

Nov. 6, 1945.

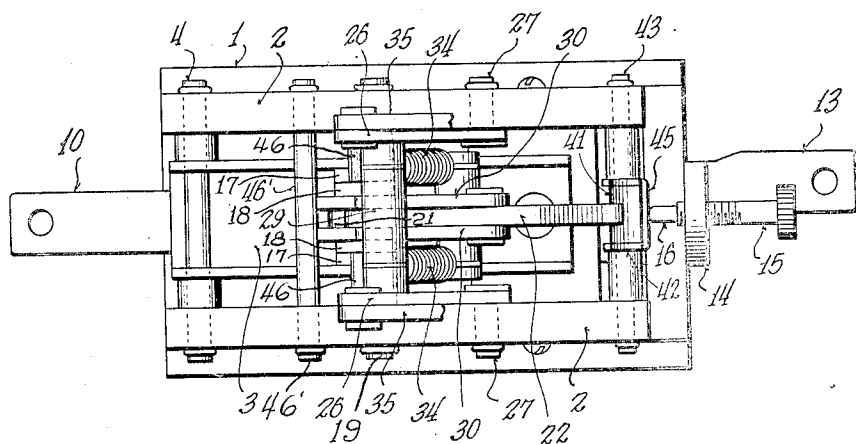
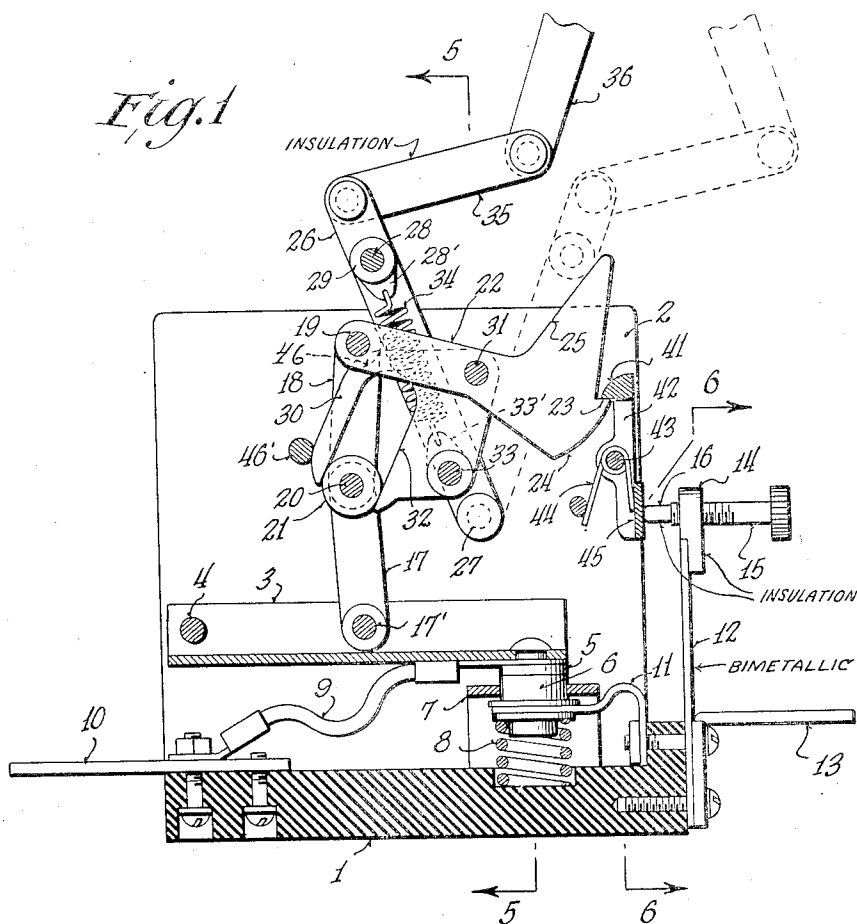
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2,388,620

