Feb. 13, 1951 M. E. VAN AUKEN 2,541,679

CIRCUIT BREAKER

Filed Aug. 2, 1946 2 Sheets-Sheet 1

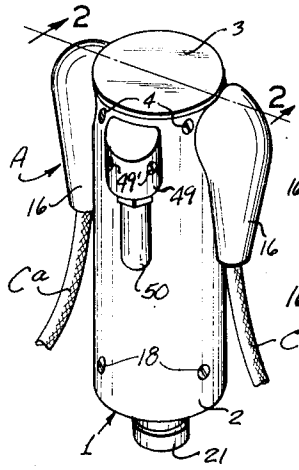


FIG. 1.

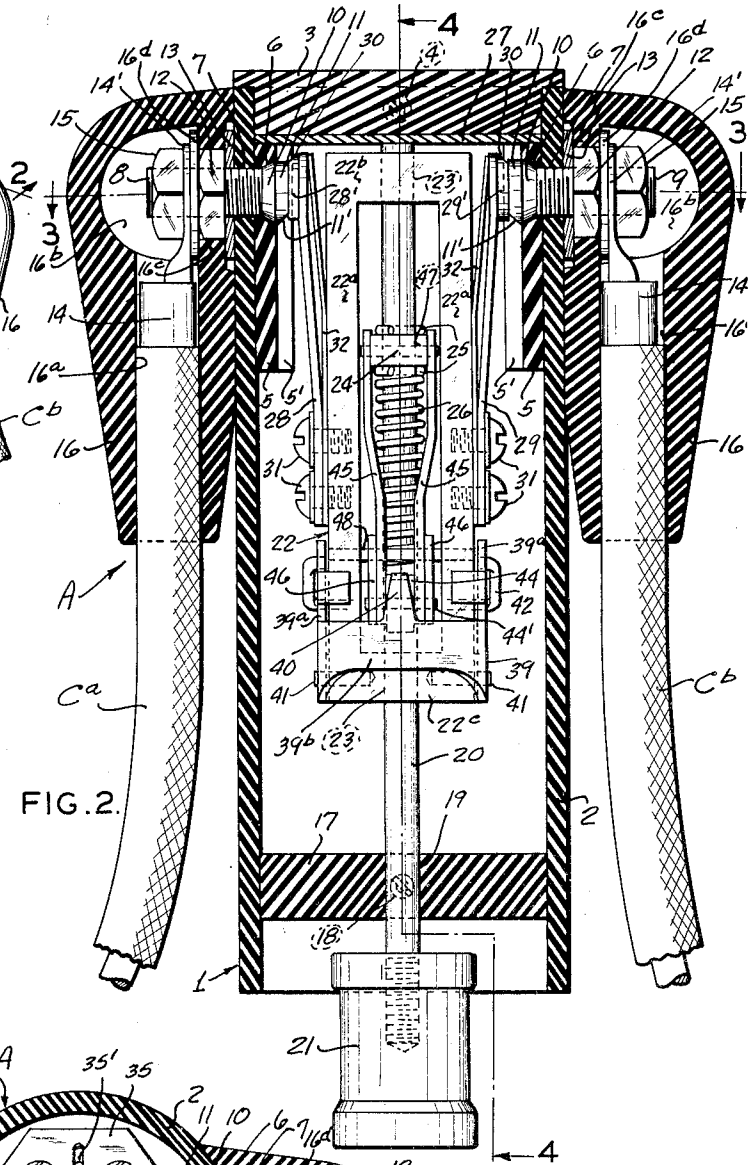


FIG. 2.

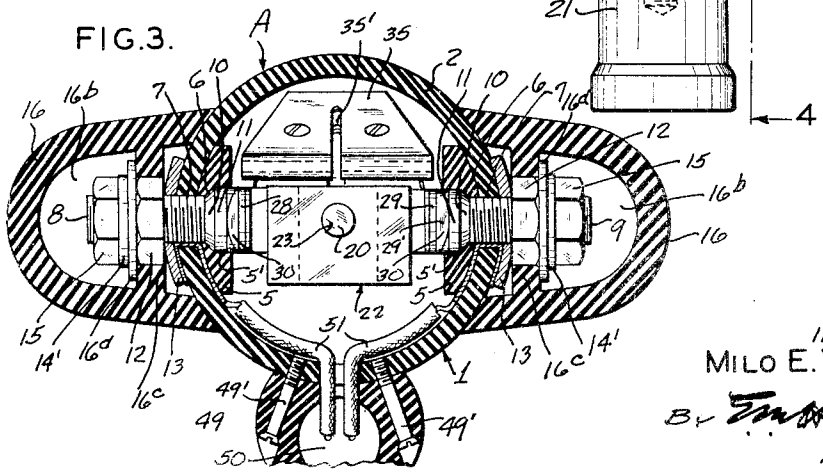


FIG. 3.

