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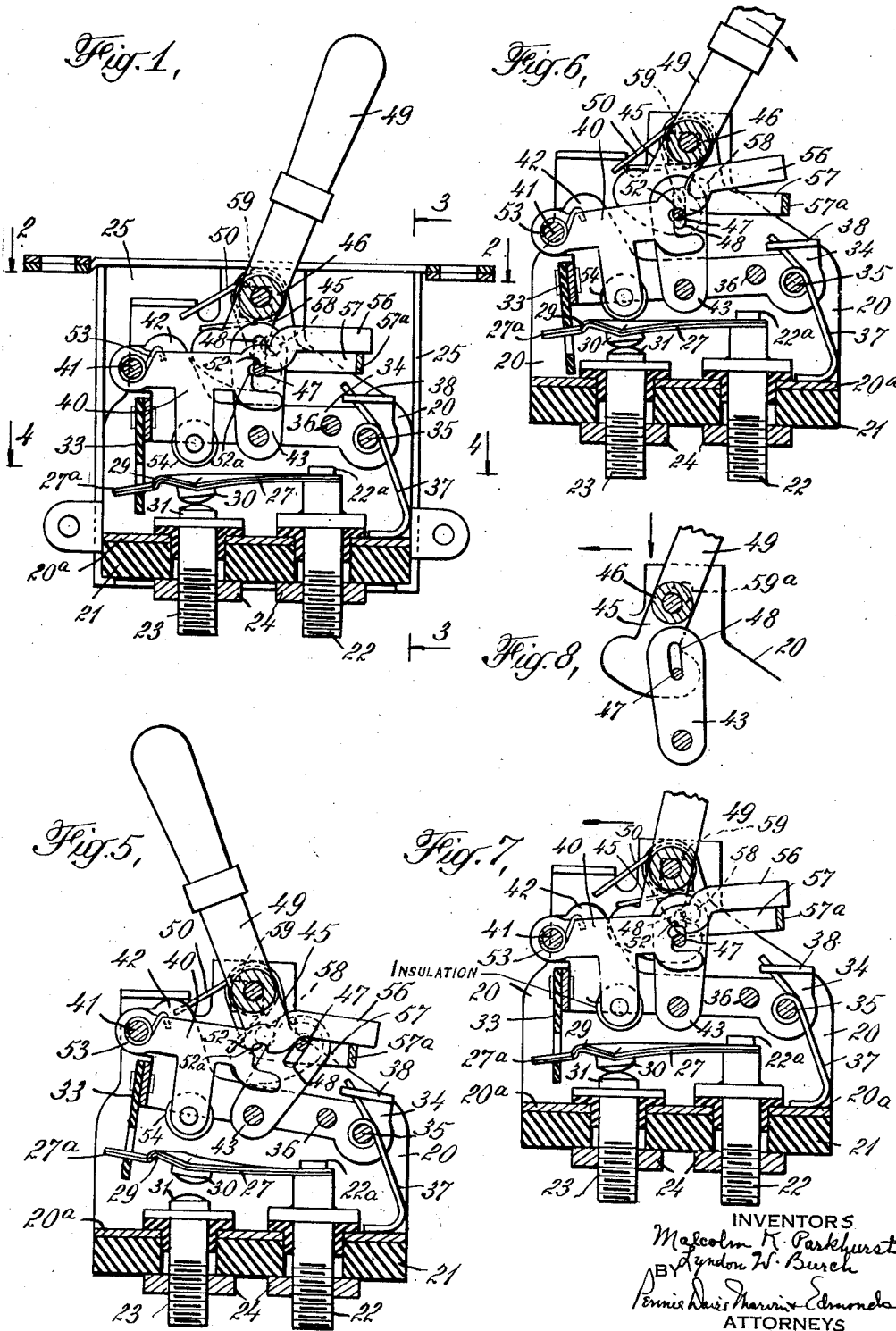
M. K. PARKHURST ET AL

