Feb. 8, 1949. W. K. OVERTURF 2,461,126

RESETTABLE CIRCUIT BREAKER

Filed May 17, 1947

2 Sheets-Sheet 1

Fig. 1.

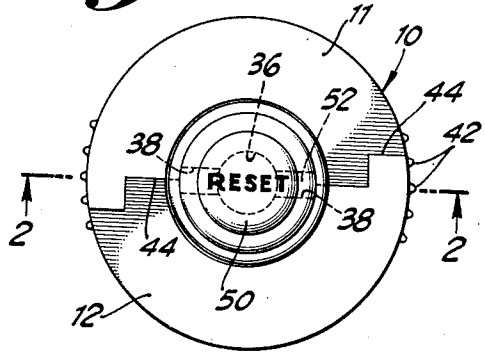
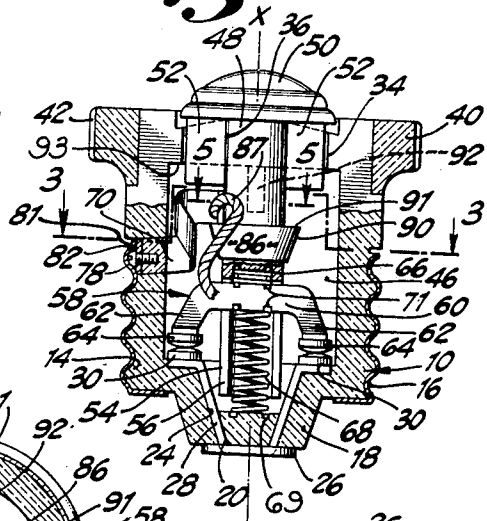


Fig. 2.



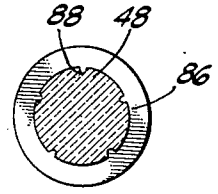


Fig. 5.

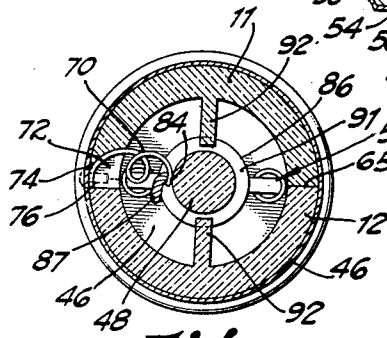


Fig. 3.

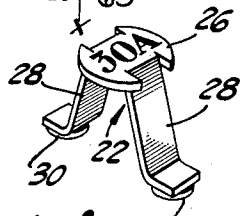


Fig. 4.

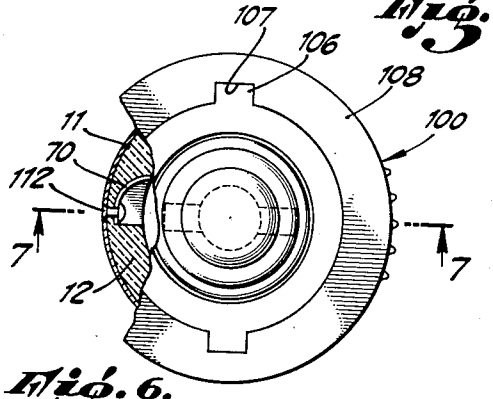


Fig. 6.

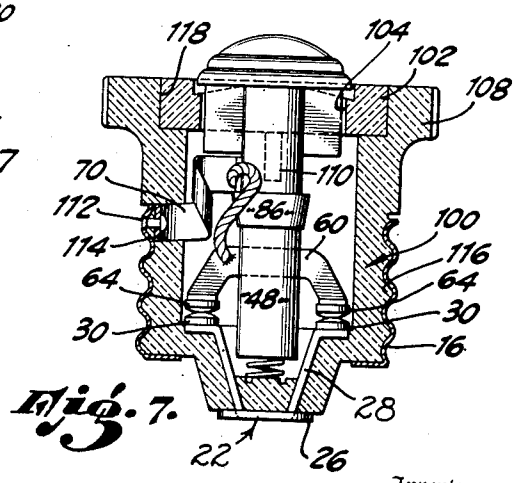


Fig. 7.

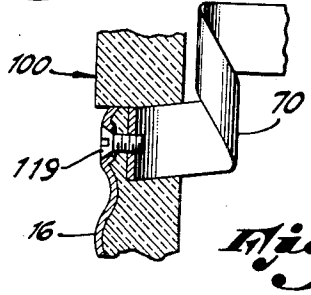


Fig. 8.

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Feb. 8, 1949. W. K. OVERTURF 2,461,126

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Filed May 17, 1947

2 Sheets-Sheet 2

Fig. 9.

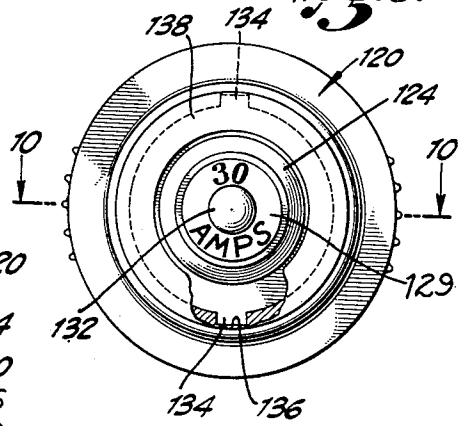


Fig. 10.