SWITCH CONSTRUCTION

Filed May 21, 1943

4 Sheets-Sheet 1



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SWITCH CONSTRUCTION

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4 Sheets-Sheet 2

Fig. 3

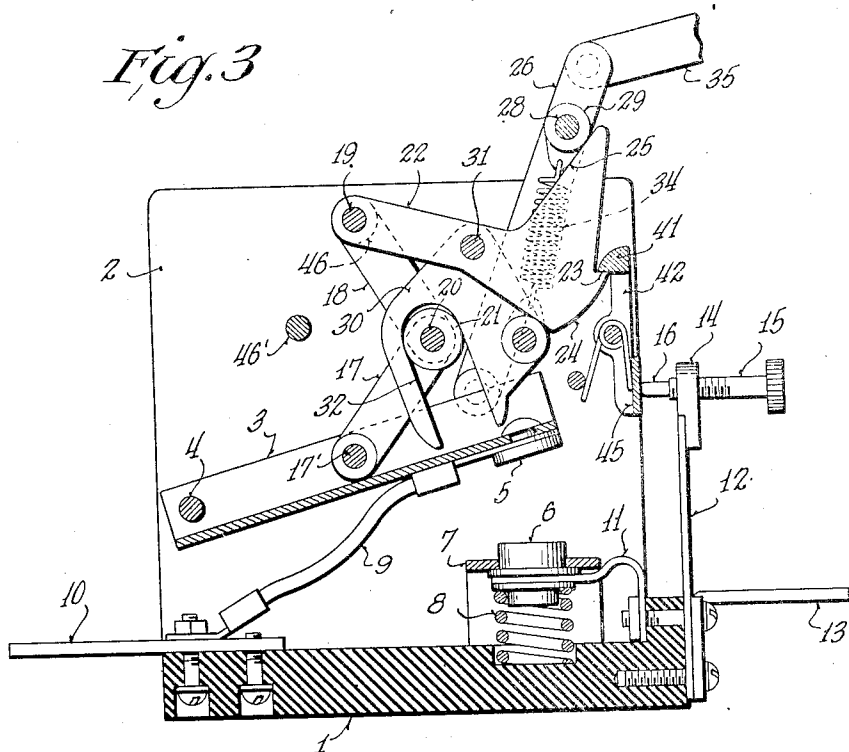
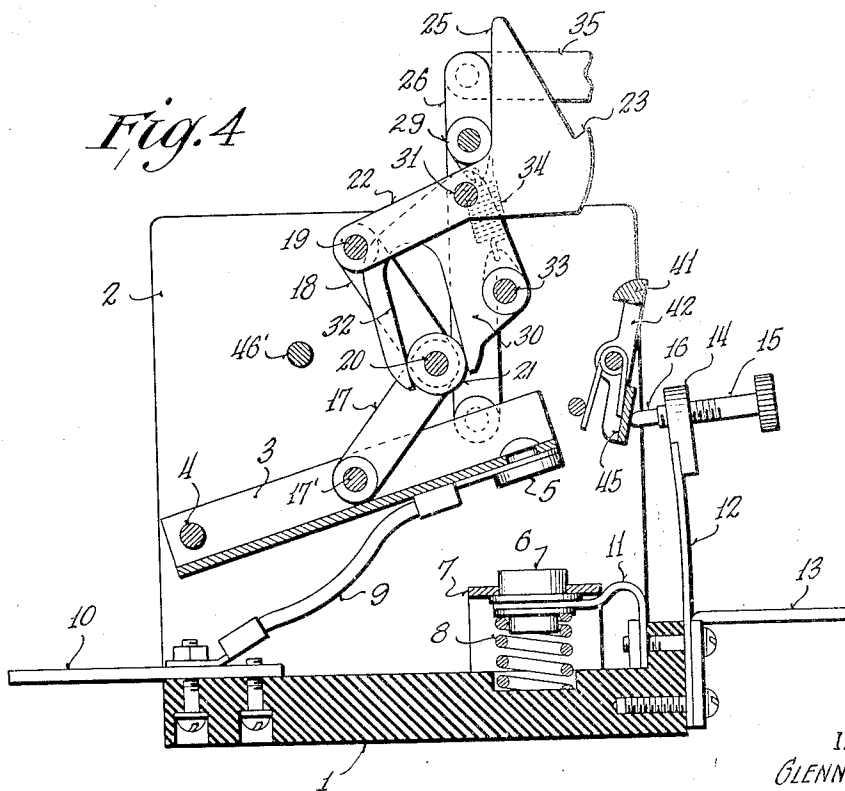


