

Jan. 16, 1945.

E. H. TAYLOR

2,367,382

CIRCUIT BREAKER

Filed July 7, 1942

2 Sheets-Sheet 1

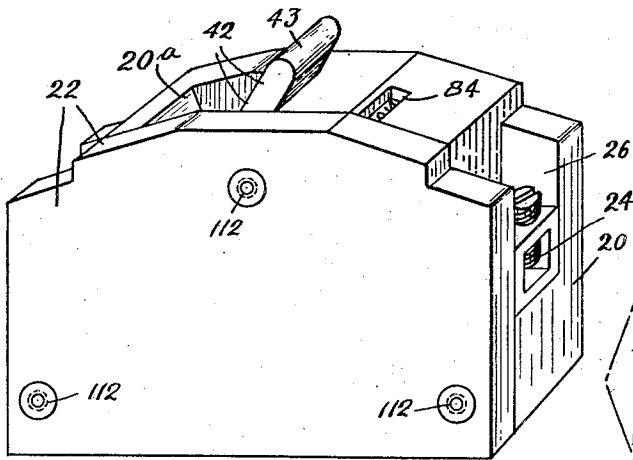


Fig. 1.

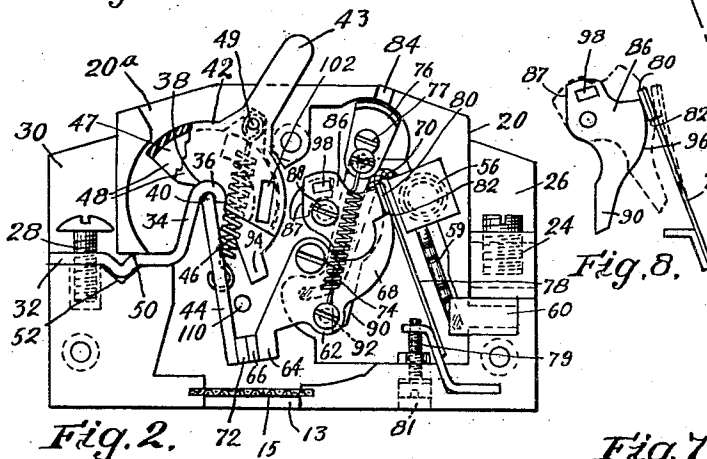


Fig. 2.

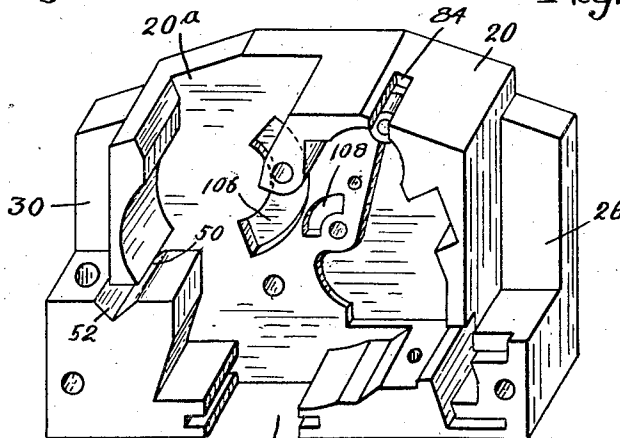


Fig. 5.

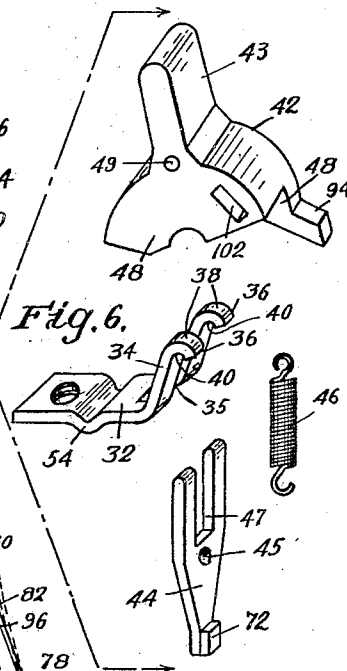


Fig. 6.

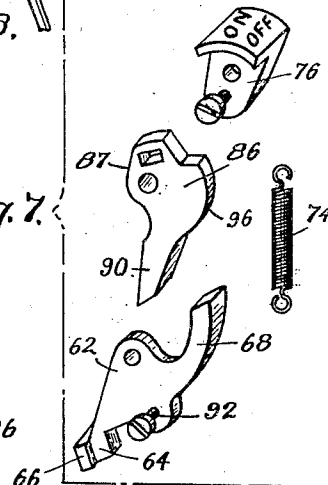


Fig. 7.

