

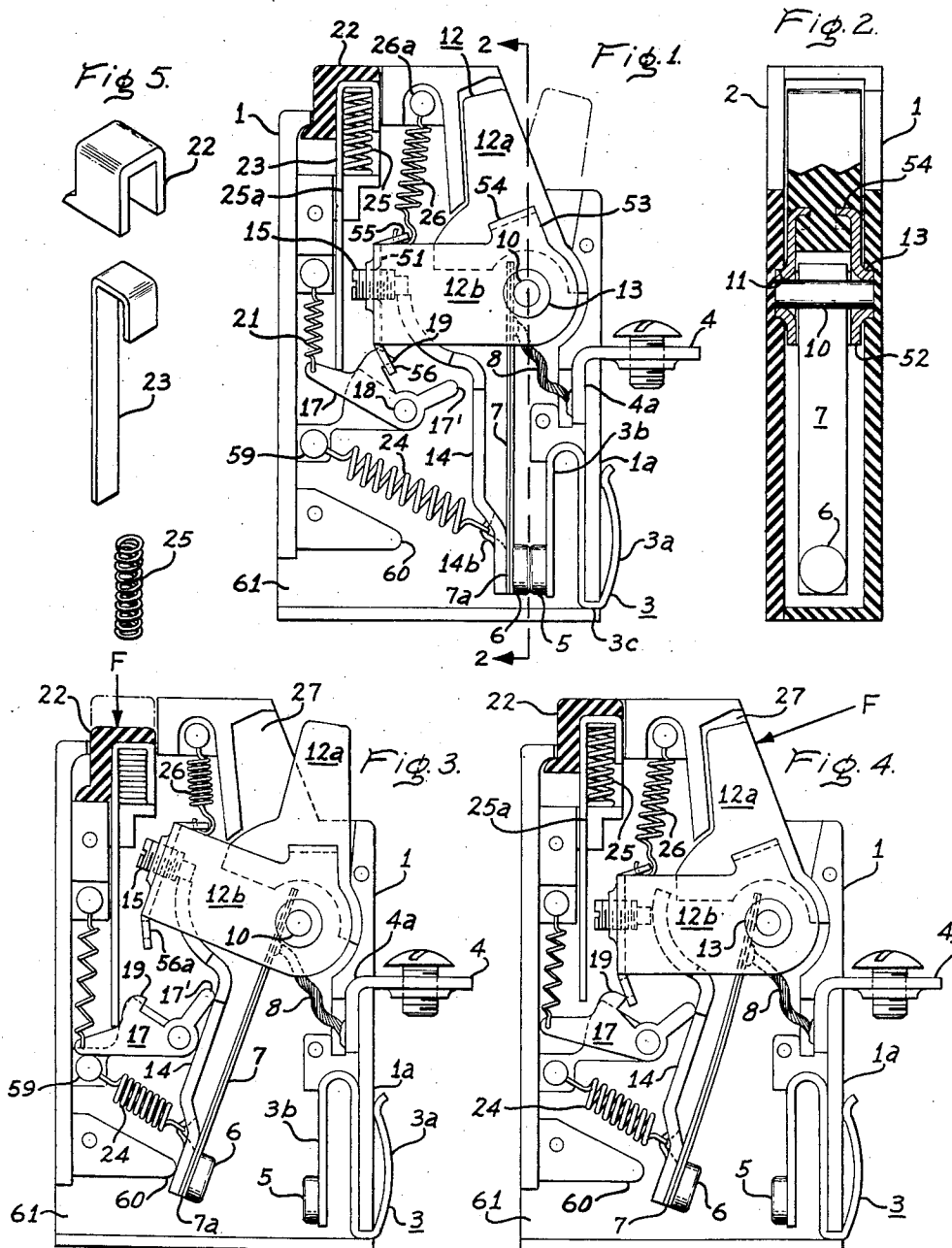
Feb. 16, 1960

R. T. CASEY
CIRCUIT BREAKER

2,925,481

Filed Oct. 7, 1954

3 Sheets-Sheet 1



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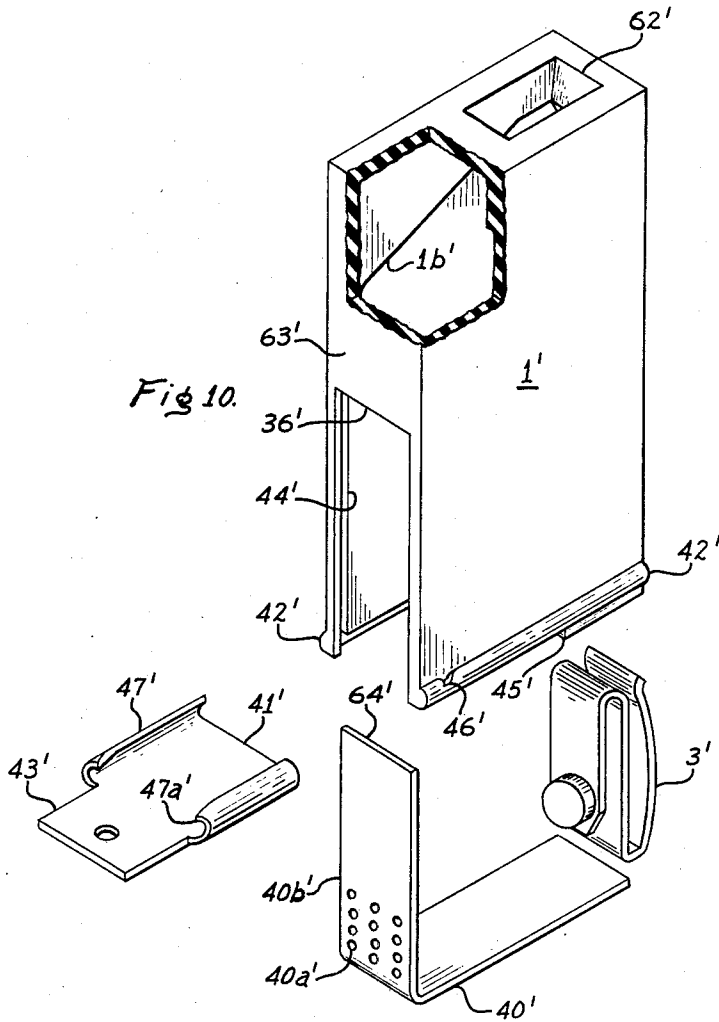
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3 Sheets-Sheet 3