Fig. 4



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Fig. 5

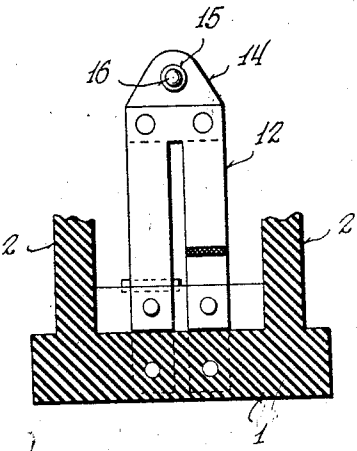
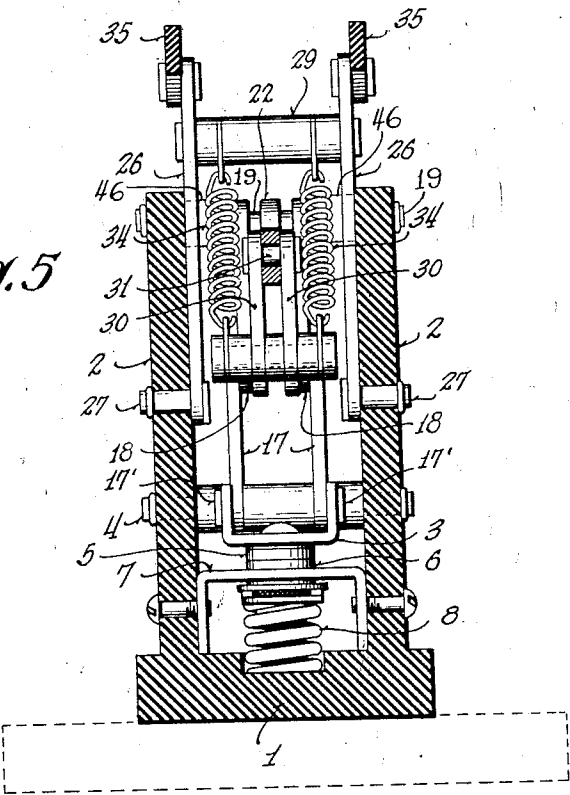


Fig. 6

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SWITCH CONSTRUCTION

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4 Sheets-Sheet 4

Fig. 7

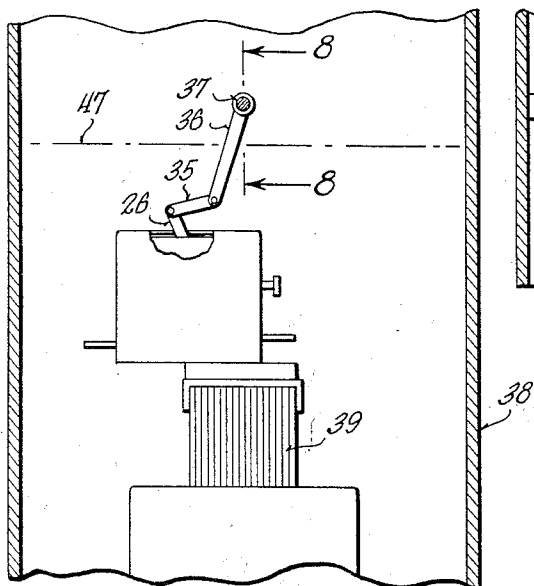


Fig. 8

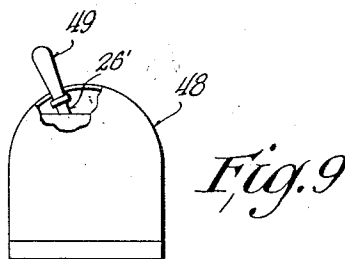
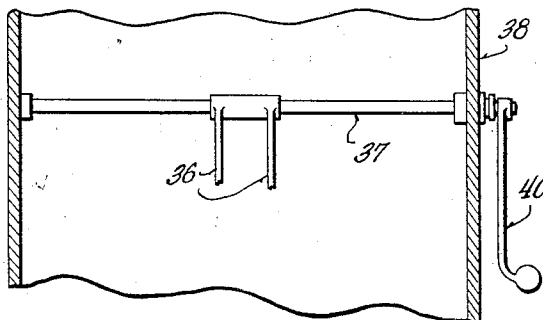