2,348,995

CONTROL DEVICE

Filed Nov. 29, 1941

2 Sheets-Sheet 1



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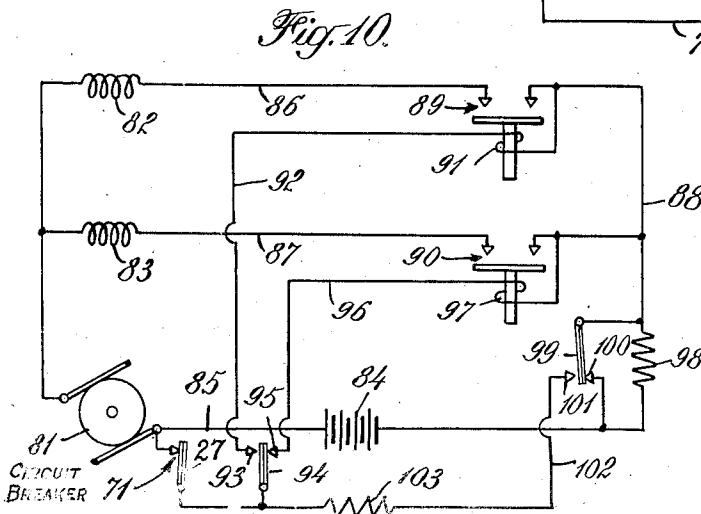
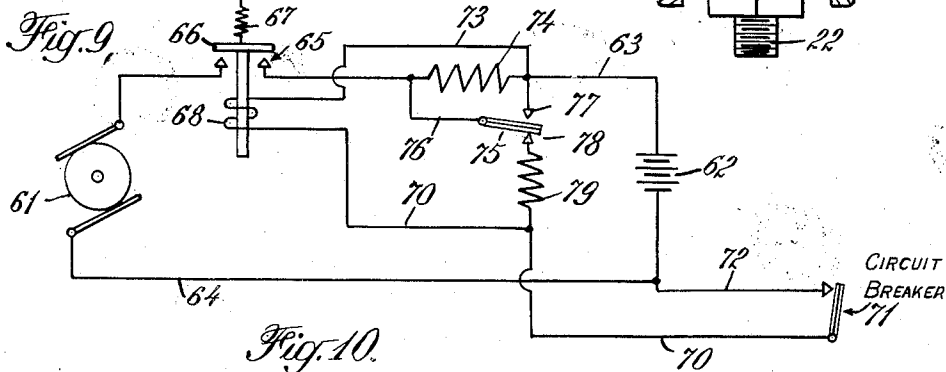
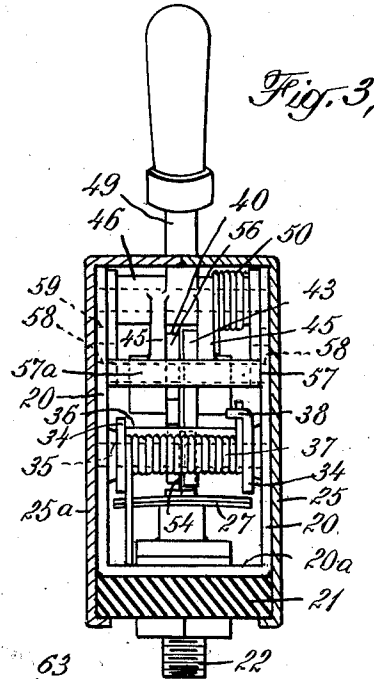
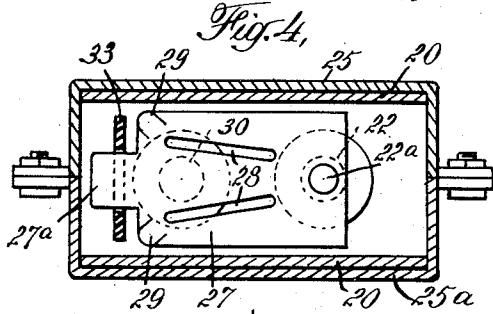
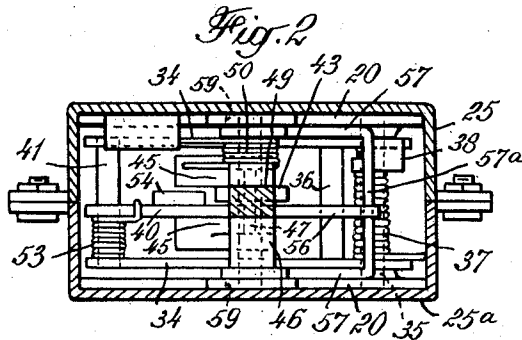
M. K. PARKHURST ET AL

2,348,995

CONTROL DEVICE

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2 Sheets-Sheet 2



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2,348,995

CONTROL DEVICE

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Application November 29, 1941, Serial No. 420,994

24 Claims. (Cl. 200—116)

This invention relates to control devices of the type having a switch, valve or other control element movable between two positions automatically by an actuator and also manually by a handle, or the like, independently of the actuator, and has particular reference to a novel device of this type which includes means under control of the handle and responsive to operation of the actuator for locking the control element in one position against movement by the actuator. The new device may be made in a compact form and is positive in operation.

The invention may be used for various purposes but may be employed to particular advantage in electrical circuits to prevent overload conditions. Accordingly, the invention will be described and illustrated in the form of an automatic circuit breaker, although it will be understood that the invention may be used for other purposes and may take other forms as well.

One feature of the invention resides in the provision of a novel circuit breaker which, when the current exceeds a predetermined value, is operated automatically by a thermo-responsive element to open a switch in the circuit and hold it open independently of the thermo-responsive element by means of a locking member, and in which the switch may be closed by manual means operatively connected to the locking member. In a circuit breaker made in accordance with the invention, the switch may be opened automatically by a thermo-responsive member forming part of the circuit, the member being preferably in the form of a bimetallic snap element, and the switch is also movable to its closed position by manual means which may be connected to the locking member for the switch. The locking member is normally inoperative, but when the thermo-responsive element is heated sufficiently to open the switch, due to a current overload, the locking member is released and holds the switch in its open position so that it cannot be closed by the thermo-responsive element. When the manual means is moved to close the switch, it also returns the locking member to its inoperative position where it is held until the switch is again actuated by the thermo-responsive element.

