Feb. 27, 1945. E. H. TAYLOR 2,370,206

CIRCUIT BREAKER

Filed Jan. 19, 1943 3 Sheets-Sheet 1

Fig. 1.

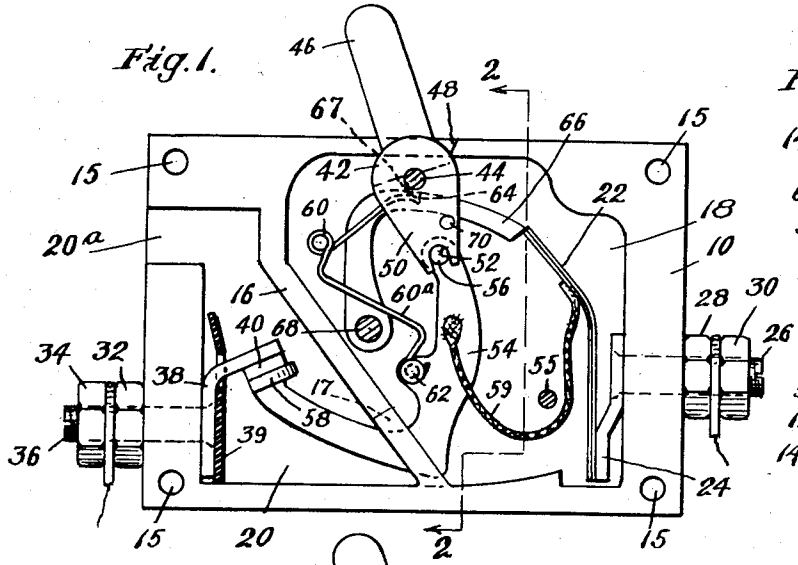


Fig. 2.

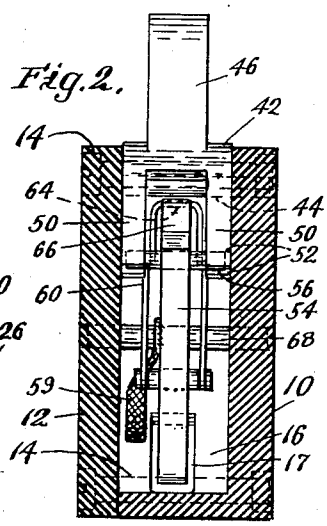


Fig. 3.

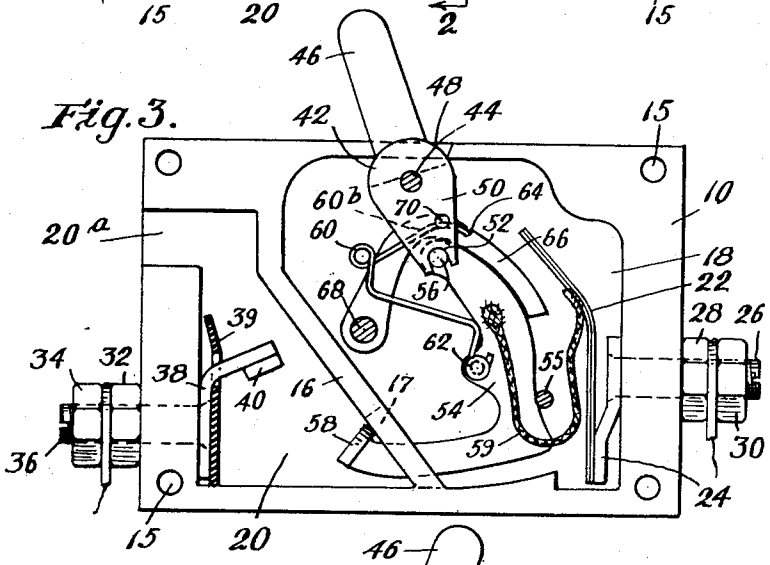


Fig. 4.

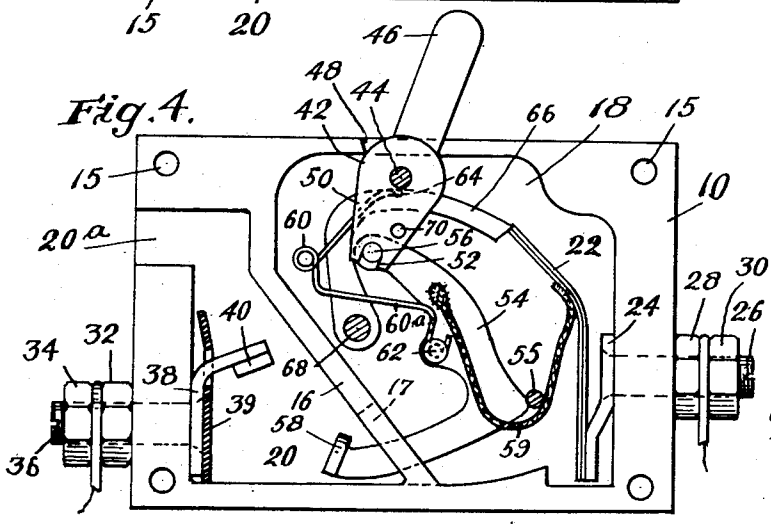
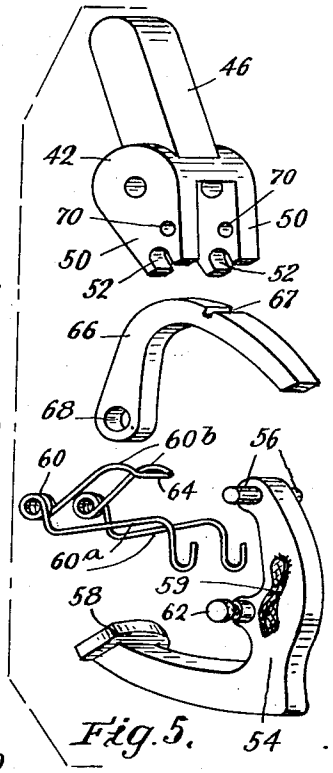


Fig. 5.