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Feb. 13, 1951 M. E. VAN AUKEN 2,541,679

CIRCUIT BREAKER

Filed Aug. 2, 1946 2 Sheets-Sheet 2

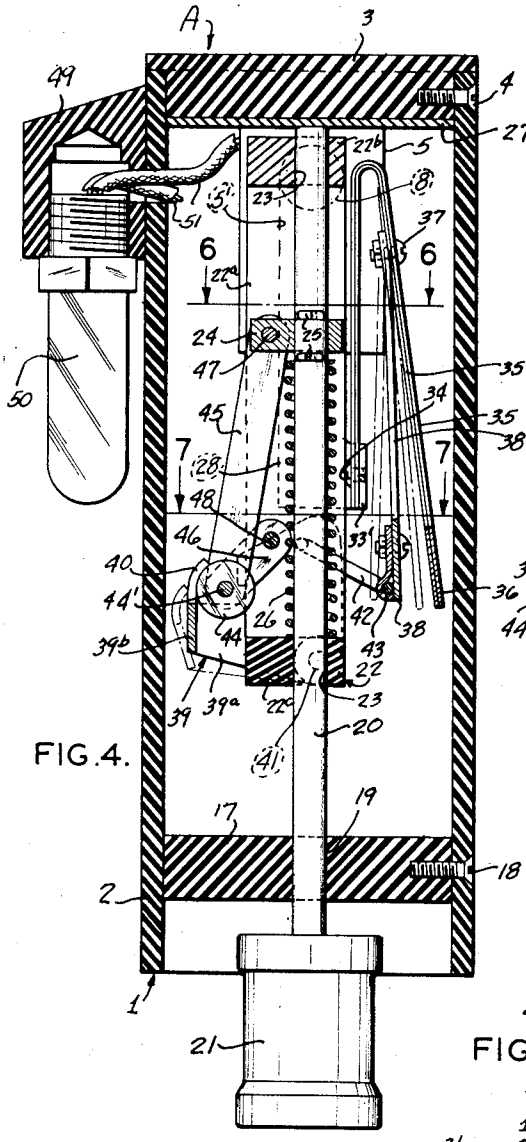


FIG. 4.

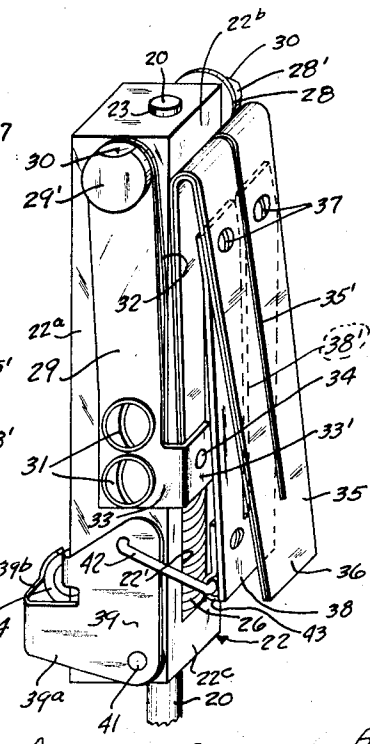


FIG. 5.

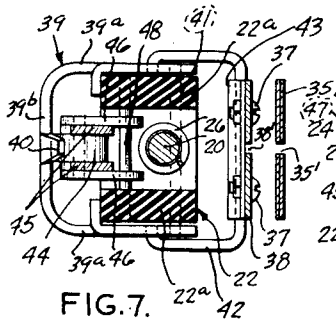


FIG. 7.

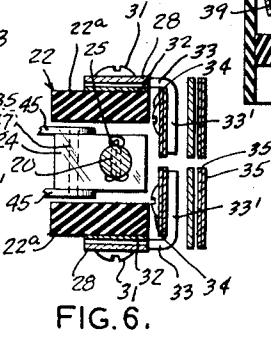


FIG. 6.

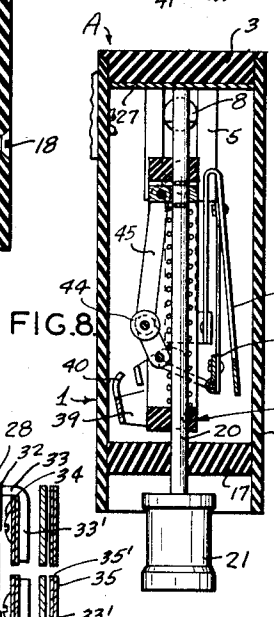


FIG. 8.

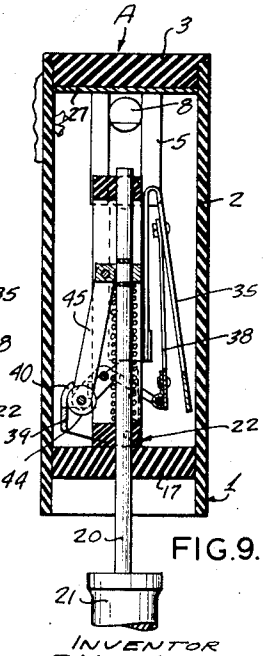


FIG. 9.