Another feature of the invention resides in the provision of a novel circuit breaker in which the switch may be opened independently of the operation of the actuator. In the preferred construction, the locking member for the switch is urged by a spring, or the like, in a direction for opening the switch but is normally held in an inoperative position by a latch which is released

automatically when the actuator moves to open the switch. When the switch is open, the manual means for the locking member is movable to return the locking member against the action of its

spring to its inoperative position where it is again latched. Also, when the switch is closed, the manual means is movable to release the latch so that the locking member under the action of its spring opens the switch independently of the operation of the actuator and locks the switch in its open position. Thus, the manual means serves the dual function of opening the switch independently of the actuator and closing the switch after it has been opened by the actuator or the manual means.

Still another feature of the invention resides in the provision of a novel circuit breaker in which the switch may be closed manually even when the actuator tends to open it due to an overload condition in the circuit. In one form of the invention, the locking member for the switch is mounted on a lever which is urged in a direction to open the switch but is normally held by the latch for the locking member in a position to permit closing of the switch. Preferably, the manual means for the locking member is movable to exert a cam action on the lever and thereby cause the lever to close the switch against the action of the actuator when the latter tends to open the switch. Accordingly, with the new construction, the circuit breaker may be closed manually and held closed in the event that an emergency makes it necessary to energize the circuit even when an overload condition prevails.

These and other features of the invention may be better understood by reference to the accompanying drawings, in which

Fig. 1 is a vertical sectional view of a circuit breaker made in accordance with the invention;

Figs. 2, 3 and 4 are sectional views on the lines 2—2, 3—3 and 4—4, respectively, in Fig. 1;

Figs. 5, 6 and 7 are views similar to Fig. 1 but with the casing of the circuit breaker removed, illustrating different positions of the device;

Fig. 8 is a vertical sectional view of part of a modified form of the circuit breaker;

Fig. 9 is a diagrammatic view of a circuit by which the circuit breaker may be employed to control a current in excess of the capacity of the circuit breaker, and

Fig. 10 is a view similar to Fig. 9 showing a modified circuit.

The circuit breaker, as illustrated, comprises a frame having sides 20 and a bottom 20a, the top

and ends of the frame being open. The bottom of the frame is seated on an insulating base 21 to which it is secured by terminal screws 22 and 23 extending through aligned openings in the frame and base, the screws being insulated from the frame and having their heads disposed above the bottom. A nut 24 is threaded on the outer end of each screw to clamp it in position and hold the frame against the insulating base. Preferably, the frame and base are enclosed in a casing made up of two removable sections 25 and 25a fitted closely over the sides of the frame and the base.

The terminal screw 22 supports an actuator in the form of a bimetallic snap element 27, the snap element being secured to the screw in any suitable manner, as by means of a reduced portion 22a on the head of the screw extending through an opening near one end of the snap element and riveted over the element so as to clamp it against the head of the screw. Preferably, the snap element is of the form shown in an application of Lyndon W. Burch, Serial No. 325,979, filed March 26, 1940, now Patent No. 2,299,562, issued October 20, 1942. More particularly, the snap element comprises a sheet of bimetal having a pair of slots 28 extending along the intermediate portion of the sheet and diverging slightly toward its free end. The slots terminate a substantial distance from the free end of the sheet, and the metal between the outer ends of the slots and the adjacent corners is crimped or gathered, as shown at 29, to reduce the effective perimeter of the sheet and cause it to assume a dished shape. A control element in the form of contact 30 is secured to the lower face of the snap element near its free end and coacts with a fixed contact 31 on the top of terminal screw 23.

By means of the terminal screws 22 and 23, the circuit breaker is connected in the circuit so that the current passes through the terminal 22, along the sheet of bimetal and through the normally closed contacts 30—31 to the terminal 23. As long as the current does not exceed a predetermined value, the snap element remains in its normal position (Fig. 1) where it holds the contacts 30—31 firmly in engagement to complete the circuit. However, if the current exceeds the predetermined value, it heats the bimetal 27 sufficiently to cause it to reverse its curvature with a snap action and open the contacts, as shown in Fig. 5. By properly proportioning the dimensions of the bimetal and the spacing between the slots 28, the snap element may be made to operate at any desired current rating to open the contacts. It will be apparent that after the circuit is broken by operation of the snap element, the latter immediately commences to cool because there is no longer a flow of current through it, and, accordingly, the snap element acts to return to its initial position and reclose the contacts.

The switch of the circuit breaker is provided with control means comprising a locking member 33 adjacent the free end of the actuator 27. Preferably, the locking member is made of insulating material and has a slot for receiving an ear 27a on the free end of the actuator, the slot being elongated vertically so that the actuator may move up and down a limited distance relative to the locking member. The locking member is secured to a cross piece at the free end of a generally U-shaped lever comprising a pair of spaced arms 34 movable on a pivot 35 extending between the side walls 20 of the frame at the opposite

end of the lever, the arms being connected together rigidly by a stud 36 intermediate their ends. The lever 34 is urged clockwise on its pivot 35, as seen in Fig. 1, by suitable means such as a spring 37 coiled around the pivot and held at one end by the frame and at the opposite end by a lug 38 on the lever above its pivot. Because of the spring 37, the free end of lever 34 is normally urged upwardly and tends to raise the locking member 33 and thereby open switch 30—31.

