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April 1, 1947.

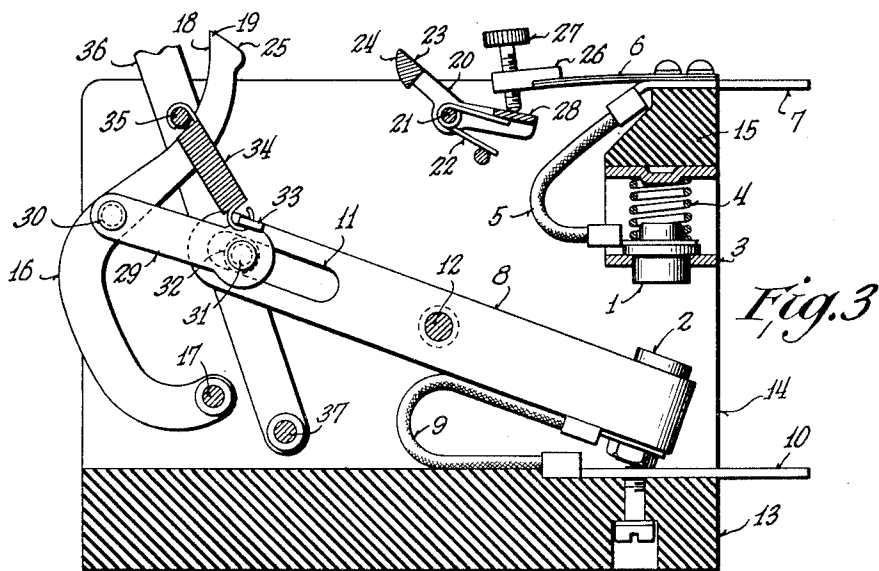
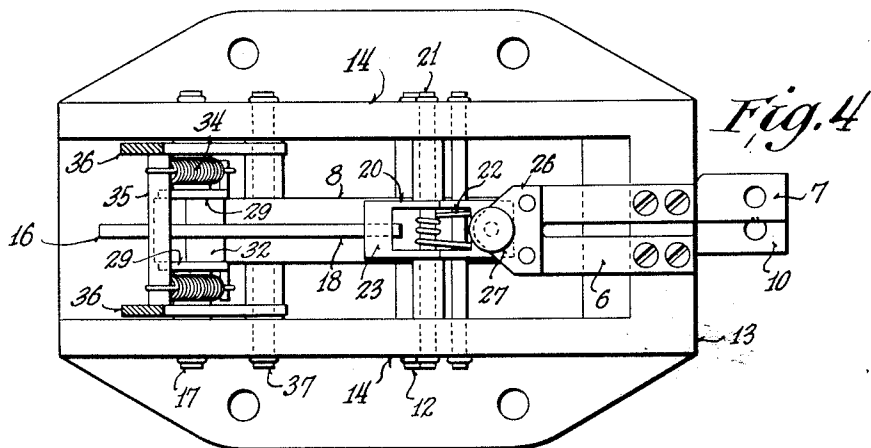
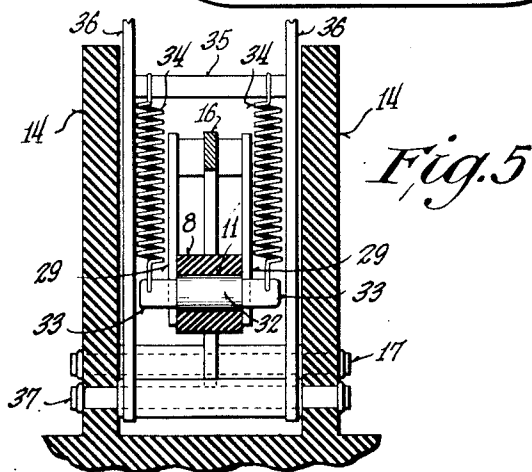
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2,418,359