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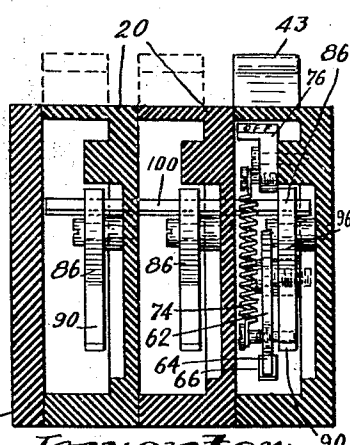
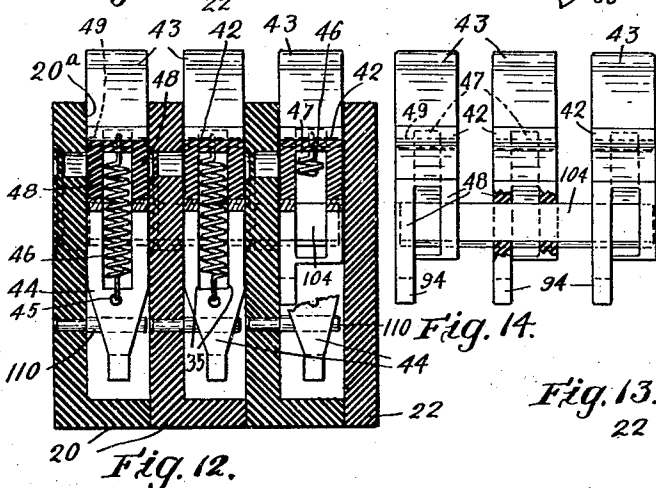
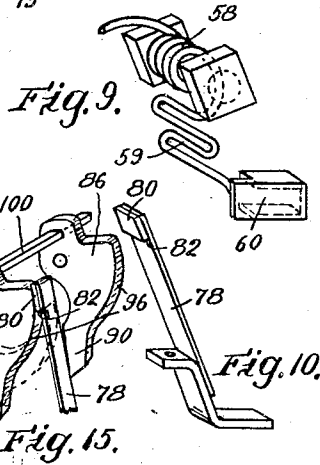
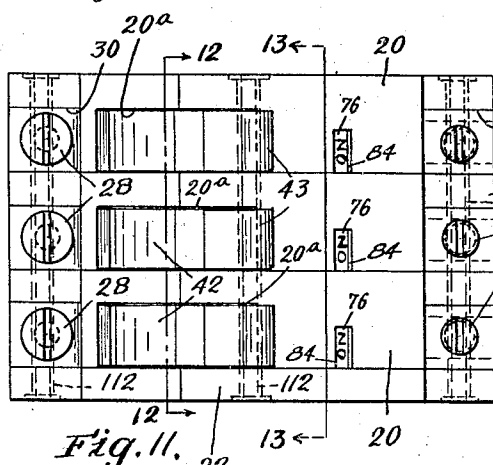
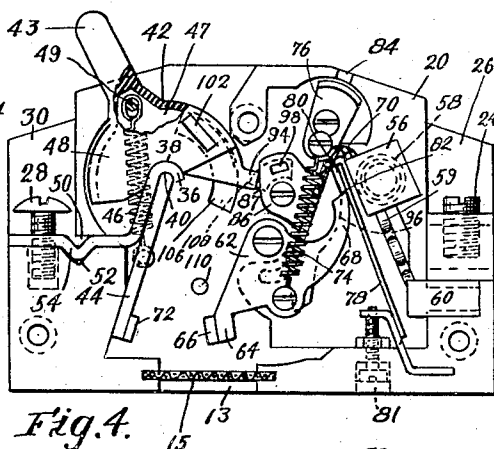
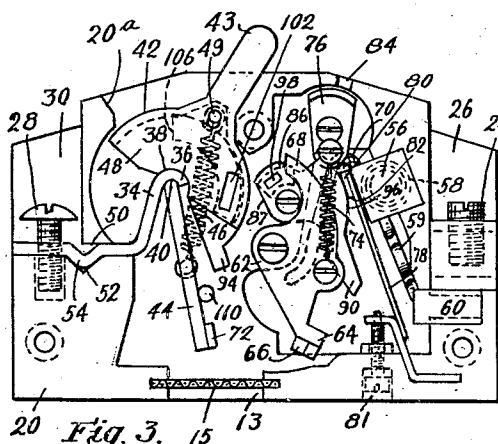
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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CIRCUIT BREAKER

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Application July 7, 1942, Serial No. 450,005

25 Claims. (Cl. 200-116)

This invention relates to improvements in switches and circuit breakers, and more particularly to circuit breakers which are manually operable for opening and closing a circuit at will and which are automatically operable in response to predetermined abnormal conditions in the circuit for opening the circuit independently of the manually operable means.

In such circuit breakers, it is well known to employ manual means including an over-center spring snap action and to combine therewith an automatic tripping means for opening the circuit when predetermined conditions exist.

It is among the objects of the present invention to provide an improved over-center snap action for the manually operable means and to associate and coordinate therewith an improved automatic tripping mechanism adapted for thermal and electric control in an assembly which is notably compact and which involves relatively few and inexpensive parts.

Another object of the invention is to employ a pair of contacts each movable toward and away from each other independently of movements of the other.