Inventor.

Elmer H. Taylor

by [illegible] Atty

Feb. 27, 1945. E. H. TAYLOR 2,370,206

CIRCUIT BREAKER

Filed Jan. 19, 1943 3 Sheets-Sheet 2

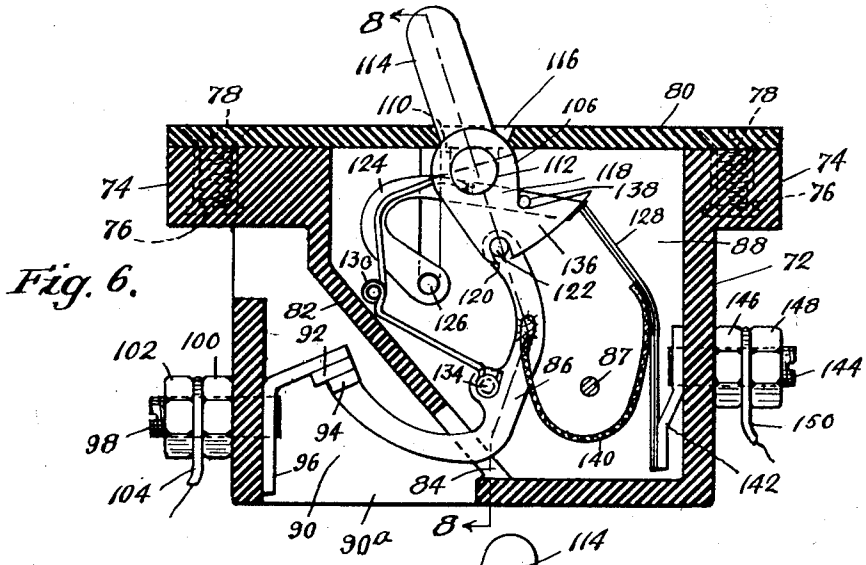


Fig. 6.

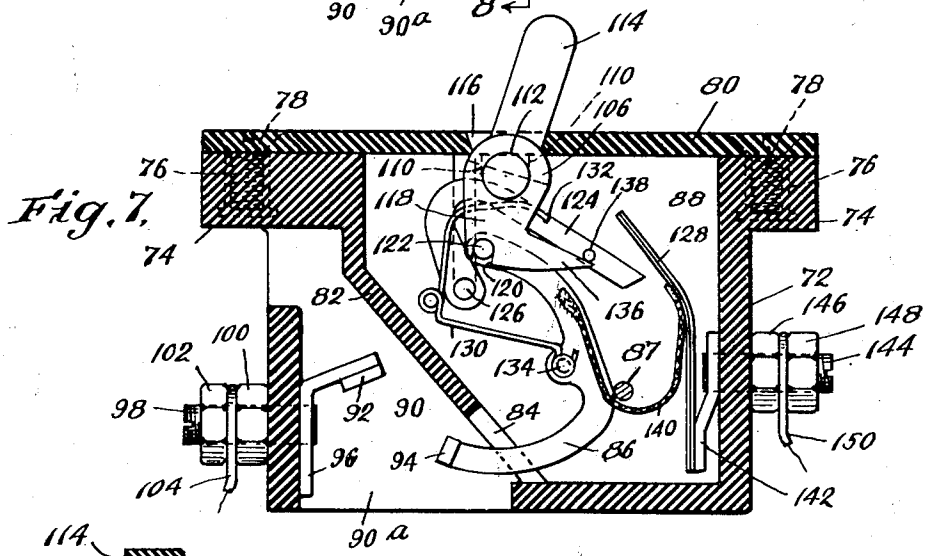


Fig. 7.

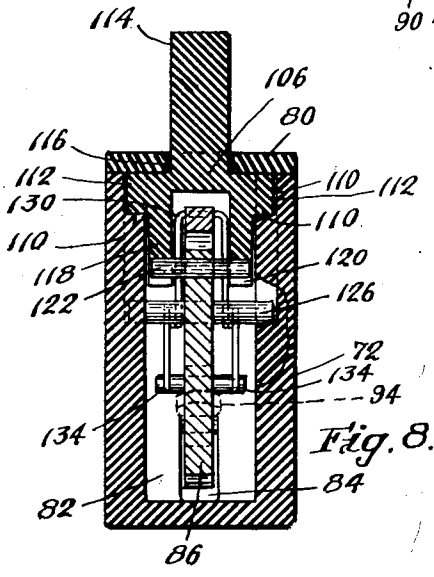


Fig. 8.

