Aug. 22, 1939. O. S. JENNINGS 2,170,412

CIRCUIT BREAKER

Filed Dec. 17, 1936

Fig. 1.

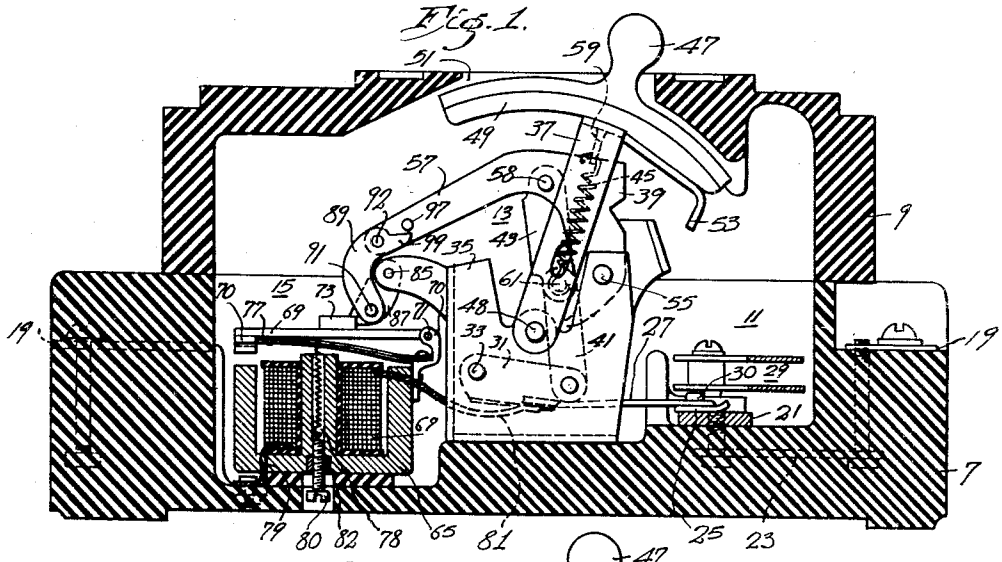


Fig. 2.

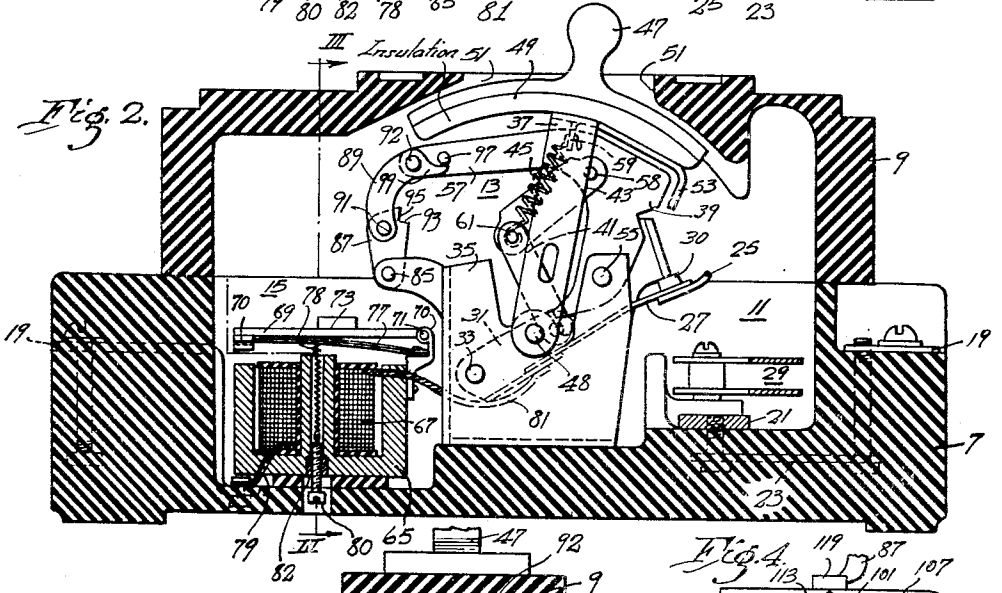


Fig. 3.

