Nov. 30, 1937. K. C. RANDALL 2,100,749

CIRCUIT BREAKER

Filed March 15, 1933 2 Sheets-Sheet 1

Fig. 1.

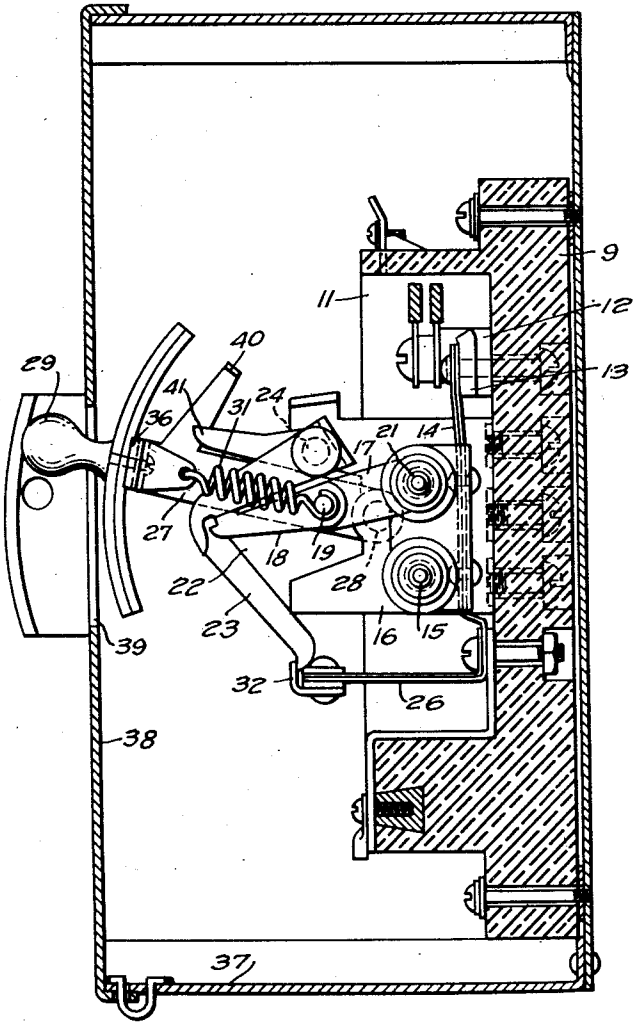
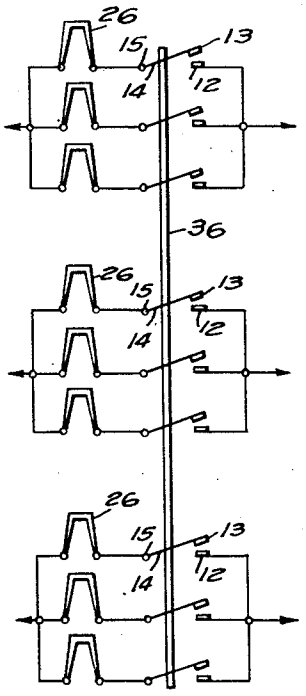


Fig. 3.