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CIRCUIT BREAKER

Robert T. Casey, Southington, Conn., assignor to General Electric Company, a corporation of New York

Application October 7, 1954, Serial No. 460,882

21 Claims. (Cl. 200—88)

My invention relates to automatic electric circuit breakers and more particularly to small air circuit breakers of the type used for control of light and power circuits in residential electrical systems.

Small air circuit breakers of the type referred to in accordance with the prior art have generally required that the complete circuit breaker be assembled within its insulating housing before it can be calibrated. This renders the calibration process more difficult and unsuited to automatic machinery. In addition, the assembly of circuit breaker mechanisms in their insulating casings has not been suited to automatic processes because it has been necessary to handle a number of parts separately and to assemble them together in the casing. Furthermore, such circuit breakers have heretofore required relatively complicated mechanisms in order to provide thermal or delayed tripping action acting in conjunction with magnetic or instantaneous tripping action.

One object of my invention is to provide a simple but effective current-responsive structure which shall provide magnetic or "instantaneous" tripping action acting in conjunction with and supplementary to a thermal or "time-delay" action.

Another object of my invention is to provide an automatic circuit breaker of the type wherein an insulating enclosing casing serves as the supporting frame for the movable parts, but wherein the said movable parts may nevertheless be pre-assembled and pre-calibrated before insertion in the enclosing casing.

A further object is to provide such a circuit breaker wherein the calibration is not affected after assembly by small dimensional changes in the said insulating casing.

A further object is to provide a small, compact circuit breaker which accommodates a thermally responsive bimetallic strip (hereinafter also referred to as a "bimetal") of relatively great length to provide a large deflection at low-current values, whereby the breaker is suitable for use in protecting low-ampere rated circuits.

A still further object is to provide a small, compact circuit breaker which provides a relatively great amount of contact separation in the open circuit condition whereby the efficient interruption of short-circuit currents is assured.

In general, in accordance with my invention, I provide a simplified circuit breaker comprising a manually operable handle member and a contact-carrying member pivotally connected thereto, a pre-calibratable latching engagement normally preventing relative rotation between the handle member and the contact carrying member in one direction, current-responsive means integral with said contact-carrying member for releasing said latching engagement, and an insulating casing for rotatably supporting said connected members in suitable bearing surfaces in opposite sides thereof for rotation as a whole about the axis of their pivotal connection. The said bearing surfaces constitute the sole support for the mechanism in said casing, whereby the calibration of said latching

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means is unaffected by small dimensional changes in the casing.

I further provide a novel enclosing casing arranged to prevent access to said operating handle when it is in the "on" position, whereby the mechanism may be positively latched in the "on" position by an auxiliary latch, making possible higher-contact pressures than otherwise attainable with such a mechanism.

I also provide separate means for releasing said auxiliary latch and permitting the mechanism to open with a "snap-action."

In a simplified embodiment of my invention, I provide a one-piece open-bottom insulating casing wherein the parts may be inserted through the open bottom by straight-line motion such as is suitable for use in automatic assembly systems, the parts being held therein by a simple retaining clip, also assembled by straight-line motion.

My invention will be readily understood from the following description taken in connection with the accompanying drawings and its scope will be pointed out in the appended claims.

Figure 1 is a side view of a circuit breaker in accordance with my invention, the side cover being removed, and the mechanism being shown in the normal "on" condition.

Figure 2 is a sectional view taken on the lines 2—2 of Figure 1.

Figure 3 is a view similar to Figure 1, the mechanism being shown in the "tripped" or "off" condition, the operating handle being unrestrained by an external force.

Figure 4 is a view similar to Figure 1, the mechanism being shown in an intermediate or transient position, through which it passes during an automatic opening operation, the handle being simultaneously held in the "on" position by an external force, such as by an operator's hand.

Figure 5 is a view in perspective of a portion of the auxiliary latch releasing mechanism of the circuit breaker of Figure 1, the parts being shown in disassembled relation.

Figure 6 is a side view of a modification of my invention the casing being shown in section, and the mechanism being shown in the "off" condition.

Figure 7 is a view of the device of Figure 6 taken on the line 7—7 of Figure 6.

Figure 8 is a view of the circuit breaker of Figure 6, the mechanism being shown in the normal "on" condition.

Figure 9 is a view of the circuit breaker of Figure 6, the mechanism being shown in the thermally tripped condition, and before the bimetal has cooled to its normal condition.

Figure 10 is a view in perspective of the casing and casing closure members of the circuit breaker of Figure 6, the parts being shown in disassembled relation.