SWITCH CONSTRUCTION

Filed May 8, 1943

3 Sheets-Sheet 2



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SWITCH CONSTRUCTION

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Fig. 6

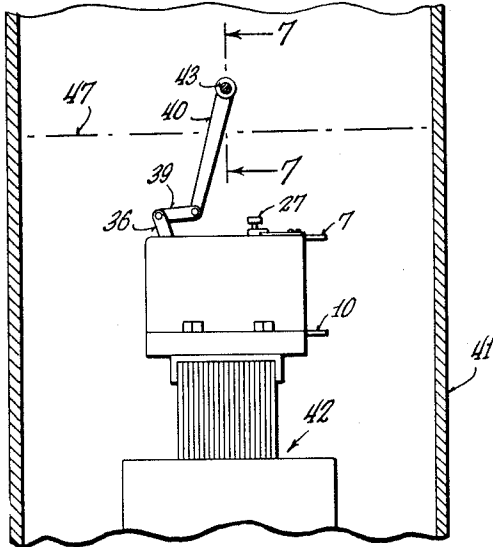


Fig. 7

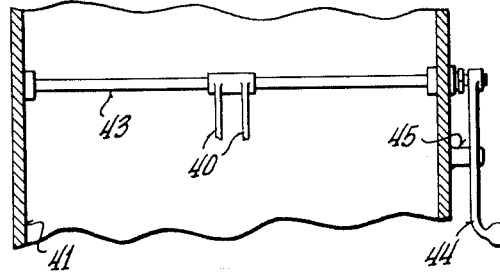
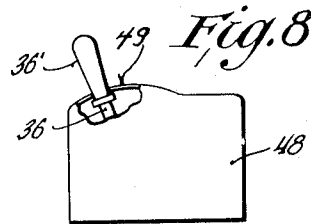
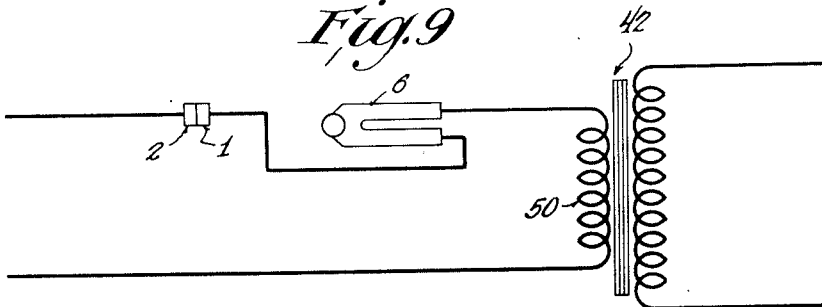
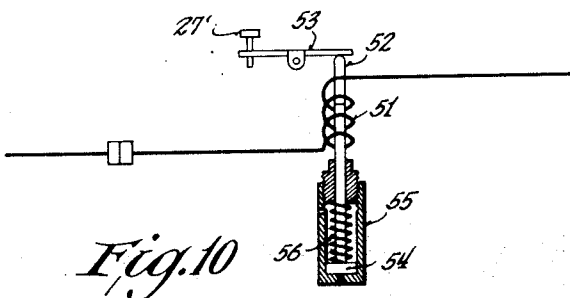


Fig. 9



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SWITCH CONSTRUCTION

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Application May 8, 1943, Serial No. 486,140

11 Claims. (Cl. 200—116)

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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 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 co-operating parts, thereby minimizing wear.

Further objects are to provide a circuit breaker in which the trip means is required to exert only

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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 having switch operating means which in turn is operated through the agency of an actuator pivotally mounted on a carrier, and to provide main operating means for normally rocking an over center spring attached at one end to the actuator back and forth across the pivot point of the actuator to cause the opening and closing of the circuit breaker and to so relate the parts of the circuit breaker that the carrier will rock the pivot point of the actuator across the center line of the spring means to cause opening of the circuit breaker directly by the pivotal rocking motion of the actuator when the carrier is released by a condition responsive means which normally restrains the carrier against motion, and to have the spring means coact with the actuator in such a manner that the actuator constitutes a bell crank lever which urges the carrier towards open position when the circuit breaker is in closed position without allowing the direct pull of the spring means to bias the actuator, and to so organize the parts that in both manual opening and closing motion and in automatic opening motion the rocking motion of the actuator itself causes a quick operation of the circuit breaker, the same actuator acting in its capacity as an actuator both for manual opening and closing and for automatic opening of the circuit breaker.