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UNITED STATES PATENT OFFICE

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CIRCUIT BREAKER

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Application August 2, 1946, Serial No. 687,869

8 Claims. (Cl. 200—116)

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This invention relates generally to circuit breakers and more specifically to secondary circuit breakers adapted for use in protecting transformers from damaging overloads and other faults to which transformers are frequently subjected while in use, the predominant object of the invention being to provide a simple secondary circuit breaker whose thermal characteristics are adapted to approach the thermal characteristics of a transformer with which it is related and which is of such improved construction and arrangement that it is capable of performing its intended functon in an improved and highly efficient manner.

The secondary circuit breaker of the present invention is particularly well adapted for use in protecting transformers in lightly developed suburban and rural areas, such as those that have been developed electrically in recent years by the rural electrification programs of the Federal Government, and where not many customers are served per transformer, and frequently where a transformer serves a single customer. In such situations transformers are installed which are only large enough to care for the anticipated peak loads of the customers served by the transformers, and if these transformers are fused on the primary sides by fuses of just enough capacity to protect them from damaging overloads and faults from the secondary sides, the fuses in most cases will be too small to withstand the induced or direct transient currents caused by storms, thereby causing excessive primary fuse failures during such storms.

Additionally, the inverse time current characteristics of the primary fuses available for use at the present time do not permit the safe use of the thermal ability of a transformer to care for short time overloads and high impedance short circuits, and transformers are not adequately protected from damaging heating caused by portable motors, home welding outfits, and machine shops in basements and garages. To prevent excessive fuse failure due to transient currents it has become the practice to specify certain minimum fuse sizes, and this, in most cases, allows the transformers to carry excessive and damaging currents before the primary fuses will function.

The improved secondary circuit breaker of the present invention eliminates all of the objections recited above, and affords, under all conditions, the maximum protection to a transformer with which it is electrically related, in a manner which will be hereinafter explained in detail when the

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operation of the improved secondary circuit breaker is described.

Fig. 1 is a perspective view of the improved secondary circuit breaker of the present invention.

Fig. 2 is an enlarged, vertical section taken on line 2—2 of Fig. 1.

Fig. 3 is a horizontal section taken on line 3—3 of Fig. 2.

Fig. 4 is a vertical section taken on line 4—4 of Fig. 2, and showing the improved circuit breaker in its circuit closing position.

Fig. 5 is a perspective view of certain internal mechanism of the improved secondary circuit breaker of the present invention.

Fig. 6 is a horizontal section taken on line 6—6 of Fig. 4.

Fig. 7 is a horizontal section taken on line 7—7 of Fig. 4.

Fig. 8 is a vertical sectional view on a reduced scale which is similar to Fig. 4 but which shows the circuit breaker in the tripped position.

Fig. 9 is a vertical sectional view similar to Fig. 8 but showing the internal mechanism of the circuit breaker in its re-set position but before the circuit breaker has been restored to the closed circuit position shown in Fig. 4.

In the drawings, wherein is shown for purposes of illustration, merely, one embodiment of the invention, A designates the improved secondary circuit breaker generally. The circuit breaker A is provided with a main housing 1 which includes a portion 2 of substantially cylindrical formation, said cylindrical portion of the main housing 1 being closed at its upper end by a top wall 3, which is secured to said cylindrical portion by suitable fastening devices 4.

The cylindrical portion 2 and the top wall 3 of the main housing 1 of the circuit breaker A are preferably formed of fiber, or other suitable electrical insulating material and at opposed points in the upper portion of the cylindrical portion 2 of the main housing 1, there is disposed a pair of members 5 which are likewise formed of fiber, or other electrical insulating material. These members are elongated vertically and the outer faces thereof are curved in substantial accordance with the curvature of the inner face of the wall of the cylindrical portion 2 of the main housing and contact with said inner face of said wall of said cylindrical housing portion. The members 5 are provided with grooves 5' which extend longitudinally of said members, and vertically of the cylindrical portion of the main housing of the circuit breaker, and formed through each of the

members 5 is an opening 6 which leads into the groove 5' thereof, said openings 6 of the members 5 being alined with openings 7 which are formed through the wall of the cylindrical housing portion 2 (see Figs. 2 and 3).