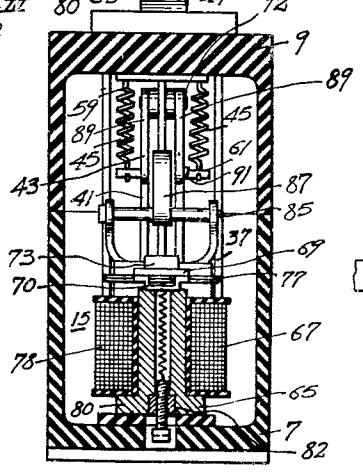
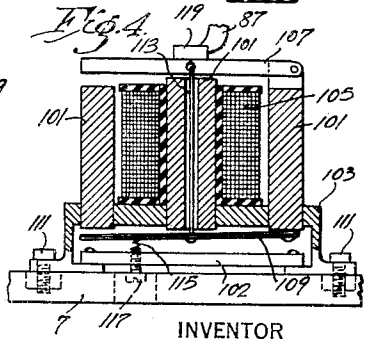


Fig. 4.



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CIRCUIT BREAKER

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12 Claims. (Cl. 200—88)

My invention relates to circuit breakers in general and more particularly to circuit breakers of the type in which the breaker operating mechanism is manually operable to open or to close the circuit and is automatically operable to open the circuit upon the occurrence of short circuit or overload conditions.

One object of my invention is the provision of an improved circuit breaker which is simple and efficient in operation and which is more rugged and capable of more reliable operation over a longer period of time than circuit breakers that have heretofore been known or used.

Another object of my invention is the provision of a circuit breaker having an improved trip mechanism for opening the circuit in response to overload conditions, the trip mechanism being capable of distinguishing between overloads of differing magnitudes so that it opens the circuit immediately in response to a short circuit or heavy overload and operates to open the circuit in response to lower magnitude overloads only after the lower magnitude overload has existed for a predetermined time interval.

Another object of my invention is the provision of a circuit breaker having an improved trip mechanism including an electromagnetic and a bimetallic trip means for opening the circuit in response to overloads of differing magnitude in which the bimetallic trip means is protected from damage due to short circuits or heavy magnitude overload currents.

Another object of my invention is to provide a trip device for a circuit breaker embodying an electromagnetic trip means and a bimetallic trip element, the bimetallic trip element being positioned in the magnetic field of the electromagnetic means so as to be heated by eddy currents set up therein and by the heat losses of said electromagnetic means, said element when heated flexing in a direction to assist said electromagnet in tripping said breaker.

Another object of my invention is to provide an improved trip device for a circuit breaker embodying an electromagnetic and a bimetallic trip means in which the bimetallic trip means is not traversed by the current of the circuit controlled by the breaker, but which is controlled indirectly by the current flowing in the electromagnetic trip means.

Another object of my invention is the provision of a circuit breaker having an improved trip device and an improved cooperating latch means controlled thereby for automatically opening the circuit upon the occurrence of predetermined overload conditions.

Another object of my invention is the provision of a circuit breaker having a releasable spring biased actuating member which when released opens the circuit controlled by the breaker, with an improved latch means for carrying the relatively heavy load of the spring biased actuating member with a very light latch pressure.

The novel features that I consider characteristic of my invention are set forth in particular in the appended claims. The invention itself, however, both as to structure and operation, together with additional objects and advantages thereof, will best be understood from the following detailed description of a specific embodiment thereof when read in connection with the accompanying drawing, in which:

Figure 1 is a vertical sectional view of my improved circuit breaker, showing the various parts thereof in the closed circuit position,

Fig. 2 is a vertical sectional view similar to Fig. 1, showing the breaker in the open circuit position after a tripping operation.

Fig. 3 is a vertical sectional view of my improved circuit breaker taken substantially on the line III—III of Fig. 2, and looking in the direction of the arrows; and,

Fig. 4 is a fragmentary sectional view of a modified form of trip device for the circuit breaker.

Referring to the drawing, the circuit breaker comprises, in general, a base 7, a cover 9, contact means indicated generally at 11, an operating mechanism indicated generally at 13, and a trip device indicated generally at 15.