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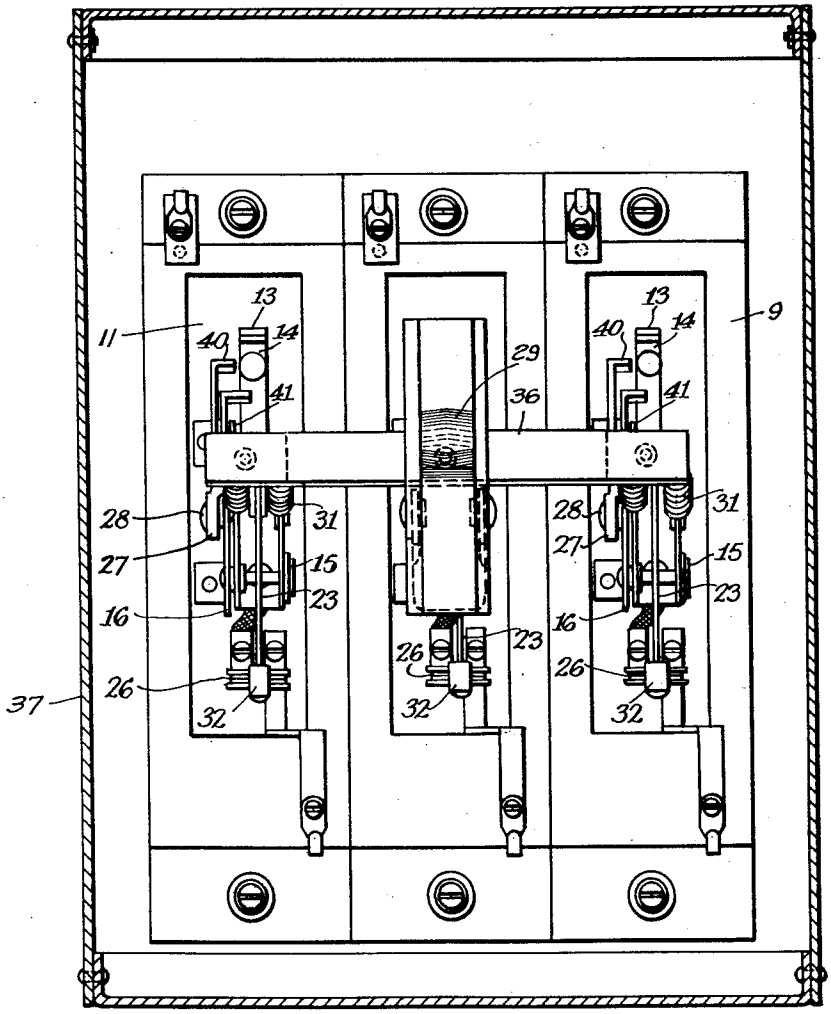
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CIRCUIT BREAKER

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Fig. 2.



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UNITED STATES PATENT OFFICE

2,100,749

CIRCUIT BREAKER

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Application March 15, 1933, Serial No. 660,936

14 Claims. (Cl. 200—116)

My invention relates to circuit breakers and particularly to circuit breakers for controlling electric lamps and similar apparatus. This application is a continuation in part of my copending application Serial No. 441,513, filed April 4, 1930 and which issued April 25, 1933 as Patent No. 1,905,501.

An object of my invention is to provide a multi-pole circuit breaker mechanism in which all of the poles of the circuit breaker are normally actuated from open to closed position by a single operating handle, but in which an excess current in any one pole will cause that pole to open irrespective of the position of the operating handle, and irrespective of the position of the other poles.

Another object of my invention is to provide a multi-pole circuit breaker in which an individual current-responsive latch is provided for normally holding each pole of the breaker in latched position, with the latch of each pole being capable of allowing its contact to move from closed to open position in response to current conditions in its pole, and in which a single operating handle is used to reset to latched position any one or greater number of poles which have been released in response to over-current.

A further object of my invention is to provide a three-pole circuit breaker which is particularly adapted for use as a main or entrance circuit breaker for a building using an Edison three-wire distribution system, due to the fact that one pole may open, if one side of the system is overloaded, without interrupting the circuits supplied from the other side of the system. This is accomplished without losing the advantages of having a single operating handle, for normally opening and closing the circuits of all three wires of the system, and for resetting any number of the poles which may have been tripped due to excess current.

A further object of my invention is to provide a multi-pole circuit breaker in which the contact arm of each pole is actuated normally from open to closed position with a snap action by a separate toggle linkage and over-center spring, but in which the linkage and spring provided for each of the plurality of poles are all normally actuated by a single operating handle. Each pole is also provided with a releasable trip member which is held by a current-responsive latch. Each releasable trip member is movable after its release independently of any movement of the releasable trip members of the other poles to cause its contact arm to move to open position independently of any movement of the contact arms of the other poles.