In carrying out my invention in one form, I provide a circuit breaker having a pre-calibrated mechanism assembly comprising a manually operable insulating handle and a generally V-shaped contact-carrying structure which is pivotally supported at one end of its diverging ends on the insulating handle, and which carries a movable contact adjacent the apex of the V; the other diverging end of the V-shaped structure having a releasable latch engagement with the handle; and at least a portion of the V-shaped structure being of bimetallic material, whereby upon heating, the structure deforms so as to alter the distance between the diverging ends and release the latch engagement with the handle. This assembly is pivotally supported within an insulating casing for movement as a whole between manually actuated "on" and "off" positions. Auxiliary means is preferably also pro-

vided for holding the handle in the closed-circuit position, and means for automatically releasing this auxiliary holding means upon release of the above-mentioned current-responsive latch.

Referring now particularly to Figures 1 through 5, I have shown my invention as embodied in a circuit breaker comprising an open-sided casing 1, having a cover 2, a line terminal 3, and a load terminal 4. The line terminal 3 is made of resilient conductive strip material and includes an arcuate outer portion 3a, adapted to make contact by a pressure or frictional-type connection with a connector (not shown) leading to a source of electric power, and an inner U-shaped portion 3b, carrying a stationary contact 5 and providing a resilient support therefor. The line terminal 3 is held in place in the casing 1 by being clipped onto the side wall 1a of the casing 1 and having a portion set into a slot 3c between the bottom wall and the side wall 1a. The load terminal 4 is similarly held in place by being set into an L-shaped slot or recess 4a. Certain aspects of the circuit breaker construction relating particularly to the contact arrangement and line terminal construction are disclosed and claimed in my copending application Serial No. 842,333, filed September 25, 1959, and assigned to the same assignee as the present invention.

A mechanism assembly, which may be pre-assembled and pre-calibrated before insertion in the casing 1, is pivotally supported in the casing in recesses 11. This assembly comprises a two-part handle 12, having an insulating portion 12a and a metallic portion 12b. The metallic handle portion 12b comprises a generally U-shaped member formed of sheet metal stock, having a bight 51 in which the calibrating screw 15 is threadedly engaged, and two side portions 52, each having an opening, surrounded by an outwardly-drawn flange 13. The two portions of the handle, 12a and 12b, are fixedly joined by interfitting portions including projections on the metallic portion 12b, having in-turned flanges 54, which snap into conforming recesses in the insulating portion 12a. The bight portion 51 of the metallic handle portion 12b is provided with an inwardly projecting integral tang 55, having a hole therein and serving to anchor one end of the tension spring 26, the other end being anchored to the casing 1 by means of headed stud 26a. The bight portion 51 has a similar but downwardly projecting tang 56, having an opening 56a therein, an edge of which serves as a latch, whereby it is releasably held by auxiliary latch 17, for a purpose to be described.

A generally V-shaped contact carrying structure is pivotally supported on the handle 12 and comprises a current-conducting bimetal 7 with movable contact 6 and latch member 14 rigidly attached thereto. The term, "bimetal," is used herein as a noun for convenience and is intended to mean, "bimetallic member." The contact 6 and the latch 14 are attached at the end 7a of the bimetal 7 on opposite sides thereof, by suitable means, such as by welding, both parts being preferably attached at the same time, in one operation.

The latch arm 14 is preferably made of ferro-magnetic material, and the main portion thereof extends in closely-spaced parallel relation to the bimetal 7, for the purpose of providing an auxiliary magnetic tripping action in a manner to be described. While the latch arm 14 is preferably constructed entirely of ferromagnetic material, I may make only a portion thereof of such magnetic material, such, for instance, as the said main portion which extends in closely spaced parallel relation to the bimetal 7. The outer end of the latch 14 is formed on a radius eccentric to the pin 10 for a purpose to be described. A lanced-out portion 14b of latch 14 serves to anchor one end of the tension-type opening spring 24, the other end of which is anchored to the casing by headed stud 59.

The bimetallic contact arm 7 is pivotally supported on the handle 12 by means of pivot pin 10, which is rigidly

attached transversely to the bimetal 7 at one end thereof such as by welding, and which has its outer ends journaled in bearings formed by the inner surfaces of drawn flanges 13 of the metallic portion 12b. The manually operable member or handle 12, is in turn pivotally supported in the conforming circular recesses 11 in the casing 1 and the cover 2, respectively.

In order normally to prevent clockwise rotation of the bimetallic contact arm 7 with respect to the handle 12 about the axis of pin 10, I provide a main latch arm 14, rigidly attached to the bimetallic contact arm 7 at its outer end 7a as described above and having the free end thereof in latching engagement with the tip of adjustable latching screw 15 carried by the metallic portion 12b of the handle 12.

In operation, the described mechanism assembly, except for load terminal 4 and the end of the flexible braid attached thereto, moves as a whole for normal switching operations from the "off" position of Figure 3 to the "on" position of Figure 1, and vice versa, the arc being drawn between the contacts 5 and 6, and expelled through the vent 61. Counterclockwise movement of the handle 12, as viewed in Figure 3, in its bearings 11 is normally transmitted to and causes simultaneous counterclockwise movement of the bimetal contact arm 7 and the movable contact 6, by reason of the engagement of calibrating screw 15 with the latch 14. Clockwise movement of the bimetal contact arm 7 takes place under the influence of opening spring 24. Handle 12 is moved in the clockwise direction from "on" to "off" position primarily by handle-return spring 26.

It will be observed that the handle 12 is always biased toward the "off" position by handle-return spring 26, and that it is also biased toward the "off" position by the additional force of contact-opening spring 24 so long as the latch 14 is in engagement with the calibrating screw 15.