The base 7 is constructed of molded insulating material and forms a support for the various elements. The cover 9 also of molded insulating material is secured to the base 7 by suitable means such as bolts (not shown) which pass through aligned openings formed in the base and cover. End terminals 19 mounted in suitable openings provided in the ends of the base 7 form the means for connecting the breaker in an electrical circuit.

The contact means indicated generally at 11 comprises a stationary contact 21 connected by a conductor strip 23 to one of the end terminals 19, a movable contact 25 carried by a resilient switch arm 27, and an arc extinguishing means indicated generally at 29. The arc extinguishing means is not an important part of my invention, and any suitable type may be used.

The movable contact 25 is secured to one end

of the resilient switch arm 27 by means of a rivet 30. The opposite end of the switch arm 27 is secured to a channel shaped movable contact supporting frame 31 by any suitable means. The channel shaped movable contact supporting frame 31 is pivotally supported by means of a pin 33 to the side walls of a U-shaped main frame 35.

The operating mechanism 13 of the circuit breaker comprises in general a bifurcated operating member 37, a pivoted actuating member 39, a pair of toggle links 41 and 43, over-center springs 45 and an operating handle 47. The operating member 37 has the lower ends of its legs pivotally supported on the side walls of the main frame 35 by means of pivot pins 48. The upper end of the operating member 37 has secured thereto an arcuate closure member 49 of molded insulating material which acts to close an opening 51 provided in the cover 9 in any position of the operating member 37. The handle 47 is formed integral with the closure member 49, and projects through the opening 51 in the cover 9. A resetting member 53 is secured to the under side of the closure member 49 for the purpose of resetting the actuating member 39 after a tripping operation has occurred, as will be described hereinafter.

The actuating member 39 is pivotally supported by means of a pivot pin 55 which extends between the side walls of the main frame 35. The actuating member has a rearwardly extending portion 57 which is adapted to be releasably held in a normally latched position by a means which will be hereinafter described.

The toggle links 41 and 43 pivotally connect the channel shaped movable contact supporting frame 31 to the actuating member 39 in a manner shown in Figs. 1 and 2 of the drawing. The over-center springs 45 are connected in tension between lugs 59 secured to the top of the operating member 37 and a knee pivot pin 61 which pivotally connects the toggle links together.

The operation of the circuit breaker as thus far described is as follows. With the various parts in the position shown in Fig. 1, i. e., with the contact means in the closed circuit position and the actuating member 39 held in its normal latched position by the trip device 15, let it be assumed that it is desired to manually open the circuit controlled by the breaker. The operating handle 47 is moved from the closed circuit position shown in Fig. 1 to an open circuit position at the opposite end of the opening 51 provided in the cover 9. The movement of the operating handle 47 to open circuit position moves the operating member 37 in a counterclockwise direction about its pivot pins 48. At a certain point in the opening movement of the operating member 37, the over-center springs 45 change their line of action with respect to the pivot point 58, of the upper toggle link 43 to the actuating member 39, and cause collapse of the toggle links 41 and 43. The collapse of the toggle links by the over-center springs 45 causes movement of the switch arm 27 to the open circuit position with a snap action.

In manually closing the circuit breaker substantially the reverse action takes place. The operating handle is returned to the closed circuit position shown in Fig. 1. At a predetermined point in the closing movement of the operating handle 47, the over-center springs 45 change their line of action with respect to the pivot point 58 and cause the toggle links to assume their extended position as shown in Fig. 1. The movement of the toggle links 41 and 43 to their extended position by the over-center springs 45 causes movement of the movable contact supporting frame 31 and the switch arm 27 to closed circuit position with a snap action to effect engagement of the movable contact 25 with the stationary contact 21.

