanism when moved in the reverse direction for opening said switch means, main operating means for moving said first spring means, a second spring means acting between two links of the toggle and permanently biasing said two links towards callapsing motion to open said switch means, and condition responsive means controlling the action of said second spring means, said first spring means when moved to the position to extend the three link toggle overpowering said second spring means.

11. A circuit breaker comprising switch means, compound toggle link mechanism for opening and closing said switch means, said compound toggle link mechanism including a center link and two outer links, one of said outer links being operatively connected to said switch means and the other outer link being pivoted at a spaced point, main operating means, spring means connecting said main operating means to said toggle link mechanism, said main operating means being movable in opposite directions to operate said toggle link mechanism to open and close said switch means, condition responsive means normally restraining said center link against substantial rocking motion and adapted to release said center link upon the occurrence of a predetermined condition, said center link and one of said outer links being biased towards collapsing toggle action to open said switch means when said center link is released, said spring means when said main operating means is moved in one direction moving said center link back to a position to be restrained by said condition responsive means.

12. A circuit breaker comprising switch means, compound toggle link mechanism for opening and closing said switch means, said compound toggle link mechanism including a center link and two outer links, said center link being arranged for rocking and sliding motion, one of said outer links being operatively connected to said switch means and the other outer link being pivoted at a spaced point, main operating means movable in opposite directions for causing toggle action between said outer links to open and close said switch means, and condition responsive means including latch means normally restraining said center link against substantial rocking motion and allowing sliding motion and adapted to release said center link upon the occurrence of a predetermined condition for rocking motion, said center link and one of said outer links being biased towards toggle action to open said switch means and having toggle action when said center link is released, said main operating means when moved in one direction rocking said center link to a position to be reengaged by said latch means.

13. A circuit breaker comprising switch means, compound toggle link mechanism for opening and closing said switch means, said compound toggle link mechanism including a center link and two outer links, said center link being arranged for rocking and sliding motion, one of said outer links being operatively connected to said switch means and the other outer link being pivoted at a spaced point, main operating means, spring means connecting said main operating means and said toggle link mechanism, said main operating means being movable in opposite directions for causing toggle action between said outer links to open and close said switch means, and condition responsive means including latch means normally restraining said center link against substantial rocking motion and allowing sliding motion and adapted to release said center link upon the occurrence of a predetermined condition for rocking motion, said center link and one of said outer links being biased towards toggle action to open said switch means and having toggle action when said center link is released, said spring means acting to restore said center link to a position to be reengaged by said latch means when said main operating means is moved in one direction.

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