Normally, the locking member 33 is held in an inoperative position against the action of spring 37 by latch means comprising a trigger 40 movable on a pivot 41 on the free end of lever 34. As shown, the pivot 41 is mounted between raised extensions 42 on the free ends of the lever arms, whereby it is located a substantial distance above the pivot 35 of the lever. The trigger cooperates with a toggle comprising a toggle arm 43 pivotally mounted between the lever arms 34 intermediate their ends, and a second toggle member in the form of a yoke having two toggle arms 45 integral with a shaft 46 mounted between the sides 20 of the frame, as will be described in greater detail presently. The upper end of the toggle arm 43 is disposed between the toggle arms 45, and a pin 47 is mounted at its ends in the arms 45 and extends through an elongated slot 48 in the arm 43. The toggle arms 45 are rotatable with the shaft 46 by means of a handle 49 which may be integral with the shaft. Preferably, the shaft 46 is normally urged counter-clockwise (Fig. 1) to break the toggle by a spring 50 coiled around the shaft.

The trigger 40 extends through the space between the toggle arms 45 and is disposed on one side of the lower toggle arm 43 above pin 47. In its lower edge, the trigger is provided with a notch 52 in which pin 47 is adapted to be engaged, the notch having an undercut portion 52a for a purpose to be described. The free end of the trigger is urged downwardly to hold the notch over the pin, as by means of a spring 53 coiled around the trigger pivot 41. Thus, in the normal position of the parts, as shown in Fig. 1, the toggle 43—45 is set against the action of springs 37 and 50 and is positively held in its set position by trigger 40 which, because of its notch 52, prevents the toggle pin 47 from moving laterally and thereby breaking the toggle.

As long as the toggle is held in its set position by trigger 40, the pin 47 engages the lower end of slot 48 and holds the lever 34 down against the action of its spring so that the locking member 33 remains in its lowermost position and permits the switch 30—31 to be closed by actuator 27. However, the toggle is adapted to be released by operation of the actuator, and to this end we provide on the trigger 40 an insulating member 54 directly above the free end of the actuator. Accordingly, when the actuator is overheated due to an excessive current in the circuit, it snaps upwardly against the trigger member 54 and raises the trigger on its pivot 41 to disengage the notch 52 from toggle pin 47. Thereupon, the toggle breaks under the action of spring 50 and allows the spring 37 to snap lever 34 upwardly on its pivot 35, with the result that locking member 33 is raised with a snap action and positively holds the switch in its open position, as shown in Fig. 5. The spring 37 is of sufficient strength to prevent the actuator 27 from moving back to its initial position and closing the switch even when the actuator cools to a very low temperature. When the toggle is re-

leased by trigger 40, the toggle pin 47 rides upwardly in slot 48 and outwardly along the lower edge of the trigger, and the handle 49 moves to the left with shaft 46.

When it is desired to close switch 30-31, the handle is moved to the right, as seen in Fig. 5, to reset the toggle. During this movement of the handle, toggle pin 47 rides down the slot 48 and at the same time moves inwardly under trigger 40 until it is opposite the notch 52, whereupon the trigger spring 53 snaps the trigger downwardly to engage the notch over the toggle pin. The resetting movement of the toggle forces lever 34 downwardly about its pivot 35 and thereby returns locking member 33 to its inoperative position so that the actuator 27, due to its cooling, closes the switch. If the overload condition in the circuit has been removed, the toggle is held in its set position by engagement of its pin 47 in the trigger notch 52, whereby the locking member 33 is maintained inoperative and the switch remains closed. However, if there is still an overload condition in the circuit, the actuator is immediately reheated by the excessive current and snaps back to its raised position so as to elevate the trigger and release the toggle, whereupon the switch is again locked in its open position as previously described.

It may be desirable in some instances to provide for closing the circuit even when it is overloaded, as, for example, when it is necessary to energize the circuit temporarily for an emergency. In our new circuit breaker, the switch may be held in its closed position manually by handle 49 regardless of the operation of the actuator 27. More particularly, when the handle 49 is moved to the right to reset the toggle and lower the locking member, as previously described, further movement of the handle to the right causes toggle pin 47 to move laterally into the undercut portion 52a of the notch 52 and exert a thrust to the left against trigger 40. Since the toggle pin is disposed a substantial distance above the pivot 35 for lever 34, this thrust exerts a turning moment on the lever and causes it to move counter-clockwise on its pivot against the action of spring 37. As a result, the insulating member 54 is moved downwardly against the free end of the actuator and forces contact 30 down against contact 31, as shown in Fig. 6, the switch being held closed as long as the handle is forced to the right as far as it will go. During this action, the trigger 40 is prevented from moving upwardly on the pivot 41 by the lateral thrust to which it is subjected by toggle pin 47 and by engagement of the toggle pin in the undercut notch portion 52a. When the handle is released, the spring 37 moves lever 34 upwardly on its pivot to return the parts to their normal positions shown in Fig. 1, and if the current passing through the actuator is still too great, the latter will snap upwardly to release the toggle and thereby cause the switch to be locked in its open position.

