Feb. 6, 1951 R. N. ROWE ET AL 2,540,491

ELECTRIC CIRCUIT BREAKER

Filed Sept. 17, 1946 3 Sheets-Sheet 1

Fig. 1

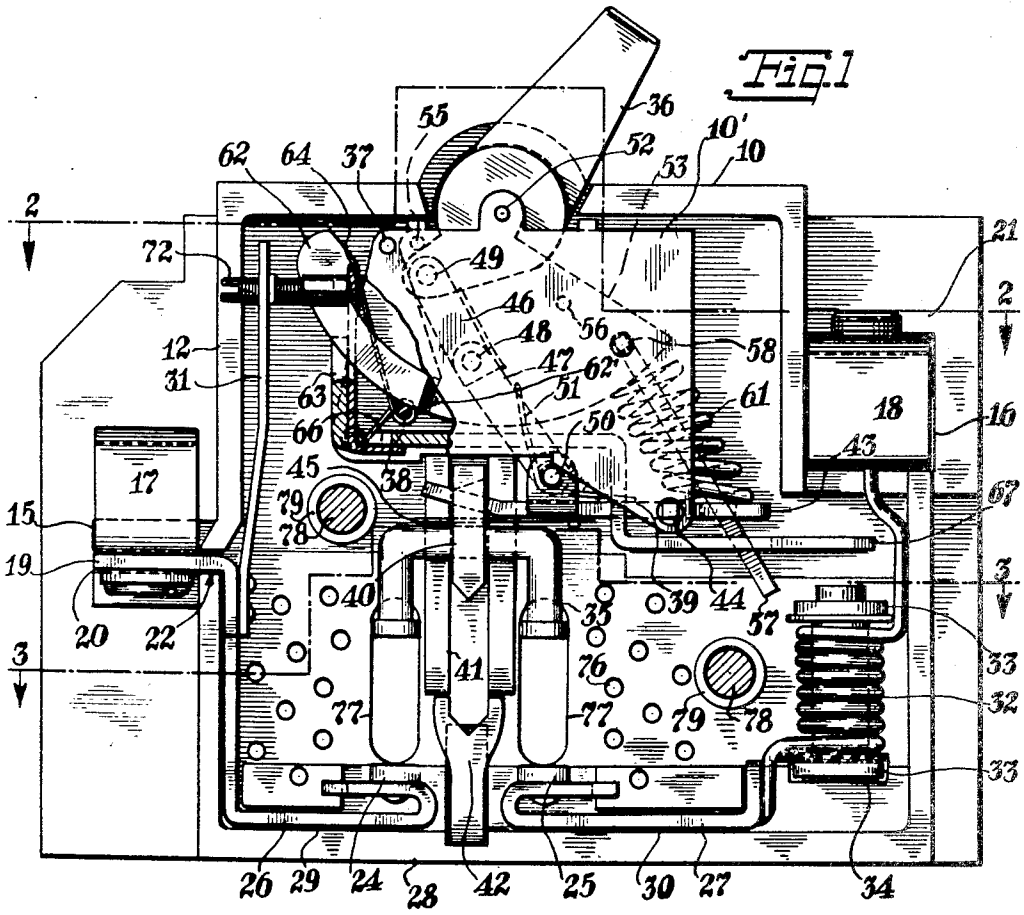
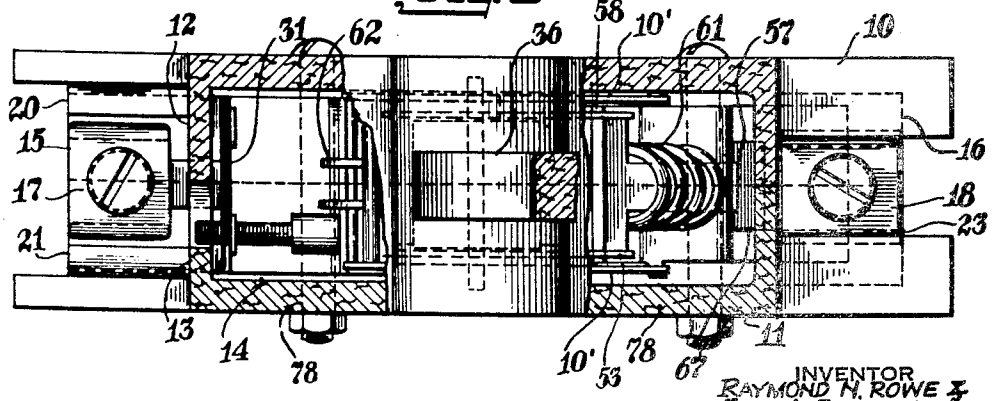


