April 27, 1954 L. W. DYER 2,677,025

CIRCUIT BREAKER

Filed May 2, 1952 2 Sheets-Sheet 1

Fig. 1.

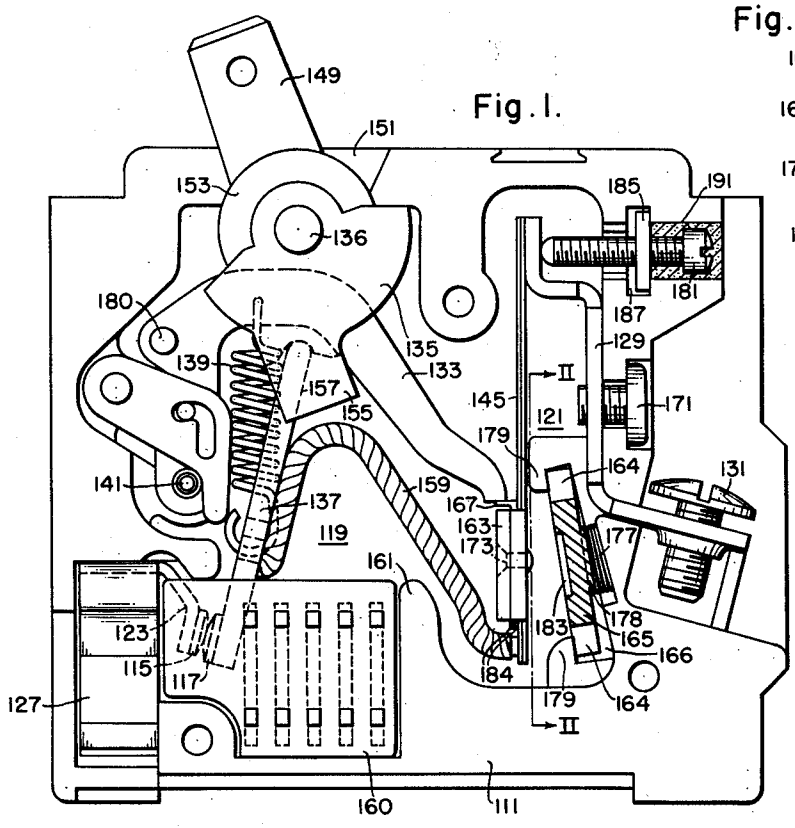


Fig. 4.

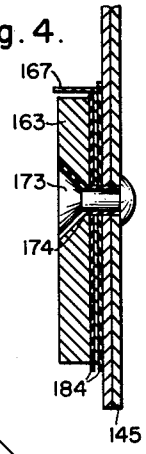


Fig. 2.

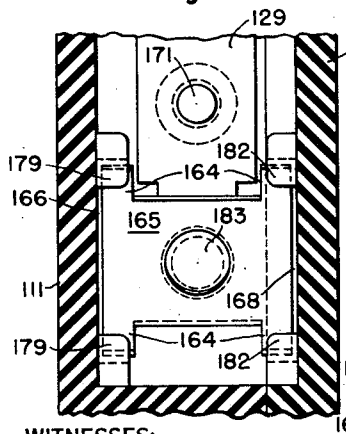
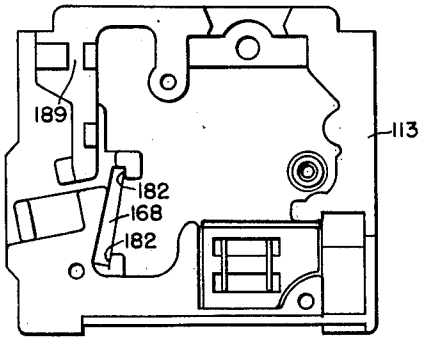


Fig. 3.



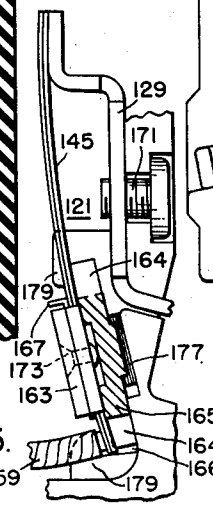


Fig. 5.

WITNESSES:

Robert C. Baird

Paul O. Harlow

INVENTOR

Lloyd W. Dyer.