The actuating member 39 is biased in a clockwise direction about its pivot pin 55 by the force exerted thereon by the over-center springs 45, and the trip device 15 under normal conditions holds the actuating member 39 in its normal latched position against the biasing action of the springs 45. If an overload of predetermined magnitude occurs in the circuit controlled by the breaker, when the breaker is in closed circuit position, the trip device operates in a manner which will be described in detail hereinafter to effect release of the actuating member 39. The actuating member, when released, rotates in a clockwise direction about its pivot pin 55 and at a predetermined point in its movement changes the line of action of the over-center springs 45 to effect the collapse of the toggle links 41 and 43 and resulting movement of the switch arm 27 to open circuit position with a snap action to interrupt the circuit controlled by the breaker. The breaker cannot be again reclosed without first moving the operating handle from its tripped position shown in Fig. 2 to the full open circuit position. The resetting movement of the operating handle 47 to the open circuit position causes the reset member 53 to engage and move the actuating member 39 in a counterclockwise direction about its pivot pin 55 to the position shown in Fig. 1 in which it is relatched by the trip device.

The trip device 15 comprises an electromagnetic trip means and a bimetallic trip means. The electromagnetic trip means consists of an E shaped core 65 of magnetic material, a winding 67 wound upon the cener leg of the core, and an armature 69 also of magnetic material, pivoted at one end by means of a pin 71 to a bracket 70 which is secured to one leg of the core 65. The armature 69 has secured thereto a latch or latch plate 73 which, in the normal position of the armature 69, engages a latch member 87 to hold the actuating member 39 in its normal or latched position. The armature 69 is biased to its normal position away from the pole faces of the core 65 by means of a bimetallic element 77 and an adjusting spring 78. One end of the bimetallic element is secured to the bracket 70 by any suitable means, and its body portion extends across the winding 67 and center leg of the core. The free end of the bimetallic strip is coupled to the free end of the armature 69 by insertion through a yoke 70 secured to the armature. The resiliency of the bimetallic strip 77 permits the armature 69 to move to its attracted position when an overload current of high magnitude passes through the winding 67. The body portion of the bimetallic element 77 is circular in shape and has a small circular opening formed therein in the center to provide a passage for the adjusting spring 78. It will be noted that the bimetallic element is positioned in a strong portion of the magnetic field that is produced by the winding 67 and core 65 of the electromagnetic means.

The trip characteristic of the breaker may be adjusted by means of the adjusting compression spring 78 of non-magnetic material disposed in a vertical opening in the center leg of the core

65. One end of the spring 78 passes through the center opening in the bimetallic element and engages the underside of the armature 69 while the other end thereof engages an adjusting screw 80 threaded through a metal insert 82 mounted in the core 65 of the breaker. The adjusting screw 80 provides a means for increasing or decreasing the tension of the spring 78 so as to predetermine the magnetomotive force that is necessary to move the armature to its attracted position and thus fix the trip characteristic of the breaker. The adjusting spring 78 and screw 80 may be omitted if desired and in such case the calibration of the bimetallic element 77 alone determines the trip characteristic of the breaker.

The circuit breaker is adapted to be used in an alternating current circuit, and when overload currents of moderate or lower magnitude occur in the circuit controlled by the breaker, the increased strength of the alternating magnetic field produced by the electromagnetic means sets up eddy currents in the bimetallic element 77. These eddy currents heat the bimetallic element, and if the overload current persists for a predetermined length of time, the element is heated sufficiently by the eddy currents set up therein and by the heat losses from the electromagnet to cause the element to flex downwardly. The downward deflection of the bimetallic element 77 reduces the biasing force acting to bias the armature to its normal position and shortens the air gap between the armature 69 and the core 65 so that the pull of the electromagnet even on low magnitude overloads is sufficient to move the armature to its attracted position to effect release of the actuating member 39 and tripping of the breaker. The bimetallic element is self heating by the eddy currents set up therein so that there will not be as great a time delay in the development of heat as in the case of a bimetal heated by a separate heater coil, and yet the advantage is obtained of not having the bimetal traversed by the line current. The bimetal is also heated to a certain extent by the heat losses from the electromagnet in which case there is a certain time delay in the transfer of heat to the element.

By this arrangement, a trip device is provided which distinguishes between overloads of differing magnitude. The trip device operates immediately upon the occurrence of a high magnitude or a short circuit overload by magnetic attraction of the armature to effect release of the actuating member to open the contacts and interrupt the circuit. The trip device also operates to release the actuating member and open the circuit when a lower magnitude overload current of predetermined duration occurs in the circuit controlled by the breaker in the manner previously described.