In greater detail, further objects are to provide a circuit breaker as set forth above in which the carrier pivotally carries the actuator and in which the spring means is connected to the actuator at an offset point so that the actuator acts in the manner of a bell crank lever to urge the carrier towards released position with a force whose value may be accurately predetermined and is only a very small fraction of the total pull of the spring means.

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 the invention are shown in the accompanying drawings, in which:

Figure 1 is a vertical sectional view through the circuit breaker showing the circuit breaker in closed position.

Figure 2 is a view corresponding to Figure 1 showing the circuit breaker manually opened.

Figure 3 is a view corresponding to Figure 1 showing the circuit breaker automatically opened.

Figure 4 is a plan view of the circuit breaker with parts sectioned off.

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

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

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

Figure 8 is a view of a further form of mounting for the circuit breaker.

Figure 9 is a wiring diagram.

Figure 10 is a view, partly in section, 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 stationary contact 1 and a movable contact 2. The stationary contact may be in the form of a plunger provided with a shoulder at its upper end and guided by means of an apertured transverse web portion 3. A spring 4 centered at its upper and lower ends as indicated in Figure 1 constantly urges the stationary contact 1 downwardly. The stationary contact 1 is connected by means of a flexible leader 5 with one arm of a U-shaped, bi-metallic thermostatic member 6, the other arm of which is connected to a terminal 7.

The movable contact 2 is carried in any suitable manner as by means of the switch operating member 8 and is connected by means of a flexible leader 9 with a terminal 10.

In the form of the invention chosen for illustration the switch operating member 8 is an insulating bar provided with a slot 11 at its left-hand end as viewed in Figure 1 and is pivoted intermediate its ends on the pivot pin 12.

It is to be noted that the circuit breaker may be provided with an insulating base portion 13 from which a pair of upwardly extending walls, also of insulating material, 14 project. These insulating walls may be joined by means of a transverse web portion 15 which carries the stationary contact 1 and the thermostatic member 6.

A carrier 16 is pivoted on the pivot pin 17 and is provided with a cam portion or face 18 adjacent its outer end and terminates in a hook like portion 19. A latch member 20 is pivoted on the pin 21 and is urged by means of the spring 22 towards a counterclockwise position. It is provided with a transverse portion 23 behind which the extreme end 19 of the carrier 16 is normally latched. It is to be noted that the lower face of the portion 23 is rounded as indicated at 24 to constitute a cam surface. It is also to be noted that the outer face adjacent the extreme end of the carrier 16 as indicated at 25 is slanting

to provide a cam surface so that when the carrier is rocked towards latched position from the unlatched position shown in Figure 3 in a manner hereinafter described, the surface 25 will ride beneath the surface 24 until the latch snaps into place and locks the carrier in the position shown in Figure 1.

Any suitable type of condition responsive means may be provided for tripping the latch. In the form shown in Figures 1, 2, 3 and 4 the bi-metallic thermostatic member 6 is employed to trip the latch. This member carries an insulating pad 26 at its outer end and the pad carries an adjusting screw 27 which is adapted to bear against a transverse web portion 28 of the latch 20 so that when the thermostatic member 6 warps downwardly as viewed in Figure 1 upon overload, it will trip the latch and release the carrier 16.

An actuator 29 is pivoted to the carrier by means of the pivot pin 30 adjacent its upper end and is provided with a pin and roller 31, 32 which rides within the slot 11. The actuator may consist of a pair of arms located on opposite sides of the carrier 16 and the roller 32 may be positioned between the arms. Each arm is provided with an offset apertured ear 33 into which the lower end of tension springs 34 are hooked. The upper end of the tension springs 34 are secured to a transverse pin 35 carried by a main operating means in the form of a pair of levers 36 pivoted at their lower ends on the pivot pin 37. The upper ends of the levers or main operating means 36 are joined by means of a transverse pin 38 which may be connected by means of links 39 to rock arms 40.