In order normally to retain the handle 12 and, therefore, the contact 6, in the closed-circuit position when moved thereto, despite the bias of springs 24 and 26, I provide an auxiliary latch 17 comprising a flat-metal punching pivotally supported in the casing 1 by means of a headed stud 18, and having a latching projection 19, which is biased by tension spring 21 into latching engagement with projection 56 of handle 12. When the handle 12 is moved to the "on" position, the movable contact 6 engages and compresses the stationary contact 5, and the latching projection 19 drops into the latch opening 56a in projection 56 positively holding the handle 12 from moving back toward the "off" position.

In order to make possible the manual release of the auxiliary latch member 17 for the purpose of manually opening the circuit breaker, I provide a second manually operable member in the form of a push button 22 shown particularly in Figure 5, and having an elongated finger 23 seated in a recess therein and biased to an upward, inoperative position by compression spring 25 seated on an abutment 25a formed in the casing 1. Upon downward movement of the push button 22, the finger 23 engages auxiliary latch member 17 and rotates it in the counterclockwise direction, causing withdrawal of the projection 19 from the opening 56a, and releasing the mechanism for movement to the "off" position under the force of spring 24.

If desired, I may omit push button 22, finger 23, and spring 25 thereby providing a circuit protective device of the "resettable cut-out" type, i.e., a device which will automatically interrupt a circuit upon the occurrence of predetermined conditions and which may be manually reclosed after such automatic opening, but which cannot be opened manually for ordinary switching operations.

When the circuit breaker is in closed position as shown in Figure 1, the electric circuit may be traced from line terminal 3 to load terminal 4 as follows—from line terminal 3 to stationary contact 5, to movable contact 6,

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to bimetallic contact arm 7, to flexible braid 8 and thence to load terminal 4.

Upon the occurrence of an electrical overload condition in the circuit in which the circuit breaker is connected, the bimetal 7 is heated by the current flowing therethrough, and deflects or assumes an arcuate condition in a well-known manner. This warping or deflection is such as to place the midpoint of the bimetal 7 on the right-hand side of a line joining the ends of the bimetal as viewed in Figure 1. This is provided for by arranging the bimetal 7 so that its high-expansion side is on the right side, i.e., the side remote from the latch 14.

It will be observed that since the latch 14 is carried by the end 7a of the bimetal 7 by being rigidly attached thereto, the latch 14 always maintains a fixed position relative to this portion of the bimetal. When the main portion of the bimetal assumes an arcuate condition, therefore, as indicated in Figure 4, in which the end 7a is at an angle to the rest of the bimetal, the latch 14 also extends at a similar angle to the remainder of the bimetal. Thus as the bimetal deflects, there is a movement of the free end of the latch 14 toward the pin 10 and away from the calibrating screw 15. When the latch 14 moves far enough in this direction, it loses its engagement with the screw 15 and the breaker "trips" or opens automatically.

While the parts can be arranged so that tripping will occur upon deflection of the bimetal in the opposite direction, the parts are arranged so that tripping occurs by reason of warping of the bimetal in the direction described especially for the purpose of making possible the cooperation of the bimetal 7 with the ferro-magnetic latch 14 in causing a magnetic tripping action. Thus the magnetic field associated with the current flowing through bimetal 7 causes an attraction between bimetal 7 and ferro-magnetic latch 14. On large short circuits, this action causes an instantaneous tripping, and on short circuits of intermediate magnitude it assists the thermal tripping action of the bimetal 7.

Upon disengagement of the end of the latch member 14 from the calibrating screw 15, the opening spring 24 rotates the bimetallic contact arm 7 and the latch 14 in the contact opening direction until the foot of latch 14 strikes the abutment 60 of the casing as shown in Figure 3. It does this even if the handle 12 is forcibly held in the "on" position. The outer end of the latch 14 is bent on a radius eccentric to the pin 10 so that upon such disengagement of the latch from the calibrating screw, the latch can rotate about the center of pin 10 without further interference between the two parts.

As pointed out above, before the handle 12 can move to the "off" position it is necessary that auxiliary latch 17 be released. In order that this may be accomplished automatically when tripping occurs, I provide an extension 17' on the auxiliary latch member 17. Upon release of the main latch member 14 and its movement clockwise toward the "off" position, the latch member 14 strikes the outer end of the extension 17' thereby rotating the auxiliary latch member counterclockwise and releasing the auxiliary latch 19 from the projection 56. The parts are shown in Figure 4 in the position they occupy at the instant that the latch 14 has moved the auxiliary latch 17 far enough to release the handle member 12b. It will be understood, however, that the latch 14 does not stop in this position, but continues its movement until stopped by abutment 60. Upon release of the manual restraining force, if any, the handle return spring 26 is free to rotate the handle 12 clockwise to the "off" position. The circuit breaker is then in condition to be manually reclosed as soon as the bimetal has cooled sufficiently to return to its normal position.

The main operating mechanism consisting of the handle member 12, the bimetallic contact arm 7, and the main latch member 14, all are supported in the insulating casing 1 at one location, namely, the recesses 11. It is there-

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fore apparent that the relation of the latch member 14 to latch screw 15 carried by the handle member 12, is not affected by the dimensional stability or instability of the casing 1. It will be further observed that the mechanism may be pre-assembled in that the handle, the bimetal and the main latch can be assembled apart from the casing 1. The calibrating screw 15 furthermore can also be adjusted outside the casing 1, and fixed in its adjusted position, as by soldering.