Fig. 2



INVENTOR
RAYMOND N. ROWE &
ERIC A. ERICSON
BY
ATTORNEY

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Fig. 4

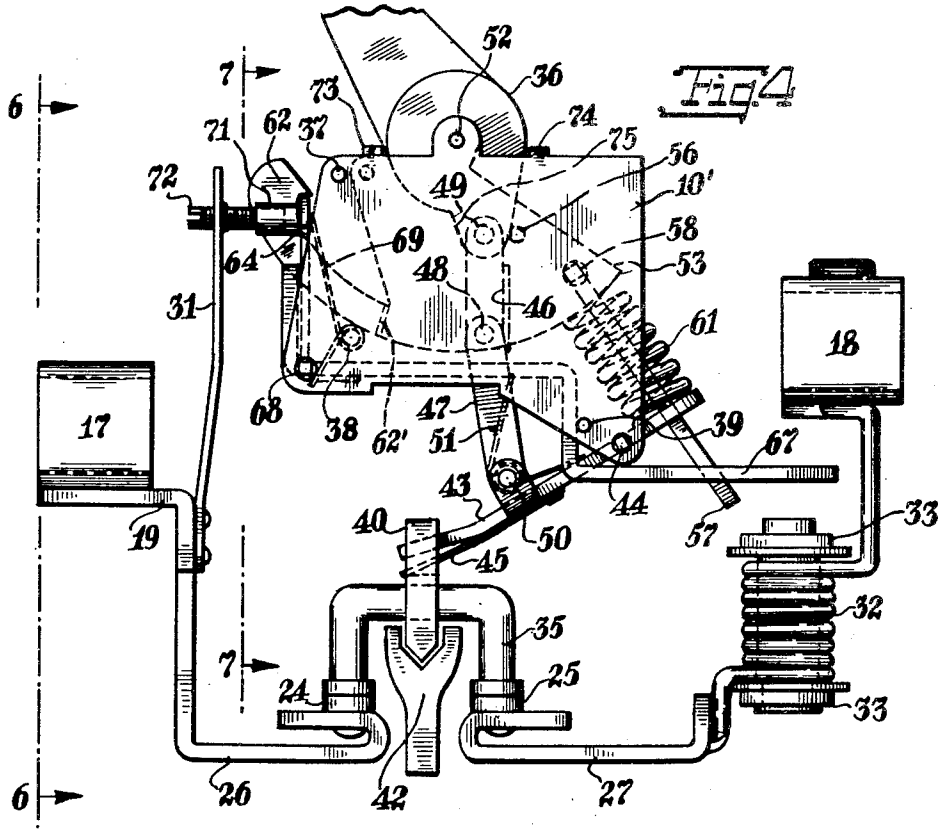
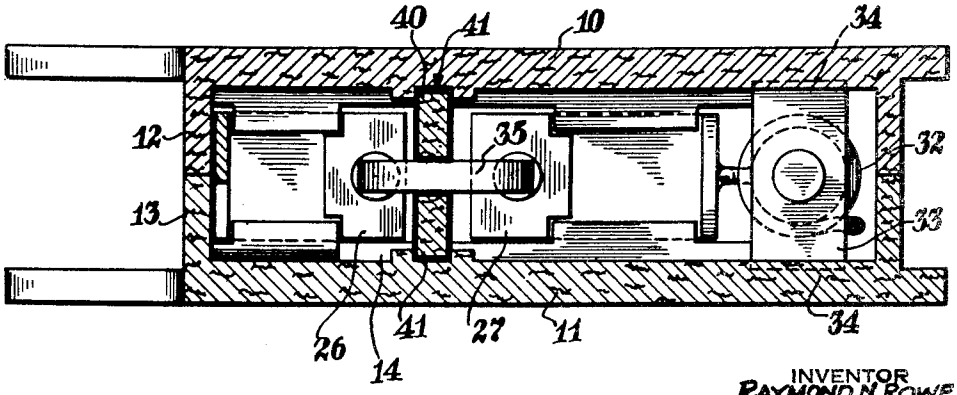