When the circuit breaker is mounted within a transformer casing 41 as shown in Figure 6, it may be mounted directly upon the upper end of the transformer indicated generally at 42. The rock arms 40 are carried by means of a rock shaft 43, one end of which projects out of the transformer casing and is provided with an operating handle 44. If desired, a stop 45 may be provided for limiting the closing motion of the handle.

It is to be noted that the pivot pin 17 is mounted almost directly below the pivot pin 30, which latter joins the actuator 29 to an intermediate portion of the carrier 16. In this way the upward direct pull of the springs though it is transmitted to the carrier does not have any appreciable effect in increasing the contact pressure between the extreme hook portion 19 of the actuator and the latch 20. However, it is to be noted also that the position of the ears 33 with reference to the pivot pin 31 is such that the actuator constitutes a bell crank lever having a relatively short effective arm to which the springs 34 are attached and a relatively longer arm, namely, the main body portion of the actuator, to which the carrier is pivotally attached. In this way substantially the entire force biasing the carrier towards open position, as shown in Figure 3, is that due to the bell crank action of the actuator and is not primarily due to the direct pull of the springs 34. The dot and dash line 46, see Figure 1, shows the path followed by the pin 30 when the carrier 16 is released and it will be seen that there is scarcely any rise of the pin 30 from its normal position shown in Figure 1 when it travels along the arc 46. Consequently it is immediately seen that, as stated above, the direct upward pull of the springs 34 produces at most only an extremely slight pressure of the actuator against the latch 20 and thus minimizes friction.

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In certain prior constructions it has been the practice to have the direct pull of springs corresponding to the springs 34 transmitted directly to the actuator and through the actuator directly to the latch. Considerable friction occurred and consequently a relatively large force had to be exerted to release the latch. However, by means of the construction hereinabove set forth, it is apparent that friction is minimized at the latch and only a very small force is required to release the latch. As a matter of fact, varying the relative distance of the ears 33 from the center of the pin 31 and the length of the other effective arm of the actuator from the pin 31 to the pin 30 will determine the amount of pressure exerted by the actuator upon the latch 20.

Upon a further examination of Figure 1 it is to be noted that a peculiar action takes place. The spring 34 keeps the pin 31 from moving to the right when the parts are in the position shown in Figure 1 and the thrust on the pin 30 urging the actuator towards counterclockwise motion is much smaller than the pull of the springs towards the left which tends to hold the pin at the extreme left-hand end of the slot 11.

When it is desired to manually open the circuit breaker, the main operating means 36 is rocked in a clockwise direction to the position shown in Figure 2 and carries the line of pull of the springs 34 to the right of the pin 30. The actuator is consequently given an extremely quick counterclockwise rotary motion and suddenly opens the circuit breaker. When it is desired to close the circuit breaker, the main operating means 36 is rocked from the position shown in Figure 2 to the position shown in Figure 1 and the line of pull of the springs 34 passes to the left of the pin 30 and consequently the actuator closes the circuit breaker with a quick action.

When overload occurs, the condition responsive means, such as the bi-metallic thermostatic member 6, warps downwardly and trips the latch 20, thus releasing the carrier 16. The carrier 16 is biased towards counterclockwise motion in the manner hereinabove described and rocks to the position shown in Figure 3, thus carrying the pin 30 from the right-hand side of the line of pull of the springs 34, see Figure 1, to the left-hand side thereof so that the actuator is caused to execute a quick counterclockwise motion to thus open the circuit breaker with a quick motion. The speed of opening of the circuit breaker is not dependent upon the speed of motion of the carrier but is dependent upon the speed of motion of the actuator. This actuator may be made very light and the springs 34 may be made sufficiently strong to cause the actuator to execute an extremely quick motion to open the circuit breaker.