Fig. 10

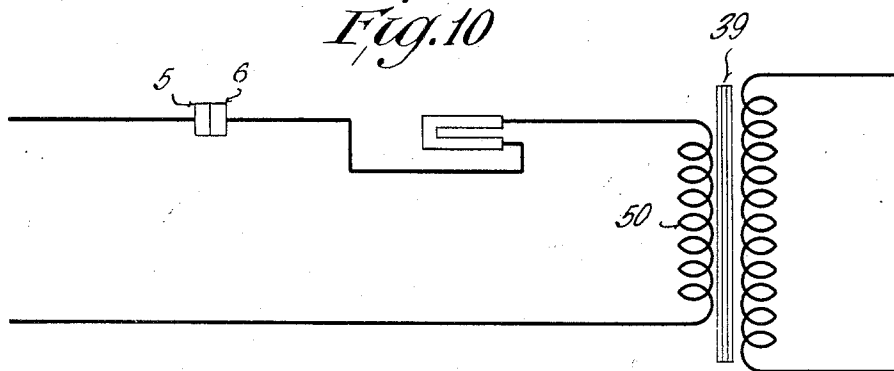
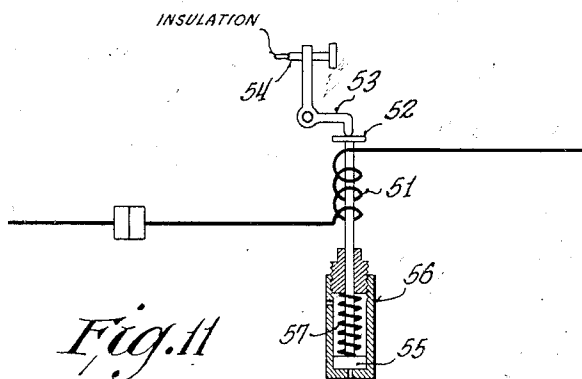


Fig. 11



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UNITED STATES PATENT OFFICE

2,388,620

SWITCH CONSTRUCTION

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Application May 21, 1943, Serial No. 487,884

14 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 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 any portion of the force due to the heavy contact pressure were transmitted to the latch mechanism.

In greater detail, further objects are to provide a circuit breaker in which the switch means is closed by toggle mechanism, in which a main operating means is provided, and in which an intermediate operating means is operatively positioned between the main operating means and the toggle link mechanism, the intermediate operating means being operatively connected to the main operating means by means of springs and being so arranged that it is operated through the agency of the springs when the automatic release operates and is also operated through the agency of the same springs upon manipulation of the main operating means, the arrangement also having the further feature of moving the main operating means to indicating position when the circuit breaker has been automatically opened.

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, showing the parts in closed position.

Figure 2 is a plan view of the structure shown in Figure 1 with parts broken away.

Figure 3 is a view corresponding to Figure 1 showing the circuit breaker after it has been manually opened.

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

Figure 5 is a sectional view approximately on the line 5—5 of Figure 1.

Figure 6 is a fragmentary sectional view on the line 6—6 of Figure 1.

Figure 7 is a sectional view showing the circuit breaker mounted in a transformer casing.

Figure 8 is a sectional view on the line 8—8 of Figure 7.

Figure 9 is a view showing another manner in which the circuit breaker may be mounted.

Figure 10 is a wiring diagram.

Figure 11 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 a base portion 1 of insulating material provided with a pair of insulating walls 2 extending upwardly therefrom. A switch member in the form of a channel 3 is pivotally mounted as indicated at 4 and is provided with a movable contact 5 which is adapted to cooperate with the stationary contact 6. The stationary contact 6 projects through an aperture in a guide member 7 and is urged upwardly by means of the spring 8, such spring being centered at both ends as indicated in Figure 1.

It is preferable to connect the movable contact 5 by means of a flexible leader 9 with a terminal 10 and to connect the stationary contact 6 by means of a flexible leader 11 with one arm of the thermostatic member 12, the other arm of such member being connected to the terminal 13. The thermostatic member 12, as will be seen from Figure 6, is in the form of an inverted U and is provided with a head 14 formed of insulating material through which the adjusting screw 15 is threaded, such screw being provided with an insulating pin 16.