Fig. 3



INVENTOR
RAYMOND N. ROWE
ERIC A. ERICSON
BY
ATTORNEY

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Fig. 5

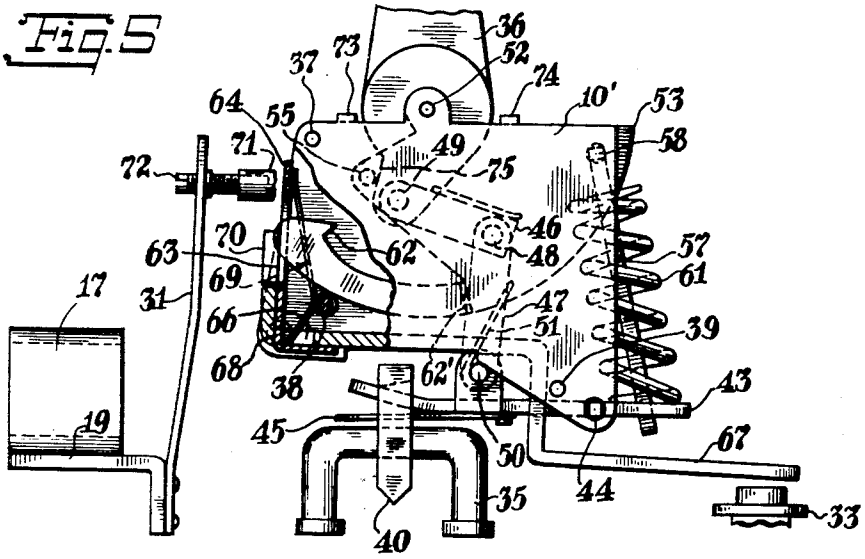


Fig. 6

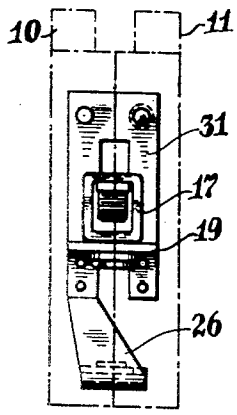


Fig. 7

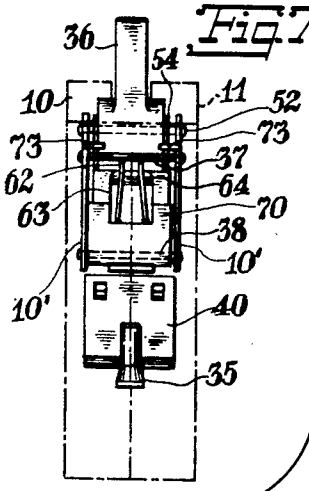
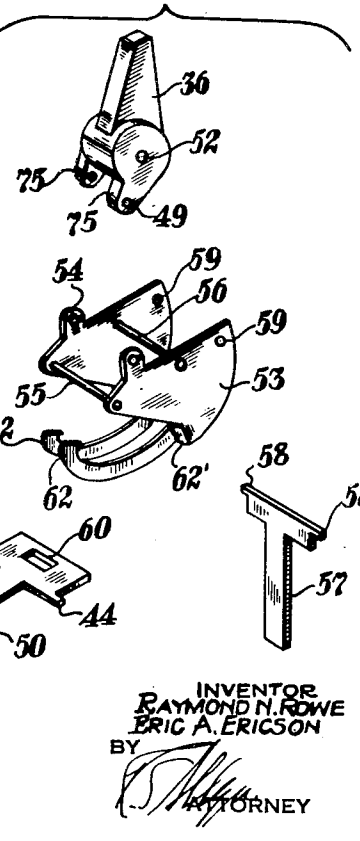


Fig. 8



INVENTOR
RAYMOND N. ROWE
ERIC A. ERICSON
BY
ATTORNEY

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2,540,491

UNITED STATES PATENT OFFICE

2,540,491

ELECTRIC CIRCUIT BREAKER

Raymond N. Rowe and Eric A. Ericson, Plainville, Conn., assignors to The Trumbull Electric Manufacturing Company, Plainville, Conn., a corporation of Connecticut

Application September 17, 1946, Serial No. 697,450

17 Claims. (Cl. 200—88)

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Our invention relates to electric switch mechanism of the type which can be actuated manually at will and will automatically open the circuit in case of an overload.