Inventor.
Elmer H. Taylor
by J. Jamieson atty

Feb. 27, 1945. E. H. TAYLOR 2,370,206

CIRCUIT BREAKER

Filed Jan. 19, 1943 3 Sheets-Sheet 3

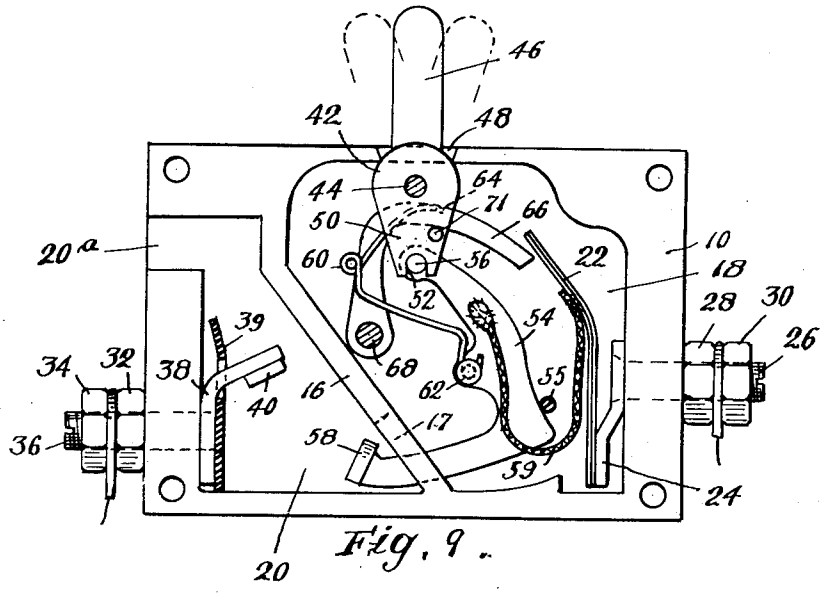


Fig. 9.

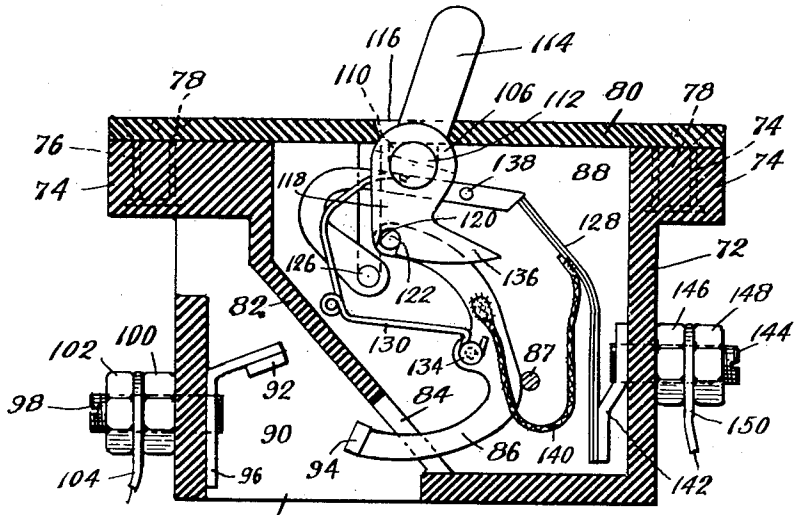


Fig. 10.

Inventor.
Elmer H. Taylor
by T. T. Greenwood
Atty

Patented Feb. 27, 1945 2,370,206

UNITED STATES PATENT OFFICE

2,370,206

CIRCUIT BREAKER

Elmer H. Taylor, Newburyport, Mass., assignor to The Chase-Shawmut Company, Newburyport, Mass., a corporation of Massachusetts

Application January 19, 1943, Serial No. 472,868

18 Claims. (Cl. 200—116)

This invention relates to improvements in circuit breakers and more particularly to circuit breakers of the general type wherein a switch is manually operable, under normal conditions in an electric circuit, for opening and closing the circuit manually at will, and is automatically operable to open the circuit in response to abnormal circuit conditions. The invention is particularly intended to provide a circuit breaker of small dimensions and one that can be manufactured at relatively low cost. The invention provides a simplified structure and arrangement of coacting elements, preferably having a desired sudden or snap action of opening and closing, including means whereby the manually operable means may be actuated to circuit open position in response to automatic opening of the circuit breaker, or may continue in circuit closed position notwithstanding automatic opening of the breaker or, as a result of the independent automatic opening, may assume some position indicative of such opening.

The primary purpose of automatic circuit breakers in electric circuits, in addition to serving as switches to manually open and close their circuits, is to protect the circuits and surroundings against the damaging effects of short-circuits and other abnormal current conditions in the circuits and more particularly to guard against burning out or other injury to electrical circuits and equipment connected therein. In house circuits and in many power circuits, for example, after the automatic opening of a circuit breaker in response to an abnormal circuit condition, it is important and desirable that the circuit breaker cannot be maintained closed against an abnormal circuit condition. Therefore, for such circuits, it is usual to have the automatic circuit opening means trip free from control by the manually operated means, so that the circuit can be opened by the overload responsive means without possibility of preventing such opening by the manually operated means. Subsequent movement of the manually operable means to some position, as to a circuit open position customarily effects a resetting movement of the automatic means and, if the abnormality no longer exists, the circuit can be re-closed manually and will remain closed unless opened by a subsequent abnormality or by being manually opened.

There are cases, nevertheless, where the desirable circuit breaker protection of a circuit and the electrical devices therein must be subjugated to a more urgent and necessary requirement that one or more of the electrical devices in a circuit be capable of being operated notwithstanding an abnormal circuit condition which has caused automatic opening of the circuit breaker. In aircraft and other installations where human lives may depend upon the ability of some one or more electrical devices to be operated notwithstanding abnormalities in the circuit, it becomes important to provide for manually holding the breaker closed to insure the operation of the device, landing gear mechanism, for instance, operated thereby notwithstanding the tendency of the breaker to open because of some circuit abnormality. Hence, for such conditions the circuit breaker is required to be non-trip-free of the manually operable means. In other words, the automatic tripping means and the manually operable means must be associated and combined in a manner which enables the manually operated member of the breaker to hold the circuit controlling element in closed circuit condition in spite of the circuit opening position of the abnormally responsive means.

An object of the present invention is to provide a circuit breaker mechanism which can be trip-free or non-trip-free of the manually operable means merely by a simple change of the mechanism, as by the presence or absence of a readily insertible and removable element. A contact carrying member is manually operable between circuit open and circuit closed positions with overcenter spring snap action, and is automatically operable to circuit open position with a similar snap action in response to circuit abnormalities of predetermined character. The automatic tripping means and the manually operable means are arranged and adapted to coact for simultaneous circuit opening movement in response to automatic tripping of the circuit breaker if and when a pin or lug is present on one or the other of said means, and in absence of such pin or lug, the automatic tripping means can move to circuit opening position without affecting the manually operative means. The providing of an efficient construction and arrangement of elements for accomplishing this interchangeability is a further object of the invention.