The switch member 3 is operated directly from a toggle mechanism composed of the two pairs of links 17 and 18, the links 17 being directly pivotally joined to the switch member 3 as indicated at 17' and the links 18 being pivoted about a fixed pin 19, such pivot pin being supported from the side walls 2. The links 17 and 18 are joined by means of a pin 20 which is provided with a roller 21. A carrier 22 is also pivotally mounted on the pin 19 and is provided with a latching lip 23, a rounded lower cam portion 24, and an upper cam face 25.

Main operating means in the form of a pair of levers 26 is provided for operating the circuit breaker. The levers 26 are pivoted as indicated at 27 to the side frames 2. These levers are provided with a transverse pin 28 which carries a roller 29 for a purpose hereinafter to appear.

An intermediate operating member 30, in the form of two duplicate plates, is pivoted to the carrier by means of the pin 31 and each plate is provided with a slot 32 within which the roller 21 is positioned. The intermediate operating member 30 is also provided with a transverse pin 33 which joins the two plates of the intermediate operating member as a unitary structure. The pins 28 and 33 are connected by means of springs 34 so as to operatively connect the main operating means 26 with the intermediate operating means 30. The springs are connected at oppo-

site ends to members 28' and 33' through which the pins 28 and 33 extend.

The main operating means may be operated in any suitable manner. For example, they may be connected by means of insulating links 35 to a pair of rock arms 36 which are rigidly carried by a rock shaft 37 which may project through the casing 38 of the transformer 39, see Figures 7 and 8. The outer end of the rock shaft 37 is provided with an operating handle 40.

Normally the lip 23 of the carrier 22 is latched beneath the latching portion 41 of a latch lever 42. It is to be noted that the latching portion 41 has a rounded upper face which coacts with the cam face 24 when the circuit breaker is reset in the manner hereinafter to appear. This latch lever is pivoted as indicated at 43 and is urged by means of the spring 44 in a counterclockwise direction. It is provided with a transverse portion 45 adjacent its lower end against which the pin 16 of the screw 15 is adapted to bear.

Figure 1 shows the circuit breaker in closed position and it is to be noted that when the circuit breaker is closed, the toggle link mechanism 17, 18 has its knee extending slightly to the left, that is, just past center, so as to tend to lock the circuit breaker in circuit closed position.

When it is desired to manually open the circuit breaker, the main operating means 26 is rocked from the full line position shown in Figure 1 to the right to the full line position shown in Figure 3. This rocking of the operating means or levers 26 to the right carries the upper ends of the springs 34 to a position past a line joining the center of the pins 31 and 33 and the springs, on continued motion of the main operating means 26, suddenly rock the intermediate rocking member 30 in a counterclockwise direction to the position shown in Figure 3. This causes the toggle link mechanism to break, that is to say, causes the knee of the toggle link mechanism to move to the right and thus opens the circuit breaker.

It is to be noted that the cam surface 25 of the carrier 22 acts as a stop to limit the right-hand motion towards switch open position of the main operating means 26 as shown in Figure 3. Also when the main operating means is rocked to the left to the full line position shown in Figure 1, it will be seen that the intermediate operating member bears against the pin 19 and further motion of the intermediate operating member is arrested. It is to be noted that the pin 19 is provided with spacing sleeves 46 against which the main operating levers 26 bear to thus constitute a stop means for limiting the left-hand motion of such operating member. If desired, an auxiliary stop means in the form of a pin 46' may be provided for engaging a portion of the intermediate operating member 30, such pin being supported from the side walls 2 of the circuit breaker.

When an overload occurs, the bi-metallic thermal member 12 warps to the left as viewed in Figure 1 and causes the trip lever 42 to rock in a clockwise direction, thus releasing the carrier 22, such carrier it will be noted being urged towards upward rocking motion about its pivot pin 19 by means of the springs 34. The carrier 22 suddenly rocks upwardly to the position shown in Figure 4 and it is to be noted that the intermediate operating member 30 rocks as a unit with the carrier as it bears against the pin 19 and as it is pivoted to the carrier by means of the pin 31. The rocking motion of the intermediate oper-

ating member 30 breaks the toggle and moves the knee of the toggle to the right as shown in Figure 4, thus suddenly opening the circuit breaker.