The circuit of the breaker extends from the left hand end terminal 19 through a conductor 79, through the winding 67, through a flexible shunt conductor 81 to the movable switch arm 27, movable contact 25, stationary contact 21 and conductor strip 23 to the right hand end terminal 19.

It will be noted that the bimetallic trip element 77 is not connected in the circuit controlled by the breaker and hence is never traversed by high magnitude overload currents or short circuit currents. This is a highly desirable feature since one of the main objections to the thermal circuit breakers of the prior art has been that the bimetallic trip element is often damaged or destroyed by the heavy current passing therethrough on heavy overloads or short circuits. In the present arrangement, only a limited amount of current flows in the bimetallic element during a short circuit. The limited current is only that produced by the eddy current set up by the changing magnetic field of the electromagnetic trip means, and this can be limited by saturation of the electromagnet so that it is never high enough to damage the element or destroy the calibration thereof.

I have provided a novel and efficient latch means for association with the trip device and actuating member of the circuit breaker in which only an extremely light force is necessary to release the latch due to the fact that the latch surfaces carry only a small portion of the latch load imposed by the overcenter springs. The improved latch means comprises generally a toggle linkage which pivotally connects the rearwardly extending portion of the actuating member to a fixed pivot pin 85 carried by the main frame 35. The toggle linkage consists of a latch link 87 having one end pivotally mounted by the fixed pivot pin 85 to the main frame, and a pair of curved connecting links 89 having their one end connected to the opposite end of the latch link 87 by a knee pivot pin 91, and their other ends pivotally connected to the end of the rearwardly extending portion 57 of the actuating member 39 by a pivot pin 92. The free end of the latch link 87 is provided with a recess 93 to form a latch face 95 which is adapted to be engaged by the latch plate 73 carried by the armature 69 of the trip device. When the actuating member 39 is in its normal latched position, the toggle linkage formed by the latch link 87 and the connecting links 89 occupies a collapsed position, in which the latch plate 73 engages the latch face 95 to hold the actuating member in its normal position as shown in Fig. 1. It will be noted that in the collapsed position of the links the knee pivot pin 91 is positioned below the fixed pivot pin 85 and is located only a short distance to the left of the center line passing through the pins 92 and 85, so that the greatest portion of the force exerted on the actuating member 39 by the over-center springs 45 is transmitted to and carried by the fixed pivot pin 85. Only a very small component of the force exerted by the over-center springs is carried by the latch plate 73 and the latch face 95. When the armature 69 is moved to attracted position either by the electromagnetic means on a high magnitude overload, or by the bimetallic trip element 77 and the electromagnetic means in response to a lower magnitude overload of predetermined magnitude and duration, the latch plate 73 disengages the latch face 95 to free the links 87 and 89 and the actuating member 39. The over-center springs 45 move the actuating member in a clockwise direction to its operative position, and as the member 39 moves, the links move to their extended position shown in Fig. 2. Clockwise movement of the actuating member is limited by the links 87 and 89 when they reach their extended position. The links 87 and 89 are prevented from moving over center by means of a pin 97 which projects through the end of the actuating member 39. The pin 97 is adapted to be engaged by extensions 99 formed on the ends of the links 89, before the links reach dead center extended position. After the breaker has been tripped by an overload condition, the actuating member 39 is reset manually in the manner

previously described. When the actuating member 39 is being moved counter-clockwise to its normal latched position, the links 97 and 89 move progressively to their collapsed position shown in Fig. 1. When the actuating member has nearly reached its normal latched position, the end of the latch link 87 engages and slightly depresses the latch piece 73 and armature 69 by its cam action, and finally moves off of the latch plate which returns to latching position in which it engages the latch face 95 of the link 87. The breaker is now in reset normal position and can be manually operated to close the circuit in the manner previously described.