Supported in the related openings 6 and 7 of the members 5 and the wall of the cylindrical housing portion 2 in a pair of circuit breaker terminals 8 and 9, the terminal 8 being disposed in the openings 6 and 7 at one side of the main housing 1 of the circuit breaker, while the terminal 9 is disposed in the openings 6 and 7 at the opposite side of said main housing of the circuit breaker. Each of the terminals 8 and 9 is in the form of a screwthreaded shank having a head portion at its inner end which is shaped as is shown to good advantage in Fig. 2; that is to say, the head portion of each of said terminals includes an inner flared portion 10 which is seated in a correspondingly shaped portion of the opening 6 of the associated member 5, and an end portion 11 which is disposed in the groove 5' of the associated member 5 and is provided with an inclined face 11' at the bottom thereof. The screwthreaded shank portions of the circuit breaker terminals 8 and 9 extend outwardly from the wall of the cylindrical housing portion 2, and mounted on the screwthreaded shank portion of each of said terminals is a nut 12. The nuts 12 are screwed into tight contact with curved washers 13 which are interposed between said nuts 12 and the outer face of the wall of the cylindrical portion of the main housing 1, so as to draw the tapered portions 10 of the terminals into close contact with the walls of the tapered portions of the openings 6 and thereby securely anchor said terminals in their proper fixed positions with respect to the housing of the circuit breaker A.

The shank portion of the terminal 8 has electrically connected thereto a conductor C*a*, and the shank portion of the terminal has electrically connected thereto a conductor C*b*, these conductors C*a* and C*b* being parts of the electrical circuit in which the secondary circuit breaker is interposed, and being provided with clips 14 having apertured upper portions 14' through which the screwthreaded shanks of the terminals 8 and 9 extend. The clips 14 of the conductors C*a* and C*b* are formed of electrical conducting material and are anchored to the terminals 8 and 9 by nuts 15 which are screwthreadedly mounted on the screwthreaded shanks of said terminals, said nuts 15 being screwed inwardly on said screwthreaded shanks of the terminals so as to tightly clamp the portions 14' of the clips 14 between the related nuts 13 and 15 associated with the terminals 8 and 9, whereby good electrical connections between the conductors C*a* and C*b* and the terminals 8 and 9 are obtained. The main housing 1 of the circuit breaker A is provided with portions 16 (Figs. 1, 2, and 3) that are formed of electrical insulating material and which embrace the connections between the conductors C*a* and C*b* and the terminals 8 and 9, so as to provide insulation for said connections. The portions 16 are of elongated formation and are provided with elongated passageways 16*a* through which portions of the conductors C*a* and C*b* extend, said passageways 16*a* communicating at their upper ends with cavities 16*b* wherein the connections between the conductors C*a* and C*b* and the terminals 8 and 9 are disposed. The cavities 16*b* are provided with ribs 16*c* which extend inwardly from the inner faces of the walls thereof and these ribs are snapped behind washers 16*d* that are interposed between the nuts 12 and the upper portions 14' of the clips 14 of said conductors C*a* and C*b*, so as to fixedly retain said portions 16 in their proper positions.

Arranged within the cylindrical housing portion 2, adjacent to the lower end thereof, is an element 17 which is of circular shape when viewed in plan and whose outer annular face contacts closely with the inner face of the wall of said cylindrical housing portion 2, said element being secured in place by fastening devices 18. The element 17 is formed of electrical insulating material and has formed centrally therethrough an opening 19 through which a rod 20 extends so that said rod is guided for vertical movement by the wall of said opening 19. The rod 20 is screwthreaded throughout its lower end portion, as is indicated by dotted lines in Fig. 2, and screwthreadedly mounted on this screwthreaded lower end portion of said rod is a hand grip 21 which is formed of electrical insulating material and facilitates the operation of manually subjecting the rod to vertical movement for purposes to be hereinafter explained.

Supported by the rod 20 is a carriage 22 which is formed of electrical insulating material and comprises spaced apart side walls 22*a* and top and bottom walls 22*b* and 22*c* which join said side walls at the upper and lower ends thereof. The carriage 22 preferably, though not necessarily, is an integral structure and the cavity 22' within said structure is open at the front and back thereof. The top wall 22*b* and the bottom wall 22*c* of the carriage 22 have alined openings 23 formed therethrough through which the rod 20 extends, said carriage, under certain conditions during the operation of the circuit breaker being free to move with respect to said rod.

Fixedly mounted on the rod 20 is a member 24 which is provided with an opening formed therethrough through which said rod extends, said member 20 being anchored to the rod 20 by a pair of cotter pins 25 which are extended through apertures formed through said rod and contact with the upper and lower faces, respectively, of said member. Arranged in embracing relation with respect to the rod 20, and in interposed relationship between the member 24 and the bottom wall 22*c* of the carriage 22, is a coil spring 26, said coil spring contacting at its upper end with the lowermost cotter pin 25 and contacting at its lower end with the upper face of the bottom wall of the carriage 22. The coil spring is arranged in the position indicated under compression and therefore said coil spring tends to move the member 24 and the rod 20 upwardly while tending to move the carriage 22 downwardly with respect to said rod, the upper end of the rod being caused by said coil spring to abut against a lining member 27 at the lower face of the top wall of the main housing 1 of the circuit breaker A.

