March 9, 1937. C. H. HODGKINS 2,073,104

CIRCUIT BREAKER

Filed Sept. 5, 1934 2 Sheets-Sheet 1

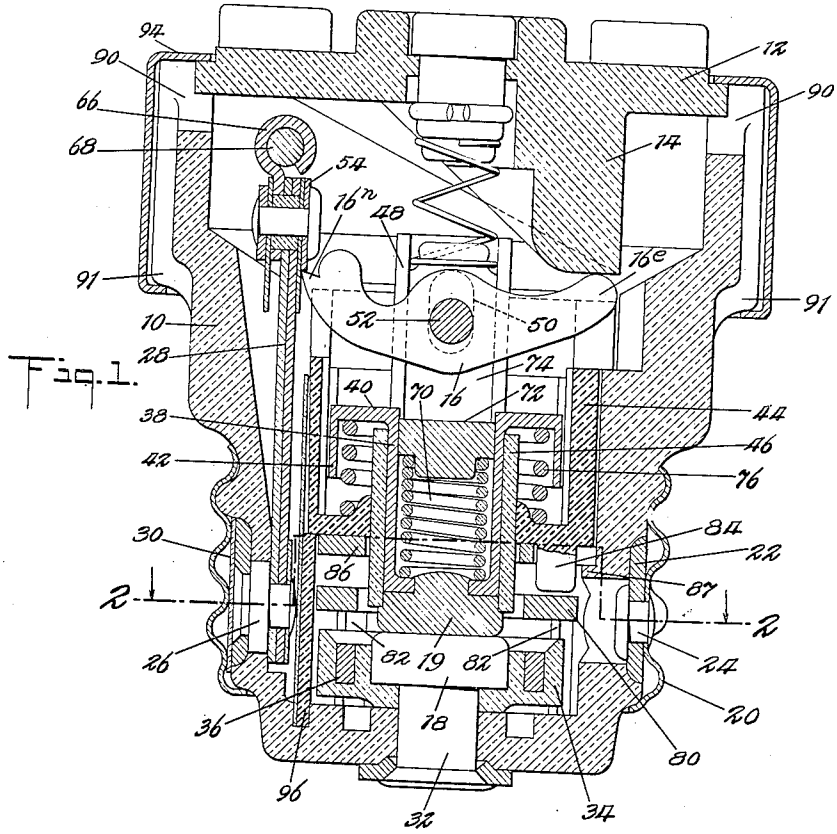


Fig. 1.

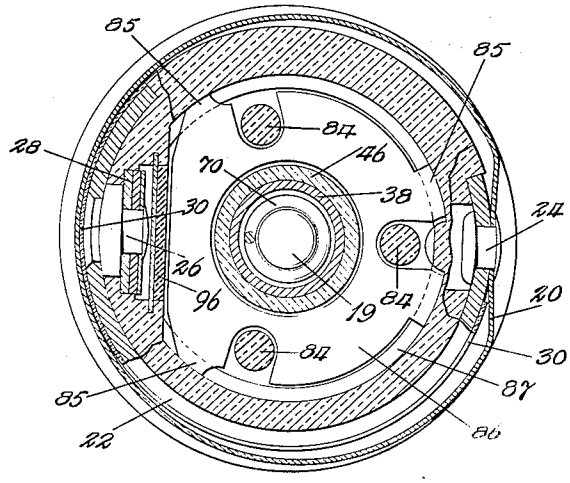


Fig. 2.

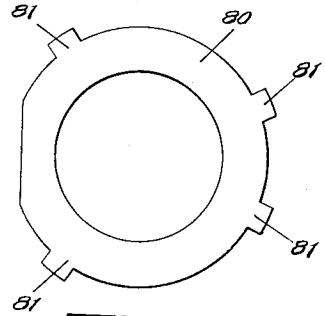


Fig. 3.

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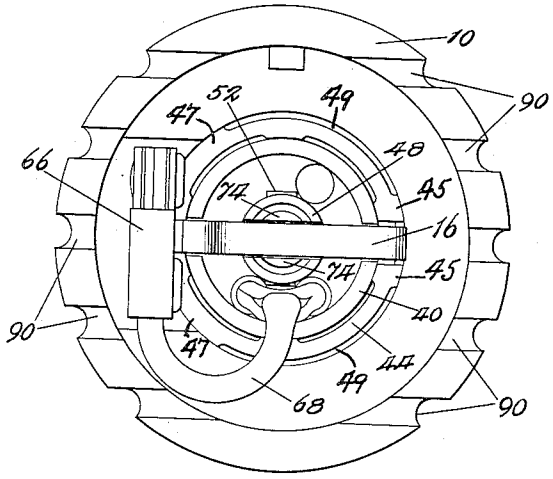


Fig. 4.