One object is to provide a relatively compact device which will automatically open the circuit in case of a sudden heavy overload or a prolonged lesser overload.

One object is to provide an automatic circuit breaker which can be manually reset and actuated by a common operating member.

Another object is to provide a device in which all the actuating and operating mechanism is enclosed.

In carrying out the invention in the form shown, the switch is of the double-break type enclosed in a housing formed of insulating material. The movable switch member is connected by toggle links to a member which extends outside the housing. A spring is interposed between a movable switch member and a rocker member and the latter is normally held by a latch which is adapted to be released by the action of a thermostatic member in case of a prolonged overload and also adapted to be released by an electromagnetic device in case of a sudden heavy overload such as a short circuit. The manually operated member is arranged to reset the rocker and prepare the switch for subsequent manual closing action.

Fig. 1 is a side view showing one-half of the housing with the switch mechanism in the normal "off" or open circuit position.

Fig. 2 is a plan and section on the plane of the line 2—2 of Fig. 1.

Fig. 3 is a plan and section on the plane of the line 3—3 of Fig. 1.

Fig. 4 is a side view of the contact and actuating mechanism in the closed circuit or "on" position.

Fig. 5 is a side view showing the actuating mechanism in the position they occupy after being tripped by an overload.

Fig. 6 is an end view showing the bimetal tripping device looking toward line 6—6 of Fig. 4.

Fig. 7 is an edge view taken generally on the plane of the line 7—7 of Fig. 4.

Fig. 8 is an exploded perspective of various parts of the actuating mechanism.

The housing has two parts 10 and 11 with flanges 12 and 13 which surround a central chamber 14 in which is mounted the switch mechanism per se. Recesses 15 and 16 are provided in the opposite ends of the housing in which are mounted the circuit terminals 17 and 18. Terminal 17

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is supported by an angular bracket 19 which is held in recesses 20, 21 between the two faces of the housing and extends through a slot 22 in the flange 12. Terminal 18 is mounted in the recess 21 and is held in place in a pocket 23.

The contact mechanism in the form shown is of the double break type but the invention in its broadest aspect is not so limited.

The switch contacts 24 and 25 are carried by supports 26 and 27 which are positioned in recesses 29 and 30, respectively, adjacent the bottom wall 28 of the housing.

A U-shaped thermostatic member 31 formed for instance of bimetal has its opposite ends secured respectively to the terminal bracket 19 and the contact support 26.

An electro-magnetic coil 32 mounted in the opposite end of the housing has pole pieces 33, 33 which are positioned in recesses 34 in the housing. The opposite ends of this coil are connected respectively to the terminal 18 and the contact member 27.

The U-shaped switch member 35 is actuated by a movable finger piece 36 and the actuating mechanism is carried by a frame which consists of side plates 10', 10' connected by pins or studs 37, 38 and 39. The switch member 35 is carried by an insulating slide 40 and is thus guided in grooves 41, 41 in the housing. A centering seat 42 for the slide may also be provided and located between the contacts 24 and 25. This is formed of insulating material and serves as a barrier between the stationary contacts. The switch lever 43 is pivoted at 44 and carries a leaf spring 45 which extends into the slide 40 and acts as a buffer. The operating member 36 is connected to the switch arm or lever 43 by toggle links 46, 47 hinged together at 48 and connected to the operating member 36 and the switch lever 43 at 49 and 50, respectively. A spring 51 biases the toggle links toward the position of Fig. 1. The operating member 36 is pivoted at 52. A kick-off piece 53 in the form of a rocker having ears 54 (see Fig. 8) is pivoted on the same axis as 52. The rocker has two sides connected by pins 55 and 56. A bar 57 has pivot ends 58, 58 pivoted in holes 59, 59 in the rocker. The other end of the bar 57 is guided in a passage 60 in the switch arm 43. A single spring 61 mounted on the bar 57 is compressed between the outer end of the switch arm 43 and the cross head of bar 57 which is pivoted on rocker 53 so as to press the switch arm 43 to the open circuit positions and bias the rocker toward the position of Fig. 5. The rocker 53 has hooks 62,