Another object of the invention is to provide a circuit breaker having a fulcrumed contact carrying member operable between open and closed positions by over-center spring action and having both ends of the spring movable independently of each other relative to the fulcrum of the contact carrying member, one of said

movements being to shift the line of action of the spring from side to side of the fulcrum. Also the fulcrum is movable across the line of action of the spring from side to side thereof. For manual operation, the fulcrum of the contact carrying member is shifted across the line of action of the spring, and for automatic operation, one end of the spring is rotated about the other end until the line of action of the spring is shifted from one side to the other of the fulcrum of the contact carrying member, after which said other end of the spring acts to snap the contact carrying member either to open or closed position. The structure and combination of elements for producing this compound shifting of the operative effect of an over-center spring is an important feature and object of my present invention.

Still another object of the invention is to provide an organization of coacting electrical contacts whereby a definite and substantial lateral rubbing of the engaged contacts precedes each manual separation thereof by snap action. The contact carrying member is fulcrumed on a pivoted manually operable member, the fulcrum being between the pivot and the carried contact so that the initial movement of the contact carrying member in response to an opening movement of the manually operable member is generally parallel to the plane of the face of the stationary contact of the circuit breaker. This contact-cleaning feature constitutes yet another object of the invention.

It is moreover an important object of the invention to generally improve the construction and operation of circuit breakers.

Certain features of this invention common with the present disclosure are described and claimed in the copending application of Morris B. Wood, Serial No. 450,029, filed July 7, 1942, and assigned to the assignee of the present application.

In the accompanying drawings—

Fig. 1 is a side elevation of a circuit breaker embodying features of my present invention, the cover plate being removed;

Fig. 2 is a cross-sectional view on line 2—2 of Fig. 1, but having the cover in place;

Fig. 3 is a view similar to Fig. 1 showing the parts in automatically tripped positions, the automatic tripping means being trip-free of the manually operable means;

Fig. 4 is a similar view showing the parts in manually opened positions;

Fig. 5 shows the movable elements of the circuit breaker in separated relation, each in perspective;

Fig. 6 shows a slightly modified form of circuit breaker including means making it non-trip-free of the manually operable means;

Fig. 7 is a view similar to Fig. 6 with the parts in automatically tripped positions;

Fig. 8 is a cross sectional view on line 8—8 of Fig. 6;

Fig. 9 is a side elevation of the circuit breaker of Figs. 1–4 but converted to a non-trip-free device, the parts being shown in automatically tripped positions; and

Fig. 10 is a side elevation of the circuit breaker of Figs. 6–8 with the parts in manually opened positions.

Referring to the drawings, and more particularly to Figs. 1–5, the housing 10 is represented as a rectangular shallow box of relatively small dimensions having one side closed by a removable cover plate 12, secured in place by screws or bolts 14 or the like passed through holes 15 of the housing body. The housing preferably is molded of a suitable insulating material, and has an inclined partition 16 dividing the interior of the housing into an operating chamber 18 and a circuit interrupting chamber 20. The operating parts of the circuit breaker are disposed mainly within chamber 18. Also in this chamber 18 is a bimetal strip 22 composed of two metals having dissimilar coefficients of thermal expansion secured together back to back mounted at its lower end on a conducting plate 24 which is held in place against the inner face of the side wall of the chamber 18 by the terminal screw 26 having suitable external conductor-engaging means as the nuts 28, 30 between which one conductor of a circuit may be clamped. The other circuit conductor may be engaged by similar means as clamped between exterior nuts 32, 34 on a terminal screw 36 which maintains the conducting plate 38, carrying fixed contact 40, in place in the circuit interrupting or arc chamber 20. As represented, the contact carrying end of plate 38 projects through an insulating shield 39 thereby to prevent arcing between the plate 38 and the movable contact member later to be described.

The operating mechanism of the circuit breaker comprises a manually operable member 42 which is pivotally mounted on a pivot pin 44 passed through said member and having bearings in the side walls of housing 10, close to the top wall as viewed in the drawings. The manually operable member 42 has a handle part 46 projecting through and movable alternately in opposite directions in a slot 48 in the top wall of the housing, and has a bifurcated part extending below the pivot 44, the spaced parallel furcations or ears 50, 50 each having a fulcrum groove 52 at its lower end, the grooves being co-axial.

A contact carrying member 54 herein conveniently of generally V-shaped is fulcrumed or pivoted on the manually operable member 42, the free end of the generally vertical leg of the member 54 being provided with the oppositely laterally extending co-axial trunnions 56 engaging in the fulcrum grooves 52 of the depending ears 50, 50. The other generally horizontal leg of the V-shaped contact carrying member 54 extends freely through a restricted opening 17 in partition 16 and carries at its free end the contact 58 for coacting with the fixed contact 40 when the circuit breaker is closed. The primary purpose of the partition and opening is to isolate the operating mechanism from the circuit interrupting arc. A flexible conductor or pig tail 59 is connected at one end to the contact carrying member 54 and at its other end to the bimetal strip 22 sufficiently remote from the anchored end thereof so that the over-current traversing the strip will develop therein enough heat to effectively warp it.

An over-center spring 60, illustrated as of the rat trap variety, maintains the contact-carrying member 54 in fulcrumed engagement with the manually operable member 42, the lower arms 60*a* of the spring engaging the oppositely laterally disposed end parts of a pin or lug 62 passed through the fulcrumed leg of the V-shaped contact carrying member at a mid part thereof, and the other legs 60*b* of the spring having an integral transverse connection 64 normally an-

chored at the opposite side of the fulcrum 56 as will be explained more fully hereinafter.