In general, the following sequence of operations may be followed in the assembly of the circuit breaker. First, pin 10, movable contact 6, main latch 14, and flexible braid 8 are welded to the respective ends of the bimetallic contact arm. The pin 10 is then snapped into place in the bearings 11 in the metallic portion 12b of the handle by spreading the sides slightly. At the same time, or immediately thereafter, the insulating handle portion 12a is snapped into place between the sides of the metallic portion 12b, the in-turned flange portions 54 seating in conforming recesses therein. The calibrating screw 15 is next adjusted in a manner well-known to the art and fixed to prevent further movement, as by soldering. Thereupon the completely assembled and calibrated mechanism is simply set into place, with the remaining springs, in the casing 1, and the cover 2 is placed thereon and attached by suitable means, such as by rivets.

The casing 1 is formed with a specially designed recess 27 into which the manually operable portion of the handle 12 enters when it is placed in the "on" position, so that it is not thereafter available for manual movement. It therefore becomes impossible to move the handle member 12 manually from its "on" position as shown in Figure 1, to its "off" position as shown in Figure 3, by grasping it directly. This construction makes feasible the use of a positive latch, such as the auxiliary latch 17 for the purpose of holding the parts in the "on" position. Such a latch holds the contact arm firmly in the "on" position against relatively high contact pressure and without danger of contact-opening spring 24 moving the handle back to the "off" position. With this handle and casing construction, the user cannot make a mistake and try to forcibly move the handle 12 to the "off" position without releasing the auxiliary latch 17 with possible consequent damage to parts.

Referring now to the modification shown in Figures 6 through 9, I have shown a form of my invention in which a single handle is used for both "on" and "off" operation, a modified auxiliary latch 19' being provided, which can be released by exerting sufficient force in the opening direction on the handle 13'. In this form I have also provided a structure which greatly simplifies assembly of the circuit breaker and which facilitates the automatic or semi-automatic assembly of the mechanism in the molded casing. Referring to the figures more particularly, the line terminal 3' is similar to the line terminal of the preferred form. The bimetallic contact arm 7' is rigidly attached to pin 10' at one end and carries a movable contact 6' and a main latch member 14' at its other end.

In this form, the pin 10' is pivotally supported in the sides of a conductive member 28' which is stationary relative to the casing and which acts as a load terminal as well as a support for the pivoted mechanism. The member 28' is supported in the casing 1' in a novel manner to be described. The handle member 13' has a metallic portion 12' which is journaled on the pin 10'. The metallic portion 12' is provided with an auxiliary latching extension 19' having a detent 29' therein. The member 28' is provided with a pin 30' extending from side to side thereof. When the handle 13' is rotated counterclockwise to the "on" position as shown in Figure 7, the detent 29' engages the pin 30' so as to releasably hold the handle member in the "on" position. The latch member 14' has a latching engagement with latch surface 32' of the handle 13'. The handle 13' is also provided with a generally vertical opening 33' to permit movement of

the latch 14' beyond the latch surface 32' on the occurrence of tripping. A compression spring 26' is provided to bias the handle member 13' toward "off" position, and a tension spring 24' is provided to bias the contact member 7' toward "off" position. Since the detent 29' acts as a releasable or defeatable latch engagement, it is possible to move the handle 13' to the "off" position by force exerted directly thereon.

The member 28' is generally U-shaped, and has a bight 31', which is provided with an extension 34' which serves as the load terminal. The end of the tension spring 24' is anchored to the member 28' by being hooked through a lanced-out portion 35'.

The current path through the circuit breaker is as follows—from line terminal 3' to the line contact 5' to load contact 6', through bimetallic contact arm 7', through the bearing pin 10', through the side portions of the terminal member 28', and thence through the load terminal portion 34'.

When the bimetallic strip 7' becomes heated by passage of current therethrough, it assumes an arcuate condition, causing the upper end of latch member 14' to move toward the pivot point 10' and into the opening 33' of the handle. This allows the tension spring 24' to rotate the latch member clockwise to open the contacts. As the latch 14' moves clockwise in this manner, it strikes the end of latch extension 19', thereby releasing the detent 29' from the pin 30'. If the handle 13' is not manually restrained in the "on" position, it will then be moved to the "off" position by the compression spring 26', the parts then being in the condition shown in Figure 9. When the bimetallic strip 7' cools fully, the latch member 14' returns to its latched position and the parts are then in the condition shown in Figure 6.

The parts of the mechanism of the form in Figures 6 through 9 are "pre-assembled" in a manner similar to that described in connection with the preferred form. All parts of the mechanism are assembled and the mechanism is calibrated by bending the bimetallic member 7', or the main latch member 14'. The assembled mechanism may then be inserted in the housing.

An important feature of this modification, which incorporates a force-defeatable holding latch as described, is the fact that the mechanism is able to "blow open" on high short circuits without the trip latch 14'—32' having tripped at all. As shown, the portion of the line terminal 3' adjacent the stationary contact extends in closely-spaced parallel relation to the bimetal 7' in the closed-circuit position while the current passes through each in opposite directions. The action of the magnetic field associated with the current in the bimetal and the terminal therefore causes these members to repel each other. Ordinarily, such repulsion is not appreciable and so does not affect the holding action of latch 14'. Upon the occurrence of currents of short-circuit magnitude, however, this repulsion force becomes very substantial. In addition to this action, it has been found that when two butt-type contacts of this type are pressed together face-to-face and a high short-circuit current is passed therethrough, there is such a rapid rise of temperature at the meeting faces of the contacts as to cause fusing and vaporization of some particles of the contacts or of impurities, with a resultant generation of rapidly expanding gases between the contact faces so as to cause the contacts to be instantly blown apart. This action, combined with the magnetic repulsion between terminal 3' and bimetal 7' previously mentioned, is sufficient to cause the opening of the contacts irrespective of the release of latch 14' by overcoming the holding force of catch 29'.