The carriage 22 has fixed to the opposed side walls 22*a* thereof a pair of contacts 28 and 29 which are provided with head portions 28' and 29' that are adapted to contact with the head portions of the terminals 8 and 9, said head portions of said contacts being provided with inclined faces 30 at their tops which serve a function to be hereinafter set forth. The contacts 28 and 29 are in the form of elongated strips of metal which is characterized by being a good conductor of electricity, and these strips are se-

cured at their lower ends to the side walls of the carriage 22 by fastening devices 31, each contact having associated therewith a strip of highly resilient material 32 which is secured at its lower end to a side wall of the carriage by fastening devices 31 (see Fig. 2) and contacts at its upper end with the upper portion of the related contact 28 or 29. The upper portions of the resilient strips 32 tend to force the upper portions of the contacts 28 and 29 outwardly so that the head portions 28' and 29' thereof will make intimate contact with the head portions of the terminals 8 and 9 when the circuit breaker is in the circuit-closing position.

The contacts 28 and 29 are provided at their lower ends with extensions 33 which are projected transversely of the side walls of the carriage 22 and are bent inwardly toward each other, as is shown in Fig. 5 wherein one of said extensions is illustrated, to provide extension portions 33'. These extension portions 33' have fixed thereto by means of fastening devices 34 a bi-metal strip 35 which is of substantially inverted U-shaped formation. The bi-metal strip 35 is provided with a s'ot 35' which extends from the extreme lower end of the inner portion of said bi-metal strip, as same is illustrated in Fig. 4, to a point spaced upwardly of the extreme lower end of the outer portion of said bi-metal strip. Thus, the bi-metal strip is provided with spaced, related portions which are out of direct electrical contact with each other throughout the major portion of the length of said strip, these spaced strip portions being joined at the lower end of the outer portion of the strip by an unslotted portion 36 of the strip (Fig. 5). It will be noted, also, that the inwardly extended portions 33' of the extensions 33 of the contacts 28 and 29, to which the inner spaced portions of the bi-metal strip are secured, are spaced apart at their adjacent, inner edges, as is shown in Fig. 6.

The outer portion of the bi-metal strip 35 has fixed thereto, through the instrumentality of a pair of fastening devices 37, a strip 38 of brass, or other suitable material. The strip of material 38 is provided with a slot 38' which extends from the upper edge thereof to a point spaced upwardly from the lower edge of said strip of material. Thus, the construction of the strip of material 38 coincides with the construction of the bi-metal strip 35 in that it is provided with spaced, related portions that are out of direct electrical contact with each other throughout substantially the entire length of said strip of material 38, these spaced portions of said strip of material being joined at the extreme lower end of said strip of material, and the respective spaced portions of the strip of material 38 are secured to and are in contact with correspondingly related portions of the bi-metal strip 35.

The carriage 22 has associated therewith at its lower portion a trip latch 39 which is of substantially U-shaped formation, as is shown in Fig. 7, said trip latch having opposed side portions 39*a*, which are disposed at the outer faces of the carriage, and a forward bridge portion 39*b* which joins said side portions. The bridge portion of the trip latch is provided with an upwardly curved latching finger 40, and said trip latch is mounted on the carriage for pivotal movement by a pivot element 41 which extends through openings formed through the opposed side portions of trip latch and through an opening formed through the bottom wall of the carriage. The trip latch 39 is connected to the lower portion of the strip of material 38 by a U-shaped link 42, the opposed side portions of said link having inturned end portions which are disposed in openings formed in upper portions of the opposed, side portions of the trip latch, while the bridge portion of said link 42 is supported for rotation in a suitable bearing member 43 which is fixed to the lower portion of the strip of material 38.

The latching finger 40 of the trip latch is adapted to engage a roller 44 for the purpose of latching the carriage 22 of the circuit breaker A in the position assumed by said carriage when the circuit breaker is in circuit-closing position. This roller 44 is supported by a toggle comprised of a pair of spaced arms 45 and a pair of spaced arms 46. The spaced arms 45 are pivoted at their upper ends to the member 24 by a pivot element 47, while at their lower ends said spaced arms 45 are provided with openings in which is supported a bearing rod 44' on which the roller 44 is supported for rotation, the roller being disposed between the lower portions of said rods 45. Likewise, the upper portions of the spaced arms 46 are supported for pivotal movement by a pivot element 48 whose opposite end portions are received in openings formed in the opposed side walls of the carriage 22, said spaced arms 46 being located outwardly of the spaced arms 45 and the lower portions of said spaced arms 46 being provided with openings in which end portions of the bearing rod 44' for the roller 44 are disposed.

By referring to Figs. 1, 3 and 4 it will be noted that housing of the circuit breaker A includes a portion 49 that is secured to the cylindrical housing portion 1 by means of suitable fastening devices 49', and which is adapted to receive a suitable electric lamp 50. The lamp 50 has associated therewith conductors 51 which feed electrical energy to said lamp when the circuit breaker has tripped out so that the tripped out condition of the circuit breaker will be indicated by the glowing lamp, said conductors 51 being in electrical contact with the terminals 8 and 9 of the circuit breaker, as is shown to good advantage in Fig. 3, and electrical energy being bypassed to the lamp by way of the terminal 8, the conductors 51, and the terminal 9 when the contacts 28 and 29 of the circuit breaker are out of contact with respect to said terminals 8 and 9.