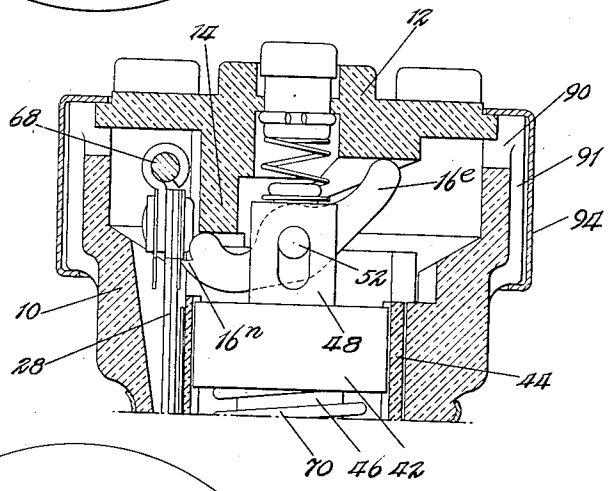


Fig. 5.

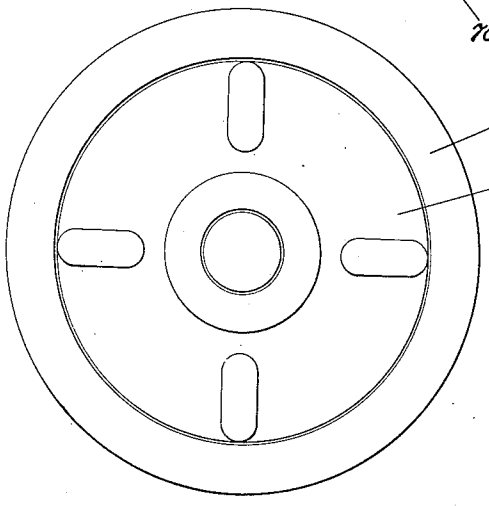


Fig. 6.

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Patented Mar. 9, 1937

2,073,104

UNITED STATES PATENT OFFICE

2,073,104

CIRCUIT BREAKER

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Application September 5, 1934, Serial No. 742,833

21 Claims. (Cl. 200—122)

This invention relates to circuit breakers. More particularly it relates to automatically operating circuit breakers which are released by the thermal and dynamic effects of an overload current.

This invention is an improvement upon the invention disclosed in my co-pending applications Ser. No. 683,673 filed August 4th, 1933 and its division Ser. No. 706,564, filed January 13, 1934.

It is an object of this invention to provide an automatic circuit breaker mechanism capable of being used within a casing of approximately the size and shape of an ordinary screw type fuse plug.

Another object is to provide a circuit breaker of the type just mentioned in which the contacts may be manually closed and opened and which will be opened automatically upon the occurrence of an overload current in the device.

Another object is to provide arc extinguishing means useful generally in circuit breakers but adapted particularly to use in a circuit breaker of the above mentioned type.

Another object is to provide a circuit breaker of the above type with means for ventilation in order that the gases incipient upon the occurrence of an arc may be expeditiously and effectively conducted from the casing.

Another object is to provide a circuit breaker of the aforementioned type which has sufficient resistance in its parts to limit materially the current flow upon short circuit conditions through the breaker.

Another object is to provide means adjacent the contacts of the circuit breaker of the above type which will protect the sides of the contacts and assist in deionizing the arc gases.

Other objects and advantages of my invention will occur as it is described in connection with the accompanying drawings.

In the drawings,

Fig. 1 is a section view with the section taken along the axis of my improved circuit breaker, the parts being in closed circuit position;

Fig. 2 is a section view with the section passing transversely through the axis of my new circuit breaker along the line 2—2 of Fig. 1;

Fig. 3 is a detail of the middle magnetic ring used in my circuit breaker;

Fig. 4 is a plan view of my new circuit breaker with the cover removed;

Fig. 5 is a fragmentary view of the upper part of my new circuit breaker, partly in elevation and partly in section with the section passing through the axis, the parts being in resetting position.

Fig. 6 is a plan view of my new circuit breaker.