62 each of which has a shoulder 62' at its base. The ends of hooks 62, 62 are adapted to extend through opening 63 in a current responsive latch 64. This latch is pivotally mounted for instance by being provided with a lug 65 which extends through an opening 66 in the release lever 67. This lever is pivoted at 68 in the frame of the mechanism and the end adjacent the magnetic coil 32 is adapted to act as an armature of the magnet. The end adjacent the pivot 68 has an upstanding arm 70 adapted to engage the latch member 64 when lever 67 is drawn down by magnet coil 32. The latch is under tension of a spring 69 which biases the latch toward the member 71 which is carried by the bimetal thermostatic member 31. The latter member 71 is adjustably mounted on a screw 72 in the bimetal member 31.

The frame 10' is provided with lugs 73 and 74 (Fig. 4) which act as stops for the rocker 53. The operating member 36 is provided with shoulders 75 adapted to engage the pin 55 of the rocker in order to reset it from the position of Fig. 5 to the position of Fig. 1.

To minimize arcing within the housing, I may provide metallic pins 76 which connect the opposite sides of the housing adjacent the movable switch member. This is made possible by spacing the overload devices from the switch member. I may also provide openings 77 in the wall of the housing for ventilation and inspection purposes.

The parts of the housing are adapted to be secured together in any suitable manner as for instance by bolts, screws or rivets 78 passing through tubular studs 79.

In the normal manual operation of the switch, to close the circuit the operating member 36 in Fig. 1 is turned counterclockwise. The toggle links 46 and 47 transmit a thrust to the switch lever 43 which depresses the slide 40 with movable switch member 35 until the parts reach the position shown in Fig. 4 where the toggle action holds the switch member in closed circuit position.

It will be noted that in the closing of the circuit the spring 61 is compressed but the rocker 53 is held in the position of Fig. 4 by the engagement of the hooks 62 with the latch 64. To open the circuit it is simply necessary to turn the member 36 clockwise from the position of Fig. 4 whereupon the toggle action is broken and the spring 61 tends to tilt the switch lever 43 about the pivot 44 and thus raise the switch member 35 and break the circuit.

If we assume the circuit to be closed as in Fig. 4, the circuit will be broken by an overload in the circuit. In the case of a sudden heavy overload, for instance, a short circuit, the magnetic coil 32 will be suddenly energized and attract the armature member 67. This member will then tilt about its axis 68 and causes the arm 70 to engage the latch 64 and move it away from the hooks 62, 62, thus releasing the rocker 53 so that the spring 61 can tilt it from the position of Fig. 4 to that of Fig. 5. The shoulders 62' at the base of the hook arms 62 strike and break the over-center toggle lock between the links 46 and 47 at the joint 48, thus allowing the spring 61 to tilt the switch arm 43 and breaking the circuit automatically.

After the breaker has been tripped as described above, the toggle spring 51 biases the toggle links 46 and 47 about the pivot point 50 on the switch lever 43 in a counterclockwise direction, thus turning the operating member 36 in a clockwise direction about its pivot point 52 until the shoulders 75 strike the pin 55 of the rocker. The operating handle 36 is then in a trip indicating position half way between its "on" and "off" positions as shown in Fig. 5.

To reset the switch after automatic breaking of the circuit, it is merely necessary to tilt the operating member 36 clockwise as viewed in Fig. 5 whereupon the shoulder 75 of the member 36 engages the pin 55 of the rocker and tilts the rocker clockwise about its axis until the hooks 62 engage the latch 64. The switch is then in open circuit position of Fig. 1 ready for manual closing of the circuit.

In case of a slight steady overload, the thermostatic member 31 will warp and thus move the latch member 64 away from the hooks 62 of the rocker and allow the spring 61 to throw the rocker from the position of Fig. 4 to that of Fig. 5 as previously described. The resetting of the switch after such action is of course accomplished in the manner previously mentioned.