The arrangement is such that, with the parts in their normal circuit closed positions of Fig. 1, the line of action of the spring is on the left hand side of the fulcrum 56. A movement of the handle 46 to the right to circuit open position (Fig. 4) causes the fulcrum 56 to move to the left across the line of action of spring 60 and the spring thereupon snaps the contact carrying member 54 to open position. The spring, in thus opening the circuit breaker with snap action, itself swings to the right about its normally fixed anchorage at 64. A stop pin or other suitable abutment 55 limits the opening travel of the contact carrying member 54. Movement of the handle 46 to the left from its circuit open position of Fig. 4 to its circuit closed position of Fig. 1 causes the fulcrum 56 to move to the right across the line of action of the spring 60, whereupon the spring snaps the contact carrying member 54 to its circuit closed position of Fig. 1 with the line of action of the spring again on the left hand side of fulcrum 56, strongly urging the contacts 40, 58 together. Due to the action of the spring in constantly urging the contact carrying member upwardly and pressing it against the operating member it is possible to use the fulcrum pin 56 which is merely seated in the bottom of the groove 52, since there is no tendency at any time to dislodge the pin.

According to the invention the circuit breaker is automatically openable upon the occurrence of abnormalities in the circuit of predetermined character creating an excess current condition without possibility of hindrance by the manually operable member and, if desired, without changing the position thereof. In other words, the automatic circuit opening means is trip-free of the manually operable means in the form of the invention illustrated in Figs. 1–5.

A hook-shaped overload responsive lever 66 is pivoted at 68 in the side walls of housing 10 and has an upper generally horizontal part that extends between the furcations or ears 50, 50 of the manually operable member 42 above the top of the contact carrying member 54 with its free end abutting against and normally engaged by the free end of the bimetal strip 22 which latches the lever 66 in its elevated unoperated position of Figs. 1 and 4. The normally fixed point of anchorage 64 of spring 60 is on this lever 66, continually urging the lever in clockwise direction about pivot 68, the anchorage 64 being retained in a notch 67 of the lever. The lever, however, normally is effectively held against movement by the bimetal strip 22. If an abnormal condition occurs in the circuit, creating current heavy enough to heat the bimetal strip to cause sufficient warping of the strip, its latching end moves out from under the tip of lever 66 and spring 60 immediately moves the lever clockwise. The upper end of the spring also moves clockwise about its lower end as a fulcrum thus shifting the line of action of the spring from the left hand side of fulcrum 56 to the right hand side, the pivoted end 68 of the lever being sufficiently below the fulcrumed end of the movable contact carrier 54, and at the left thereof, Fig. 3, for this purpose. The clockwise movement of lever 66 is limited by the fulcrumed end of the contact carrying member 54, as seen in Fig. 3. However, before its movement is arrested, the line of action of the spring will have been shifted to the right side of fulcrum 56 and the spring thus will promptly snap the contact-carrying member to its open circuit position of Fig. 3. Meanwhile the manually operable member 46, with the arrangement and disposition of the parts shown in Figs. 1–5, remains in its circuit closed position and cannot be actuated in any manner to reclose the circuit so long as the abnormality in the circuit persists. A movement of handle 46 to the right to its circuit open position causes the fulcrumed end of the contact carrying member to cam the trip lever 66 counter-clockwise for resetting it, the bimetal strip having cooled off and returned to its original position.

It is a feature of the present invention to provide a structure whereby, with a simple change, the breaker may be connected from trip-free operation to non-trip-free operation so as to permit the circuit to be maintained closed manually regardless of the abnormal condition of the circuit.

In the device of Figs. 1–5, this conversion may be accomplished merely by inserting a pin in suitably positioned aligned holes 70 which may be provided in the depending ears 50, 50 of the manually operable member. Fig. 9 illustrates such a pin 71 in place where it underlies and is adapted, on overload, to be engaged by the trip lever 66 and shows the switch open in response to automatic tripping with the handle 46 carried to a neutral position by the spring biased trip lever 66 acting on said pin. The trip lever 66 is unlatched and its clockwise travel, in camming engagement with pin 71, has cammed the manually operable member clockwise toward its circuit open position causing the fulcrum 56 to traverse the line of spring action and the spring acting to snap the contact-carrying member to its circuit opening position. It will be noted that, in the automatic operation of the mechanism of Figs. 1–4, the movement of the freed trip lever effects opening movement of the breaker by carrying the line of spring action to the right across the fulcrum 56 of the movable contact member. With the arrangement of Fig. 9, however, the movement of the free lever cams the fulcrum across the line of spring action. While the line of spring action shifts to the right somewhat by the swing of the trip lever, its shift is not made sufficient to open the switch per se, otherwise the switch would not be non-trip-free and could not be held closed against its tendency to open on excess current. When this property of the switch is not desired, however, the disposition of the parts can be such that the spring shaft can of itself cause the opening of the switch as well as causing movement of the handle either to assist such opening movement or to indicate the opened condition.

The breaker can be reclosed by moving the handle 46 to the left to its circuit closed position. By this movement, the trip lever 66 is elevated by engagement of the pin 71 with the trip lever and the upper end of the spring is moved counter-clockwise and the fulcrum 56 is also shifted across the line of action of the spring by the handle movement so that the contact carrying member is snapped to its circuit closed position and may be manually held there notwithstanding that the trip lever 66 may be unlatched again by the abnormal condition which caused automatic opening of the circuit. It should be noted also that a movement of handle 46 to its circuit open position will cause the trip lever to be lifted to its re-set position. A clockwise movement of handle 46 causes the fulcrumed end of the contact carrying member to cam against the depend-

ing leg of the trip lever and rotate it counterclockwise and thus elevate the horizontal leg thereof to engage the bimetal latch. Hence, assuming that the circuit abnormality which caused an automatic tripping of the circuit breaker has been corrected, the automatic trip may be re-set simultaneously with a closing of the switch by moving handle 46 to its circuit closed position, or the automatic trip may be re-set by a circuit opening movement of handle 46 after which the switch may be closed by moving handle 46 to its circuit closed position. Thus, the breaker of Figs. 1 through 5 and 9 can be operated trip-free or non-trip-free as desired merely by the absence or presence of the pin 71. The pin can be loose in the holes 70 of the handle member as the sides of the enclosing housing prevent escape of the pin from the holes, or the pin may be a tight fit in the holes. Thus, the design permits the switch for widely different types of operative service for the same essential elements.