BY Arthur T. Stratton

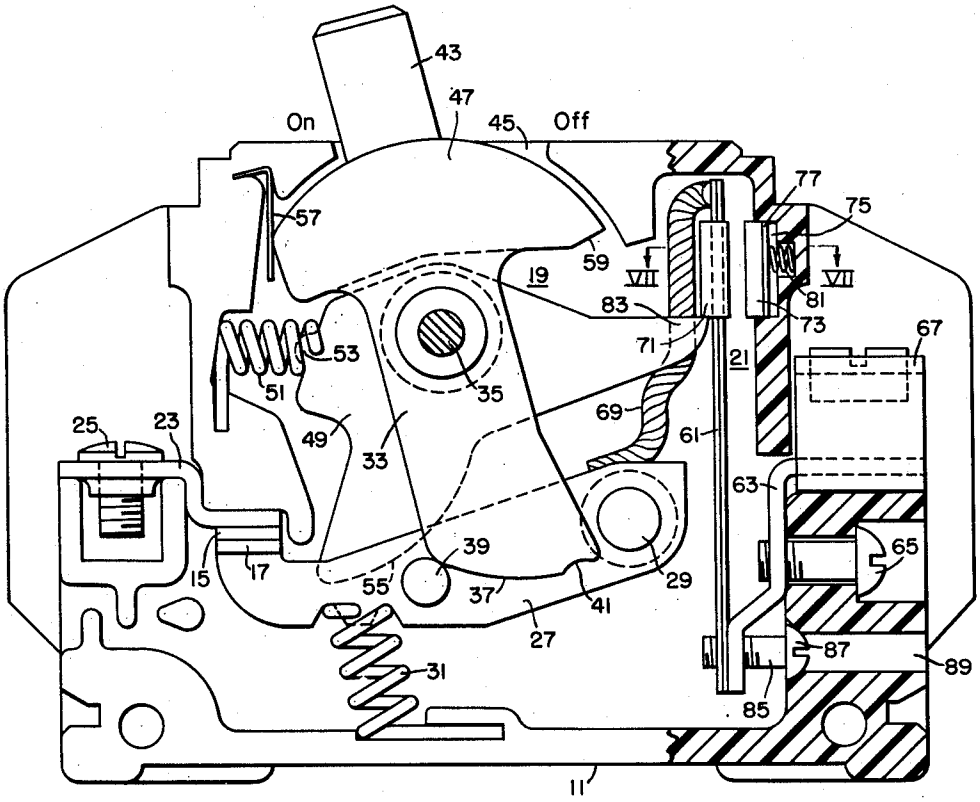
ATTORNEY

April 27, 1954 L. W. DYER 2,677,025

CIRCUIT BREAKER

Filed May 2, 1952 2 Sheets-Sheet 2

Fig.6



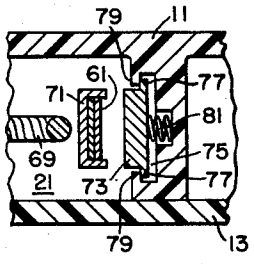


Fig. 7

WITNESSES:

Robert C. Baird

Paul H. Harlow

INVENTOR

Lloyd W. Dyer.

BY

Arthur J. Stratton

ATTORNEY

Patented Apr. 27, 1954 2,677,025

UNITED STATES PATENT OFFICE

2,677,025

CIRCUIT BREAKER

Lloyd W. Dyer, Beaver, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application May 2, 1952, Serial No. 285,598

17 Claims. (Cl. 200—88)

1

This invention relates to circuit breakers and more particularly to circuit breakers of the type which are automatically operated instantaneously on heavy overload currents or short circuit currents, and after a time delay in response to persistent overload currents of lesser magnitude.

This application is a continuation-in-part of abandoned application Serial No. 251,953, filed October 18, 1951, by Lloyd W. Dyer and assigned to the assignee of the instant application.

An object of the invention is the provision of a circuit breaker having an improved electromagnetic and a bimetallic trip device having means permitting maximum deflection of the bimetal without such opposition by the magnetic means as would tend to give the bimetal a permanent set.

Another object of the invention is the provision of a circuit breaker having an improved trip electromagnetic and a bimetallic trip device in which resilient means permits movement of one of the magnetic members whereby the bimetal element may flex a maximum amount with a minimum of opposition by the magnetic member.

Another object of the invention is the provision of a circuit breaker having a bimetal element and a pair of magnetic members for magnetically bending said bimetal to trip the breaker, one of said magnetic members being resiliently supported to permit maximum thermal bending of said bimetal element.

Another object of the invention is the provision of a circuit breaker as previously described which is compact, simple and inexpensive to manufacture and which has a minimum number of parts.

The invention, both as to construction and operation, together with additional objects and advantages thereof, will be best understood from the following detailed description thereof when read in conjunction with the accompanying drawings.

In said drawings:

Fig. 1 is a vertical elevational view of a circuit breaker with the cover removed and partly in section embodying the principles of the invention.

Fig. 2 is a sectional view taken on line II—II of Fig. 1 showing the magnet yoke and its mounting.

Fig. 3 is a reduced elevational view of the cover of the breaker showing the surfaces and recesses for receiving and supporting the parts.

Fig. 4 is a vertical sectional view through the armature, bimetal element, and the latch showing the method of insulating the latch from the armature and bimetal element.

Fig. 5 is a side elevational view of the thermal-magnetic trip device showing the maximum position to which the parts may move when actuated thermally.