In order that the aforesaid forces including the magnetic repulsion and the blow-apart action may be utilized to cause or assist in instantaneous tripping of the breaker even when the handle 13' is manually held in the "on" position, I provide a degree of flexibility in the latch 14' by reducing the portion 14a' in width. By reason of this

flexibility, the high forces generated by short-circuit currents in the manner indicated can cause bending of the latch 14' at the portion 14a' if the handle 13' is manually held during a short-circuit, and release of the latch engagement even though the bimetal 7' has not had time to deflect. The latch 14' is preferably made of ferromagnetic material for the purpose of adding a third force tending to cause tripping on the occurrence of short-circuit conditions, namely, the attraction of such a latch by the field associated with the current on bimetal 7' in a manner similar to that described in connection with the preferred form.

It is a special feature of the design of this modification that the cost of manufacture is reduced, and ease of assembly is enhanced by the unique design of the casing and the method of retaining the parts therein, as shown in the drawings and particularly in Figure 10. In accordance with this aspect of my invention, I provide a one-piece open-bottomed generally rectangular insulating casing, and parts comprising a pre-assembled mechanism, a load terminal and a fiber closure member which are each adapted to be inserted in place in the casing by a straight-line inserting motion through the bottom, and all of which are held in operative position by a single fastening element.

Referring particularly to Figure 10, the insulating casing 1' comprises an open-bottomed enclosure which is preferably formed as a single piece by suitable means such as by molding. The bottom opening is extended part way up the side 63', extending upwardly to abutment 36'. A handle opening 62' is provided in the top wall of the casing. In assembly, the pre-assembled mechanism comprising the handle 13', the bimetallic contact arm 7', the main latch 14', the terminal member 28' and the associated springs 26' and 24', are inserted into the casing from the bottom, as one piece, until the load terminal portion 34' of the member 28' rests against the abutment 36', and the rounded portions 37' of the member 28' rest against the curved surfaces 39, see Figure 9. After insertion of the mechanism, the line terminal 3' is inserted, also vertically from the bottom, being slid onto or clipped onto the lower portion of the side wall 1'. An L-shaped insulating shield 40' having vent openings 40a' is then slid into place vertically, closing the open bottom, and the open portion of the side 63', vertical slots 44' being provided in the inner surfaces of the side walls of the casing 1' to receive the edges of the portion 40b' of member 40'. The insulating member 40' is held in place thereafter by sliding in place horizontally a retaining clip 41' which has return-bent side flange portions 47' adapted to extend around ridges 42' formed along opposite bottom edges of the side walls of the casing 1'. Shoulders 45' are provided at the bottom of the casing 1' to limit the sliding movement of the clip 41' in the assembling direction. The ridges 42' are also provided with notches 46', and the ends 47a' of the return-bent side flanges 47' are closed tighter than the main portion thereof, and dimensioned so that when the clip 41' is fully assembled, the ends 47a' snap into the notches 46', and prevent withdrawal or removal thereof. The clip 41' is also provided with a projecting tongue portion 43' to facilitate mounting and holding of the circuit breaker. It will therefore be seen that, after pre-assembly, the mechanism may be assembled in the circuit breaker case through the bottom, by a straight-line movement, and retained therein by a simple clip which is merely slid in place also by straight-line movement.

The member 28' is held in place in the casing 1 in a novel manner, as follows—the edge 64' of the insulating member 40' in the assembled condition rests against the underside of the extension 34' of the member 28', and is held there by the action of the clip 41'. The insulating member 40', though of relatively thin sheet fiber, affords ample support to the terminal 28' at this point

by reason of its being column-loaded and being prevented from buckling by its engagement in slots 44'. Although there is no support directly under the opposite end of the terminal member 28', it will be seen that it is impossible to move the terminal member 28' downwardly in the casing as by a force exerted on the handle. Downward pressure of the handle 13' tends to rotate the member 28' clockwise about the supporting edge 64'. Since the end surfaces 37' are against the side wall of the casing 1', however, such movement is not possible.

The member 28' is restrained from movement in an upward direction by engagement of the upper edges 28a' with generally diagonal shoulders 1b' formed on the inner wall of each of the major sides of the casing 1'. These shoulders, together with the abutment 36' also serve to position the mechanism assembly when it is initially inserted in the casing.

It will be observed that I have provided a circuit breaker construction which is simple and easy to assemble and to calibrate and which lends itself readily to automatic or semi-automatic assembly systems. It will be further observed that I have provided a circuit breaker construction which is extremely compact in form and which may be made in a very small size but which nevertheless provides a substantial amount of contact opening.

While I have shown particular embodiments of my invention, it will be understood that I do not wish to be limited thereto since many modifications may be made. I, therefore, contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An automatic electric circuit breaker comprising a support, a first manually operable handle member pivotally mounted on said support, a movable contact member pivotally supported on said support on the same axis as said handle member, first releasable latching means carried by said contact member and said first handle member eccentric to said axis, current responsive means for releasing said first releasable latching means on the occurrence of predetermined conditions, second latching means carried by said first handle member and said support for positively retaining said first handle member in a predetermined position, and a second manually operable handle member operatively connected to said second latching means and being manually movable to cause release of said second latching means.