In the previously described embodiment of the trip device shown in Figs. 1 and 2, the eddy currents set up in the bimetal element produce a small reactionary force which tends to oppose the movement of the armature to attracted position. This reactionary force on lower magnitude overloads is negligible and on heavy overloads or short circuits merely reduces the speed of movement of the armature to its attracted position a small amount. In Fig. 4 I have shown a modified form of trip device which functions in substantially the same manner as the trip device shown in Figs. 1 to 3, except that the arrangement of the elements is such that the reactionary force produced by the eddy currents set up in the bimetallic element aids in moving the armature to attracted position so that a faster tripping action is obtained. Referring to Fig. 4, the modified form of trip device comprises a plurality of vertical core members 101 and a horizontal core member 102, secured together by means of a non-magnetic support 103, a winding 105 disposed about the center core leg and connected in circuit with the contacts of the breaker, a pivoted armature 107, and a bimetallic trip element 109. The support 103 is secured to the base 7 by means of screws 111. The armature 107 is pivotally connected to one leg of the core and extends across the center and end core members 101. The bimetallic element has one end fixed to the lower end of one of the core members 101, its body portion extending across the lower ends of the vertical core members 101 and disposed between the lower ends of the vertical core members 101 and the horizontal core member 102 so that it is positioned in a strong portion of the magnetic field produced by the electromagnet. A member 113 extends through a passage in the center vertical core member 101 and connects the bimetallic element 109 to the armature 107. An adjusting spring 115 and a cooperating adjusting screw 117 provide a means for biasing the armature to its normal position away from the pole faces as shown, and for adjusting the trip characteristic of the breaker. A latch plate 119, similar to the latch plate 73, is secured to the armature 107 for engaging the latch link 87 in the normal position of the armature 107 to hold the actuating member 39 of the breaker in its normal latched position.

The operation of this form of trip device is substantially similar to the form shown in Figs. 1 through 3. On high magnitude overloads or short circuits, the pull of the electromagnet moves the armature 107 to its attracted position to effect release of the actuating member of the breaker. The pull of the electromagnet is augmented by the reactionary force produced by the eddy currents set up in the bimetallic element 109 so that a fast tripping action is produced. On lower magnitude overloads of continuing nature the bimetallic element is heated by the eddy currents set up therein by the changing magnetic field of the electromagnet and by the heat losses of the electromagnet. When the element is heated a predetermined amount, it deflects in a direction away from the winding 105. The reactionary forces produced by the eddy currents assist in causing deflection of the bimetallic element away from the winding. When the bimetallic element deflects in the manner described above, it reduces the biasing force of the adjusting spring 115 and moves the armature toward attracted position. The movement of the armature toward attracted position shortens the air gap so that the pull of the electromagnet is sufficient to move the armature to its attracted position to effect release of the actuating member and tripping of the breaker.

It will thus be seen that I have provided an improved circuit breaker structure embodying a novel trip device for tripping the breaker which is capable of distinguishing between overloads of differing magnitude and the bimetallic trip element of which is not traversed by the current flowing in the circuit controlled by the breaker. I have also provided an improved latch means for cooperating with the trip device and actuating member of the circuit breaker in which the latch engaging surfaces carry only a very small component of the load of the biasing springs, so that only a small tripping force is necessary to effect opening of the contact means of the breaker.

While I have shown and described a preferred embodiment of my invention in accordance with the patent statutes, it is to be understood that various changes and modifications in the details of construction may be made without departing from the spirit of my invention, and I desire, therefore, that the invention be limited only by the reasonable construction of the language of the accompanying claims and by the prior art.

I claim as my invention:

1. In a circuit breaker, relatively movable contacts, an actuating member movable from a normal latched position to an operative position to open said contacts, means biasing said member to its operative position, a pair of toggle links, one of said links having one end pivoted to a fixed support, the other link having one end pivoted to the opposite end of said one link and its other end pivoted to said actuating member, said links occupying a normal position when said member is in its normal position, in which the largest component of the force exerted by said biasing means on said member is carried by the pivot connection of said one link to the fixed support and only a small component of the force tends to move said links away from their normal position, an electromagnet including a pivoted armature movable from a normal position to an attracted position, a bimetallic element positioned in the magnetic field of said electromagnet having one end secured to a fixed support, means connecting said armature to said bimetallic element for movement thereby, said bimetallic element when heated, adapted to deflect in a direction to move said armature toward its attracted position, a latch plate carried by said armature for engaging one of said links in the normal position of said armature for holding said links in their normal position to hold said member in its normal position, the pivot axis of said armature being positioned close to the line of action of the small component of force which tends to move said links away from their nor-

mal position so that only a small force is necessary to disengage said latch plate from said link.