2

Fig. 6 is a vertical elevational view of a modification of the invention as applied to a different type of circuit breaker.

Fig. 7 is a sectional view taken on line VII—VII of Fig. 6 showing the bimetal element and the magnetic members of the Fig. 6 modification.

Referring to Fig. 1 of the drawings, the circuit breaker comprises a casing including a housing 111 and a cover plate 113 (Fig. 2) constructed of molded insulating material, stationary contact means 115, movable contact means 117, an operating mechanism 119, and a trip device 121.

The stationary contact 115 is rigidly secured to the inner end of a conducting strip 123, the outer end of which is provided with a terminal connecting means, such as a plug-in member 127 for connecting the breaker in an electric circuit. At the opposite end of the housing 111 is a conducting strip 129 which at its inner end is connected to the trip device (to be later described) and which is provided with a terminal connecting means, such as a screw 131 at its outer end for connecting the breaker in an electric circuit.

The movable contact 117 is rigidly secured on the free end of a U-shaped switch arm 137 having its legs 157 supported in recesses in the legs 155 of a U-shaped operating lever 135 of molded insulating material. The operating lever 135 is pivotally supported by trunnions 136 molded integral therewith and mounted in suitable companion opens in the housing 111 and in the cover plate 113. An operating spring 139 is connected under tension between the bight of the switch member 137 and a releasable carrier 133 pivoted on a pin 141 supported in openings in the housing 111 and in the cover plate 113.

The operating lever 135 is provided with an operating handle 149 molded integral therewith and extending outwardly through an opening 151 in the housing 111. The operating lever 135 is also provided with an arcuate member 153 molded integral therewith and cooperating with the housing 111 to substantially close the opening 151 in any position of the handle 149. The switch arm 137 is electrically connected by means of a flexible conductor 159 to one end of a thermal element 165 forming part of the trip device 121 which is suitably secured, preferably by welding, to the inner end of the conducting strip 129.

The switch arm 137 is operated to manually open and close the contacts 115—117 by manipulation of the handle 149. Movement of the handle 149 in a clockwise direction carries the upper

pivoted ends of legs 157 of the switch arm 137 across to the left of the line of action of the operating spring 139 which then biases the switch arm to the open position and causes movement of the switch arm to open position with a snap action.

The contacts are manually closed by reverse movement of the handle. Counterclockwise movement of the handle 149 from the open position to the closed position moves the upper pivoted ends of legs 157 of the switch arm 137 across to the right of the line of action of the spring 139 which thereupon acts to close the contacts with a snap action.

An arc extinguisher 160 is provided to quickly extinguish the arc drawn when the circuit is interrupted. The arc extinguisher may be of any suitable type but preferably comprises a stack of spaced slotted plates of magnetic material.

The circuit breaker is adapted to be tripped open instantaneously in response to overload currents above a predetermined value, or in response to a short circuit current, and after a time delay on lesser overload currents, by means of the trip device 121. Operation of the trip device 121 releases the carrier 133 whereupon the operating spring 139 moves the carrier 133 clockwise moving the line of action of the spring 139 across to the right of the pivot of the switch arm 137. Thereafter the spring 139 acts to move the switch arm to open position with a snap action. The movement of the carrier is arrested by engagement with a projection 161 of the housing 111.

The trip device 121 comprises a bimetallic thermal element 145 connected by means of the flexible conductor 159 to the switch arm 137 and an electromagnet including a magnetic member or armature 163 mounted on the thermal or bimetal element 145 and an H-shaped magnetic member or magnet yoke 165 having the long ends 164 mounted in a recess 166 in the side wall of the housing 111 and in a companion recess 168 in the cover 113 (Fig. 3) for limited movement relative to the magnetic member 163. The conducting strip 129 is secured to the end wall of the casing 111 by means of a screw 171 and the bimetal element 145 is rigidly secured by suitable means such as welding to an offset portion of the upper inner end of the conducting strip 129.

The magnetic member 163 is rigidly secured to and surrounds three sides of the thermal member 145. The magnetic member 163 is secured to the thermal or bimetal element 145 by means of a rivet 173, which is formed from enamel or plastic coated wire, and also serves to secure a latch element 167 to the bimetal element. The latch 167 normally engages and releasably restrains the carrier 133 in operative position. The holding force is applied to the bimetal 145 in tension and does not stress the bimetal with a bending force.

The reason for insulating the latch 167 from the current carrying bimetal 145 is to prevent the drawing of an arc between the latch 167 and the end of the releasable member 133 when they separate on tripping. While the flexible conductor 159 is provided to carry the main flow of current from the bimetal to the moving contact, there would also be a parallel current path, if the latch were not insulated, from the latch to the releasable member and through the spring 139 to the contact actuating arm 137 and the contact 117. With such a parallel path, there would be a small arc drawn between the end of the member 133 and the latch 167 upon separation due to the transfer of the current flowing through the parallel path to the main path through conductor 159. By eliminating the drawing of an arc at the latch surfaces, burning or roughening of these surfaces is avoided so that latch friction is maintained constant and the calibration of the breaker does not change with use.