It will be seen that when the circuit breaker is manually opened or closed, the springs 34 are rocked to a position to suddenly cause the toggle mechanism to move to the right from the position shown in Figure 1 to that shown in Figure 3, and to the left from the position shown in Figure 3 to that shown in Figure 1 respectively, thus causing the circuit breaker to execute a quick opening and quick closing stroke.

When the circuit breaker is automatically released, as for example on overload as described hereinabove, the carrier 22 suddenly rocks upwardly to the position shown in Figure 4 and through the agency of the intermediate operating means 30 rocks the knee of the toggle mechanism to the right, thus quickly opening the circuit breaker.

It is to be noted that by means of the toggle link mechanism heavy contact pressure is obtained when the circuit breaker is closed. However, none of this pressure is transmitted to the carrier and consequently none of it is transmitted to the latch mechanism of the automatic trip means. Instead the pressure from the switch mechanism is transmitted through the toggle link mechanism directly to the fixed pin 19. Thus it is to be noted that there is no increase in friction for the trip lever and the associated parts due to the heavy contact pressure.

It is to be noted also from a comparison of Figures 1 and 4 that when the carrier 22 is released and rocks upwardly to the position shown in Figure 4, the line of pull of the springs 34 crosses to the right of the line joining the pin 28 and the pin 27 and consequently the main operating means 26 is rocked from switch closed position to the indicating position of Figure 4 showing that automatic operation of the circuit breaker has taken place.

The cam face 25 of the carrier 22 acts as a stop to arrest the motion of the main operating means 26.

When it is desired to reset the circuit breaker, the operating means 26 is rocked to the right from the position shown in Figure 4 and the roller 29 rides on the cam face 25 of the carrier 22 and rocks the carrier downwardly so that it will be again engaged by the latch 41 of the locking lever 42 provided the thermostatic member 12 has cooled sufficiently. Thereafter the main operating means 26 is rocked to the left, thus closing the circuit breaker. During the downward motion of the carrier the cam surface 24 engages the rounded upper surface of the latch 41 and rocks the lever 42 in a clockwise direction until the latch 41 moves inwardly to engage the shoulder 23. However, if the thermostatic means has not cooled sufficiently, it is impossible to lock the carrier in its reset position and no strain can be imposed upon the latch mechanism or the thermostatic member.

Upon reference to Figure 7 it will be seen that the circuit breaker may, if desired, be supported directly from the transformer 39 and may be mounted within the transformer casing 38, below the oil level indicated at 47. 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 there-through.

The circuit breaker is also adapted for wall mounting. For example, it may be mounted within a casing 48, see Figure 9, and an insulating handle 49 may extend through the curved wall of the casing and may be directly attached to the operating means 26 which corresponds to the operating means 26 hereinbefore described.

Figure 10 shows the wiring diagram, in which the circuit breaker is connected in series with a secondary 50 of the transformer 39.

Obviously other forms of condition responsive means may be employed. For instance, a solenoid type of condition responsive means is shown in Figure 11 in which the solenoid 51 is adapted to raise the plunger 52 to thereby operate the bell crank lever 53 and move the adjusting screw 54 into contact with the trip lever in the same manner as that hereinbefore described.

Any suitable form of time delay means may be provided such as the piston 55 connected to the plunger 52 and operating within the cylinder 56, suitable apertures being provided for the flow of fluid. It is preferable to provide a spring 57 for returning the plunger to its lowermost position. 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 circuit breaker may respond may be determined by the setting of the adjusting screw 54 of Figure 11 or 15 of Figure 1.

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 toggle link mechanism is employed for opening and closing the circuit breaker and for locking the circuit breaker in closed position, and in which quick motion mechanism independent of the toggle link mechanism is employed for operating the toggle link mechanism, main operating means being provided for operating the quick motion mechanism to open and close the switch means, and means including condition responsive means being provided for opening the switch means upon the occurrence of a predetermined condition. It is to be noted further that the line of pull of the spring means when the circuit breaker is in closed position is very close to the pivot point of the carrier so that very little force is trans-

mitted from such spring means to the latch mechanism and, as stated hereinbefore, no force whatsoever is transmitted to the latch mechanism from the toggle link mechanism.

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.