It will be seen that the magnetic release actuating member 32 and the attached circuit terminal 18 and switch contact 25 are connected together in such a way as to constitute a unit which can be assembled and installed as a unit in the housing. Similarly the thermal releasing device 31 and its associated terminal 17 and switch contact 24 constitute a unit entirely independent to the magnetic release.

It will be noted that the arc interruption principle of this breaker is similar to that of Patent No. 2,450,256, dated September 28, 1948, in that the double break contacts are arranged so that the arcs mutually repel each other into arc extinguishing pins, grids or the like.

We claim:

1. A circuit breaker comprising a bimetal actuator and an electromagnet coil actuator independent of the bimetal actuator, a movable switch member adapted to connect said actuators in circuit, a switch lever connected to said switch member, a pivoted rocker, a spring compressed between said rocker and said lever, a pivoted operating finger piece, toggle links connecting said finger piece and said switch lever, a latch normally holding the rocker and adapted to be disengaged by the bimetal actuator upon a continued overload and an armature for the coil actuator having means for disengaging the latch from said rocker upon a sudden heavy overload, said rocker having means for coacting with said toggle links and permitting said spring to move said movable switch member and open the circuit.

2. A circuit breaker comprising a resistor actuator and a magnetic actuator independent of said resistor actuator, a movable switch member adapted to connect said actuators in circuit, a switch lever connected to said switch member, a pivoted rocker, a spring compressed between said rocker and said lever, an operator pivoted concentrically with the rocker, toggle links connecting said operator and said switch lever, a latch normally holding the rocker and adapted to be disengaged by the resistor actuator upon a continued overload and means including an armature for the magnetic actuator supporting said latch and for disengaging the latch upon a sudden heavy overload, said rocker having means for coacting with said toggle links and permitting said spring to open the circuit on a heavy overload.

3. A circuit breaker comprising a housing formed of insulating material, a bimetal actu-

ator mounted in one end of the housing, a magnetic actuator mounted in the other end of the housing, a rocker, a pivoted latch adjacent the bimetal actuator for holding the rocker in the "off" and in the "on" positions during manual operation, a switch member for connecting said actuators in circuit, a spring compressed between said switch member and said rocker, a lever extending from the magnetic actuator at one end of the housing and supporting the latch and for retracting the latch and a manual operator having a toggle connection with said switch member, said rocker having means for coacting with the toggle connection and permitting said spring to move said switch member and open the circuit.

4. A circuit breaker comprising a housing, a bimetal actuator having a circuit terminal mounted in one end of the housing, a magnetic actuator having a circuit terminal mounted in the other end of the housing, a rocker, a latch adjacent the bimetal actuator for holding the rocker in the "off" and in the "on" positions during manual operation, a switch member for connecting said actuators in circuit, a spring interposed between said switch member and said rocker, a lever having an armature for the magnetic actuator at one end of the housing and extending to the latch for retracting said latch and manual operating means connected to said switch member for resetting said rocker and for opening and closing a circuit through said actuators and means actuated by said rocker when released by said latch for coacting with a part of said manual operating means to permit said spring to move said switch member and open the circuit upon an overload in the circuit.

5. A circuit breaker comprising a housing formed of insulating material, a bimetal actuator mounted in one end of the housing, an electromagnetic actuator having pole pieces mounted in recesses in the housing, a pivoted rocker, a latch adjacent the bimetal actuator for holding the rocker in the "off" and in the "on" positions of manual operation, a switch actuating lever, a spring interposed between said switch actuating lever and said rocker, a member having an armature adjacent the magnetic actuator for retracting the latch and a manual operator having a toggle connection with said switch member and having means for resetting said rocker and means carried by said rocker for breaking the toggle connection upon an overload in the circuit.

6. A circuit breaker comprising a housing formed of insulating material having a central chamber and recesses in the opposite ends, a bimetal actuator mounted in one end of the chamber and having a circuit terminal in one recess, a magnetic actuator mounted in the other end of the chamber and having a circuit terminal in the other recess, a rocker, a latch adjacent the bimetal actuator for holding the rocker in the "off" and in the "on" positions during manual operation, a switch lever, a spring interposed between said switch lever and said rocker, an armature for the magnetic actuator having a part extending from one recess to the other for retracting the latch and a manual operator having a toggle connection with said switch lever, said rocker having means for coacting with the toggle connection for breaking the same upon an overload in the circuit.