2. In a circuit controlling device, an electromagnet comprising a core of magnetic material, a winding for said core adapted to be connected in an alternating current circuit, a control armature mounted at one end of said core movable from a normal position spaced from the end of said core to an attracted position close to the end of said core, means biasing said armature to its normal position, a bimetallic element mounted at the opposite end of said core within the magnetic field of said electromagnet, said element when heated a predetermined amount by the eddy currents set up therein and by the heat losses of said electromagnet deflecting in a direction away from said opposite end of the core substantially in the direction of the longitudinal axis of said core, and means connecting said armature and element for movement together, the eddy currents set up in said element producing a reactionary force aiding in the deflection of said element away from said opposite end of the core.

3. In an alternating current circuit breaker having relatively movable contacts and a spring biased actuating member releasable to effect separation of said contacts, a trip device comprising a core of magnetic material, a winding for said core connected in circuit with said contacts, an armature mounted adjacent one end of said core movable from a normal position to an attracted position to effect release of said member, means biasing said armature toward its normal position, a bimetallic element mounted adjacent the opposite end of said core, said element when heated a predetermined amount by the eddy currents set up therein by the magnetic field produced by said winding and core and by the heat losses of said winding and core deflecting in a direction away from said opposite end of the core, said eddy currents producing a reactionary force also tending to deflect said element away from said opposite end of the core, means connecting said armature to said element for movement together, the pull of said winding and core on heavy magnitude overloads moving said armature to its attracted position, and the deflection of said element in response to lower magnitude overloads of predetermined value and duration moving said armature toward attracted position so that pull of said winding and core becomes sufficient to move said armature to its attracted position.

4. A circuit controlling device comprising a core of magnetic material, a winding disposed about said core adapted to be connected in an alternating current circuit, an armature at one end of said core movable from a normal position spaced from the end of said core to an attracted position close to the end of said core, means biasing said armature to its normal position, a bimetallic element at the opposite end of said core within the magnetic field produced by said winding and core, said element when heated a predetermined amount by the eddy currents produced therein and the heat losses of said winding and core deflecting in a direction away from the end of said core substantially in the direction of the longitudinal axis of said core; the eddy currents set up therein producing a reactionary force also tending to deflect said element away from the end of said core, and means connecting said element and said armature for movement together, and means for adjusting the force exerted by said biasing means.

5. In electrical apparatus, an actuating member movable from a normal latched position to an operative position to actuate said apparatus, means biasing said member to its operative position, means for releasably restraining said member in its normal position comprising a latch member having one end pivoted to a fixed support, a link having one end pivoted to the opposite end of said latch member by a knee pivot pin and its other end pivotally connected to said actuating member, said knee pivot pin when said actuating member is in its normal position being so positioned with respect to said fixed pivot that substantially the greatest part of the force exerted on said member by said biasing means is carried by said fixed pivot, a latch engaging said opposite end of said latch member for normally restraining said knee pivot pin in said last-mentioned position, and electro-responsive means for causing said latch to release said latch member to free said actuating member.

6. In electrical apparatus, an actuating member movable from a normal latched position to an operative position to actuate said apparatus, means biasing said member to its operative position, means for releasably holding said member in its normal position comprising a latch member having one end pivoted to a fixed support, a link having one end pivotally connected to the opposite end of said latch member by a knee pivot pin and its opposite end pivotally connected to said actuating member, said latch member and said link forming a toggle linkage which is collapsed when said actuating member is in said normal position with its knee pivot pin so positioned that the greatest component of the force exerted on said member by said biasing means is carried by said fixed pivot, a latch for normally restraining said latch member with said knee pivot in said last mentioned position, and means for causing said latch to release said latch member to free said actuating member.