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, toggle link mechanism for opening and closing said switch means, said toggle link mechanism having one end operatively connected to said switch means and having the other end pivoted at a fixed point, a movable carrier biased for motion outwardly from said switch means, condition responsive means normally holding said carrier against motion and releasing said carrier upon the occurrence of a predetermined condition, intermediate operating means pivoted on said carrier and arranged to operate said toggle link mechanism, and main operating means for operating said intermediate operating means.

2. A circuit breaker comprising a body portion, stationary contact means carried thereby, switch means including movable contact means adapted to engage and disengage said stationary contact means, toggle link mechanism having one outer end pivoted to said switch means and having the other outer end pivoted to said body portion, a carrier movably supported from said body portion, condition responsive means normally holding said carrier against motion and adapted to release said carrier, movable main operating means, intermediate operating means movably carried by said carrier and operatively connected to an intermediate portion of said toggle link mechanism, and spring means connecting said intermediate operating means and said main operating means for operating said intermediate operating means from said main operating means, said spring means biasing said carrier towards outward motion.

3. A circuit breaker comprising a body portion, stationary contact means carried thereby, switch means including movable contact means adapted to engage and disengage said stationary contact means, toggle link mechanism having one outer end pivoted to said switch means and having the other outer end pivoted to said body portion, a movable carrier pivotally supported from said body portion, condition responsive means normally holding said carrier against motion and adapted to release said carrier, movable main operating means, intermediate operating means pivoted on said carrier and operatively connected to an intermediate portion of said toggle link mechanism, and spring means connecting said intermediate operating means and said main operating means for operating said intermediate operating means from said main operating means, said spring means biasing said carrier towards outward motion, the line of pull of said spring means passing from one side to the other of the pivot point of said intermediate operating means when said main operating means is moved.

4. A circuit breaker comprising a body portion, stationary contact means carried thereby, switch means including movable contact means

adapted to engage and disengage said stationary contact means, toggle link mechanism having one outer end pivoted to said switch means and having the other outer end pivoted to said body portion, a movable carrier pivotally supported from said body portion, condition responsive means normally holding said carrier against motion and adapted to release said carrier, movable main operating means, intermediate operating means pivoted on said carrier and operatively connected to an intermediate portion of said toggle link mechanism, and spring means connecting said intermediate operating means and said main operating means for operating said intermediate operating means from said main operating means, said spring means biasing said carrier towards outward motion, the line of pull of said spring means passing from one side to the other of the pivot point of said intermediate operating means when said main operating means is moved and being closely adjacent the pivot point of said carrier when the circuit breaker is closed.

5. A circuit breaker comprising switch means, toggle link mechanism for opening and closing said switch means, said toggle link mechanism having one end operatively connected to said switch means and having the other end pivoted at a fixed point, quick motion means for operating said toggle link mechanism, main operating means for causing said quick motion means to operate said toggle link mechanism to open and close said switch means, and means including condition responsive means for operating said quick motion means to open said switch means.

6. A circuit breaker comprising switch means, toggle link mechanism for opening and closing said switch means, said toggle link mechanism having one end operatively connected to said switch means and having the other end pivoted at a fixed point, quick motion means for operating said toggle link mechanism, main operating means for causing said quick motion means to operate said toggle link mechanism to open and close said switch means, and means including condition responsive means for operating said quick motion means to open said switch means, said quick motion means including a movable member pivoting about one point when operated by said main operating means and pivoting about a different point when said switch means opens in response to the operation of said condition responsive means.

7. A circuit breaker comprising switch means, toggle link mechanism for opening and closing said switch means, said toggle link mechanism having one end operatively connected to said switch means and having the other end pivoted at a fixed point, quick motion means for operating said toggle link mechanism, main operating means for causing said quick motion means to operate said toggle link mechanism to open and close said switch means, and means including condition responsive means for operating said quick motion means to open said switch means, said quick motion means including a movable member pivoting about one point when operated by said main operating means and pivoting about a different point when said switch means opens in response to the operation of said condition responsive means, said movable member being permanently biased for motion in one direction about said last mentioned point.

8. A circuit breaker comprising a body portion, stationary contact means carried thereby, switch means including movable contact means adapted

to engage and disengage said stationary contact means, toggle link mechanism having one outer end pivoted to said switch means and having the other outer end pivoted to said body portion, a carrier pivoted to said body portion and biased for outward motion, condition responsive means normally holding said carrier against motion and adapted to release said carrier, movable main operating means, intermediate operating means pivoted to said carrier and operatively connected to an intermediate portion of said toggle link mechanism, and spring means connecting said intermediate operating means and said main operating means for operating said intermediate operating means from said main operating means, said intermediate operating means pivoting about the pivot point on said carrier when operated by said main operating means and pivoting with said carrier about the pivot point of said carrier when said carrier is released.