In Figs. 6–8, there is shown a modified form of circuit breaker designed to be non-trip-free of the manually operable means but which can be quickly converted to a trip-free circuit breaker. The housing 72 in this case has end flanges 74, 74 with internally threaded bushings 76 molded therein for receiving screws 78 which secure the cover plate 80 removably on the housing body 72. The interior of the housing is divided into two chambers, as in the previously described modification, by an inclined partition 82, slotted at 84 for passage therethrough of the contact carrying member 86. Chamber 88 contains the operating parts of the circuit breaker, while chamber 90 contains the fixed contact 92 with which the movable contact 94 on the contact carrying member 86 coacts.

The fixed contact 92 is carried on a plate 96 which is secured to an end wall of the housing by terminal screw 98 and nuts 100, 102, to which a lead conductor 104 may be attached.

Manually operable member 106 is mounted in chamber 88, close to the cover plate 80, and has oppositely laterally extended co-axial trunnions 112 pivotally located in the bottom of confronting grooves 110 in the side walls of the casing, the grooves being open at the top of the casing and closed by the cover 80 which overlies the trunnions and holds them in the grooves. The manually operable member 106 has a handle part 114 projecting through a slot 116 in the cover plate, and has a bifurcated part below its pivot providing ears 118 which are notched in their under sides as at 120. The contact carrying member has trunnions 122 at one end fitting in the notches 120 for fulcruming the contact carrying member on the manually operable member.

A trip lever 124 is pivotally mounted at 126 in the side walls of housing 72, below the fulcrum 122 of the contact carrying member. The lever is hook shaped and extends from its pivot up and thence across between the pivot of the manually operable member and the fulcrum 122 of the contact carrying member and also between the ears 118 of the manually operable member, with its free end in position to be latched by the bimetal strip 128. A spring 130, shown as of the rat trap type, is tensioned between the trip lever at 132 and the contact carrying member at 134, the line of action of the spring being on the left hand side of fulcrum 122 when the switch is closed, biasing the movable contact 94 strongly against the fixed contact 92. A manual movement of handle 114 to its circuit open position, as shown in Fig. 10, moves the fulcrum 122 across the line of the spring from the right side to the left side thereof, whereupon the spring promptly snaps the contact carrying member 86 to its circuit open position of Fig. 10. Pin 87 limits its opening travel. Similarly, as seen in Fig. 7, an automatic tripping of trip lever 124 moves the upper end of the spring to the right from its position of Fig. 6 until the line of action of the spring is shifted from the left hand side of fulcrum 122, as shown in Fig. 6, to the right hand side of fulcrum 122, whereupon the spring snaps the contact-carrying member 86 to its circuit open position of Fig. 7.

However, in Figs. 6 and 7, automatic tripping of the trip lever 124 causes simultaneous movement of the handle 114 from its circuit closed to its circuit open position. For this purpose, a depending ear 118, and preferably each ear, of the manually operable member has a lateral projection or toe 136 coacting with a pin 138 carried by and projecting at each side of the trip lever. The pin engages the upper surface of both toes 136 and, when the trip lever 124 is released and forced down by spring 130, the pin 138 forces the manually operable member clockwise from its circuit closed to its circuit open position. Hence, it will be obvious that the line of action of the spring moves to the right due to movement of the upper end 132 of the spring, and the fulcrum 122 simultaneously moves to the left due to the clockwise rotation of the manually operable member 106. However, it should be understood that the device of Figs. 6–8 and 10 can be quickly converted to a trip-free circuit breaker merely by removal of pin 138. In either case the circuit may enter at either of the external terminals, for example, through canductor 104 and terminal screw 98 to plate 96 which carries the fixed contact 92 whence, with the switch closed, it passes through the contact carrier 86 to the bimetal strip 128 by means of the flexible conductor or pigtail 140 which is connected at opposite ends to these elements. From the bimetal strip the current passes to plate 142 and thence through terminal screw 144, nuts 146, 146 and out through conductor 150.

In each illustrated embodiment of the invention, the initial opening movement of the contact carrying member is parallel to the face of the fixed contact, providing a substantial rubbing action while the contacts continue to be urged strongly together. This effectively cleans the contacts prior to each opening of the circuit breaker.

Also, the pigtail conductor connecting the contact carrying member and the bimetal strip, in each embodiment, has a generally U-shape whereby the magnetic repulsion as between the arms of the U acts in direction tending to move the bimetal strip out of latching position with heavy currents.

The arc chamber 20 of Figs. 1–5 and 9 has a side opening 20*a* but is otherwise closed while the arc chamber 90 of Figs. 6–10, in addition to the side opening, has a bottom opening 90*a*. The particular enclosure containing the switch casings, and the duty required of the breaker, will determine which type of chamber to employ.

I claim as my invention:

1. In a circuit breaker, a contact carrying member having a fulcrum about which it can move between circuit open and circuit closed positions, an over-center spring for actuating the contact carrying member, manually operable

means for shifting said fulcrum across the line of action of the spring to cause actuation of the contact carrying member by the spring, said spring biasing the contact carrying member and the manually operable means in opposite rotative directions and electro-responsive means for permitting shifting of the line of action of the spring from one side to the other of said fulcrum to cause actuation of the contact carrying member by the spring.