The handle 49 may also be operated to open the switch independently of automatic movement of the actuator 27. In the preferred construction, the trigger 40 is provided at its free end with an extension 56 overlying a cross piece 57a on a bell crank lever 57. The lever, as shown, comprises two arms connected by the cross piece and pivoted intermediate their ends on pins 58 secured to the sides 20 of the frame. At their ends remote from the cross piece, the arms of the bell crank lever are provided with openings

through which reduced ends of the toggle shaft 46 extend, the outer ends of the shaft being disposed in enlarged openings 59 in the sides of the frame. The shaft 46 is normally urged to the right in the frame openings 59, as by means of spring 37. With this construction, when handle 49 is moved to the left, as seen in Fig. 7, the toggle shaft 46 is swung bodily to the left in the openings 59 about the pins 58 of the bell crank lever as a pivot, the toggle pin 47 being held by trigger 40 against lateral movement, but being movable downwardly against the action of spring 37 to accommodate this movement of shaft 46. As the shaft 46 swings to the left, bell crank lever 57 is moved counter-clockwise on its pivot 58 so that the cross piece 57a is raised against the extension 56 of the trigger and moves the trigger upwardly so as to disengage its notch 52 from the toggle pin 47 and thereby release the toggle. The lever 34 is then snapped upwardly by spring 37, as previously described, and the locking member 33 is raised so as to move the free end of the actuator 27 upwardly and thereby open the switch. Thereafter, the switch is held in its open position until handle 49 is moved to the right to reset the toggle and the trigger.

In the device shown in Figs. 1 to 7, inclusive, the switch is closed and held closed independently of the actuator by forcing the handle to the right beyond its normal position, as shown in Fig. 6, so that the toggle pin 47 exerts a lateral thrust on the side of notch 52 which is transmitted to the trigger pivot 41, resulting in a turning moment on the lever which moves it counter-clockwise to cause insulating member 54 to depress contact 30. In the modified form of the device shown in Fig. 8, the turning moment for moving the lever to close the switch forcibly is obtained in a different manner. As there shown, the circuit breaker is similar in all respects to that shown in Fig. 1 except that the reduced ends of toggle shaft 46 are mounted in inclined slots 59a in the side walls 20 of the frame. With this construction, the switch may be closed against the force of the actuator by operating the handle 49 to reset the toggle, as shown in Fig. 1, and then pressing the handle downwardly so as to cause the shaft 46 to ride down the slot 59a. Since the toggle pin 47 is at the lower end of slot 48 when the toggle is reset, this downward movement of shaft 46 depresses the lower arm 43 of the toggle, with the result that the free end of lever 34 is moved downwardly about pivot 35 to engage the insulating member 54 with the actuator and force contact 30 against contact 31. When member 54 is forced downwardly against the actuator, the trigger 40 may be held against upward movement on its pivot 41 by engagement of toggle pin 47 in the undercut notch portion 52a, or this undercut portion may be eliminated and the trigger allowed to move upwardly a slight amount limited by the toggle shaft 46, so that member 54 is effective to depress contact 30.

The new circuit breaker is of compact construction and for this reason is admirably suited for use in the circuits of aircraft, and the like, or for other uses in which the space requirement is an important item. The circuit breaker is positive in action, and because of the latching trigger 40, the switch is prevented from opening accidentally due to shocks or vibrations which are frequently encountered in aircraft, tanks, automobiles, and other vehicles. Also, after an overload condition occurs in the circuit, the locking mechanism holds the switch positively in its

open position and prevents reclosing of the switch due to cooling of the actuator to very low temperatures or to vibration or shock. The handle 49 serves to reset the toggle so that the switch may be closed by the actuator and also serves to open or close the switch independently of the operation of the actuator. Since the actuator 27 has an inherent time lag, it allows a momentary overload to occur in the circuit, as in starting a motor, or the like, without opening the switch and tripping the locking mechanism. The circuit breaker may be made in a number of different current ratings depending on the resistance of the bimetallic actuator 27, and it may be used to replace the fuse and toggle switch combination now in general use in aircraft, the device being adapted to be mounted in the space previously occupied by the usual toggle switch.

For some purposes, it may be desirable to use the circuit breaker to control a circuit carrying a current considerably in excess of the current rating of the circuit breaker. We have shown in Fig. 9 one form of a system in which the circuit breaker is adapted for such use. As there shown, the circuit is arranged to energize a translating device, such as a motor 61, from a battery 62 or other source of electric power, the battery being connected to the motor through wires 63 and 64. The wires are of sufficient size to carry a heavy current for energizing the motor, and the flow of current through the motor is under control of a relay 65 having a pair of contacts normally bridged by a switch member 66. The switch is urged away from its contacts by a spring 67 but is normally held in engagement with the contacts by a solenoid 68.