7. In a circuit breaker, relatively movable contacts, an actuating member movable from a normal position to an operative position to effect separation of said contacts, means biasing said member to its operative position, means for releasably restraining said member in its normal position comprising a pair of pivotally connected links, one of said links being pivotally connected to said actuating member and the other of said links being pivotally connected to a fixed support, said links occupying one position when said member is in its normal position and being movable to another position by movement of said member to its operative position, a movable latch for normally engaging one of said links to hold said links in said one position to hold said member in its normal position, electro-responsive means for moving said latch to release said links and free said member in response to predetermined conditions, the largest part of the force tending to move said actuating member to operative position being carried by said fixed support when said links are in said one position, so that only a small force is necessary to move said latch to release said link.

8. In a circuit breaker, relatively movable contacts, an actuating member movable from a normal position to an operative position to effect separation of said contacts, means biasing said member to its operative position, means for releasably restraining said member in its normal

position comprising a pair of pivotally connected links, one of said links being pivotally connected to said actuating member and the other of said links being pivotally connected to a fixed support, said links occupying one position when said member is in its normal position and being movable to another position when said member moves to its operative position, a pivoted latch for normally engaging one of said links to hold said links in said one position to hold said member in its normal position, electro-responsive means for moving said latch to release said link and free said member in response to predetermined conditions, the greatest portion of the force tending to move said actuating member to operative position being carried by the fixed support point of said links in their said one position, so that only a small component of said force tends to move said links away from said one position, the pivot axis of said latch being positioned close to the line of action of said small component of the said force.

9. In a circuit breaker, relatively movable contacts, an actuating member movable from a normal latched position to an operative position to effect separation of said contacts to interrupt the circuit, means biasing said actuating member to its operative position, a pair of toggle links pivotally connected together by a knee pivot pin, one of said links being pivotally connected to a fixed support and the other being pivotally connected to said actuating member so that said links occupy a collapsed position when said member is in its normal position and move to an extended position when said member moves to its operative position a latch normally engaging one of said links for holding said links in their collapsed position and said actuating member in its normal position, and electro-responsive means for causing said latch to release said link to free said actuating member in response to predetermined conditions, the greatest portion of the force exerted by said biasing means on said actuating member being carried by said fixed support in the collapsed position of said links so that only a small force is required to cause said latch to release said link.

10. In a circuit breaker, relatively movable contacts, operating mechanism for opening and closing said contacts, an actuating member movable from a normal latched position to an operative position to cause said operating mechanism to open said contacts, means biasing said member to its operative position, latch means for releasably restraining said member in its normal position comprising a pair of toggle links pivotally connecting said member to a fixed pivot pin, said links occupying one position when said member is in its normal position and being movable to another position by movement of said member to its operative position, a releasable latch normally engaging one of said links to hold said links in said one position to hold said member in its normal position, the major portion of the force tending to move said actuating member to operative position being carried by said fixed pivot pin in the said one position of said links so that only a light force is carried by said latch in holding said links in said one position, and electromagnetic means connected in circuit with said contacts for moving said latch to release said links and free said actuating member upon the occurrence of predetermined overload currents in the circuit controlled by the breaker.

11. In a circuit breaker, relatively movable contacts, operating mechanism for opening and closing said contacts, an actuating member movable from a normal latched position to an operative position to cause said operating mechanism to open said contacts, means biasing said member to its operative position, latch means for releasably restraining said member in its normal position comprising a pair of toggle links pivotally connecting said member to a fixed pivot pin, said links occupying one position when said member is in its normal position and being movable to another position when said member is moved to its operative position, a releasable latch normally engaging one of said links to hold said links in said one position to hold said member in its normal position, the major portion of the force exerted on said member by said biasing means being carried by said fixed pivot pin in the said one position of said links so that only a light force is carried by said latch in holding said links in said one position, and a bimetallic element operable to move said latch to release said links and free said member in response to predetermined conditions.

12. In an alternating current circuit interrupter, relatively movable contacts, an electromagnet energized from the circuit and having an armature movable from a normal position to an attracted position in response to predetermined overload conditions to cause opening of said contacts, a bimetallic element isolated from the circuit and disposed in the air gap between said armature and the electromagnet in a strong portion of the magnetic field to be heated in response to the current flowing in the circuit, said bimetallic element being engageable with said armature and operable when heated a predetermined amount in response to different overload conditions to move said armature toward attracted position so that the pull of said electromagnet is sufficient to move said armature to attracted position.

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