When, in the operation of the improved secondary circuit breaker disclosed herein the circuit breaker is in its normal, circuit-closing position, the path of the electrical energy is to the terminal 8 by way of the conductor C*a*, and by way of the contact 28 to the portion of the bi-metal strip 35 at one side of the slot 35' thereof to which said contact 28 is electrically connected. The electrical energy then flows upwardly of the inner portion of said portion of said bi-metal strip 35 and then downwardly of the corresponding portion of the outer portion of the bi-metal strip to the lower end thereof. At the lower portion 36 of the bi-metal strip the electrical energy flows across said strip portion to the portion of the strip at the opposite side of the slot 35' thereof, said electrical energy flowing upwardly of said opposite side portion of the bi-metal strip at the outer portion of said bi-metal strip and downwardly of the corresponding portion of the strip at the inner portion of the bi-metal strip to the contact 29, the electrical energy flowing

through the contact 29 to the terminal 9 and from said terminal 9 by way of the conductor Cb.

When the circuit breaker A is in its normal circuit-closing position the curved finger 40 of the trip latch 39 engages the roller 44 and thereby holds the carriage 22 in an elevated position against the force of the coil spring 26 which tends to move said carriage downwardly. However, when a fault occurs on the circuit in which the circuit breaker is interposed, the bi-metal strip 35 is subjected to a heating action which causes the outer portion of said bi-metal strip, and the associated strip of material 38, to move inwardly, and such inward movement of the strip of material 38 will be transmitted by the link 42 to the upper portion of the trip latch 39. This will result in the trip latch being rotated about its pivot 41 so that its forward portion moves downwardly, the curved finger 40 of the trip latch being disengaged from the roller 44 and the coil spring 26 moving the carriage rapidly downwardly to separate the upper portions of the contacts 28 and 29 from the head portions of the terminals 8 and 9 (see Fig. 8). It is to be noted that when the carriage moves downwardly as described, the head portions 28' and 29' of the contacts 28 and 29 travel downwardly through the grooves 5' of the members 5 so as to guide the carriage during its downward movement, said head portions of the contacts being disposed in said grooves even when the carriage is in its lowermost position (see Fig. 9).

An important feature of this invention is that the improved circuit breaker follows the transformer thermal ability curve for about the first hour and then levels off at about 150% of the transformer rating. This is accomplished by employing the strip of metal 38 and associating it with the bi-metal strip in such manner that it shunts approximately one-half of the bi-metal strip out of the circuit and so that said strip of material 38 shields this electrically inactive portion of the bi-metal strip from the radiant heat given off by the electrically active portion of the bi-metal strip. This retards the operation of the circuit breaker due to fault currents of large magnitude, while on currents of lower value the circuit breaker takes a longer time in which to operate. The electrically inactive portion of the bi-metal strip is heated by thermal conduction and radiation of the strip of material 38, and the rising ambient temperature within the circuit breaker housing, thus giving a positive breaker operation on these lower yet damaging currents, but allowing them to flow up to the danger point of the transformer and then opening the circuit breaker so as to protect the transformer.

It is important to note that when sufficient force has been stored up in the bi-metal strip 35, the trip latch 39 is caused to move suddenly to release the roller 44 and permit the coil spring 26 to expand freely. When the coil spring expands, the rod 20 is forced by said spring against the top wall 3 of the housing, thus imparting a jarring push to the carriage 22 and the mechanism carried thereby which tends to eliminate any tendency of the contacts 28 and 29 to stick with respect to the terminals 8 and 9 due to blistering caused by previous operations.

When the circuit breaker has been actuated, as described above, the lamp 50 will glow to indicate that the circuit has been interrupted, and after a short cooling period to allow the bi-metal strip 35 to return partially to its normal position, the circuit breaker may be reset and reclosed by simply pulling the hand grip 21 downwardly until the curved finger 40 of the trip latch 39 snaps over the roller 44 (see Fig. 9). The hand grip 21 may then be subjected to a quick upward push which moves the carriage 22 and the mechanism carried thereby into the closed position of the circuit breaker, whereupon service is restored. Obviously, the circuit breaker A may be operated to its open position manually by merely pulling the hand grip 21 downwardly, so as to cause the inner mechanism of the circuit breaker to assume the position shown in Fig. 9.