To accomplish this, the latch member 167 is insulated from the armature 163 and from the bimetal element 145 by thin sheets of insulating material 184 (Fig. 4) inserted between the parts and by means of the enameled shank of the rivet 173 which is formed from a section of wire precoated with a suitable insulating material such as enamel or a vinyl plastic 174. The fact that the rivet 173 is formed from coated or enameled wire, or is otherwise provided with an enameled or insulated shank, has the advantage that the latch piece 167 need not be accurately positioned relative to the rivet during the assembly of the parts so as to provide clearance between the rivet and the edge of the hole in the latch piece 167, as would be necessary if the shank of the rivet were not covered with insulation.

The magnet yoke 165 is biased by means of a light compression spring 177 toward the armature 163 and against shoulders 179 of the recess 166 in the housing 111 and shoulders 182 of the recess 168 in the cover plate 113 (Fig. 3).

The stop projections 179 and 182 hold the magnet yoke 165 away from the armature 163 a distance greater than the amount of movement that is required to release the end of the trip member 133 from the latch portion 167, so that upon both thermal and magnetic tripping the tripping action takes place before there is any movement of the magnetic member 165 and independently thereof and of the spring 177. The distance between the projections 179 on member 111 and the projections 182 on member 113 is greater than the width of the bimetal 145 so that the bimetal may move therebetween. Likewise, the distance between the two projections 179 and the distance between the two projections 182 is each greater than the depth of the armature so that the armature can move between the two projections of each pair even though the armature is wider than the bimetal and the distance between projections 179—179 and 182—182 on the two members. Thus, the armature and bimetal together form a cross-shaped structure which moves between the four projections on the housing members.

A spring guide projection 178 is formed on the magnet yoke 165 by any suitable process such as embossing which also provides a recess 183 on the opposite side of the magnet yoke thus providing clearance for the head of the rivet 173 when the armature 163 is attracted against the magnet yoke 165.

With normal rated current flowing through the bimetal element 145 the magnetic member 165 is in the position shown in Fig. 1. Upon the occurrence of an overload current above the rated current and below a predetermined value of, for instance, 1000% of normal rated current, the bimetal element 145 is heated by the current flow therein and deflects toward the right causing the latch 167 to release the carrier 133 whereupon the operating mechanism functions in the previously described manner to automatically open the breaker contacts.

Upon the occurrence of a heavy overload current or short circuit current, such for example as 1000% or more of normal rated current, the current flowing through the bimetal element 145

energizes the electro-magnetic means a sufficient amount to cause the magnetic member 165 to instantaneously attract and operate the magnetic member 163 thus bending the bimetal element and causing release of the carrier 133 and effecting instantaneous opening of the breaker contacts.

Before the contacts can be closed following an automatic opening operation, it is necessary to reset and relatch the mechanism. This is accomplished by moving the handle 149 clockwise to the full open position during which movement the legs 155 of the operating lever 135 engage a pin 180 in the carrier 133 and moves the carrier counterclockwise about its pivot 141. Near the end of its counterclockwise movement, the free end of the carrier 133 wipes by the latch 167, slightly bending the bimetal element which thereafter resumes its normal latching position. The switch arm is then moved to close the contacts in the previously described manner by movement of the handle 149 counterclockwise to the closed position.

During the time interval between the initiation of the tripping action and the mechanical opening of the contacts and the extinguishing of the arc, the excessive current continues to flow through and heat the bimetal, and the bimetal continues to flex and bend beyond the tripping point. If the thermal bending of the bimetal element is opposed by any substantial force such as by engaging a fixed magnet yoke while the bimetal is hot, it may take a permanent set which will destroy its calibration. For this reason, and to take care of the greater movement of the bimetal at its outer end, the magnetic member 165 is normally positioned at an angle to the bimetal and to the movable armature 163; and the recesses 166 and 168 are made wider at their lower ends to permit movement of at least the lower end of the magnet yoke in the direction of thermal bending of the bimetal element 145 so that, upon continued bending, the bimetal has to overcome only the relative light force of the spring 177. After the bimetal has cooled, the light spring 177 restores the magnet yoke 165 to its normal position.