2. In a circuit breaker, a contact carrying member having a fulcrum about which it can move between circuit open and circuit closed positions, an over-center spring for actuating the contact carrying member, manually operable means for shifting said fulcrum across the line of action of the spring to cause actuation of the contact carrying member by the spring said spring biasing the contact carrying member and the manually operable means in opposite rotative directions, a pivoted trip lever carrying one end of the spring, electro-responsive means normally latching said lever against the bias of the spring and movable to release the lever upon the occurrence of a circuit abnormality of predetermined character, thereby to permit the lever to rotate its end of the spring about the other end to cause actuation of the contact carrying member by the spring to circuit open position.

3. In a circuit breaker, a contact carrying member having a fulcrum about which it can move between circuit open and circuit closed positions, an over-center spring for actuating the contact carrying member, manually operable means for shifting said fulcrum across the line of action of the spring to cause actuation of the contact carrying member by the spring said spring biasing the contact carrying member and the manually operable means in opposite rotative directions, means normally maintaining one end of the spring stationary during operation of the manually operable means and operative in response to circuit abnormalities to permit rotation of said one end of the spring about its other end to cause actuation of the contact carrying member by the spring to circuit open position.

4. In a circuit breaker, a pivoted manually operable member having a part projecting on one side of the pivot, a contact carrying member fulcrumed on said projecting part of the manually operable member, a pivoted trip lever on the side of said fulcrum toward the pivot of the manually operable member, a spring secured at one end to said trip lever and at its other end to the contact carrying member, the bias of said spring being on one side of said fulcrum biasing both the contact carrying member and the manually operable member in opposite rotative directions to their circuit closed positions, and biasing the trip lever to its tripped position, means responsive to circuit abnormalities normally holding the trip lever against the bias of the spring and operable to release the trip lever and thereby cause shifting of its end of the spring for biasing the contact carrying member to circuit open position.

5. In a circuit breaker, a contact-carrying member having a fulcrum about which it can move between circuit open and circuit closed positions, an over-center spring for actuating the contact carrying member, and means for simultaneously shifting the line of action of said spring and said fulcrum across each other to effect actuation of the contact carrying member by the spring to circuit open position.

6. In a circuit breaker, a manually operable member, a contact carrying member fulcrumed on the manually operable member, a trip lever, an over-center spring biasing the trip lever to tripped position and the contact carrying member to circuit closed position, a bimetal strip latching the trip lever against the bias of the spring and responsive to circuit abnormalities to release the trip lever, said trip lever being constructed and arranged thereby to cause shifting of the line of action of the spring across the said fulcrum to bias the contact carrying member to circuit open position, means for resetting the trip lever simultaneously with a manual reclosing of the contact carrying member, and means for resetting the trip lever independently of a reclosing of the contact carrying member.

7. In a circuit breaker, a contact carrying member having a fulcrum about which it can move between circuit open and circuit closed positions, an over-center spring for actuating the contact carrying member, means for shifting the line of action of the spring from one side to the other of said fulcrum to cause actuation of the contact carrying member by the spring, and means to shift said fulcrum across the line of action of the spring to cause actuation of the contact carrying member by the spring, and selectively insertible means for operating said means to shift said fulcrum in response to operation of said means for shifting the line of action of the spring.

8. In a circuit breaker, a contact carrying member having a fulcrum at one end, a trip member, and an over-center spring engaging the contact carrying member and the trip member on opposite sides of said fulcrum, manual means for moving said fulcrum across the line of spring action from one side to the other thereof said spring biasing the contact carrying member and the manual means in opposite rotative directions, and means for initiating movement of the trip member for causing shifting of the line of action of the spring from one side to the other of said fulcrum.

9. In a circuit breaker, a contact carrying member having a fulcrum at one end, and means for actuating it between open and closed positions comprising an over-center spring having one end engaging the contact carrying member and the other end movably supported at the opposite side of said fulcrum, electro-responsive means for permitting movement of the movably supported end of the spring to shift the line of action of the spring from one side to the other of said fulcrum thereby to cause snap movement of the contact carrying member, and manual means for moving the fulcrum of the contact carrying member across the line of action of the spring from one side to the other thereof to cause snap movement of the contact carrying member, said manual means and said contact carrying member being biased by said spring in opposite rotative directions.

10. In a circuit breaker, a manual operating member, a contact carrying member having a pivotal support on the manual operating member, an over-center spring acting with respect to said pivotal support to hold said contact carrying member in circuit closed position when the line of action of said spring is on one side of said pivotal support and to hold said contact carrying member in circuit open position when the

line of action of said spring is on the other side of said pivotal support, said manual operating member being constructed and arranged to shift said pivotal support from one side to the other side of the line of action of said spring to effect movement of said contact carrying member between said two circuit positions, a trip lever comprising a support for one end of said spring, and latch means holding said trip lever normally in an unoperated position and including a bimetal strip responsive to the heating effect of excess current to warp and release said trip lever for movement under urge of said spring into an operated position, said trip lever having a pivotal support disposed when said lever is released by said latch cause movement of the line of action of said spring from one to the other side of said pivotal support of said contact carrying member to effect a change in the position of said contact carrying member, said trip lever and one of said manual operating member and said contact carrying member having inter-engaging parts responsive to an operating movement of said trip lever to move the pivotal support of said contact carrying member across the line of action of the spring and said contact carrying member away from circuit closed position.

11. An electric switch having a manually operated member movable between positions corresponding to switch open and switch closed positions, mechanism operated thereby including a spring for permitting opening and closing of the switch, electro-responsive means for effecting opening of the switch, and means selective at will to permit the opening of said switch by the spring in response to said electro-responsive means with and also without associated movement of said manual operating member.