Referring to the drawings, the automatic circuit breaker mechanism is housed in an insulating casing 10 which in a general way resembles the size and shape of a conventional screw type fuse plug. The casing is provided with a cover 12 which is rotatable upon the casing in order that a circular cam 14 which is formed integrally with the cover on the under side thereof, may cooperate with one end 16e of a centrally pivoted lever 16 to cause engagement and disengagement of the switch contacts 18 and 19 as will hereinafter be more fully described.

Around the lower end of the casing there is a conventional screw shell 20 which is adapted for screwing the device into a screw socket. In the periphery of the casing 10 behind the screw shell there is a groove or a recess running circumferentially half way around the casing and having seated in it a metal band 22 preferably made of "nichrome" alloy. One end of this band is riveted to the screw shell 20 by a rivet 24 and the other end is riveted by a rivet 26 to the lower or inner end of bimetallic strip 28 which extends up toward the top of the casing in a position parallel to the axis of the casing but adjacent the side wall thereof. At all points except at the rivet 24, the metal band 22 is insulated from the screw shell 20 by a sheet of insulation 30 of any suitable insulating material. The main function of this metal band is to heat the bimetal 28, it being obvious that the band being of high resistance will suffer a considerable temperature rise upon the passage of an overload current through it. Since the band is metallically connected to the bimetal the heat from the band is conducted directly to the bimetal. The bimetal therefore need not be made so thin and so subject to burning as if the heat developed within the bimetal by reason of its own resistance were alone depended upon to cause warping of the bimetal on overload. Another function of this metal band is to increase the resistance of the device since it has been found upon experiment that the parts of a circuit breaker constructed as herein described afford so little resistance in themselves that upon the occurrence of a short circuit the current rise in the device is much larger than desirable. The metal band increases the resistance and cuts down the current rise and it has been found to be a valuable safety feature.

In the bottom of the casing 10 and coaxial therewith is a stationary contact 18 which is generally cylindrical in shape and has a rivet stem 32 passing through the bottom of the casing by which it is secured in position. This stationary contact is imbedded in an annular piece of fibrous insulation 34 which also has imbedded in it a ring 36 of magnetic material such as iron, this ring 36 being coaxial of the contact and insulated therefrom by means of the fibre 34. Engaging with the stationary contact 18 is a movable contact 19 which is generally cylindrical in

shape and is secured to a contact carrier 38 whose bottom portion is in the form of a hollow cylinder at the lower end of which the movable contact 19 is secured. At the central portion of the contact carrier 38 there projects a circular flange or shoulder 40 from the edge of which depends a wall 42 which fits slidably within a cylindrical insulating cup 44. Surrounding the lower end of the contact carrier 38 and passing through the bottom of the insulating cup 44 is a fibre sleeve 46 which extends from just beneath the flange or shoulder 40 half way down the side of the movable contact 19.

It has been found by experiment that arcs which develop between the movable contact 19 and the stationary contact 18 and play upon the fibre sleeve 46 and the annular fibre member 34 cause gases to be given out by the fibre members which tend to deionize the arc gases and hence assist in the early extinguishment of the arc.

The top part of the contact carrier 38 consists of a pair of parallel hollow semi-cylindrical arms 48 which extend up from the shoulder or flange 40 approximately the same distance as the lower end of the member 38 extends downwardly. The axis of curvature of these arms 48 is coaxial with the main axis of the device. In the arms 48 are a pair of slots 50 in which slide the ends of a shaft 52 which is transverse to the general axis of the whole device. Mounted upon this shaft 52 is the lever 16 which preferably is a metal stamping having the shape illustrated in Fig. 1, so that its end 16e may be engaged and moved by the cam 14, while its other end has a nose 16n which engages with the lower edge of the plate 54 which is secured to the bimetallic member 28. The plate 54 is insulated from the bimetallic member by suitable insulation and is riveted to the bimetallic member which also serves to secure to the bimetallic member a terminal 66 in which is engaged one end of a flexible conductor 68, the other end of which is electrically connected to the flange 40 of the contact carrier.

In order to provide lost motion between the movable contact 19 and the lever 16 there is provided a helical spring 70 within the lower end of the contact carrier 38. This spring bears against the bottom of the contact carrier and against the under side of a member 72 whose lower end is cylindrical to slide within the contact carrier 38 and whose upper end comprises two parallel arms 74. These arms slide within the arms 48 of the contact carrier and between them the lever 16 is located, the pivot shaft 52 of the lever 16 being journalled in the arms 74.