2. A circuit breaker comprising a manually operable handle member, a contact member pivotally supported on said handle member and including two generally parallel elongated side portions, one of said side portions being adapted to carry current passing through said circuit breaker and the other of said side portions having a releasable latching engagement with said handle member and said side portions comprising magnetic means for altering the distance between said side portions on the occurrence of predetermined current through said one of said side portions to cause release of said releasable latch.

3. A circuit breaker comprising a manually operable handle member, a contact carrying member comprising two generally parallel side portions, one of said side portions being pivotally connected to said handle member and comprising a portion of thermally responsive bimetallic material, the other of said side portions having a releasable latching engagement with said handle member by movement of said portion toward said one portion, said side portions being connected together at their ends remote from said handle member, said second side portion comprising a portion of magnetic material disposed closely adjacent said portion of bimetallic material whereby said portion of magnetic material is attracted to said first side portion by the magnetic field associated with high currents passing through said bi-

metallic portion to cause release of said releasable latch.

4. A circuit breaker comprising an insulating casing, a manually operable handle pivotally supported in said insulating casing, an elongated bimetallic contact arm pivotally supported in said insulating casing on the same axis as said manually operable handle, a relatively rigid latch member fixedly attached to said bimetallic contact arm adjacent its free end and having a latching engagement with said manually operable handle at its free end, a second latch means for holding said manually operable handle in its closed-circuit position, and means for causing the release of said second latch member upon the release of said main latch member.

5. A circuit breaker comprising an insulating casing, a manually operable member pivotally supported in said insulating casing, contact means operatively connected to said manually operable member at all times during normal off-on operation of said circuit breaker, for opening and closing an electric circuit through said circuit breaker, said insulating casing including a recess in which said manually operable portion of said manually operable member enters when in closed circuit position, whereby said operating handle when in open-circuit position is accessible for movement to closed-circuit position and said handle when in closed-circuit position is inaccessible for manual movement to open-circuit position.

6. A circuit breaker comprising an insulating casing, a first manually operable member pivotally supported in said insulating casing, contact means operatively connected to said manually operable handle at all times during normal off-on operation of said circuit breaker for opening and closing an electric circuit through said circuit breaker, said casing having a recess adapted to receive the manually operable portion of said operating handle when in closed circuit position whereby said operating handle when in open-circuit position is accessible for movement to closed-circuit position and said handle when in closed-circuit position is inaccessible for manual movement to open-circuit position and a second manually operable member operable to cause opening movement of said contact means.

7. A circuit breaker comprising an insulating casing, a manually operable member pivotally supported in said insulating casing and movable between "on" and "off" positions, contact means operatively connected to said manually operable handle at all times during normal off-on operation of said circuit breaker for closing an electric circuit through said circuit breaker, current responsive means for releasably retaining said operating handle in said "on" position, said casing having a recess therein into which the manually operable portion of said handle member enters when in the "on" position so as to be inaccessible for manual movement from said "on" toward said "off" position.

8. A circuit breaker comprising an insulating casing, a manually operable handle member pivotally supported in said insulating casing and movable between "on" and "off" positions, two relatively movable contacts movable into and out of engagement with each other, said manually operable handle member being connected to move said contacts into engagement when moved from said "off" to said "on" position, current responsive means for releasably retaining said contacts in engagement, means operable upon the release of said releasable means tending to cause movement of said handle from said "on" toward said "off" position, said casing having a recess therein into which the manually operable handle enters when in said "on" position so as to be inaccessible for manual movement from said "on" to said "off" position.

9. An automatic electric circuit breaker as set forth in claim 1 wherein the support on which the first handle member is mounted also includes portions arranged to render said handle member substantially inaccessible

for manual operation when said handle member is latched in the predetermined position.

10. An automatic electric circuit breaker as set forth in claim 1 wherein the movable contact member comprises a generally V-shaped structure having one of its diverging ends pivotally supported on the support for the handle member and having its other end in releasable latching engagement with the handle member and carrying an electrical contact adjacent the apex of said V.

11. A manually operable circuit breaker comprising a generally rectangular insulating casing having four side walls, a top wall and an open bottom wall, a handle opening in said top wall, a terminal opening in one of said side walls extending from said open bottom wall toward said top wall, an operating mechanism comprising a manually operable handle, a movable contact and current responsive latching means for releasably retaining said movable contact in a predetermined position, a terminal member electrically connected to said movable contact and projecting through said terminal opening in said side wall, said mechanism being insertable in operative position in said casing through the said open bottom wall thereof with said handle projecting through and substantially closing said handle opening in said top wall, and closure means adapted to close said open bottom wall and the open portion of said terminal opening in said side wall, said closure means comprising a generally L-shaped member of insulating material having portions of the opposite edges thereof received in slots in the inner surface of the side walls of said insulating casing, said closure means also serving to retain said mechanism in said operative position, and means for retaining said closure means in place.

12. An electric circuit breaker comprising an insulating casing, a manually operable member pivotally supported on a fixed pivotal axis in said insulating casing comprising an insulating portion projecting through an opening in said insulating casing and a metallic portion within said insulating casing, a bimetallic member pivotally supported on the said bimetallic portion of said manually operable member, a relatively stationary contact carried by said insulating casing, a relatively movable contact carried by said bimetallic member, latching means carried by one end of said bimetallic member, a latch member carried by said metallic portion of said manually operable member, a releasable latching engagement between said latching means and said latch member, said bimetallic member being arranged and constructed to warp when heated in a direction to cause release of said latch engagement, and a magnetic member carried by said bimetallic member and movable by magnetic forces to bend said bimetallic member in the same direction as said bimetallic member warps when heated.