The distance between each shoulder 179 on one section 111 of the housing and the opposite shoulder 182 on the other section 113 is greater than the width of the bimetal 145 so that the bimetal may bend and move between the shoulders without engaging them. Likewise, the space between the projecting ends 164 of the H-shaped magnetic member 165 is greater than the width of the bimetal so that the bimetal does not engage the ends 164. These features of construction, together with the recess 183 for the formed-over end 173 of the rivet and the movable mounting of the magnetic member 165 with provision for greater movement at the movable end of the bimetal element, permit a maximum amount of thermal bending of the bimetal element, as illustrated in Fig. 5, to a greater extent than is likely to take place in actual use. This insures against the bimetal losing its calibration due to having been restrained against movement when it is highly heated, and this result is obtained in a structure which is compact and requires a minimum of space, it being noted that the magnetic trip structure fits into the relatively small space between the bimetal 145 and conducting strip 129 and terminal 131.

Adjusting means is provided whereby the trip device may be adjusted to vary the tripping point of the thermal trip means. The adjusting means comprises an adjusting screw 181 threadedly engaging a plate or square nut 185 disposed in a recess 187 in the housing 111 and a slot 189 in the cover plate 113 (Fig. 3). The inner end of the screw 181 engages the upper end of the conducting strip 129. An opening 191 in the housing provides access permitting the insertion of a screw driver to turn the screw 181 to thereby adjust the trip device. The opening 191 may be sealed after adjustment to prevent tampering by unauthorized persons.

Referring now to Figs. 6 and 7 of the drawing, the circuit breaker of this embodiment comprises a casing including a housing 11 (Fig. 6) and a cover 13 (Fig. 7), both of molded insulating material, stationary contact means 15 and cooperating movable contact means 17, operating mechanism indicated generally at 19 and a trip device indicated generally at 21. The stationary contact 15 is rigidly secured on the inner end of a terminal conductor 23 which extends outwardly through an opening in the adjacent end wall of the housing 11 and has a connecting means 25 at its outer end. The movable contact 17 is rigidly mounted on one end of a switch arm 27 pivotally supported at its other end on a pivot 29 molded integral with the side wall of the housing 11.

The switch arm 27 is biased closed by a compression spring 31 having one end seated in a spring seat in the base of the housing 11 and having its other end engaging a spring seat on the switch arm. An operating lever 33 pivoted on a pivot 35 molded integral with the side wall of the housing 11 has a cam surface 37 on the inner end thereof adapted, upon clockwise movement of the lever 33, to engage a pin 39 in the switch arm 27 and move the switch arm counterclockwise to an open position in which a recess 41 in the lever 33 engages the pin 39 to hold the switch arm in the open position.

The operating lever 33 is provided with a handle member 43 extending outwardly through an opening 45 in the housing and an integral arcuate portion 47 of the handle substantially closes the opening 45 in all positions of the handle.

The contacts are manually opened by clockwise movement of the handle 43 and the operating lever 33 to the "off" position during which movement the cam surface 37 acts on the pin 39 to move the switch member 27 to the open position further compressing the spring 31. Movement of the handle 43 and the operating lever 33 counterclockwise to the "on" position permits the spring 31 to move the switch member 27 to close the contacts.

Pivotally mounted on the pin 35 is a releasable member 49 biased in a counterclockwise direction by means of a spring 51 having one end seated in a spring seat in the end wall of the housing 11 and the other end engaging a spring guide 53 on the releasable member 49. The releasable member 49 is normally biased by the spring 51 for movement in a counterclockwise direction but is releasably restrained by means of the trip device 21. Operation of the trip device, which will be hereinafter described in detail, releases the releasable member 49 whereupon the spring 51, which is of considerably greater strength than the spring 31, rotates the releasable member 49 sharply counterclockwise. This movement causes a cam surface 55 on the releasable member 49 to engage the pin 39 and move the switch member 27 to the open position.

When the switch member 27 is automatically moved to the open position by the releasable member 49, the handle 43 is moved to an intermediate indicating position by means of a leaf spring 57 having one end seated in a recess in the housing 11 and bearing against the arcuate portion 47 of the handle.

The releasable member 49 is reset and relatched and the contacts closed following an automatic operation by first moving the handle clockwise to the full "off" position and then counterclockwise to the "on" position. When the handle 43 is moved to the "off" position a surface 59 on the arcuate portion 47 thereof engages and moves the releasable member 49 to its normally restrained position. Counterclockwise movement of the handle 43 then permits the spring 31 to close the contacts.

The trip device 21 comprises a bimetal element 61 having its lower end (Fig. 6) rigidly secured to the inner end of a terminal conductor 63 rigidly supported by means of a screw 65 on the end wall of the housing, and having a portion extending out through an opening in the end wall of the housing. A terminal connector 67 is secured to the outer end of the conductor 63. The upper or free end of the bimetal element is connected by means of a flexible conductor 69 to the switch member 27.

A U-shaped magnetic member or armature 71 surrounds three sides of the bimetal element adjacent the free end thereof. A fixed magnet yoke 73 is supported in a recess 75 in the end wall of the housing 11 for limited movement relative thereto. The magnet yoke 73 is provided with flanges 77 which engage shoulders 79 on the housing 11 to limit the movement of the magnet yoke 73 toward the armature 71. A light compression spring 81 seated in a spring seat in the end wall of the housing 11 biases the fixed magnet yoke 73 toward the armature 71 and against the shoulders 79 on the housing to provide a normal air gap between the magnet yoke 73 and the armature 71. The armature 71 also serves as a latch and normally engages a latching portion 83 of the releasable member 49 and releasably restrains the releasable member in operative position as shown.