9. A circuit breaker comprising a body portion, stationary contact means carried thereby, switch means including movable contact means adapted to engage and disengage said stationary contact means, toggle link mechanism having one outer end pivoted to said switch means and having the other outer end pivoted to said body portion, a movable carrier pivotally supported from said body portion, condition responsive means normally holding said carrier against motion and adapted to release said carrier, movable main operating means, intermediate operating means pivoted on said carrier and having a slot and pin connection with an intermediate portion of said toggle link mechanism, and spring means connecting said intermediate operating means and said main operating means for operating said intermediate operating means from said main operating means, said spring means biasing said carrier towards outward motion, the line of pull of said spring means passing from one side to the other of the pivot point of said intermediate operating means when said main operating means is moved.

10. A circuit breaker comprising switch means, toggle link mechanism for opening and closing said switch means, said toggle link mechanism having one end operatively connected to said switch means and having the other end pivoted at a fixed point, a movable carrier biased for motion outwardly from said switch means, condition responsive means normally holding said carrier against motion and releasing said carrier upon the occurrence of a predetermined condition, intermediate operating means pivoted on said carrier and arranged to operate said toggle link mechanism, and main operating means for operating said intermediate operating means, said main operating means having means for moving said carrier to reposition said carrier after release of said carrier.

11. A circuit breaker comprising a body portion, stationary contact means carried thereby, switch means including movable contact means adapted to engage and disengage said stationary contact means, toggle link mechanism having one outer end pivoted to said switch means and having the other outer end pivoted to said body portion, a carrier movably supported from said body portion, condition responsive means normally holding said carrier against motion and adapted to release said carrier, movable main operating means, intermediate operating means movably carried by said carrier and operatively connected

to an intermediate portion of said toggle link mechanism, and spring means connecting said intermediate operating means and said main operating means for operating said intermediate operating means from said main operating means, said spring means biasing said carrier towards outward motion, said main operating means having means for engaging said carrier to cause said carrier to be reengaged by said condition responsive means.

12. A circuit breaker comprising a body portion, stationary contact means carried thereby, switch means including movable contact means adapted to engage and disengage said stationary contact means, toggle link mechanism having one outer end pivoted to said switch means and having the other outer end pivoted to said body portion, a carrier movably supported from said body portion, condition responsive means normally holding said carrier against motion and adapted to release said carrier, movable main operating means, intermediate operating means movably carried by said carrier and operatively connected to an intermediate portion of said toggle link mechanism, and spring means connecting said intermediate operating means and said main operating means for operating said intermediate operating means from said main operating means, said spring means biasing said carrier towards outward motion, said carrier having a cam face and said main operating means having a roller for engaging the cam face of said carrier to reset said carrier.

13. A circuit breaker comprising a body portion, stationary contact means carried thereby, switch means including movable contact means adapted to engage and disengage said stationary contact means, toggle link mechanism having one outer end pivoted to said switch means and having the other outer end pivoted to said body portion, a carrier movably supported from said body portion, condition responsive means normally holding said carrier against motion and adapted to release said carrier, movable main operating means, intermediate operating means movably carried by said carrier and operatively connected to an intermediate portion of said toggle link mechanism, and spring means connecting said intermediate operating means and said main operating means for operating said intermediate operating means from said main operating means, said spring means biasing said carrier towards outward motion, said spring means moving said main operating means to an indicating position when said carrier is released.

14. A switch comprising switch means, toggle link mechanism for opening and closing said switch means, said toggle link mechanism having one end operatively connected to said switch means and having the other end pivoted at a fixed point, a quick motion member separate and distinct from said toggle link mechanism and operatively connected to said toggle link mechanism for operating said toggle link mechanism, said quick motion member being pivotally mounted, pivotally mounted main operating means, and spring means joining said main operating means and said quick motion member and so arranged that its line of pull is on opposite sides of the pivot point of said quick motion member when said main operating means is rocked back and forth.

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