These and other objects that will be made apparent throughout the further description of my invention are obtained by circuit-breaker apparatus hereinafter described and illustrated in the accompanying drawings, wherein;

Figure 1 is a longitudinal section through a circuit breaker embodying features of my invention, portions of the circuit breaker being shown in elevation;

Fig. 2 is a plan view of the circuit-breaker apparatus shown in Fig. 1, but with the housing shown in section; and

Fig. 3 is a diagrammatic view illustrating the electrical connections of the breaker with the U-shaped bi-metallic thermal element electrically connected in series with each contact, and illustrating the application of my invention to a multi-pole circuit breaker in which each pole comprises a plurality of individual units in parallel.

In Figs. 1 and 2, I have shown my invention applied to a circuit breaker comprising a plurality of current-responsive circuit-breaker units, such as is disclosed in Patent No. 1,794,901, issued to O. S. Jennings, and assigned to the assignee of this application. Briefly, each circuit-breaker unit comprises an insulating base 9 having a recess 11 in which a stationary contact 12 is mounted and which is adapted to be engaged by a movable contact 13 carried upon a switch arm 14 that is pivoted, at 15, upon a sheet-metal frame or bracket 16 which is mounted on the base 9 within the notch 11. The switch arm 14 is operated by a pair of toggle links 17 and 18, that are pivoted together by a knee pivot 19. The link 17 is pivotally mounted on a shaft 21 which is carried by the switch arm 14, and the link 18 is pivotally seated in a notch 22 of V-shape provided in a releasable carrier 23 that is pivotally mounted on the frame 16 for rotation about a shaft 24.

The current responsive trip member or carrier 23 is releasably retained in the operable position shown in Fig. 1 by a bimetal thermal element 26 of U-shape and is diagrammatically illustrated in Fig. 3. An operating lever 27 is mounted for rotation about the shaft 28 that is secured to the frame 16, and is provided with an insulating handle 29 by means of which the switch may be manually operated. A tension spring 31 connects the outer end of the operating lever 27 to the knee pivot 19 of the toggle links 17 and 18 and serves to move the toggle

links to the "made" or straightened positions shown in Fig. 1 wherein the knee pivot 19 lies slightly above a line connecting the shaft 21 and the pivot seat of the link 18.

When the toggle is in the "made" position, the contact of the switch arm 14 is releasably retained in closed position, and, when the operating handle 29 has been moved downwardly a sufficient distance, the spring 31 causes the toggle to collapse and move the switch arm 14 to open position with a snap action. By reason of this construction, the switch arm is actuated to open and to closed position by the over center spring 31, when the switch or circuit breaker is manually operated through the medium of the handle 29.

The spring 31 also tends to move the carrier 23 in a clockwise direction, and, regardless of the position of the operating handle, does actually move the carrier 23 when the thermal element 26 has been heated sufficiently to move the latch 32, that is secured to its outer end, out of engagement with the free end of the carrier 23. This rotation of the carrier 23 about its pivot 24 carries the end of the toggle link 18 which engages the notch 22 across the line of action of the spring 31 and results in the collapse of the toggle and the opening of the contacts 12 and 13. The trip member or carrier 23 is returned to reset or latched position by rotation of the operating lever 27 counter-clockwise due to the motion imparted to the carrier by the engagement of the projection 40 on the operating lever 27 with the arm 41 on the carrier 23.

The bimetal element may be proportioned to release or trip the circuit breaker to open position in response to a predetermined overload or a short-circuit condition and to retain the circuit breaker in closed position so long as the value of the current passing through the circuit breaker remains below a predetermined amount.

It will be understood that the bimetal element is normally connected in series with the circuit-breaker contacts and is heated by the current flowing through the circuit breaker contacts to the circuit to which the circuit breaker is connected. It will be further understood that the circuit breaker is trip-free of the handle and, therefore, the handle cannot interfere with the opening movement of the circuit breaker in response to an overload or short-circuit condition, regardless of its position, or whether it is being held by the operator.