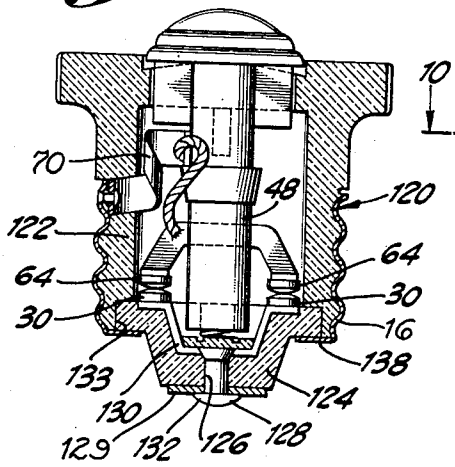
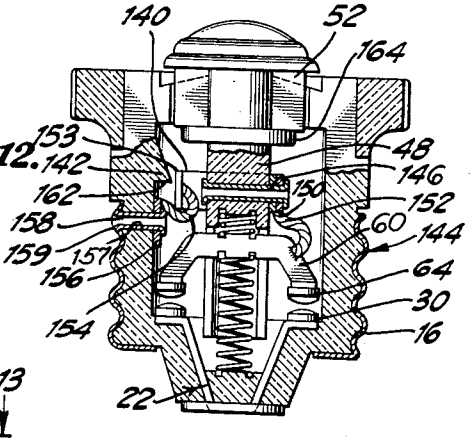


Fig. 12.



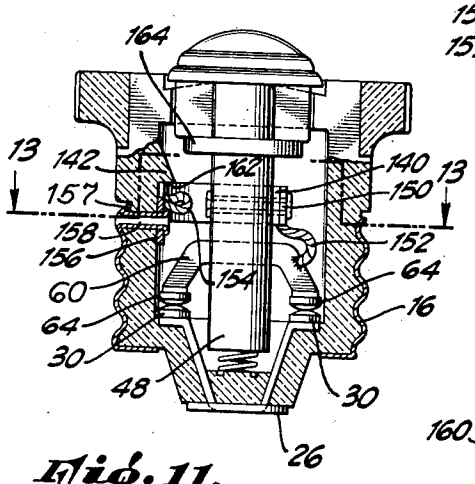


Fig. 11.

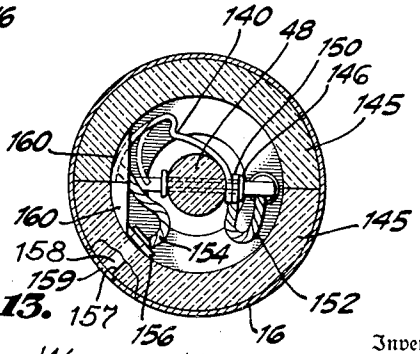


Fig. 13.

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RESETTABLE CIRCUIT BREAKER

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Application May 17, 1947, Serial No. 748,724

9 Claims. (Cl. 200—116)

1

My invention relates to automatic circuit breakers and particularly to automatic circuit breakers of the type which are adapted to be screwed into fuse plug sockets.

One object of my invention is to provide such a circuit breaker which is of simple, compact, and inexpensive construction.

Another object of my invention is to provide such a circuit breaker which has a minimum number of parts and which is readily assembled.

Another object of my invention is to provide an improved circuit breaker of the fuse plug type which employs a thermally responsive element for breaking a circuit when it becomes overloaded.

Another object of my invention is to provide such a circuit breaker having a plurality of mutually spaced stationary contacts with a corresponding plurality of movable contacts which register therewith to complete a circuit.

Another object of my invention is to provide such a circuit breaker having a bimetallic element which is electrically connected at one end to movable contacts and at the other end to the threaded shell which screws into a plug socket.

A further object of my invention is to provide such a circuit breaker which is formed by a plurality of body members which are held firmly together by means of a threaded shell.

And a still further object of my invention is to provide such a circuit breaker with a novel arrangement of movable contacts.

The foregoing and other objects of my invention, together with various features thereof, will appear more fully upon consideration of the following detailed description of several embodiments of the invention taken in connection with the accompanying drawings in which:

Figure 1 is a top plan view of one embodiment of my invention;

Fig. 2 is a vertical sectional view taken on the line 2—2 of Fig. 1.

Fig. 3 is a horizontal sectional view taken on the line 3—3 of Fig. 2;

Fig. 4 is an inverted prospective view of a stationary contact unit;

Fig. 5 is a sectional view of the detent taken on the line 5—5 of Fig. 2;

Fig. 6 is a top plan view, partly in section, of a second embodiment of my invention;

Fig. 7 is a vertical sectional view taken on the line 7—7 of Fig. 6;

Fig. 8 is a detailed fragmentary view of an alternative arrangement for supporting the bimetallic element;

2

Fig. 9 is a bottom plan view of a third embodiment of my invention;

Fig. 10 is a vertical sectional view taken on the line 10—10 of Fig. 9;

Fig. 11 is a vertical sectional view of a fourth embodiment of my invention showing the contacts in closed-circuit condition;

Fig. 12 is a similar vertical view of this form of the invention showing the contacts in open-circuit condition; and

Fig. 13 is a horizontal sectional view taken on the line 13—13 of Fig. 11.