It is to be noted that in both manual operation and automatic operation the same actuator is employed to operate the switch operating means 8. It is also to be noted from reference to Figure 1 that the actuator 29 rocks slightly past center and thus locks the circuit breaker closed.

It is to be noted from reference to Figure 2 that the pin 35 engages the cam surface 18 of the carrier 16 and thus acts to limit the clockwise rotation of the main operating means 36. If desired, a pin not shown may be carried by the walls 14 to limit the counterclockwise motion of the main operating means 36 or if desired the stop 45, see Figure 7, may be employed for this purpose.

After the circuit breaker has been automatically tripped, it is reset by rocking the main operating means 36 to the right from the position shown in Figure 3. Upon examination of Figure 3 it will be seen that the pin 35 engages the cam surface 18 of the carrier 16 and rocks the carrier to the position shown in Figure 2. If the thermostatic element 6 has cooled sufficiently, latching will occur, the cam surface 25 of the carrier 16 riding beneath the cam surface 24 of the latch 20. On the other hand, if the thermostatic element has not cooled sufficiently, latching will not occur and no jamming or binding of the parts can occur as the latch is merely held clear of the portion 19 of the carrier 16.

After the carrier has been relatched following an overload, the circuit breaker is closed by rocking the main operating means 36 from the position shown in Figure 2 to the position shown in Figure 1.

It is to be distinctly understood that if desired the pivot pin 17 may be mounted directly beneath the pivot pin 30 or may be mounted slightly to the left of the pivot pin 30 as shown in Figure 1.

It will be seen that a circuit breaker has been provided which has a quick opening stroke whether manually or automatically opened and which has a quick closing stroke when manually closed. It will also be seen that heavy contact pressure is provided though the circuit breaker may be operated by means of a relatively small force and that this heavy contact pressure is maintained up to the instant that the circuit breaker is quickly opened either automatically or manually.

If the circuit breaker is mounted in the manner shown in Figure 6, it may be mounted below the oil level indicated by the line 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 therethrough.

The circuit breaker may be mounted in any suitable manner as hereinabove stated. For example, it may be arranged for wall mounting. In that event the circuit breaker is mounted within a casing or box 48 which may be provided with a slotted rounded portion 49 through which a handle 36', which may be of insulating material, may project, the handle being directly carried by the main operating means 36 hereinbefore described.

Referring to the wiring diagram shown in Figure 9, it will be seen that the secondary 50 of the transformer 42 may be connected to one arm 75 of the bi-metallic thermostatic member 6, the

other arm of which is connected to the stationary contact 1.

Any suitable form of condition responsive means may be employed. For example a solenoid type of condition responsive means may be employed as shown in Figure 10 and may comprise the solenoid 51 adapted to raise the plunger 52 on overload. The plunger 52 is designed to rock the lever 53 which carries the adjusting screw 27' corresponding to the screw 27 hereinbefore described, the screw 27' being adapted to trip the latch as previously described.

Any suitable time delay means may be provided. For example, the plunger 52 may be provided with a piston 54 which is mounted within the cylinder 55, such cylinder being provided with apertures for the flow of fluid. A suitable spring 56 is provided for returning the plunger to its lowest position.

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 27 of Figure 1 and 27' of Figure 10.

The purpose of the time delay means such as shown for instance in Figure 10 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 circuit breaker is designed.

Other time delay means could, of course, 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 understood that the circuit breaker may be mounted in any desired position and references hereinabove to a pivot point being positioned below another pivot point are not intended as limiting but are merely intended to give the relative position of the parts.

It will be seen that a circuit breaker has been provided which is of extremely simple construction, in which the same actuator is employed for operating the switch operating means whether the circuit breaker is operated manually or automatically. It will be seen further that very little force is required to be exerted by the condition responsive means as friction has been minimized by preventing a heavy pressure on the latching parts due to the direct pull of the spring means, but instead the biasing action due to the spring means is transmitted through the bell crank construction of the actuator so that the force exerted at the latch means is greatly minimized and may be predetermined and may be of any value desired, depending on the design of the apparatus.