It will be understood that, where a plurality of circuit breakers of the "trip-free of the handle" type are utilized to form a multi-pole breaker, a single operating handle 29 is provided that is connected to an insulating bar 36 which is connected to the operating levers 27 of the several circuit breakers, as indicated in Fig. 2. Since each of the breakers forming one pole of the multi-pole breaker may trip free of the handle and since each pole has a complete tripping mechanism, any one pole of the breaker may trip and cause its switch arm 14 to move to open position independently of the position of the mechanisms including carriers 23 and toggle links 17 and 18, and the switch arms 14 of the other poles and independently of the common operating handle 29. Movement of the operating handle 29 counter-clockwise to the "off" position causes corresponding movement of each of the operating levers 27. If any pole of the breaker has been tripped, it is returned to latched position with the carrier 23 engaging the latch 32 by the movement of the handle, due to the engagement of projection 40 on operating lever 27 with the arm 41 on carrier 23.

It is thus seen that the multi-pole circuit breaker of my invention has a single operating handle for normally opening and closing the switch arms of all poles in unison, and for resetting any one or more poles which may have been tripped, but that this use of a single handle does not interfere with the ability of each pole to trip to open position without movement of the corresponding parts of the other poles.

This structure is particularly advantageous for use as a main or entrance circuit breaker for a three-wire distribution system where the load is connected between each outer conductor and the neutral, since an overload on one side of the system will cause only the outer pole of the breaker to trip. This opens and fully protects the overloaded side of the system without in any way disturbing the supply of current to the load on the other side of the system. Power may then be restored to both sides of the system by merely moving the operating handle to the "off" position, momentarily interrupting the side of the system which has not tripped open, and then moving the handle back to the "on" position.

In Figs. 1 and 2, I have shown a circuit breaker having three poles all mounted within a metal housing 37 having a cover 38 that may be sealed in closed position and is provided with a slot 39, through which the operating handle 29 projects.

In Fig. 3, I have disclosed the manner in which a three-phase circuit breaker is arranged by providing three parallel-connected circuit-breaker units for each phase of the circuit. The operating bar 36 extends across the circuit-breaker units and is connected to each of the operating levers of the nine circuit breakers. Since the individual circuit-breaker units are all trip-free of the handle, they may trip open without affecting the other circuit breakers connected in the circuit.

Other forms of current-responsive devices may also be used, and various changes, modifications, substitutions, additions, and omissions may be made in the apparatus illustrated without departing from the spirit and scope of my invention as set forth in the appended claims.

I claim as my invention:

1. In a circuit interrupter, a plurality of switch means movable to open and close a circuit, a single operating member for normally moving a plurality of said switch means simultaneously to both open and closed position, spring means between said single operating member and said plurality of switch means for causing said simultaneous movement of the switch means to take place with a snap action when moving to both open and closed position, a plurality of trip members each responsive to current flow through one of said switch means, each of said trip members being movable to tripped position independently of movement of the other of said trip members to tripped position and thereby causing movement of one of said switch means movable to both open and closed position with a snap action to open position, each of a plurality of said switch means movable to both open and colsed position with a snap action being movable to open position upon movement of one of said trip members independently of movement of the other of said switch

means to open position and independently of the position of said single operating member.

2. In a multi-pole circuit interrupter, a movable contact member for normally opening and closing the circuit through each of a plurality of said poles, energy storing means for each of said movable contact members for normally opening and closing the circuit, a single operating means movable to both open and close all of said contact members, said operating means imparting energy to each of said energy storing means and then causing release of said energy to simultaneously move all of said contact members for normally opening and closing the circuit with a snap action, a trip member for each of said plurality of poles and each of said trip members controlling one of said contact members and being movable to tripped position, current responsive means for each of said plurality of poles, each of said current responsive means upon the occurrence of predetermined conditions in the circuit through its pole causing actuation of one of said trip members to tripped position to cause the contact member for normally opening and closing the circuit through the pole controlled thereby to move to open position independently of any movement of the other of said contact members.