12. An electric switch having switch operating mechanism including an operating handle movable between positions corresponding to switch open and switch closed positions for moving said mechanism manually into and out of said positions, electro-responsive means for permitting operation of said mechanism into switch open position, and means selective at will to condition said handle for movement with said mechanism in response to the operation of said electro-responsive means and also to permit switch opening movement of said mechanism in response to operation of said electro-responsive means independently of movement of said handle into switch open position.

13. An electric switch having a manually operable member, a circuit controlling member pivotally supported by said manually operable member, an over-center spring acting on said circuit controlling member to maintain said member yieldably in circuit closed position when it is in said position and in circuit open position when it is in said latter position, a trip lever controlling the action of said spring, current responsive means controlling the action of said trip lever, said trip lever being constructed and arranged when released by the operation of said current responsive means and when free for unimpeded movement to cause shifting of the action of said spring on said circuit controlling member from a position where said spring holds said current controlling member in switch closed position to a position where it biases said circuit controlling member for movement into an open circuit position, one of said manually operable member and said circuit controlling member also having provision for engagement with said trip lever in its unlatched movement and said trip lever then having provision for movement of the member engaged thereby into circuit opening position.

14. An electric switch having a manually operable member, a circuit controlling member pivotally supported by said manually operable member, an over-center spring acting on said circuit controlling member to maintain said member yieldably in circuit closed position when it is in said position and in circiut open position when it is in said latter position, a trip lever controlling the action of said spring, current responsive means controlling the action of said trip lever, said trip lever being constructed and arranged when released by the operation of said current responsive means and when free for unimpeded movement to cause shifting of the action of said spring on said circuit controlling member from a position where said spring holds said current controlling member in switch closed position to a position where it biases said circuit controlling member for movement into an open circuit position, said manually operable member having provision for receiving an abutment positioned in the path of movement of said trip lever and said trip lever then being operative to engage said abutment and move said manually operable member in a direction to effect circuit opening movement of said circuit controlling member.

15. In an electric switch, a manually operable member, a switch member pivotally carried by said manual member, a spring biasing said members in opposite rotative directions for moving said switch member into and out of circuit closed and circuit open positions in response to corresponding movement of said manually operable member, and electro-responsive means for activating said spring to effect movement of said switch member out of one of said positions independently of manual operation of said manually operable member, said manually operable member constructed and arranged to prevent the circuit opening movement of said switch member in response to the operation of said electro-responsive means when said manually operable member is held in switch closed position.

16. In an electric switch, a pivoted manually operable member, a switch arm pivotally carried by said manually operable member, the pivot being movable with said member, a trip arm, a bimetal strip influenced by current in the switch circuit normally holding said trip arm in an unoperated position and adapted to warp on excess current and release said trip arm for operation, an over-center spring having one end connected with said switch arm and the other end connected with said trip arm, said ends being on opposite sides of the pivotal connection between said switch arm and said manually operable member and biasing said arm and said manually operable member in opposite rotative directions, said manually operable member being operative to move the pivot of said switch arm from one to the other side of the line of action of said spring and said spring thereupon being operative to change its action on said switch arm from an action which maintains said switch arm in circuit closed position to an action which moves said switch arm out of said circuit closed position, said trip arm being pivotally supported and the pivot therefor being arranged on the side of the line of action of said spring opposite the pivot of said switch arm when said

switch arm is in closed position effective to cause movement of the line of action of said spring across the pivot of said switch arm when said trip arm is released for movement to effect circuit opening movement of said switch arm.

17. In an electric switch, a pivoted manually operable member, a switch arm pivotally carried by said manually operable member, the pivot being movable with said member, a trip arm, a bimetal strip influenced by current in the switch circuit normally holding said trip arm in an unoperated position and adapted to warp on excess current and release said trip arm for operation, an over-center spring having one end connected with said switch arm and the other end connected with said trip arm, said ends being on opposite sides of the pivotal connection between said switch arm and said manually operable member, said manually operable member being operative to move the pivot of said switch arm from one to the other side of the line of action of said spring and said spring thereupon being operative to change its action on said switch arm from an action which maintains said switch arm in circuit closed position to an action which moves said switch arm out of said circuit closed position, said trip arm being pivotally supported and the pivot therefor being arranged on the side of the line of action of said spring opposite the pivot of said switch arm when said switch arm is in closed position effective to cause movement of the line of action of said spring across the pivot of said switch arm when said trip arm is released for movement to effect circuit opening movement of said switch arm, said manually operable member having provision for receiving an abutment positionable in the path of movement of said released trip arm and in position to effect movement of said manually operable member in a circuit opening direction in response to movement of said trip arm.

18. In an electric switch, a manually operable member, a switch arm pivotally carried by said member, a stationarily supported trip arm, electro-responsive means normally holding said trip arm in unoperated position, an over-center spring exerting force on said switch and trip arms tending to hold said switch arm in switch closed position when said manually operable member is in switch closed position and tending to hold said switch arm in open position when said manually operable member is in switch open position, said trip arm and said over-center spring being constructed and arranged to carry the line of action of said spring across the pivotal connection of said switch arm with said manually operable member when said trip arm is released for operation, and thereby effect the switch opening movement of said switch arm, said trip arm and said switch arm having inter-engaging parts operative to effect the resetting of said trip arm in response to a movement of said manually operable member.

ELMER H. TAYLOR.

DISCLAIMER

2,370,206.—*Elmer H. Taylor*, Newburyport, Mass. CIRCUIT BREAKER. Patent dated Feb. 27, 1945. Disclaimer filed Sept. 12, 1946, by the assignee, *The Chase-Shawmut Company*.

Hereby enters this disclaimer to claims 11 and 12 in said specification.

[*Official Gazette October 15, 1946.*]