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 a 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 and switch operating means for opening and closing the switch means, a pivoted carrier, an actuator having one end pivoted to said carrier and having a free end slidably engaging said switch operating means, movable main operat-

ing means, over center spring means operatively connecting said main operating means to a point on said actuator spaced laterally from the effective axis of said actuator in a direction away from the point about which said carrier is pivoted, said actuator constituting a bell crank lever biasing said carrier towards motion due to the bell crank action of said actuator, and condition responsive means normally restraining said carrier against motion and releasing said carrier upon the occurrence of a predetermined condition, said carrier when said circuit breaker is closed and when said carrier is released moving the pivot point of said actuator across the line of pull of said spring means.

2. A circuit breaker comprising switch means and switch operating means for opening and closing the switch means, a pivoted carrier, an actuator having one end pivoted to said carrier and having a free end slidably engaging said switch operating means, movable main operating means, spring means operatively connecting said main operating means and said actuator and coacting with said actuator to bias said actuator towards rotation about its free end to thereby bias said carrier towards rocking motion, said actuator being arranged to normally exert a direct thrust against said carrier substantially longitudinally of said actuator and along a line passing approximately through the point about which said carrier is pivoted, said main operating means being adapted to move said spring means to opposite sides of the pivoted end of said actuator to open and close said switch means, and condition responsive means releasably latching said carrier against motion.

3. A circuit breaker comprising switch means and switch operating means for opening and closing the switch means, a pivoted carrier, an actuator having one end pivoted to said carrier and having a free end slidably engaging said switch operating means, movable main operating means, spring means operatively connecting said main operating means and said actuator and coacting with said actuator to bias said actuator towards rotation about its free end to thereby bias said carrier towards rocking motion, said main operating means being adapted to move said spring means to opposite sides of the pivoted end of said actuator to open and close said switch means, and condition responsive means releasably latching said carrier against motion, said carrier when released by said condition responsive means being arranged to move the pivoted end of said actuator across the line of pull of said spring means.

4. A circuit breaker comprising switch means and switch operating means for opening and closing the switch means, a pivoted carrier, an actuator having one end pivoted to said carrier and having a free end slidably engaging said switch operating means, movable main operating means, spring means operatively connecting said main operating means and said actuator, said main operating means being adapted to move said spring means to opposite sides of the pivoted end of said actuator, said spring means biasing said carrier towards rocking motion, the thrust from said spring means through said actuator being applied to said carrier approximately in line with the pivot point of said carrier when said switch means is closed and said carrier is in its normal position, and condition responsive means releasably latching said carrier against motion.

5. A switch construction comprising switch means and switch operating means for opening and closing said switch means, an actuator having a pivoted end and having a free end slidably engaging said switch operating means for actuating said switch operating means to open and close said switch means, movable main operating means, spring means operatively connecting said main operating means with the free end of said actuator, said main operating means being effective to move said spring means to opposite sides of the pivoted end of said actuator, and means arranged to automatically move the pivoted end of said actuator across the line of pull of said spring means.

6. A switch construction comprising switch means and switch operating means for opening and closing said switch means, an actuator having a pivoted end and having a free end slidably engaging said switch operating means for actuating said switch operating means to open and close said switch means, movable main operating means, spring means having at least its major portion located on one side of said switch operating means and operatively connecting said main operating means with the free end of said actuator, said main operating means being effective to move said spring means to opposite sides of the pivoted end of said actuator, a carrier pivoted on the side of said switch operating means opposite said spring means and having an intermediate portion pivotally carrying said actuator at the pivoted end of said actuator, said intermediate portion being located on the same side of said switch operating means as said spring means, said carrier being biased towards rotary motion and arranged to carry the pivoted end of said actuator across the line of pull of said spring means, and latch means releasably holding said carrier against motion.