In order to cause the contacts to separate with a snap action a helical spring 76 is fitted around the fibre sleeve 46 on the contact carrier 38 and presses at its lower end upon the bottom of the insulating cup 44 while its top presses against the under surface of the flange 40 of the contact carrier 38.

Referring now to Fig. 1 where the parts are shown in closed circuit position, it will be apparent that upon an overload the bimetallic member will heat up and flex toward the wall of the casing thereby disengaging the nose 16n of the lever 16 and allowing the spring 76 to press up the contact carrier 38 and separate the contacts. Now upon rotation of the cover 12 of the casing the low point of the cam 14 will come around adjacent the end 16e of the lever 16 and at the same time the high point of the cam will press against the other end of the lever adjacent the nose 16n and cause the nose to again be engaged under the lower edge of the plate 54 as may readily be seen in Fig. 5. Now upon reversing the rotation of the cover 12 the high point of the cam will again engage the end 16e forcing it down and causing the lever 16 to pivot about the nose 16n which will cause engagement of the contacts as shown in Fig. 1.

In order to facilitate extinguishment of the arc upon contact separation three magnetic rings preferably of iron and located in spaced parallel planes are employed. The position of the ring 36 has already been described. Another ring 80 is positioned above the ring 36 and parallel to and is held in such position by radial extensions 81 which engage with the side wall of the casing. This ring is also held in place by its lower face resting upon lugs or ribs 82 which extend out from the inside of the casing at appropriate points. As a further means of holding the ring 80 in position three circular projections 84 spaced equidistantly from each other and from the axis project down from the bottom of the insulating cup 44 and press upon the upper surface of the ring 80.

A third arc extinguishing ring 86 also of iron or other magnetic material is positioned above the ring 80 and lies adjacent the bottom surface of the insulating cup 44. This ring is held from upward movement by the cup and from downward movement by portions 85 of its circumference resting upon circumferential shoulders 87 running partway around the inside of the casing at an appropriate position.

It will be noted that portions of the circumference of each of the rings 80 and 86 do not extend out to the edge of the casing and thus there is provided between the casing and the circumference of the rings space for the passage of gases incident to the arcing on contact separation. Thus those gases may be quickly removed from the vicinity of the arc and conducted quickly up to the top of the casing where there is more room for them to expand. To facilitate the passage of these gases up to the top of the casing the insulating cup 44 as may be seen in Fig. 4 has a pair of proximate parallel ribs 45 in its periphery running axially. On the opposite side of the cup from the ribs 45 are other ribs 47 also running axially these ribs being wider at the top than at the bottom. The outside surface of the cup between the ribs 45—47 is cut back to produce passages 49 for the arc gases. These passages while adequate for passage of the arc gases are narrow and compel the gases to pass in contact with the cool walls of the cup and casing so that their volume and temperature are reduced in the passage, which is very desirable. In order that the gases may pass out from the casing a series of grooves 90 are cut in the top edge of the casing beneath the cover 12 cooperating with grooves 91 cut in the outside wall in the top of the casing and running in a direction parallel to the casing axis.

To hold the cover and casing together a flanged metal band 94 fits around the top portion of the casing with the flange overlying the edge of the cover. The arc gases may pass out of the casing through the passages 90 and 91 and exit therefrom by reason of the fact that the securing band 94 does not close the ends of these passages.

In order to protect the bimetallic strip from the action of the arc a baffle member 96 of insulating material is seated in the bottom part of the casing adjacent the lower end of the bime-

tallic member and extends a suitable distance up the side of the casing adjacent the bimetallic member. It has been found that the deionizing effect of the use of the fibre members about the switch contacts 18 and 19 together with the use of the arc extinguishing rings 36, 80 and 86 and furthermore together with the ventilation of the casing makes it possible for the applicant with his new device to interrupt currents which heretofore it was impossible to interrupt with any device of equal size. In fact much larger devices have been necessary to handle continuously the currents which may be handled with ease by the device just described. The importance of this will be apparent when it is remembered that in a device to be used in place of a fuse it is necessary to interrupt often very high current values such as result when a short circuit occurs.

Thus a device to be successful in this field of use must be capable of interrupting repeatedly high short circuit currents and to quickly extinguish an arc in order to preserve the condition of the contacts.

Many modifications within the scope of my invention will occur to those skilled in the art and therefore I do not limit myself to the exact form of the embodiment shown.