7. A circuit breaker including an operating handle, a switching arm, a pair of normally locked toggle arms connecting the handle and switching arm for moving the switching arm between normal "on" and "off" positions upon movement of the handle, a kick-off piece, a current responsive latch normally engaged thereby and movable upon overload to release said kick-off piece to a trip position where it breaks the toggle lock and renders the connection between handle and switch arm inoperable, a single spring compressed between said switch arm and said kick-off piece for biasing both the switching arm toward "off" position and the kick-off piece toward trip position, and means carried by the handle for engaging directly with the kick-off piece to move it to latched position and for straightening the toggle arms to normally locked position when the handle is moved to the "off" position.

8. A circuit breaker comprising a pivoted switch member, a pivoted finger piece, toggle links connecting said finger piece and said switch member, a rocker pivoted concentrically with said finger piece, a compression spring interposed between the rocker and the switch member for biasing the switch member toward closed circuit position and biasing said rocker toward a tripped position, a latch engaging said rocker to hold it normally against the pressure of the biasing spring, magnetically actuated means for retracting said latch, thermally actuated means for retracting said latch independently of the magnetic actuation, means of connection between said rocker and said toggle links for collapsing said links when said latch releases said rocker, means of connection between the finger piece and the rocker for resetting the rocker after it has been tripped by an overload or short circuit and means carried by said rocker for moving the finger piece to a position intermediate its normal "off" and "on" positions.

9. In an automatic circuit breaker, supporting side pieces, a manually operable member pivotally supported by said side pieces, a relatively stationary contact, a relatively movable contact, a switching member pivotally supported by said side pieces and adapted to carry said relatively movable contact, a collapsible toggle having a pivotal connection with said manually operable member at one end and a pivotal connection with said switching member at the other end, a member releasable upon the occurrence of abnormal circuit conditions to cause breaking of said collapsible toggle, thermal and electromagnetic means for causing the release of said releasable member and unitary spring means compressed between said switching member and said releasable member for biasing said releasable member to its operative position and for biasing said switching member toward the open-circuit position at all times.

10. In an automatic circuit breaker, two opposed supporting sides, manual operating means pivotally engaging said sides, a switching member pivotally engaging said sides, at least one stationary contact, at least one movable contact, said movable contact being carried by said switching member, at least one of said contacts being resiliently mounted, a toggle linkage having its members normally working in compression, said toggle linkage connected to transmit switch-closing force from said manual operating means to said movable contact through said switching member, a kick-off member pivotally supported in said sides for breaking said toggle linkage, a guide link serving as a pivotal lost-motion connection between said kick-off mem-

ber and said switching member, and a compression spring on said link normally urging said kick-off member and said switching member to rotate in opposite directions about their respective pivots, and an overload actuated latch normally restraining movement of said kick-off member.

11. In an automatic circuit breaker, a frame, manual operating means pivotally mounted in said frame, a switch member pivotally mounted in said frame, a stationary contact, a movable contact carried by said switch member, at least one of said contacts being resiliently mounted, a toggle linkage having its members normally working in compression to transmit contact-closing force from said manual operating means to said movable contact through said switch member, a kick-off member for said toggle linkage pivotally mounted in said frame, a latch normally restraining movement of said kick-off member, overload actuated means for releasing said latch, a guide link having a pivotal connection with said kick-off member at one point and having a lost-motion connection with said switch member at another point, and spring means on said link normally tending to cause separation of said points of connection, said kick-off member having means co-acting with said toggle linkage for permitting the spring to move the switch member and open the circuit upon an overload.