A further object of the invention is the provision of an improved form of switch or circuit breaker having two separately operable switches, one of which is opened and closed manually and the other is opened automatically in response to overload and is closed as a part of the closing operation of the manual switch, the two switches preferably having mutually engageable contact members, one of which constitutes the relatively fixed contact member for the other switch, and both switches being preferably operative at least into open position with a rapid action free from manual control after they have started their opening movement.

Another object of the invention is the provision of a circuit breaker having a manually operative switch and an automatically opening switch combined with improved means for indicating the open condition of the automatically opening switch.

A further object of the invention is the provision of improved operating mechanism for the circuit controlling contacts of cooperating manual and automatic switches.

Another object is to provide circuit breaker units which may be conveniently and economically combined with other similar units in stacked relation for control of multi-pole circuits.

A feature is that means is provided in each unit

readily removable for adapting the units for multi-pole assembly.

A further object is to provide improved means whereby the automatic tripping or opening of any single unit of a multi-pole assembly of units results in immediate tripping of the other units.

Still another object is to provide improved means for manual resetting of all of the automatic trips of a multi-pole assembly of units while all of the switches remain open.

It is, moreover, an object of the invention to generally improve both the structure and operation of circuit breakers for single and multi-pole circuit control.

The switch or circuit breaker, in the novel features herein illustrated, is adapted to connect a branch circuit with a line, to control the operation of and protect an electric motor against harmful overloading, and the like. The invention herein disclosed is primarily directed to the mechanism for effecting movement of the circuit-controlling contact members between positions corresponding to open and closed switch positions and not to the current carrying and interrupting ability of the device which depends upon matters not pertinent to the present invention.

The mentioned objects and results may be attained with mechanism and an organization of parts more particularly described in connection with the accompanying drawings in which:

Fig. 1 is an isometric view of a circuit breaker unit embodying features of the invention;

Fig. 2 is a side elevation of the unit of Fig. 1 with the cover plate removed and showing the switch mechanism in circuit-closed position;

Fig. 3 is a similar view showing the switch open as a result of automatic tripping;

Fig. 4 is a similar view showing the switch open as a result of manual operation;

Fig. 5 is an isometric showing of the casing body of a unit, the cover plate being removed and the switch elements being absent;

Fig. 6 shows isometric detail views of the separate elements making up the manually operable switch section;

Fig. 7 shows isometric detail views of elements of the automatically tripping switch section and the indicating means;

Fig. 8 is a diagrammatic showing of the cam means for tripping of interconnected units in response to the automatic tripping of any one unit;

Fig. 9 is a detail isometric view of the electromagnet and its terminal connector;

Fig. 10 is an isometric detail showing of the bimetal latching element and its support;

Fig. 11 is a top plan view of three units associated for multi-pole circuit control;

Fig. 12 is an elevation in section on 12—12 of Fig. 11;

Fig. 13 is an elevation in section on 13—13 of Fig. 11;

Fig. 14 is an elevation of the three handles of Fig. 12 separated from the casing to illustrate more clearly their connections for simultaneous operation; and

Fig. 15 is an isometric view somewhat diagrammatic showing the interconnected cam tripping elements of the three units.

Referring to the drawings, and more particularly to Figs. 1 through 10, my improved switch or circuit breaker unit comprises a casing body 20 of suitable insulation material preferably molded into shape, the body having the general characteristics of a box with bottom, top, two ends and a rear wall, and a front cover wall 22 which is removable and which may be of similar insulation material. A terminal 24 on, say, the line side of the unit may be mounted in a recess 26 exteriorly of the casing and a terminal 28 on the, say, branch side of the unit may be similarly in a recess 30. This branch side terminal 28 preferably includes a metal plate conductor 32 having an upwardly extending inclined portion 34 whose extremity is bent over and downward as at 36 to provide an upper convex fulcrum surface 38 and an under concave fulcrum surface 40. A manually operable member 42, having an operating handle 43 at a part thereof operable between positions in opposite ends of a slot 20a of the casing body corresponding to open and closed positions of the manually operable part of the switch, is fulcrumed on the convex surface 38 and a contact-carrying metal plate 44 has one end fulcrumed on the concave surface 40. A tension coil spring 46 has one end connected at a mid location along the plate 44, by having its end hooked into a hole 45 in the plate, and its other end connected to the manually operable member 42, the latter being hollow, as at 47, at its mid region between two end bearing portions or side plates 48, 48, which rest on the convex fulcrum surface 38 and the other end of the spring being hooked over a pin 49 which traverses the hollow and is carried by the side plates. The spring 46 extends into the hollow 47 and is adapted to hold the manually operable member 42 and the contact-carrying plate or member 44 on their respective fulcrum seats and when the manually operable member is moved from one to the other end of the slot 20a the spring shifts its line of tension from one side of the fulcrum points to the other side, thereby to move the contact-carrying member with snap action from closed to open or from open to closed positions.