An important feature of the present invention is that the opposed members 5 at the upper end of the cylindrical portion 2 of the main housing 1 of the circuit breaker A are formed of horn fiber, or other material, which is characterized by the ability to give off gas in the presence of an electrical arc which tends to extinguish the arc. Therefore, when arcs are formed when the head portions of the contacts 28 and 29 move out of contact with respect to the head portions of the terminals 8 and 9 on opening operation of the circuit breaker, these arcs are drawn within the grooves 5' of the members 5 and said arcs are extinguished by the gas given off by said members 5. Also, because of the presence of the inclined faces 30 at the tops of the head portions 28' and 29' of the contacts 28 and 29, and the inclined face 11' at the bottoms of the portions 11 of the heads of the terminals 8 and 9, the head portions 28' and 29' of the contacts are cammed rearwardly by coaction of said inclined faces when the circuit breaker is being reclosed, so as to bring said terminal head portions and said contact head portions into proper contacting relation.

Another important feature of the invention has to do with the shape of the bi-metal strip 35, in that said bi-metal strip is wider at its longitudinal center, where it is bent, and tapers from said wider part to narrower widths at its opposite ends. The importance of this feature is that it provides for a uniform temperature rise throughout the length of the bi-metal strip due to electrical heating, whereby hot spots on the bi-metal strip are eliminated, and a desirable tripping curve may be obtained.

I claim:

1. A circuit breaker comprising a housing, circuit breaker terminals having portions disposed within said housing, a rod disposed within said housing and movable therein, a carriage supported by said rod for movement with respect thereto, contacts mounted on said carriage and movable therewith into and out of contact with said terminal portions, spring means adapted to subject said carriage to movement which moves said contacts out of contact with respect to said terminal portions, a latch structure for latching said carriage in a position where said contacts are in contact with said terminal portions, said latch structure including a toggle comprising a pair of arm structures which are pivotally interconnected at corresponding end portions thereof and with the opposite end portions of said arm structures pivotally connected to said rod and said carriage respectively, an element mounted at the interconnected end portions of said arm structures, and a tripable member for engaging said element, and means comprising a heat-responsive element which is adapted to actuate said tripable member of said latch structure and permit said carriage moving means to move said carriage so as to

withdraw said contacts out of contact with respect to said terminal portions, said rod being movable with respect to said housing for resetting the circuit breaker in closed-circuit position after actuation thereof to open-circuit position.

2. A circuit breaker comprising a housing, circuit breaker terminals having portions disposed within said housing, a rod disposed within said housing and movable therein, a carriage supported by said rod for movement with respect thereto, contacts mounted on said carriage and movable therewith into and out of contact with said terminal portions, spring means adapted to subject said carriage to movement which moves said contacts out of contact with respect to said terminal portions, a latch structure for latching said carriage in a position where said contacts are in contact with said terminal portions, said latch structure including a toggle comprising a pair of arm structures which are pivotally interconnected at corresponding end portions thereof and with the opposite end portions of said arm structures pivotally connected to said rod and said carriage respectively, a roller mounted at the interconnected end portions of said arm structures, and a tripable member provided with an extension for engaging said roller, and means comprising a heat-responsive element which is adapted to actuate said tripable member of said latch structure and permit said carriage moving means to move said carriage so as to withdraw said contacts out of contact with respect to said terminal portions, said rod being movable with respect to said housing for resetting the circuit breaker in closed-circuit position after actuation thereof to open-circuit position.

3. A circuit breaker comprising a housing, circuit breaker terminals having portions disposed within said housing, members arranged within said housing and having grooves in which said terminal portions are exposed, a rod disposed within said housing and movable therein, a carriage supported by said rod for movement with respect thereto, contacts mounted on said carriage and movable therewith into and out of contact with said terminal portions, spring means adapted to subject said carriage to movement which moves said contacts out of contact with respect to said terminal portions, a latch structure for latching said carriage in a position where said contacts are in contact with said terminal portions, and means comprising a heat-responsive element which is adapted to actuate said latch structure and permit said carriage moving means to move said carriage so as to withdraw said contacts out of contact with respect to said terminal portions, said contacts having head portions which travel through the grooves of said grooved members during movement of said carriage and said rod being movable with respect to said housing for resetting the circuit breaker in closed-circuit position after actuation thereof to open-circuit position.

4. A circuit breaker comprising a housing, circuit breaker terminals having portions disposed within said housing, members arranged within said housing and having grooves in which said terminal portions are exposed, a rod disposed within said housing and movable therein, a carriage supported by said rod for movement with respect thereto, contacts mounted on said carriage and movable therewith into and out of contact with said terminal portions, spring means adapted to subject said carriage to movement which moves said contacts out of contact with respect to said terminal portions, a latch structure for latching said carriage in a position where said contacts are in contact with said terminal portions, and means comprising a heat-responsive element which is adapted to actuate said latch structure and permit said carriage moving means to move said carriage so as to withdraw said contacts out of contact with respect to said terminal portions, said rod being movable with respect to said housing for resetting the circuit breaker in closed-circuit position after actuation thereof to open-circuit position, said contacts having head portions which travel through the grooves of said grooved members during movement of said carriage, and said grooved members being formed of material which is characterized by the ability to give off gas in the presence of an electric arc which tends to extinguish the arc.