Means is provided for calibrating the trip device. This means comprises a screw 85 threaded into the terminal conductor 63 at the point where the bimetal element 61 is mounted thereon. The screw 85 has a round head 87 seated in a recess in the end wall of the housing 11. An opening 89 is provided for the insertion of a screw driver to rotate the adjusting screw 85. Turning the screw 85 will cause bending of the conductor 63 and corresponding variation in the position of the bimetal element 61 according to the direction in which the screw 85 is rotated to thereby vary the tripping point of the breaker.

Upon the occurrence of a low, persistent overload current below a certain value, for instance, ten times normal rated current, the bimetal element is heated and bends toward the right (Fig. 6) causing release of the releasable member 49. The releasable member causes movement of the switch arm 27 to the open contact position in the manner previously described.

When an overload current above ten times normal or a short circuit current occurs, the electromagnetic trip means is energized and the armature 71 is attracted toward the magnet yoke 73 bending the bimetal element and causing instantaneous release of the releasable member 49

and opening of the contacts. The releasable member 49 is reset and relatched following an automatic opening operation in the previously described manner.

During the time interval between the tripping action and the mechanical opening of the contacts the excessive current continues to flow through and heat the bimetal, and the bimetal element continues to flex or bend beyond the tripping point. If the thermal bending of the bimetal element is opposed by any substantial force such as by striking a fixed magnet yoke while the bimetal is hot, it will take a permanent set which will destroy its calibration. For this reason the magnet yoke 73 is movable in the direction of thermal bending of the bimetal element 61 so that, upon continued bending, the bimetal element has only to overcome the relatively light force of the spring 81. After the bimetal element has cooled and resumed its normal position the spring 81 restores the magnet yoke 73 to its normal position with the flanges 77 thereon abutting against the shoulders 79 on the housing 11.

Having described the invention specifically in accordance with the provisions of the patent statutes, it is to be understood that various changes and modifications may be made in the structural details and combination of elements disclosed without departing from some of the essential features of the invention.

I claim as my invention:

1. In a circuit breaker having separable contact means and means releasable to effect separation of said contact means, trip means for effecting release of said releasable means in response to overload currents comprising a bimetal element, magnetic means including an armature mounted on said bimetal element, said bimetal and armature having a portion for releasing said releasable means, thermal bending of said bimetal element causing release of said releasable means, a magnetic yoke mounted separate from said bimetal element and supported for limited movement in the direction of thermal bending of said bimetal element to permit maximum bending of said bimetal element without substantial opposition, relatively light spring means biasing said magnetic yoke to normal position relative to said armature, and said magnetic yoke upon energization of said magnetic means attracting said armature and bending said bimetal element to cause instantaneous release of said releasable means.

2. In a circuit breaker having separable contact means and means releasable to effect separation of said contact means, trip means for effecting release of said releasable means in response to overload currents comprising a thermally responsive element, magnetic means including a first magnetic member mounted on said thermally responsive element, said first magnetic member having a latch surface movable therewith engaging and releasably restraining said releasable means, thermal bending of said thermally responsive member in response to overload currents causing said magnetic member to release said releasable means, a second magnetic member mounted on a fixed support for limited movement in the direction of thermal bending of said thermally responsive element, spring means biasing said second magnetic member to a predetermined position to form a predetermined initial air gap with said first magnetic member, said spring means permitting thermal bending

of said thermally responsive element a distance greater than said initial air gap with a minimum of opposition, and said magnetic members when energized in response to excessive currents bending said thermally responsive means to effect instantaneous release of said releasable means.

3. In a circuit breaker having relatively movable contact means and means releasable to effect opening of said contact means, current responsive means for effecting release of said releasable means in response to overload currents comprising a magnetic yoke mounted on a fixed support for limited movement, means energizing said magnetic yoke in response to current flow through said breaker, an armature member movable toward said magnetic yoke to bend said bimetal element and effect release of said releasable means in response to overload currents, spring means biasing said magnetic yoke to a predetermined position, said magnetic yoke in said predetermined position cooperating with said armature to define a predetermined initial magnetic air gap, and said spring means permitting said armature to move a distance greater than said predetermined initial air gap.

4. In a circuit breaker having relatively movable contact means and means releasable to effect opening of said contact means, current responsive means for effecting release of said releasable means in response to overload currents comprising a bimetal element, an armature mounted on and embracing said bimetal element to be energized in response to current flowing through said bimetal element, a magnetic yoke mounted separate from said bimetal element for limited movement, means limiting movement of said magnetic yoke toward said armature, spring means biasing said magnetic yoke against said limiting means to provide a normal initial air gap between said magnetic yoke and said armature, said armature engaging and moving said magnetic yoke upon excessive thermal bending of said bimetal element.