I claim:

1. In an electric switch, a rotatable switch operating cover, switch mechanism, contacts operated by said cover and mechanism, means to prevent holding said contacts closed manually on overload, thermally responsive means to operate said switch on overload, and a casing in which said parts are contained and are movable, said casing having substantially the size and shape of a conventional screw type fuse plug and having passages from the interior to the exterior of the casing adjacent to said cover for exit of arc gases.

2. In an electric switch, a rotatable switch operating cover, switch mechanism, contacts operated by said cover and mechanism, means to prevent holding said contacts closed manually on overload, thermally responsive means to operate said switch on overload, and a casing in which said parts are contained and are movable, said casing having substantially the size and shape of a conventional screw type fuse plug and having passages in its rim beneath said cover connecting with grooves in its outer surface for conducting arc gases from the casing.

3. In an electric switch, a rotatable switch operating cover, switch mechanism, contacts operated by said cover and mechanism, means to prevent holding said contacts closed manually on overload, thermally responsive means to operate said switch on overload, and a casing in which said parts are contained and are movable, said casing having substantially the size and shape of a conventional screw type fuse plug, a ring member for holding said cover to said casing, said casing having passages from the interior of the casing adjacent said ring for exit of arc gases.

4. In an electric switch, a rotatable cover, switch mechanism, contacts operated by said cover and mechanism, means to prevent holding said contacts closed manually on overload, thermally responsive means for operating said switch on overload, a casing having substantially the size and shape of a conventional screw type fuse plug and having venting passages for the arc gases, and a plurality of rings of magnetic material for arc-quenching, said venting passages extending from said rings to the exterior of said casing.

5. In an electric switch, a rotatable cover, switch mechanism, contacts operated by said cover and mechanism, means to prevent holding said contacts closed manually on overload, thermally responsive means for operating said switch on overload, a casing having substantially the size and shape of a conventional screw type fuse plug and having venting passages for the arc gases, and a plurality of rings of magnetic material for arc-quenching, said contacts being surrounded by fibrous material over which an arc may pass and generate deionizing gases.

6. In an electric switch, a rotatable cover, switch mechanism, contacts operated by said cover and mechanism, means to prevent holding said contacts closed manually on overload, thermally responsive means for operating said switch on overload, a casing having substantially the size and shape of a conventional screw type fuse plug and having venting passages to the exterior for the arc gases, said contacts being surrounded by fibrous material over which an arc may pass and generate deionizing gases.

7. In an electric switch, a rotatable cover, switch mechanism, contacts operated by said cover and mechanism, means to prevent holding said contacts closed manually on overload, thermally responsive means for operating said switch on overload, a casing having substantially the size and shape of a conventional screw type fuse plug and having venting passages for the arc gases, and a plurality of rings of magnetic material for arc-quenching, certain of said rings having portions cut away from their peripheries to afford passages for the movement of arc gases into said venting passages and to the outside of the casing.

8. In a switch, a rotatable cover switch mechanism, contacts operated by said cover and mechanism, means to prevent holding said contacts closed during overload, thermally responsive means for operating said switch on overload, a casing for said switch, socket contacts on said casing for engaging said device in a socket, a high resistance connecting member non-fusible when traversed by short circuit currents and connecting one of said socket members to said thermally responsive means for limiting the current rise in said device on short circuit conditions.

9. In an electric switch, a rotatable cover, switch mechanism, contacts operated by said cover and mechanism, means to prevent holding said contacts closed manually on overload, thermally responsive means for operating said switch on overload, a casing having substantially the size and shape of a conventional screw type fuse plug in which the contacts and switch mechanism are contained and moved, said contacts being surrounded by fibrous material over which an arc may pass and generate deionizing gases.

10. In a circuit interrupter, a casing, a stationary contact positioned adjacent one end of said casing, a movable contact actuable into and out of engagement with said stationary contact, means providing a vent from said casing adjacent the end opposite said stationary contact, a member positioned within said casing adjacent the central portion thereof, the outer surface of a large part of said member extending along the inner surface of said casing at a small distance therefrom providing a narrow passage extending from the contact-containing end to the other end of the casing, and the wall of said passage

having a large area of surface for cooling and deionizing the gases flowing therethrough.

11. In a circuit interrupter, a casing, arc extinguishing means comprising at least one metal plate fitted within said casing adjacent one end thereof for extinguishing the arc resulting during circuit interruption, said arc extinguishing means having an opening extending therethrough, means for interrupting a circuit in said opening, means providing a ventilating passage between the outer edge of said plate and said casing, a member within said casing having its outer surface extending along the inner surface of said casing providing a narrow passage from said ventilating passage to said end of the casing with a large area of surface to cool and deionize gases flowing therethrough.