One side of the solenoid is connected through a wire 70 to one terminal of the circuit breaker of our invention, shown diagrammatically at 71, the other terminal of the circuit breaker being connected by a wire 72 to the main circuit at one side of the battery. The other side of the solenoid is connected by a wire 73 to the main circuit between the other side of the battery and the relay 65. A low resistance element 74 connected in the main circuit between the battery and the relay is normally shunted by a bimetallic snap element 75 connected by a wire 76 to one side of the resistance and normally engaging a contact 77 connected to the other side of the resistance and the wire 73. The snap element 75 is preferably similar to the snap element 27 of the circuit breaker, and when it is heated sufficiently by the passage of current through it, its free end disengages contact 77 and snaps into engagement with a contact 78 connected through a resistance 79 to the wire 70.

The value of resistance 74 is such that a small portion of the main current passes through snap element 75 and contact 77, and when the current in the main circuit becomes too high, the snap element 75 is heated to the point where it moves away from contact 77 and engages contact 78. As a result, the current flowing through the circuit breaker 71 increases since it is now connected to one side of the battery through parallel paths of relatively low resistance, one path including solenoid 68 and the other path including resistance 79 and snap element 75. The snap element in the circuit breaker 71 has a current rating such that this increase in the current flowing through it, which is limited to a safe value by resistance 79, causes it to open, whereby the energizing circuit for solenoid 68 is opened

and the switch 66 is disengaged from its contact so as to break the main circuit.

When it is desired to reenergize the motor 61, the circuit breaker 71 is closed by operation of its handle 49, as previously described, with the result that the solenoid 68 is reenergized and operates the relay to close the main circuit. If there is no longer an overload condition in the main circuit, the snap element 75, which cools and reengages contact 77 as soon as the main circuit is broken, maintains its normal engagement with contact 77 so that the circuit breaker remains closed. If the overload condition still exists in the main circuit and it is necessary to energize the circuit temporarily due to an emergency, the circuit breaker is held manually in its closed position, as previously described. While the main circuit is thus energized, the snap element 75 engages contact 78 due to the heating of this element by the overload current, but the resistor 79 is of such size that sufficient current flows through the solenoid 68 to hold the relay in its closed position.

The relay, resistors and snap element 75 may be included in a compact unit and mounted near the element to be controlled, and, accordingly, when the system is to be used on aircraft or other vehicles, it is unnecessary to employ heavy wires in the control compartment, and the circuit breaker 71 may be mounted on the instrument panel where it requires no more space than the usual low capacity circuit breaker.

The circuit shown in Fig. 10 is arranged to energize a reversible electric motor 81 having forward and reverse field windings 82 and 83, respectively, connected in parallel. The motor is adapted to be energized from a battery or other current source 84 connected by a wire 85 to one side of the motor armature. The field windings 82 and 83, which are connected to the other side of the motor armature, have wires 86 and 87, respectively, leading to a wire 88 connected to the other side of the battery. Relays 89 and 90 are disposed in series with the field windings 82 and 83, respectively, for controlling the energizing of these windings from the battery.

The relay 89 is operated by a solenoid 91 connected at one side to wire 88 and at the opposite side through a wire 92 to a contact 93 coacting with a double throw switch 94. The other contact 95 of switch 94 is connected by a wire 96 to one side of a solenoid 97 for operating the other relay 90, the other side of the solenoid being connected to wire 88. A low resistance element 98 is connected in the main circuit in series with the battery and the field windings and is normally shunted by a bimetallic snap element 99 connected to one side of the resistance and normally engaging a contact 100 connected to the other side of the resistance. The value of the resistor 98 is such that a small part of the main current passes through the snap element 99, and when an overload condition occurs, the snap element is heated so that it disengages contact 100 and snaps into engagement with a contact 101 connected through a wire 102 and a resistance 103 to one terminal of the circuit breaker 71, the other terminal of the circuit breaker being connected to the armature of motor 81.

In operation, the switch 94 may be moved into engagement with contact 93 to energize solenoid 91 and close relay 89, so that the field winding 82 is energized to cause the motor to rotate in

the forward direction. When it is desired to reverse the motor, the switch 94 is moved into engagement with contact 95 to close relay 90 and thereby energize the reversing field winding 83, the relay 89 being then deenergized to open the circuit through the field winding 82. When an overload condition occurs in the main circuit in either position of switch 94, the snap element 99 moves away from contact 100 into engagement with contact 101. As a result, the current through the actuator 27 of circuit breaker 71 increases and operates the actuator to break the circuit through the solenoid 91, 97 which is energized at the time, whereby the main circuit is opened.

It is to be understood that the control device of our invention may take other forms than that illustrated and is not limited to use in controlling a switch, as it could be arranged to operate a valve or other control element. Also, the actuator 27 for the control element may be of a different type than that illustrated and may be made to respond to any desired condition.