5. In a circuit breaker having separable contact means and means releasable to effect separation of said contact means, a bimetal element responsive to overload currents for effecting release of said releasable means, a first magnetic member supported on said bimetal element to be energized by current flowing through said bimetal element, said first magnetic member having a portion movable therewith normally engaging and releasably restraining said releasable means, a second magnetic member, means separate from said bimetal element supporting said second magnetic member for limited movement, stop means limiting the movement of said second magnetic member toward said armature, biasing means biasing said second magnetic member against said stop means providing a normal air gap, said first magnetic member engaging and moving said second magnetic member upon thermal bending of said bimetal element.

6. In a circuit breaker having relatively movable contacts and means releasable to effect opening of said contacts, current responsive means for effecting release of said releasable means in response to overload currents below a predetermined value comprising a bimetal element, magnetic means for effecting instantaneous release of said releasable means comprising a magnet yoke mounted for limited movement, an armature mounted on said bimetal element on the side thereof away from said magnet yoke, a rivet securing said armature to said bimetal element having a head on the side of said bimetal element adjacent said magnet yoke, a relatively light spring biasing said magnet yoke to a predetermined position, said magnet yoke being embossed to form a clearance recess for said rivet head on one side thereof and a raised portion on the opposite side thereof forming a seat for said spring.

7. A circuit breaker including an open-sided housing member of molded insulating material and a closure member also of molded insulating material mounted on said open-sided housing, relatively movable contacts, means releasable to effect opening of said contacts, current responsive means for effecting release of said releasable means in response to certain overload currents comprising a bimetal element, magnetic means for effecting release of said releasable means in response to certain other overload currents comprising a magnet yoke, said open-sided housing member and said closure member each having matching recesses and surfaces therein for receiving and supporting one of the opposite edges of said magnet yoke for limited movement, an armature mounted on said bimetal element and movable toward said magnet yoke upon energization of said magnetic means by said other overload currents, spring means biasing said magnet yoke to a predetermined position to form an initial air gap with said armature, and said spring means permitting said armature to move a distance greater than said initial air gap.

8. A circuit breaker including an open-sided housing member of molded insulating material and a closure member also of molded insulating material mounted on said open-sided housing, relatively movable contacts, means releasable to effect opening of said contacts, current responsive means for effecting release of said releasable means in response to certain overload currents comprising a bimetal element, magnetic means for effecting release of said releasable means in response to certain other overload currents comprising a magnet yoke, said open-sided housing member and said closure member each having supporting means for receiving one side of said magnet yoke and the distance between the supporting means on the housing member and the supporting means on the closure member being greater than the width of the bimetal element to permit the bimetal element to move between the supporting means on the two members, said supporting means permitting limited movement of said magnet yoke, an armature mounted on said bimetal element and movable toward said magnet yoke upon energization of said magnetic means by said other overload currents, spring means biasing said magnet yoke to a predetermined position to form an initial air gap with said armature, and said spring means permitting said armature to move a distance greater than said initial air gap.

9. A circuit breaker including an open-sided housing member of molded insulating material and a closure member also of molded insulating material mounted on said open-sided housing, relatively movable contacts, means releasable to effect opening of said contacts, current responsive means for effecting release of said releasable means in response to certain overload currents comprising a bimetal element, magnetic means for effecting release of said releasable means in response to certain other overload currents comprising an H-shaped magnetic member and an

armature member on the bimetal element of greater width than the bimetal element, said open-sided housing member having a pair of spaced projections for engaging the opposite ends of one side of the H and said closure member having a pair of spaced projections for engaging the opposite ends of the other side of the H, the distance between the projections on the two members being greater than the width of the bimetal element and the space between the projections on each member being greater than the depth of the armature so that the bimetal and armature may move together between the four projections.

10. A circuit breaker including an open-sided housing member of molded insulating material and a closure member also of molded insulating material mounted on said open-sided housing, relatively movable contacts, means releasable to effect opening of said contacts, current responsive means for effecting release of said releasable means in response to certain overload currents comprising a bimetal element, magnetic means for effecting release of said releasable means in response to certain other overload currents comprising an H-shaped magnetic member and an armature member on the bimetal element of greater width than the bimetal element, said open-sided housing member having a pair of spaced projections for engaging the opposite ends of one side of the H and said closure member having a pair of spaced projections for engaging the opposite ends of the other side of the H, the distance between the projections on the two members being greater than the width of the bimetal element and the space between the projections on each member being greater than the depth of the armature so that the bimetal and armature may move together between the four projections, and said H-shaped magnetic member being movable by said bimetal and armature only after release of said releasable means.