12. In an automatic breaker, a frame, manual operating means pivotally mounted in said frame, a switching member pivoted in said frame, a stationary contact, a movable contact, at least one of said contacts being resiliently mounted, a toggle linkage having its members normally working in compression to transmit contact-closing force from said manual operating means to said movable contact, said toggle linkage having associated therewith spring means biasing it to the "made" position, a kick-off member pivotally mounted in said frame, a latch normally restraining movement of said kick-off member, overload actuated means for releasing said latch, and a guide member having a pivotal connection with said kick-off member at one point and having lost-motion connection with said movable switch member at another point, and spring means on said guide member tending to cause separation of said points of connection, said kick-off member having means co-acting with said toggle linkage for permitting the spring to move the switch member and open the circuit upon an overload.

13. In an automatic circuit breaker, a housing, a manually operable member, a pivotally mounted switch member, a movable contact connected to said switch member, a stationary contact adapted to cooperate with said movable contact, operative means adapted to connect said manually operable member to said movable switch member, said operative means being defeatable to cause automatic opening of said movable contact, and thermal means and electromagnetic means both operable upon the occurrence of abnormal circuit conditions to cause the automatic opening of said movable contact, said electromagnetic means including an electrically energized magnet located in one end of said circuit breaker housing and latching means located in the opposite end of said housing and an armature pivotally mounted at said opposite end of said housing and adapted to be attracted by said magnet located in said one end of said housing, latch means normally restraining movement of the thermal means and electro-magnetic means, said armature serving when attracted to actuate said latching means and cause the release of said defeatable operating means.

14. A circuit breaker having opposed supporting side pieces, a pivoted switch member having its axis journalled in said side pieces, said axis being located intermediate the ends of said switch member, a pivoted operating lever also having its axis journalled in said side pieces, toggle means for moving said switch member between open and closed circuit positions including a first link pivoted on said operating lever and a second link connected to said first link and to said switch member, spring means biasing said toggle means toward the "made" condition at all times, a pivoted kick-off member having its axis journalled in said side pieces, spring means stressed by said switch member during movement of said switch member to "on" position, said latter spring means biasing said switch member toward the open circuit position at all times and also biasing said kick-off member to overcome the bias of said spring means biasing said toggle means to "made" condition and to cause collapse of said toggle means, said kick-off member having means for collapsing the toggle means in case of an overload, a latch normally restraining movement of said kick-off member and overload actuated means for releasing said latch.

15. In a circuit interrupter, stationary contact means, movable contact means, an operating arm for said movable contact means and having a resilient connection therewith, a bimetallic member fixedly mounted at one end and having a movable portion at the other end, manual operating means, a collapsible toggle connected to said manual operating means and to said operating arm for said movable contact, said collapsible toggle remaining in the "made" or rigid condition during normal off-on operation of said circuit interrupter, toggle kick-off means movable when released to break said toggle, latching means normally restraining said toggle kick-off means from moving, said latching means adapted to be moved by said movable portion of said bimetallic member so as to release said toggle kick-off means for movement, and a single spring means biasing said operating arm for said movable contact means away from said stationary contact means when in the closed circuit position and biasing said toggle kick-off means for movement to break said toggle.

16. In a circuit breaker, a hinged switch actuating lever for opening and closing a circuit, a hinged rocker member, a spring compressed between said rocker member and said lever, a movable latch member normally restraining movement of said rocker member, an overload actuated member for releasing said latch upon an overload and permitting said spring to rotate said rocker member, a manually operable member, hinged toggle links connecting said manually operable member and said actuating lever for moving said actuating lever to open and close a circuit and means of connection between said rocker member and said toggle links for breaking the toggle connection and permitting said spring to tilt said lever and open the circuit when said rocker member is released by the latch member.

17. In a circuit breaker, two switch contacts, a thermostatic member connected to one contact, a magnetic overload device connected to the

other contact, a movable switch member for connecting said contacts, an actuating lever for moving said switch member, a rocker member, a spring compressed between said rocker member and said lever, a latch member normally restraining movement of said rocker member, means actuated by said thermostatic member for releasing said latch upon an overload, a lever actuated by said magnetic overload device for releasing said latch and permitting said spring to rotate said rocker member, a manually operable member, hinged toggle links connecting said manually operable member and said actuating lever for moving said switch member to open and close a circuit and means of connection between said rocker member and said toggle links for breaking the toggle connection and permitting said spring to tilt said lever and open the circuit when said rocker member is released by the latch member.

RAYMOND N. ROWE.
ERIC A. ERICSON.

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