Conveniently and economically the terminal plate 32 may fit edgewise into a groove 50 which may be molded or otherwise formed in the casing body with a slight depression or jog 52 into which a depressed part 54 of the conductor plate may seat to maintain the plate against longitudinal movement. The cover 12 holds the conductor plate 32 in the said groove 50.

The line-side terminal 24 is shown as a rectangular tubular member with a set screw for clamping the end of a conductor in the tube.

Mounted interiorly of the casing at this line-side thereof and in a retaining recess of the casing is an electro-magnet 56 having a winding 58

thereon one end of which is connected to the resistance conductor 59, or of itself forms such conductor, arranged in sinuous configuration and extended from the electro-magnet to a metal connector 60 to which it is suitably electrically and mechanically secured, the connector being welded or otherwise electrically secured to the tubular part of the line terminal. As illustrated in Figs. 2, 3 and 4, it may be welded to the under side of the tube for insertion with the tube, a suitable recess in the casing body accommodating it, and the cover 12 maintaining it and the terminal tube in position when the cover is in place.

A second and movable contact-carrying member 62, of conducting material, constituting the movable switch member of the automatically-opening switch, is pivotally mounted within the casing on a screw or stud carried by the casing body. Said contact carrying member has a head portion 64 carrying a contact member 66 and a latch-engaging tail portion 68 extending to the opposite side of the pivot. A flexible conductor 70 electrically connects the winding of the electro-magnet 56 with the contact carrier 62 for completing the electrical circuit between the contact 66 and the line terminal 24 and permitting the contact carrier 62 to swing about its pivot in a circuit opening or counter-clockwise direction.

The contact carrier 62 is constantly biased for movement in a counter-clockwise direction to open position by a tension coil spring 74 connected at one end to the carrier 62 and at its other end to a switch-condition indicator 76 pivotally mounted above the carrier 62 on a screw or stud 77 of the casing body. A bimetal strip 78, comprised of two metals having different coefficients of expansion secured together back to back, is mounted on the bottom wall of the casing with its free end adjacent to the electro-magnet 56. A projecting latch plate 80 is secured on the free end of the bimetal strip on its side away from the electro-magnet providing a latching shoulder 82 for engagement with the end face of the tail 68 of the carrier member 62 for latching the latter in its closed position. The heating element 59 extends adjacent to the bimetal strip and serves also as a heating element for causing warping of the bimetal strip in response to overloads of predetermined duration. Warping of the bimetal strip causes its end to swing in a clockwise direction free of the tail 68 of the carrier member 62, thereby permitting the spring 74 to swing this carrier member to open position. Simultaneously, the indicator 76 is swung about its pivot by spring 74 to bring its indication "off" in front of a window 84 in the top wall of the casing.

Heavier overloads in the circuit, such as a short circuit, cause the electro-magnet instantly to attract the free end of the bimetal strip, thereby to release the carrier member 62 for movement to "off" position by its biasing spring 74.

Resetting of the trip mechanism may be accomplished by an actuator 86 pivoted to the casing body by a stud or screw 88 and having an arm 90 extending into engagement with a projection 92 on the carrier member 62 in the region of the connection of spring 74 thereto. A projection 94 on the manually operable member is adapted to engage an edge face 87 of the actuator 86 when the manual member is moved to its open position and this engagement causes the actuator to rotate clockwise and the arm 90 of the actuator to force the carrier member 62 to closed

position against the pull of the biasing spring 74. As soon as the tail 68 of the carrier member 62 reaches a point beyond the shoulder 82 on the bimetal strip the latter will snap into place to latch the contact carrier member 62 in closed position.

In the circuit closed condition of the device, the movable members 44 and 62 of the manual and automatic switches are engaged, the respective contacts 72 and 66 thereof being in contact. When the manual operating member 42 is moved to a position corresponding to circuit open position, the movable switch member 44 is moved into the position illustrated in Fig. 4, opening the circuit through the contacts, the switch member 62 being held in its position by the thermal latch 78. When the circuit is closed by reason of the engagement of the contacts 72 and 66 and the latch releases the movable switch member 62, said member is moved by its spring 74 to the open circuit position illustrated in Fig. 3, the movable switch member 44 remaining substantially in its circuit closed position, although advancing slightly in such position, by being brought by its spring 46 against a stop pin or abutment 110 of the casing body. Movement of the manual operating member 42 in a switch opening direction effects the resetting of the member 62 into its closed position and moves the switch member 44 in an opening direction, the switch member 44 moving away from its closed position before the switch member 62 is completely reset.

The actuator or resetting member 86 may be provided with a cam surface 96 arranged when rotated in a counterclockwise direction to engage the free end of the bimetal strip and push the latch in a tripping direction and out of engagement with the switch member. This is useful in cases where a plurality of units are combined for multi-pole circuit control. Similarly for use in multi-pole circuit breakers an opening 98 is provided in each actuator 86 through which a bar 100, see especially Figs. 13 and 15, may extend to connect within the casings the actuators of a series of units for simultaneous operation. Thus, when any particular unit is tripped automatically and its actuator caused to move counter-clockwise by the opening movement of its associated switch member 62 under urge of its spring 74 the cam surfaces 96 on the actuators of associated units will cam the free ends of the latching strips of those units out of engagement with their respective switch members causing those members to be tripped to open position by their biasing springs 74 substantially simultaneously with the tripping of the first unit.