12. In a circuit breaker, a casing, stationary and movable switch contacts, means for causing engagement and disengagement of said contacts, means providing a vent from said casing at an end remote from said contacts, means within said casing having its outer surface extending along the inner surface of said casing providing a narrow passage from the neighborhood of said contacts to said vent means, said passage having a large surface area for cooling and deionizing arc gases.

13. In a circuit breaker, a casing, stationary and movable switch contacts, means for causing engagement and disengagement of said contacts, means for guiding said movable contact in its movement, an insulating sleeve around said movable contact for keeping the arc from playing on the sides of said movable contact and for keeping the surfaces of said contact in condition to slide freely over said guide means.

14. In a circuit interrupter, a casing, a stationary contact member mounted therein, a movable contact member having a contact tip on one end thereof, said movable contact member being slidable longitudinally to bring said contact tip into and out of butt engagement with said stationary contact member, a guide member of insulating material for said movable contact member, and means formed of insulating material and covering the portion of the sides of said movable contact member which slides within said guide member for preventing damage by the arc or arc products to the surfaces in sliding engagement and for keeping said surfaces in condition to slide freely.

15. In a circuit interrupter, a casing, a stationary contact adjacent to one end thereof, a movable contact slidable into and out of engagement with said stationary contact, guide means through which said movable contact is slidable, said guide means fitting closely around said movable contact and substantially preventing the flow of arc products between said movable contact and said guide means, means forming a passage at one or more points around the outer periphery of said guide means to permit the flow of arc products from adjacent said stationary contact to the other end of said casing, and means at said other end thereof to vent said arc products to the outside of said casing.

16. In a circuit interrupter, a casing, a pair of contacts in said casing for opening and closing the circuit, a bimetallic element extending longitudinally along said casing, a heater strip thermally and electrically connected at one end to one end of said bimetallic element, said heater strip extending circumferentially around said casing, means for connecting said heater strip and bimetallic element in the circuit so that the bimetallic element is caused to bend upon the occurrence of predetermined current conditions, and means for causing the opening of said pair of contacts upon the bending of said bimetallic element.

17. In a circuit interrupter, a casing, a pair of contacts in said casing for opening and closing the circuit, a bimetallic element extending longitudinally along said casing, a heater strip thermally and electrically connected at one end to one end of said bimetallic element, said heater strip extending circumferentially around said casing, means for connecting said heater strip and bimetallic element in the circuit so that the bimetallic element is caused to bend upon the occurrence of predetermined current conditions, and means for causing the opening of said pair of contacts upon the bending of said bimetallic element, said bimetallic element being located within said casing and said heater strip being located around the outside of said casing.

18. In a circuit breaker, a casing, stationary and movable switch contacts, means for causing engagement and disengagement of said contacts, means for guiding said movable contact in its movement, an insulating sleeve around said movable contact for keeping the arc from playing on the sides of said movable contact and for keeping the surfaces of said contact in condition to slide freely over said guide means, said sleeve extending from immediately adjacent the contacting surface up the sides of the contact into said guiding means.

19. In a circuit breaker, a casing, stationary and movable switch contacts, means for causing engagement and disengagement of said contacts, means for guiding said movable contact in its movement, an insulating sleeve around said movable contact for keeping the arc from playing on the sides of said movable contact and for keeping the surfaces of said contact in condition to slide freely over said guide means, said sleeve being carried by said movable contact and extending from immediately adjacent the contacting surface up the sides of the contact into said guiding means.

20. In a circuit breaker, a casing, stationary and movable switch contacts, means for causing engagement and disengagement of said contacts, means for guiding said movable contact in its movement, an insulating sleeve around said movable contact for keeping the arc from playing on the sides of said movable contact and for keeping the surfaces of said contact in condition to slide freely over said guide means, said sleeve being carried by said movable contact.

21. In a circuit interrupter, a casing, a stationary contact member mounted therein, a movable contact member having a contact tip on one end thereof, said movable contact member being slidable longitudinally to bring said contact tip into and out of butt engagement with said stationary contact member, a guide member of insulating material for said movable contact member, and means formed of insulating material and covering the portion of the sides of said movable contact member which slides within said guide member for preventing damage by the arc or arc products to the surfaces in sliding engagement and for keeping said surfaces in condition to slide freely, said last-named means being carried by said movable contact.

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