5. A circuit breaker comprising a housing, circuit breaker terminals having portions disposed within said housing, a rod disposed within said housing and movable therein, a carriage supported by said rod for movement within said housing and with respect to said rod, contacts mounted on said carriage and adapted for movement therewith into and out of contact engagement with said terminal portions, means adapted to subject said carriage to movement which moves said contacts out of contact engagement with respect to said terminal portions, a latch for latching said carriage in position where said contacts are in contact engagement with said terminal portions, and means adapted to actuate said latch so as to permit said carriage-moving means to move said carriage so as to withdraw said contacts out of contact engagement with respect to said terminal portions, the last-mentioned means including a heat responsive element, a strip of material secured to said heat-responsive element and extended throughout a portion of the length thereof, said strip of material being so related to said heat-responsive element that it shunts a portion of said heat-responsive element out of the circuit and shields this electrically inactive portion of the heat-responsive element from the radiant heat given off by the electrically active portion of the heat-responsive element so as to retard operation of the circuit breaker, and means for connecting said strip of material to said latch, said rod being movable with respect to said housing for resetting the circuit breaker in closed-circuit position after actuation thereof to open-circuit position.

6. A circuit breaker comprising a housing, circuit breaker terminals having portions disposed within said housing, a rod disposed within said housing and movable therein, a carriage supported by said rod for movement within said housing and with respect to said rod, contacts mounted on said carriage and adapted for movement therewith into and out of contact engagement with said terminal portions, means adapted to subject said carriage to movement which moves said contacts out of contact engagement with respect to said terminal portions, a latch for latching said carriage in position where said contacts are in contact engagement with said terminal portions, and means adapted to actuate said latch so as to permit said carriage-moving means to move said carriage so as to withdraw said contacts out of contact engagement with respect to said terminal portions, the last-mentioned means including a heat-responsive element, a strip of material secured to said heat-responsive element and extended throughout a

portion of the length thereof, said strip of material being fixed at one of its ends to said heat-responsive element and having an opposite free end portion, said strip of material being so related to said heat-responsive element that it shunts a portion of said heat-responsive element out of the circuit and shields this electrically inactive portion of the heat-responsive element from the radiant heat given off by the electrically active portion of the heat-responsive element so as to retard operation of the circuit breaker, and means for connecting said strip of material to said latch, said rod being movable with respect to said housing for resetting the circuit breaker in closed-circuit position after actuation thereof to open-circuit position.

7. A circuit breaker comprising a housing, circuit breaker terminals having portions disposed within said housing, a rod disposed within said housing and movable therein, a carriage supported by said rod for movement within said housing and with respect to said rod, contacts mounted on said carriage and adapted for movement therewith into and out of contact engagement with said terminal portions, means adapted to subject said carriage to movement which moves said contacts out of contact engagement with respect to said terminal portions, a latch for latching said carriage in position where said contacts are in contact engagement with said terminal portions, and means adapted to actuate said latch so as to permit said carriage-moving means to move said carriage so as to withdraw said contacts out of contact engagement with respect to said terminal portions, the last-mentioned means including a heat-responsive element, a bifurcated strip of material secured to said heat-responsive element and extended throughout a portion of the length thereof, said strip of material being so related to said heat-responsive element that it shunts a portion of said heat-responsive element out of the circuit and shields this electrically inactive portion of the heat-responsive element from the radiant heat given off by the electrically active portion of the heat-responsive element so as to retard operation of the circuit breaker, and means for connecting said strip of material to said latch, said rod being movable with respect to said housing for resetting the circuit breaker in closed-circuit position after actuation thereof to open-circuit position.

8. A circuit breaker comprising a housing, circuit breaker terminals having portions disposed within said housing, a rod disposed within said housing and movable therein, a carriage supported by said rod for movement within said

housing and with respect to said rod, contacts mounted on said carriage and adapted for movement therewith into and out of contact engagement with said terminal portions, means adapted to subject said carriage to movement which moves said contacts out of contact engagement with respect to said terminal portions, a latch for latching said carriage in position where said contacts are in contact engagement with said terminal portions, and means adapted to actuate said latch so as to permit said carriage-moving means to move said carriage so as to withdraw said contacts out of contact engagement with respect to said terminal portions, the last-mentioned means including a bifurcated heat-responsive element, a bifurcated strip of material secured to said heat-responsive element and extended throughout a portion of the length thereof, said strip of material being so related to said heat-responsive element that it shunts a portion of said heat-responsive element out of the circuit and shields this electrically inactive portion of the heat-responsive element from the radiant heat given off by the electrically active portion of the heat-responsive element so as to retard operation of the circuit breaker, and means for connecting said strip of material to said latch, said rod being movable with respect to said housing for resetting the circuit breaker in closed-circuit position after actuation thereof to open-circuit position.

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