3. In a mutli-pole circuit interrupter, a movable contact member for normally opening and closing the circuit through each of a plurality of said poles, energy storing means for each of said movable contact members for normally opening and closing the circuit, a single operating means movable to both open and close all of said contact members, said operating means imparting energy to each of said energy storing means and then causing release of said energy to simultaneously move all of said contact members for normally opening and closing the circuit with a snap action, a trip member for each of said plurality of poles and each of said trip members controlling one of said contact members and being movable to tripped position, current responsive means for each of said plurality of poles, each of said current responsive means upon the occurrence of predetermined conditions in the circuit through its pole causing actuation of one of said trip members to tripped position to cause the contact member for normally opening and closing the circuit through the pole controlled thereby to move to open position independently of any movement of the other of said contact members and irrespective of the position in which said operating means may be held.

4. In a multi-pole circuit interrupter, a movable contact member for normally opening and closing the circuit through each of a plurality of said poles, energy storing means for each of said movable contact members for normally opening and closing the circuit, a single operating means movable to both open and close all of said contact members, said operating means imparting energy to each of said energy storing means and then causing release of said energy to simultaneously move all of said contact members for normally opening and closing the circuit with a snap action, a trip member for each of said plurality of poles and each of said trip members controlling one of said contact members and being movable to tripped position, current responsive means for each of said plurality of poles, each of said current responsive means upon the occurrence of predetermined conditions in the circuit through its pole causing actuation of one of said trip members to tripped position to cause the contact member for normally opening and closing the circuit through the pole controlled thereby to move to open position independently of any movement of the other of said contact members and irrespective of the position in which said operating means may be held, and any trip member which has moved to tripped position being reset by movement of said operating means without reclosing said contact member which moved to open position upon movement of the trip member to tripped position.

5. An electric circuit breaker comprising a plurality of contact-actuating mechanisms connected for joint operation each having its own actuating spring, said mechanisms being operable to move the contact sets to both open and closed circuit position with a snap motion, a plurality of contact sets operable by said mechanisms, a plurality of means to release said mechanisms on overload, and a plurality of current responsive means to cause actuation of said releasing means.

6. An electric circuit breaker comprising a plurality of contact-actuating mechanisms connected for joint operation each having its own actuating spring, said mechanisms being operable to move the contact sets to both open and closed circuit position with a snap motion, a plurality of contact sets simultaneously movable upon operation of said mechanisms, separate means for releasing said mechanisms upon overload, and a plurality of current responsive means to cause operation of said releasing means.

7. In a multi-pole circuit interrupter, a movable contact member for normally opening and closing the circuit through each of a plurality of said poles, energy storing means for each one of said movable contact members, a single operating means movable to both open and close all of said contact members, said operating means when moved in circuit closing direction causing each of said energy storing means to move one of said contact members to close the circuit, and each of said energy storing means acting on one of said contact members when in closed circuit position to bias it to move to open circuit position, current responsive means for each one of said plurality of poles, each of said current responsive means controlling one of said contact members, and each of said current responsive means upon the occurrence of predetermined conditions in the circuit through its pole causing the contact member for normally opening and closing the circuit through the pole controlled thereby to move to open position independently of any movement of the other of said contact members.

8. In a multi-pole circuit interrupter, a plurality of movable contact members for normally opening and closing the circuit through a plurality of said poles, a plurality of separate biasing means each associated with one of said movable contact members, a single operating member movable to normally both open and close all of said plurality of contact members, said operating member when moved in circuit closing direction causing each of said biasing means to move its associated contact member to close the circuit, each of said biasing means acting on its associated contact member when in the closed position and biasing it to move to open circuit position, and each of a plurality of said contact members having a normally latched part associated therewith which when latched prevents said biasing means from automatically moving its associated contact member to open circuit position, a plurality of current responsive means each normally

in latching engagement with one of said normally latched parts for holding it against movement and being disengageable therefrom for initiating movement of the contact member controlled thereby to open position independently of any movement of the other contact members, and said single operating member being operable to normally move said contact members to open circuit position without causing disengagement of said current responsive means from said normally latched parts.