7. A circuit breaker comprising switch means and switch operating means for opening and closing the switch means, a pivoted carrier, an actuator having one end pivoted to said carrier and having a free end slidably engaging said switch operating means, movable main operating means, spring means operatively connecting said main operating means and said actuator and coacting with said actuator to bias said actuator towards rotation about its free end to thereby bias said carrier towards rocking motion, said actuator being arranged to normally exert a direct thrust against said carrier substantially longitudinally of said actuator and along a line passing approximately through the point about which said carrier is pivoted, said main operating means being adapted to move said spring means to opposite sides of the pivoted end of said actuator to open and close said switch means, condition responsive means releasably latching said carrier against motion, and means operatively connecting said main operating means and said carrier to reset said carrier when said main operating means is moved to switch open position after release of said carrier by said condition responsive means.

8. A circuit breaker comprising switch means and switch operating means for opening and closing the switch means, a pivoted carrier, an actuator having one end pivoted to said carrier and having a free end slidably engaging said switch operating means, movable main operating means, spring means operatively connecting said main operating means and said actuator and coacting with said actuator to bias said actuator

towards rotation about its free end to thereby bias said carrier towards rocking motion, said main operating means being adapted to move said spring means to opposite sides of the pivoted end of said actuator to open and close said switch means, condition responsive means releasably latching said carrier against motion, said carrier when released by said condition responsive means being arranged to move the pivoted end of said actuator across the line of pull of said spring means, and means operatively connecting said main operating means and said carrier to reset said carrier when said main operating means is moved to switch open position after release of said carrier by said condition responsive means.

9. A circuit breaker comprising switch means and switch operating means for opening and closing the switch means, a pivoted carrier, an actuator having one end pivoted to said carrier and having a free end slidably engaging said switch operating means, movable main operating means, over center spring means operatively connecting said main operating means to a point on said actuator spaced laterally from the effective axis of said actuator in a direction away from the point about which said carrier is pivoted, said actuator constituting a bell crank lever biasing said carrier towards motion due to the bell crank action of said actuator, and condition responsive means normally restraining said carrier against motion and releasing said carrier upon the occurrence of a predetermined condition, said carrier when said circuit breaker is closed and when said carrier is released moving the pivot point of said actuator across the line of pull of said spring means, said pivoted carrier having a cam portion and said main operating means having a portion adapted to engage the cam portion to reset said carrier when said main operating means is moved to switch open position after release of said carrier by said condition responsive means.

10. A circuit breaker comprising switch means and switch operating means for opening and closing the switch means, a pivoted carrier, an actuator having one end pivoted to said carrier and having a free end slidably engaging said switch operating means, movable main operating means, over center spring means operatively connecting said main operating means to a point on said actuator spaced laterally from the effective axis of said actuator in a direction away from the point about which said carrier is pivoted, said actuator constituting a bell crank lever biasing said carrier towards motion due to the bell crank action of said actuator, and condition responsive means including latch means normally restraining said carrier against motion and releasing said carrier upon the occurrence of a predetermined condition, said carrier when said circuit breaker is closed and when said carrier is released moving the pivot point of said actuator across the line of pull of said spring means, the pivot point of said carrier and the pivot point of said actuator being arranged with reference to said spring means so that the major pressure exerted on said latch means by said carrier is due primarily to the bell crank action of said actuator and is relatively free from pressure due to the direct thrust from said spring means.

11. A circuit breaker comprising switch means and switch operating means for opening and closing the switch means, a pivoted carrier, an actuator having one end pivoted to said carrier and having a free end slidably engaging said

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switch operating means, movable main operating means, over center spring means operatively connecting said main operating means to a point on said actuator spaced laterally from the effective axis of said actuator in a direction away from the point about which said carrier is pivoted, said actuator constituting a bell crank lever biasing said carrier towards motion due to the bell crank action of said actuator, and condition responsive means normally restraining said carrier against motion and releasing said carrier upon the occurrence of a predetermined condition, said carrier when said circuit breaker is closed and when said carrier is released moving the pivot point of said actuator across the line of pull of said spring means, the speed of opening the switch means on automatic release being independent of the speed of the carrier and being

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dependent on the speed of operation of the actuator.

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