The invention provides also for simultaneous resetting of the latches in a multi-pole circuit breaker. For this purpose an opening 102 is provided in each manually operable member 42 through which a bar 104 may extend to connect a series of manually operable members for movement in unison. Thus the resetting of the latches may be accomplished by moving the manually operable member counter-clockwise to its switch open position, thereby causing the lug 94 on each to engage the actuator 86 of its unit thereby causing the actuator to move the associated contact carrier 62 to closed position where it becomes latched by its bimetal strip.

To facilitate adaptation of individual units for multi-pole circuit control, the rear wall of each casing may be provided with thinned wall portions, see especially Fig. 12, constituting "knock out" regions from which the thinned wall mate-

rial may be removed to provide slots 106, 108 in these walls through which the connecting bars 100 and 102 may extend and be operative for the automatic tripping and the resetting of multi-pole circuit breakers.

In operation, the switch unit normally will be as represented in Fig. 2 with the contacts 66 and 72 engaged and with bimetal strip 78 in latching position. The indicator 76 will be in position for its "on" indication to stand opposite the window 84. When the unit is single or is combined with other units, movement of a manually operable member 42 counter-clockwise will cause spring 46 to shift from one side to the other of the fulcrum 36, thereby to cause snap movement of contact plate 44 to its open position. A movement of the manually operable member back to its position of Fig. 2 will cause a similar snap movement of plate 44 to its closed position, a stop pin 110 limiting movement of the plate in closing direction.

If a moderate overload of extended duration occurs in the circuit, the bimetal strip 78 of the affected unit will become gradually warped as a result of heat transmitted from the heating element 58 until its end moves clear of the tail 68 of the contact carrier 62, thereby permitting spring 74 to snap this member to open position. If other units are interconnected in a multi-pole circuit their actuator cams 96 through bar 100 swing into latch releasing position, thereby tripping the associated units. Similarly, the electromagnet of any unit may trip the unit instantly for automatic opening in response to short circuits or other sudden overloads of predetermined character and cause immediate tripping of associated units.

Resetting of a circuit breaker which has been automatically tripped may be accomplished by moving the manually operable member 42 counter-clockwise which results in movement of its contact-carrying member to its circuit open position and which positively urges actuator 86 in clockwise direction by engagement of lug 94 with the actuator. Arm 90 of the actuator forces contact carrier 62 clockwise about its pivot until its tail 68 becomes engaged and held by the latch. Preferably the spring 46 of the manually operable member will be somewhat stronger than spring 74 so that spring 46 can overcome spring 74 to effect resetting of the switch carrier 62 without manual aid after the manually operable member has been moved manually to carry its spring past the center line, although the manual movement might be relied upon until the resetting of the latch is effected.

It is a feature of the invention that circuit breaker units may be produced, each complete in itself, for control of single circuits and which quickly and practically may be adapted for combination with similar units for multi-pole circuit control. This is possible according to the invention by constructing the casings with wall portions adjacent to the manually operable member and the actuator with thinned wall "knock out" regions which can provide the arcuate slots 106, 108 in these walls through which the connecting bars 100 and 104 may rigidly interconnect the manually operable members and the actuators of successive units. And yet each unit is complete and devoid of such openings when used as a unit in a single pole circuit.

As illustrated in the drawings, the connecting bars may be rectangular in cross section and of length to reach from a location close to the

outer cover wall of one end unit to a location close to the rear wall of the other end unit, the bars preferably having nice fit in the interconnected members although, if desired, mechanical means may be provided for locking them against longitudinal movement.

When it is desired to combine a series of units for multi-pole circuit control, it will be obvious that the open side of each unit will be closed by the back wall of the adjacent unit excepting one unit at the end of the group whose opening will be covered by one of the front cover plates 22. The group may be secured together by suitable bolts 112 extending through the casings of the respective units.

Referring specifically to Fig. 6, the terminal plate 32 may have its fulcrum region bifurcated as at 35 to save metal and to reduce the extent of the fulcrum bearing surfaces. Similarly, the contact-carrying plate 44 may be bifurcated as at 47 for similar reasons and to coact with the spaced fulcrum surfaces of the terminal 32. The over-center spring 46 conveniently operates between the furcations.

Preferably the bimetal strip 78 is adjustable as by the screw 79 to bring its latching end more or less over the tail of the contact carrier 62 as may be desired in any particular situation. Once the bimetal strip is adjusted to a proper setting, the head of the adjusting screw 79 may be covered as at 81 to prevent any change once the unit has been tested and shipped from the factory.