We claim:

1. A control device comprising a control element, an actuator for moving the control element, a locking member responsive to operation of the actuator for locking the control element against movement by the actuator, manually operable means for moving the locking member to an inoperative position in which the control element is movable by the actuator, and means operable by said manual means for moving the control element independently of the operation of said actuator.

2. A control device comprising a control element, an actuator for moving the control element, a locking member responsive to operation of the actuator for locking the control element against movement by the actuator, manually operable means for moving the locking member to an inoperative position in which the control element is movable by the actuator, and means operable by said manual means for moving the control element selectively from one position to another independently of the operation of said actuator.

3. A control device comprising a control element, an actuator for moving the control element, a locking member responsive to operation of the actuator for locking the control element against movement by the actuator, and manually controlled means connected to said member for actuating it to move the control element independently of the operation of the actuator.

4. A control device comprising a control element, an actuator for the element, a locking member responsive to movement of the control element by the actuator from one position to a second position for locking the control element against movement back to its first position, manual means operatively connected to the locking member, means operable by the manual means for moving the locking member to an inoperative position to release the control element, and means controlled by the manual means for operating the locking member to move the control element from its first position to said second position independently of the operation of the actuator.

5. A control device comprising a control element, an actuator for the element, a locking member responsive to movement of the control element by the actuator from one position to a second position for locking the control element against movement back to its first position, man-

ual means operatively connected to the locking member, and means operable by said manual means for moving the control element back to its first position independently of the operation of the actuator.

6. A control device comprising a control element, an actuator for the element, a locking member responsive to movement of the control element by the actuator from one position to a second position for locking the control element against movement back to its first position, manual means operatively connected to the locking member, means operable by said manual means for moving the locking member to release the control element and for moving the control element back to its first position independently of the operation of the actuator, and means controlled by said manual means for operating the locking member to move the control element from its first position to said second position independently of the operation of the actuator.

7. A control device comprising a switch, an actuator for opening and closing the switch, control means for the switch including a locking member responsive to opening of the switch by the actuator for locking the switch against closing, and manual means connected to the control means and operable to move the control means to one position for releasing the switch from the locking member and to a second position for opening the switch independently of the operation of the actuator.

8. A control device comprising a switch, an actuator for opening and closing the switch, control means for the switch including a locking member responsive to opening of the switch by the actuator for locking the switch against closing, and manual means connected to the control means and operable to move the control means to one position for releasing the switch from the locking member and to a second position for closing the switch independently of the operation of the actuator.

9. A control device comprising a switch, an actuator for opening and closing the switch, control means for the switch including a locking member responsive to opening of the switch by the actuator for locking the switch against closing, and manual means connected to the control means and operable to move the control means to one position for releasing the switch from the locking member, to a second position for closing the switch independently of the operation of the actuator, and to a third position for opening the switch independently of the operation of the actuator.

10. A control device comprising a control element, an actuator for the control element, a locking member operable to lock the control element in one position against movement by the actuator, a toggle connected to the locking member and normally holding the locking member in an inoperative position in which the control element is movable by the actuator, means responsive to operation of the actuator for moving the toggle in one direction to release the locking member, and manual means for moving the toggle in the opposite direction to secure the locking member in said inoperative position.

11. A control device comprising a control element, an actuator for the control element, a locking member operable to lock the control element in one position against movement by the actuator, the locking member having an inoperative position in which the control element is movable by the actuator, means normally urging the locking member toward its locking posi-

tion, latch means normally set to hold the locking member in its inoperative position, means responsive to operation of the actuator for releasing said latch means, and a manually operable device for moving the locking member to its inoperative position and setting the latch means.

12. In a control device having a movable control element, the combination of a locking member operable to lock the control element against movement and normally urged toward its locking position, a latch carried by the locking member for holding said member in an inoperative position, and means responsive to movement of the control element for releasing the latch to cause said member to lock the control element.

13. In a control device having a movable control element, the combination of a locking member operable to lock the control element against movement, a latch carried by the locking member for holding said member in an inoperative position, means responsive to movement of the control element for releasing the latch, and means responsive to release of the latch for moving the locking member to an operative position to lock the control element.

14. In a control device having a movable control element, the combination of manual means for actuating the control element, automatic means for actuating said element, a locking member operable to lock the control element in one position, a latch coacting with said manual means for holding the locking member in an inoperative position, means responsive to movement of the control element by said automatic means for releasing the latch, and means responsive to release of the latch for moving the locking member to an operative position to lock the control element.

15. In a control device having a movable control element, the combination of a locking member operable to lock the control element against movement and movable between operative and inoperative positions, manually operable means connected to said member for moving it to its inoperative position, a latch carried by the locking member for coacting with said manual means to hold the locking member in its inoperative position, means responsive to movement of the control element for releasing the latch, and means responsive to release of the latch for moving the locking member to an operative position to lock the control element.

16. In a control device having a movable control element, the combination of a locking member for the control element, a pivot on which the locking member is movable between operative and inoperative positions, means for urging the locking member toward its operative position, a latch pivoted on the locking member for holding the member in its inoperative position, and means responsive to operation of the control element for moving the latch on its pivot to release the locking member and cause it to lock the control element.