11. In a circuit breaker, a housing of insulating material, separable contacts, means releasable to effect separation of said contacts, trip means for effecting release of said releasable means comprising a bimetal element, an armature positioned on one side of said bimetal element and movable to effect release of said releasable means, a magnetic member positioned on the other side of said bimetal element and supported by the housing of insulating material for movement in the direction of movement of the bimetal element when heated, said magnetic member being movable by movement of the bimetal element when heated and being supported by the housing at such distance from the bimetal element that the magnetic member is not moved until after the bimetal element has moved a distance sufficient to cause release of said releasable means.

12. In a circuit breaker having relatively movable contacts and means releasable to effect opening of said contacts, current responsive means for effecting release of said releasable means in response to overload currents, a latch member normally engaging and holding said releasable member, said latch member being mounted on said current responsive means and insulated therefrom by means including a fastening member passing through said latch member and said current responsive member, and a coating of an insulating composition on the shank of said fastening member.

13. In a circuit breaker having relatively movable contacts and means releasable to effect opening of said contacts, current responsive means for effecting release of said releasable means in response to overload currents, a latch member normally engaging and holding said releasable member, said latch member being mounted on said current responsive means and insulated therefrom by means including a piece of enameled wire passing through said latch member and said current responsive member and having a headed portion at each end thereof.

14. In a circuit breaker having relatively movable contacts and means releasable to effect opening of said contacts, a bimetal element for effecting release of said releasable means, latch means on said bimetal element normally restraining said releasable means, magnetic means energizable by current flowing through said bimetal element for effecting release of said releasable means comprising a magnet yoke mounted for limited movement, an armature mounted on said bimetal element and movable toward said magnet yoke, means rigidly securing said armature on said bimetal element comprising a rivet having a head disposed on the side of said bimetal proximate to said magnet yoke, said rivet having the surface of its shank coated with insulating material to assist in insulating said latch means from said bimetal element and said armature, spring means biasing said magnet yoke to a predetermined position to form an initial air gap with said armature, said magnet yoke having a raised portion on one side forming a seat for said spring means and having a recess on the other side for accommodating the head of said rivet to permit close engagement of said armature with said magnet yoke, and said spring means permitting said armature to move a greater distance than said initial air gap.

15. In a circuit breaker having relatively movable contacts and means releasable to effect opening of said contacts, trip means for effecting release of said releasable means in response to overload currents comprising a bimetal element, magnetic means including a magnet yoke supported for limited movement in the direction of thermal bending of said bimetal element to permit maximum bending of said bimetal element without substantial opposition, a spring biasing said magnet yoke to a normal position, an armature mounted on said bimetal element, a latch member mounted on said bimetal element between said bimetal element and said armature, insulating means for insulating said latch member from said bimetal element and said armature including a rivet having a coating of insulating material thereon and having a projecting head on the side of said bimetal element adjacent said magnet yoke, said magnet yoke having a recess on the side thereof adjacent said bimetal element to accommodate said rivet head and having a raised portion on the side opposite to said recess forming a seat for said spring, and said magnet yoke upon energization of said magnetic means attracting said armature to bend said bimetal element and cause instantaneous release of said releasable means.

16. In a circuit breaker, separable contact means, a movable member for effecting separation of said contact means upon the occurrence of an overload, a bimetal element which bends when heated, a portion rigid with said bimetal element and movable therewith at all times, said portion when moved to a predetermined position initiating movement of said movable member to effect separation of the contact means, a member of magnetic material movably mounted on

a stationary support adjacent said bimetal element for magnetically bending said bimetal element and moving said portion rigid therewith to said predetermined position, stop means limiting movement of said member of magnetic material toward said bimetal element, and said member of magnetic material being movable relative to its stationary support away from said stop means in the direction in which the bimetal element bends when heated.

17. In a circuit breaker, separable contact means, a movable member for effecting separation of said contact means upon the occurrence of an overload, a bimetal element which bends when heated, means connecting said bimetal element in the circuit through the contact means so as to be traversed by current and heated thereby, a portion rigid with said bimetal element and movable therewith at all times, said portion when moved to a predetermined position initiating movement of said movable member to effect separation of the contact means, a member of magnetic material movably mounted on a stationary support adjacent said bimetal element, said

member of magnetic material being energized by the current flow through the bimetal element for magnetically bending said bimetal element and moving said portion rigid therewith to said predetermined position upon the flow of a heavy current, stop means limiting movement of said member of magnetic material toward said bimetal element, a spring biasing said member of magnetic material against said stop means, and said member of magnetic material being movable relative to its stationary support away from said stop means in the direction in which the bimetal element bends when heated and against the bias of said spring.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,447,652	Jennings	Aug. 24, 1948
2,539,567	Best	Jan. 30, 1951
2,573,306	Casey	Oct. 30, 1951
2,590,663	Walker	Mar. 25, 1952