Figs. 2, 3, 4 and 5 show a vent opening 13 in the bottom wall of the casing traversed by an arc-suppressing member or screen 15 allowing venting of the arc gases from the casing, the window confronting the contacts and their path of separation.

It will be noted that when the switch is closed the current path through the movable switch members is generally in the form of a V of which the apex is the contact members 72, 66. This configuration of the current path creates a magnetic circuit tending to move the circuit interrupting arc formed between the separating contacts downwardly away from the contact members and into the venting window or passage and against the screen or other arc inhibiting device.

I claim as my invention:

1. In a circuit breaker, a contact-carrying member, an operating member therefor and a relatively fixed support for both of said members, said support comprising a rigid and arcuate generally inverted U-shaped fulcrum region whose one side is concave and seats a bearing part of the contact-carrying member, and whose opposite side is convex and seats a bearing part of the operating member, and resilient tension means acting between the two said members holding them swingably on their respective concave and convex seats, said resilient tension means being connected to said members on opposite sides of said fulcrum region for movement of one of said members to shift the line of tension of said resilient tension means from one side to the other of said fulcrum region prior to movement of the other said member, thereby providing over-center snap movement of the other said member in the general direction of shifting of the said line of tension.

2. In a circuit breaker, the combination as in claim 1 wherein the said support and the said contact-carrying member are electrical conductors constantly held by said resilient tension

means in intimate electrical contact with each other at said fulcrum region and through which current passes when the switch is closed, said intimate electrical contact being promoted by frictional rubbing incident to movement of said contact-carrying member.

3. In a circuit breaker, a contact-carrying member, an operating member therefor and a fixed support comprising a rigid and arcuate generally inverted U-shaped fulcrum region on whose opposite sides the two said members are separately fulcrumed in opposed relation, a coil spring stretching between mid points on said members at one side of their fulcrums holding said members in said fulcrumed relations and shiftable to the other side of their fulcrums by movement of one of said members while the other is stationary, thereby to produce movement of the other member in the same general direction with over-center spring snap action, a second contact-carrying member mounted on an axis parallel to the axis of the first contact-carrying member for swinging movement toward and from the first member and biased for movement away therefrom to its circuit open position; a latch releasably maintaining said second contact-carrying member in its circuit closed position opposing said biasing means, and means responsive to circuit overloads for tripping said latch.

4. In a circuit breaker, the combination as in claim 3 wherein the said second contact-carrying member has a head part on which its contact is mounted and a tail part engageable by said latch, and a coil spring is secured at one end to the second contact-carrying member on the tail side of its pivot and at its other end to a relatively stationary point of anchorage, thereby to provide said bias.

5. In a circuit breaker, a pivoted contact-carrying member having a head on which its contact is mounted at one side of its pivot and a tail at the other side of its pivot engageable by a latch, an indicator pivotally mounted on an axis parallel to the axis of said member, a coil spring secured at one end to the indicator on the near side of its pivot and at its other end to said contact-carrying member on the tail side of its pivot, whereby the line of tension of the spring constantly coincides with a straight line passing through the pivot of the indicator and the point of the spring's securement to the contact-carrying member, and means coacting with the indicator whereby the latter visually indicates the position of the contact-carrying member.

6. In a circuit breaker, two movable contact-carrying members, one being pivoted and having a head on which its contact is mounted at one side of its pivot and a tail at the other side of its pivot, an actuator for moving the pivoted contact-carrying member to a circuit closed position, means normally free from effects of movement of the other contact-carrying member biasing said pivoted member to circuit open position, a latch engageable with the tail of said member for latching it in its circuit closed position in opposition to said biasing means, said latch comprising a flexible strip free from current flow having a keeper at a movable part thereof, and means associated with the strip and responsive to circuit overloads for causing movement of the keeper part of the strip to latch-releasing position.

7. In a circuit breaker, the combination as in claim 6 wherein the said flexible strip is a thermally warpable bimetal strip, and said circuit

overload responsive means is an electric heater arranged adjacent to the strip and connected in the circuit which is being controlled for moving the keeper to latch-releasing position in response to persistent moderate overloads in the circuit.

8. In a circuit breaker, the combination as in claim 6 wherein said circuit overload responsive means is an electro-magnet mounted adjacent to the keeper part of said strip and connected in the circuit which is being controlled, for moving the keeper to latch-releasing position in response to sudden large overloads in the circuit.

9. In a circuit breaker, a casing, two contact-carrying members, an actuator and a manually operable member all mounted swingably on parallel axes within the casing, said contact-carrying members being movable toward each other to circuit closed positions thereof and independently movable away from each other to circuit open positions thereof, means biasing one of the contact-carrying members to its circuit open position, a latch engageable with said biased member for holding it in its circuit closed position in opposition to said bias, electro-responsive means for tripping the latch upon the occurrence of a predetermined abnormal condition in a circuit, said actuator being constructed and arranged and being in position to be engaged and swung in one direction on its pivot by the movement of the biased member when the latch is tripped, and coacting means respectively on the manually operable member and on the actuator whereby a movement of the manually operable member swings the actuator in opposite direction for moving the biased member to circuit closed position, for resetting of its latch.