17. In a control device having a movable control element, the combination of a locking member for the control element, a pivot on which the locking member is movable between operative and inoperative positions, means for urging the locking member toward its operative position, a toggle connected to the locking member for moving the member to its inoperative position, a latch pivoted on the locking member and coacting with the toggle to hold the locking member in its inoperative position, and means responsive

to operation of the control element for moving the latch on its pivot to release the locking member and cause it to lock the control element.

18. In a control device having a movable control element and a locking member for the control element movable between operative and inoperative positions, the combination of a toggle connected to the locking member, means normally acting to expand the toggle and move the locking member to its operative position, a latch coacting with the toggle to hold it in a set position against the action of said means and thereby maintain the locking member inoperative, and means responsive to movement of the control element for actuating the latch to release the toggle and cause said member to lock the control element."

19. In a control device having a movable control element and a locking member for the control element movable between operative and inoperative positions, the combination of a toggle connected to the locking member, means normally acting to expand the toggle and move the locking member to its operative position, a latch movable on the locking member and coacting with part of the toggle for holding it in a set position to maintain the locking member inoperative, the latch having a part operable by actuation of the control element for moving the latch to release the toggle and cause said member to lock the control element, a handle connected to the toggle for setting it, the handle being operable to move the toggle beyond its set position against the action of said expanding means to exert a thrust on said latch part for positively holding the control element in one position, and a member operable by the handle for moving the latch to release the toggle.

20. In a control device having a movable control element and a locking member for the control element movable between operative and inoperative positions, the combination of a toggle connected to the locking member, means normally acting to expand the toggle and move the locking member to its operative position, a latch movable on the locking member and coacting with part of the toggle for holding it in a set position to maintain the locking member inoperative, the latch having a part operable by actuation of the control element for moving the latch to release the toggle and cause said member to lock the control element, a handle connected to the toggle for setting it, and a member operable by the handle for moving the latch to release the toggle.

21. In a control device having a movable control element and a locking member for the control element movable between operative and inoperative positions, the combination of a toggle connected to the locking member, means normally acting to expand the toggle and move the locking member to its operative position, a latch movable on the locking member and coacting with part of the toggle for holding it in a set position to maintain the locking member inoperative, the latch having a part operable by actuation of the control element for moving the latch to release the toggle and cause said member to lock the control element, and a handle connected to the toggle for setting it, the handle being operable to move the toggle beyond its set position against the action of said expanding means to exert a thrust on said latch part for positively holding the control element in one position.

22. In a control device having a movable con-

trol element, the combination of a member operable to lock the control element against movement and normally urged toward its locking position, manual means for moving the locking member to an inoperative position and including an operating shaft which is rotatable and movable laterally, a latch for holding the locking member in its inoperative position and movable on actuation of the control element to release the locking member, a lever connected to the shaft, a pivot spaced from the shaft and on which the lever is movable, and a handle for rotating the shaft to actuate the manual means and operable to move the shaft laterally to fulcrum the lever on its pivot and thereby move the latch to release the locking member.

23. A control device comprising a switch, an actuator operable to open the switch and acting to close the switch on opening thereof, a normally inoperative member movable to an operative position for opening the switch independently of said actuator and for locking the switch open, a pivot for the locking member, a latch pivoted on the free end of the locking member, a toggle connected to the locking member and having an operating shaft which is rotatable and movable laterally, biasing means acting to expand the toggle and move the locking member to its operative position, the latch normally holding the toggle in a set position against the action of the biasing means and being movable by the actuator to release the toggle, a lever connected to the toggle shaft and pivoted independently of the shaft, and a handle for rotating the shaft to set the toggle and move the locking member to its inoperative position, the handle being operable to move the shaft laterally to fulcrum the lever on its pivot and thereby move the latch to release the toggle.

24. A circuit breaker comprising a normally closed switch, a bimetallic actuator for operating the switch, means for connecting the actuator and the switch in series in the circuit whereby excessive current heats the actuator and causes it to flex and open the switch, a lever engageable at its free end portion with the actuator, a pivot on which the lever is movable to cause the actuator to open the switch and hold it open, a toggle connected to the lever for moving it to an inoperative position to permit closing of the switch by the actuator, the toggle including a toggle arm connected rigidly to the lever, an operating shaft, a toggle arm on the shaft, and a pin on one of the arms disposed in a slot in the other arm, biasing means acting to break the toggle and move the lever to lock the switch in its open position, a latch pivoted on the free end portion of the lever and having a notch engageable with the pin to hold the toggle in a set position in which the lever is inoperative, the actuator being movable relative to the lever to fulcrum the latch on its pivot and thereby disengage the notch from the pin, means for urging the latch toward the pin, a latch releasing member connected to the toggle shaft and pivoted at a point remote from the shaft, and a handle for rotating the shaft to set the toggle and operable to move the toggle beyond its set position against the action of said biasing means to cause the pin to exert a turning moment on the lever through the latch and thereby move the latch bodily to close the switch against the action of the actuator, the handle being operable to move the shaft bodily to fulcrum said member on its pivot and release the latch independently of the actuator.

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