9. In a multi-pole circuit interrupter, a plurality of movable contact members for normally opening and closing the circuit through a plurality of said poles, a plurality of separate biasing means each associated with one of said movable contact members, a single operating member movable to normally both open and close all of said plurality of contact members, said operating member when moved in circuit closing direction causing each of said biasing means to move its associated contact member to close the circuit, each of said biasing means acting on its associated contact member when in the closed position and biasing it to move to open circuit position, and each of a plurality of said contact members having a normally latched part associated therewith which when latched prevents said biasing means from automatically moving its associated contact member to open circuit position, a plurality of current responsive means each normally in latching engagement with one of said normally latched parts for holding it against movement and being disengageable therefrom for initiating movement of the contact member controlled thereby to open position independently of any movement of the other contact members, said single operating member being operable to normally move said contact members to open circuit position without causing disengagement of said current responsive means from said normally latched parts, and the disengagement of any one of said latched parts by its current responsive means causing movement of its associated contact member to open circuit position irrespective of the position in which said operating member may be held.

10. In a multi-pole circuit breaker, a plurality of movable contacts for normally opening and closing the circuit through a plurality of said poles, a single operating member movable to normally both open and close all of said plurality of contacts, a plurality of springs each of which biases and moves one of said contacts to closed circuit position upon movement of said single operating member to closed circuit position, and each of said springs exerting a biasing force when the circuit breaker is closed to move one of said contacts from closed circuit position to open circuit position, a plurality of latch portions each associated with one of said contacts for controlling its movement to open circuit position due to the bias of its spring, a plurality of bimetallic members each normally engaging and holding one of said latch portions, each of said bimetallic members being responsive to the current flow through one of said contacts and being movable upon the occurrence of an abnormal condition to disengage its associated latch portion and permit the spring associated with its contact to move it to open circuit position independently of the other contacts, and said single operating member being movable to return any of said latch portions to latched engagement with their bimetallic members and being movable to normally open all of said contacts without disengaging said bimetallic members from their latch portions.

11. An electric circuit breaker comprising a plurality of contact-actuating mechanisms connected for joint operation each having its own actuating spring, said mechanisms having a common handle and being operable thereby to move the contact sets to both open and closed circuit position with a snap motion, a plurality of contact sets operable by said mechanisms, a plurality of means to release said mechanisms on overload, and a plurality of current responsive means to cause actuation of said releasing means, said actuation of the releasing means causing at least one of the contact sets to move to open circuit position irrespective of the position in which said common handle may be held.

12. An electric circuit breaker comprising a plurality of contact-actuating mechanisms connected for joint operation each having its own actuating spring, said mechanisms having a common handle and being operable thereby to move the contact sets to both open and closed circuit position with a snap motion, a plurality of contact sets operable by said mechanisms, a plurality of means to release said mechanisms on overload, and a plurality of current responsive means to cause actuation of said releasing means, said actuation of the releasing means causing at least one of the contact sets to move to open circuit position irrespective of the position in which said common handle may be held, and said common handle being operable after actuation of the releasing means to cause resetting thereof and place the circuit breaker in condition to be normally operated to both open and closed circuit positions by said common handle.

13. An electric circuit breaker comprising a plurality of contact-actuating mechanisms connected for joint operation each having its own actuating spring, said mechanisms being operable to move the contact sets to both open and closed circuit position with a snap motion, a plurality of contact sets operable by said mechanisms, a plurality of means to release said mechanisms on overload, a plurality of current responsive means to cause actuation of said releasing means, and each of a plurality of said contact sets being movable to open circuit position upon actuation of one of said releasing means without movement of other of said plurality of contact sets.

14. An electric circuit breaker comprising a plurality of contact-actuating mechanisms connected for joint operation each having its own actuating spring, said mechanisms having a common handle and being operable thereby to move the contact sets to both open and closed circuit position with a snap motion, a plurality of contact sets operable by said mechanisms, a plurality of means to release said mechanisms on overload, a plurality of current responsive means to cause actuation of said releasing means, and each of a plurality of said contact sets being movable to open circuit position upon actuation of one of said releasing means without movement of other of said plurality of contact sets, and independently of the position of said common handle, and said common handle being operable to cause resetting of said releasing means.

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