10. In a circuit breaker, two contact-carrying members, an actuator and a manually operable member all mounted on parallel axes, the two said contact-carrying members being swingable toward each other to circuit closed positions and from each other to circuit open positions, means biasing one of said contact-carrying members to its circuit open position, a latch engageable with the biased member for holding it in circuit closed position in opposition to its said bias, and means responsive to circuit overloads for tripping the latch independently of movement of the manually operable member, there being means on the manually operable member and on the actuator for rigid connection of these members to corresponding members of similar circuit breaker units in a multi-pole electric circuit.

11. In a circuit breaker, two contact-carrying members, an actuator and a manually operable member all mounted on parallel axes, the two said contact-carrying members being swingable toward each other to circuit closed positions and from each other to circuit open positions, means biasing one of said contact-carrying members to its circuit open position, a latch engageable with the biased member for holding it in circuit closed position in opposition to its said bias, and means responsive to circuit overloads for tripping the latch independently of movement of the manually operable member, there being means on the actuator for rigid connection to corresponding members of similar circuit breaker units in a multi-pole electric circuit.

12. In a circuit breaker, the combination as in claim 10 in which a casing encloses the described mechanism and there are thinned knock-out regions in the walls of the casing adjacent to said means for connecting the actuator to corresponding members of other units whereby rigid means

may extend through the casing wall from the actuator of one unit to the actuator of an adjacent unit.

13. A multi-pole circuit breaker comprising a series of switch mechanisms, one contact of each switch mechanism being biased to circuit opening position, a separate latching means for each biased member engageable therewith for holding it in circuit closed position, electro-responsive means associated with each latching means for tripping the associated latching means in response to overloads in a circuit, a separate actuator for each biased member mounted and arranged to be moved in one direction by its biased member when released, a manually operable member engageable with each actuator for moving the actuator in direction to move the biased member to circuit closed position, and rigid means interconnecting all of the manually operable means and another rigid means interconnecting all of the actuators whereby a movement of either the actuator or the manually operable means associated with any one pole produces a corresponding movement of these members associated with the other poles.

14. A multi-pole circuit breaker comprising a series of switch mechanisms, one contact of each switch mechanism being biased to circuit opening position, a separate latching means for each biased member engageable therewith for holding it in circuit closed position, electro-responsive means associated with each latching means for tripping the associated latching means in response to overloads in a circuit, a separate actuator for each biased member mounted and arranged to be moved in one direction by its biased member when released, a manually operable member engageable with each actuator for moving the actuator in direction to move the biased member to circuit closed position, and rigid means interconnecting all of the actuators for simultaneous movement.

15. In an electric switch, terminals, manual means including a contact-carrying member for opening and closing the circuit between said terminals with a snap action, automatically acting means including a second contact-carrying member and an actuating member responsive to an overload to interrupt the circuit between said terminals, means including a manual operating member reciprocable between positions corresponding to circuit open and circuit closed positions operative to effect the operation of said first named means, and coacting means respectively on the manual operating member and on said actuating member operative in response to a movement of said manual operating member in one direction to restore the condition of said operated automatically operative means.

16. In an electric switch, input and output terminals, a pivoted contact-carrying member reciprocable between circuit closed and circuit open positions thereof, a second contact-carrying member, electro-responsive means normally maintaining said second contact-carrying member in a closed circuit position thereof, means operative upon the operation of said electro-responsive means for moving said second contact-carrying member into a position interrupting the circuit between said terminals, operating mechanism for said contact-carrying members including an operating handle reciprocable between positions corresponding to open circuit and closed circuit conditions of the switch, means responsive to the movements of said handle for moving said

pivoted contact-carrying member into and out of closed circuit and open circuit positions with a snap action, and means including a pivoted actuator and coacting elements respectively on the operating handle and on said actuator responsive to a movement of said operating handle operative to restore said second contact-carrying member to a circuit closed position.

17. An electric circuit breaker comprising an overload contact-carrying member, a manually operated contact-carrying member, an operating handle reciprocable between positions corresponding to open circuit and closed circuit conditions of the circuit breaker, mechanism operated by said handle in its reciprocatory movements effective to open and close said manually operated contact-carrying member with a snap action independently of corresponding movement of said handle, and mechanism including a pivoted actuator and interengaging means respectively on said handle and on said actuator operated by said handle in one only of its two reciprocatory movements operative to restore the position of said automatically operative contact-carrying member following an overload opening thereof.