13. An electric circuit breaker comprising a casing of insulating material, a manually operable member pivotally supported on a fixed pivotal axis in said casing, said manually operable member comprising a portion of insulating material projecting outwardly through an opening in said casing for direct manual engagement and a metallic portion contained entirely within said insulating casing, a bimetallic strip pivotally supported on a fixed pivotal axis on said metallic portion, a relatively stationary contact in said insulating casing, a relatively movable contact mounted directly on said bimetallic strip at a point spaced away from the pivotal support of said strip, a latching surface carried by said bimetallic strip at a point spaced away from its pivotal support, a latching projection carried by the said metallic portion of said manually operable member, a biasing spring constantly biasing said bimetallic strip for rotation about its pivotal support, said latching surface normally engaging said latching projection and preventing movement of said bimetallic strip about its pivotal support relative to said metallic portion of said manually operable member.

14. An electric circuit breaker as set forth in claim 13

wherein the bimetallic strip carries a member of magnetic material which is movable due to magnetic forces set up by current carried through said bimetallic strip to bend said bimetallic strip in the same direction as said strip bends when heated to cause tripping.

15. An electric circuit breaker as set forth in claim 13, said circuit breaker including a member of magnetic material extending in closely spaced relationship to the bimetallic member throughout a substantial portion of the length thereof, said bimetallic member and said magnetic member being attracted toward each other on the occurrence of high short circuit currents to cause bending of said bimetallic member in the same direction as said bimetallic bends when heated to cause tripping.

16. A manually operable circuit breaker comprising a generally rectangular insulating casing portion having four side walls, a top wall and an open bottom, a handle opening in said top wall, an operating mechanism supported in the upper portion of said insulating casing portion including a manually operable handle a movable contact and current responsive latching means for releasably retaining said movable contact in a predetermined position, said open bottom wall being large enough to permit the assembly of said mechanism within said casing portion therethrough and comprising the only entrance for the insertion of said mechanism into said casing portion, said handle projecting through said handle opening in said top wall and substantially closing said handle opening when said operating mechanism is in said assembled position, and an insulating closure closing said bottom opening and supporting said operating mechanism in said assembled position without said mechanism being positively fastened to said casing portion.

17. A manually operable electric circuit breaker comprising a generally rectangular insulating casing portion having four side walls, a top wall and an open bottom wall, a handle opening in said top wall, operating mechanism for said relatively movable contact including a frame member having two opposed side portions, a manually operable handle member pivotally supported between said side portions, a movable contact member pivotally supported between said opposed side portions, said operating mechanism also including latch means releasable upon the occurrence of predetermined electrical conditions to permit automatic opening of said movable contact member, said open bottom wall being large enough to admit said operating mechanism including said frame and being the only entrance for said operating mechanism into said casing portion, and means for supporting said operating mechanism including said frame within said casing portion in operative position with said handle member projecting through said handle opening comprising insulating means adapted to be connected to said casing portion and to close said open bottom wall.

18. A manually operable circuit breaker comprising a generally rectangular insulating casing having four side walls, a top wall and an open bottom wall, a handle opening in said top wall, an operating mechanism comprising a manually operable handle and a movable contact and latching means for releasably retaining said movable contact in a predetermined position, a terminal member electrically connected to said movable contact and projecting through one of said side walls, said opening in said bottom wall being large enough to admit said operating mechanism when in assembled condition therethrough and a frame member having opposed side portions providing pivot bearings for said manually operable handle and for said movable contact member for supporting said operating mechanism in assembled condition in said casing and means supporting said frame member up in said casing including insulating closure means for said open bottom wall comprising a member of insulating material adapted to be connected to said insulating casing and including a portion engaging said terminal member

and supporting it against movement downwardly out of said casing.

19. A manually operable circuit breaker comprising a generally rectangular insulating casing having four side walls, a top wall, and an open bottom, a handle opening in said top wall, operating mechanism comprising a manually operable handle and a movable contact, means pivotally supporting said handle and said movable contact for rotation about pivotal supports in the upper portion of said casing, current-responsive releasable latching means for releasably retaining said movable contact in a predetermined position, said open bottom comprising an opening large enough to receive said mechanism whereby said mechanism is insertable in operative position in said casing through said open bottom with said handle projecting through and substantially closing said handle opening in said top wall, insulating means closing said open bottom wall and retaining said pivotally supporting means and said current-responsive latching means in said operative position without being positively fastened thereto, said movable contact arm extending downwardly toward said bottom wall from its pivotal support and a relatively stationary contact supported adjacent one of said side walls and said bottom wall whereby contact making and breaking action takes place in the bottom portion of said casing and said mechanism is supported in said upper portion of said casing.

20. A manually operable circuit breaker as set forth in claim 19 wherein said bottom closure means includes a side wall portion extending generally perpendicular to said bottom wall adjacent said contact making and breaking portion of said casing, said upstanding wall portion including at least one aperture therein for providing for venting of arc interruption gases generated by said contact making and breaking action.

21. A manually operable circuit breaker as set forth in claim 19 wherein said circuit breaker also comprises a pair of terminal members each having a portion posi-

tioned within said casing and a second portion projecting outwardly of said casing for connection to an external electrical conductor, said terminals projecting between said casing and said bottom closure, at least one of said terminals being supported on one of said side wall portions of said insulating casing and being restrained from movement downwardly by said insulating bottom closure means.

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