18. A circuit breaker comprising terminals, a manually operable contact-carrying member and an overload opening contact-carrying member connected in series between said terminals, a manual operating handle reciprocable between positions corresponding to circuit closed and circuit open conditions of the breaker, operating mechanism for the manual switch including an over-center spring responsive to reciprocatory movements of said handle for opening and closing the circuit through said manual contact-carrying member with snap action independently of corresponding movement of said handle, and mechanism responsive to a movement of said manual handle operative to effect closing of said overload contact-carrying member following an opening thereof, said mechanisms being operative to effect opening of the manual contact-carrying member prior to reclosing of the automatic contact-carrying member.

19. A circuit breaker comprising terminals, a manual switch member and an overload opening switch member connected in series between said terminals, said manual switch member being movable between open and close positions, an operating handle reciprocable between positions corresponding to open and closed conditions of the breaker, operating mechanism including an over-center spring connecting said handle and manual switch member effective following a predetermined movement of said handle operating in appropriate directions to move said switch member out of open circuit and out of closed circuit positions with snap action and to hold both said switch member and said operating handle yieldingly in open circuit and in closed circuit position, means associated with said overload opening switch member releasably holding said overload switch member in a closed circuit position thereof, means operative following the release of said switch member by said holding means to move said switch member into an open circuit position, and closing mechanism therefor responsive to a movement of said manual operating handle for effecting movement of the overload switch member into a closed position but only after said manually operating switch has been moved out of closed position.

20. In a circuit breaker, two swinging switch members arranged in generally parallel confront-

ing relation having mutually engageable contacts at their similar ends, manually operative means for effecting movement of one switch member with snap action toward and away from the other independently of control of said manually operative means following initiation of the snap action movement, electro-responsive means for moving the other switch member away from the first, the operating means for said switch members having inter-operating parts operable to effect the closing of the automatically opened switch member in response to an operation of the means for operating the other switch member.

21. A multi-circuit breaker comprising a circuit breaker unit for each circuit, each unit comprising terminals and a manually opened and closed switch and an automatically opened switch in series between said terminals, each automatically opened switch having electro-responsive means for effecting its opening, each of said automatically opened switches having an actuator and the actuators of all automatically opened switches being connected for unitary movement in response to operation of the electro-responsive means of any one of the automatically opened switches for effecting the opening of the other automatically opened switches, and said manually opened and closed switches having means for restoring all of said automatically opened switches to closed position by movement of said manually opened and closed switches to open position.

22. A multi-circuit breaker comprising a circuit breaker unit for each circuit, each unit comprising terminals, an automatically opening switch and manual means for opening and closing the circuit between said terminals, each automatically opening switch comprising a movable contact member, electro-responsive means for maintaining said contact member releasably in closed position, and means for moving said contact to open position following operation of said electro-responsive means, means associated with all of said automatically opening switches effective in response to the opening movement of one of said switches to effect the opening movement of all other switches, including a cam member associated with each electro-responsive means movable into engagement therewith to move it in a direction to release its associated switch member, each cam member being positioned to be operated in a direction to disengage its associated electro-responsive means upon movement of its associated switch member in a circuit opening direction, means interconnecting said cam members for conjoint operation in the same direction, and a manually operated member having means acting through said cam members for restoring them to an initial position and for resetting the overload opening switches associated therewith into closed position.

23. In an electric switch, an operating member movable manually between positions corresponding to circuit open and circuit closed conditions of the switch, a switch member movable between corresponding positions, circuit making and breaking contacts controlled by said switch member, means including an over-center spring for moving said switch member into and out of circuit open position with snap action, a circuit opening member normally maintained in a position corresponding to the circuit closed condition of the switch, circuit making and breaking contacts controlled by said circuit opening member, all contacts being in series relation, electro-responsive means for effecting movement of said

circuit opening member out of circuit closed position, and means responsive to movement of said manual operating member for restoring said circuit opening member to circuit closed position.

24. In an electric switch, an operating member 5 movable manually between positions corresponding to circuit open and circuit closed conditions of the switch, a switch member movable between corresponding positions, circuit making and breaking contacts controlled by said switch member, means including an over-center spring for 10 moving said switch member into and out of circuit open position with snap action, a circuit opening member normally maintained in a position corresponding to the circuit closed condition of the switch, circuit making and breaking contacts controlled by said circuit opening member, all contacts being in series relation, electro-responsive means for effecting movement of said 15 circuit opening member out of circuit closed position, and means responsive to movement of said manual operating member for restoring said circuit opening member to circuit closed position and as a part of the same movement for moving

said switch member into open circuit position, said movement of said switch member into open circuit position being effected prior to restoration of said circuit opening member into circuit closed position.

25. In a circuit breaker, a contact-carrying member, an operating member therefor and a relatively fixed support for both of said members, said support having a fulcrum region providing 10 separated fulcrum bearing surfaces for said contact-carrying member and said operating member on which bearing surfaces said members are separately swingable about a common axis, resilient tension means acting between the two said 15 members and holding them in opposed relation on their respective fulcrum bearing surfaces, said resilient tension means being connected to said members on opposite sides of said fulcrum region for movement of one of said members to shift the 20 line of tension of said resilient tension means from one side to the other of said fulcrum region prior to movement of the other said member.

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