For simplicity of description, the four embodiments of the automatic circuit breaker, or switch, here illustrated are described as though mounted in a vertical position. Also for simplicity, one embodiment of the invention is described hereinafter in considerable detail and only so much of the others are described as is necessary for an appreciation of the distinguishing features therebetween. All four embodiments of the invention described are of the same construction except as specifically pointed out hereinafter and identical parts in the different embodiments of the invention are designated by the same legends.

Referring first to Figs. 1, 2, 3, and 4, the embodiment of my invention there illustrated includes a hollow switch body 10 of cylindrical or tubular configuration which comprises two semi-cylindrical body members 11 and 12 composed of insulating material. The two body members 11 and 12 are formed with external screw-threaded portions 14 which mesh with a threaded metal shell 16. The threaded shell 16 holds the two body members 11 and 12 together firmly and forms a first external electric terminal for completing a circuit by engagement with a corresponding threaded portion of a fuse plug socket (not shown) into which it is screwed.

The lower end walls of the two body members 11 and 12 are shaped to form a switch base 18 in the form of an inverted truncated cone. The lower end walls of the body members are provided with pairs of opposed slots to establish a first or lower passage 20 having two separate branches in which a stationary metal contact unit 22 is clamped. The slots are inclined in the end walls parallel to the outer surface of the base and extend into shallow grooves 24 within the switch body 10 into which the upper portion of the stationary contact unit 22 nests.

The stationary contact unit 22 comprises a unitary construction including a second external electric terminal 26 connected by two flaring arms, or strips, 28 to two upwardly facing sta-

tionary contacts 30 at their upper extremities. These arms 28 fit snugly within the two branches of this first passage 20 and lie flat within the shallow grooves 24 mentioned, with the two contacts 30 on opposite sides of the longitudinal or vertical axis X—X of the switch body 10. The second external terminal 26 lies flat against the lower horizontal surface of the base 18 and is preferably imprinted with a legend which indicates the rating or load limit of the switch.

The upper end walls of the body members 11 and 12 are provided with opposed slots to form a second or upper passage 34 which is of non-circular cross-section having a central circular opening 36 and two lateral guide branches 38, the purpose of which will be hereinafter explained. The upper ends of the body members are also provided with outwardly extending portions which form a flanged head 40 which is preferably provided with knurls 42 upon its outer side to facilitate screwing the switch into a fuse plug socket. This head is preferably divided along an irregular line 44 between the two body members 11 and 12 in order to facilitate rigid assembly of the switch body 10.

The two body members 11 and 12 are recessed in order to form a central cylindrical chamber 46 in the switch body 10 within which the main working parts of the circuit breaker are arranged.

A rod member 48 composed of insulating material extends through the upper passage 34 and is movable therein along the axis X—X between a first, or inner, or lower, or closed-circuit position and a second, or outer, or upper, or open-circuit position. The rod member 48 is provided with an externally rounded reset button or thumb-head 50 at its outer end to facilitate pushing it inwardly. The portion of the rod member 48 directly beneath the button 50 is provided with two integrally-formed laterally extending guide ears, or splines, 52 which are slidably arranged in the lateral branches 38 of the upper passage 34. The guide ears 52 prevent rotation of the rod member 48 about its axis during its movement from one extreme position to the other. The lower or inner portion 54 of the rod member is of tubular shape and the tubular portion is provided with two longitudinally extending slots 56 on opposite sides thereof. If the rod member 48, or at least the button 50, is composed of glass or a transparent plastic and the switch body 10, or at least its head 40, is colored such as by paint or dye, the button 50 takes on the color of the head 40 in its inner position and is clearer in its outer position. This feature facilitates identifying an open switch of a bank of switches in a fuse box.

A movable metal contact unit 58 is provided which includes a cross-arm 60 which passes through the tubular portion 54 of the rod member extending horizontally outward through the slots 56. Two inclined legs 62 depend from opposite sides of the cross-arm 60 and carry movable contacts 64 at their lower extremities. Preferably the guide ears 52 and the slots 56 lie in the plane of the contacting surfaces 65 of the semi-cylindrical body members 11 and 12 and the stationary contact unit 22 and the movable contact unit 58 also lie in this plane, in order to assure registering the movable contacts 64 with the stationary contacts 30 when the rod member 48 is forced into its lower position.

The cross-arm 60 floats between coaxial upper and lower helical springs 66 and 68. The upper spring 66 is arranged between the cross-arm 60 and the upper inner wall of the tubular portion 54. The lower spring 68 is arranged between the cross-arm 60 and the base 18. The lower spring 68 preferably fits within an annular recess 69 within the base in order to prevent this spring from contacting the stationary contact unit 22 and thereby short-circuiting the switch. Both springs preferably engage suitable notches 71 in the cross-arm 60. The lower spring 68 is compressed highly when the rod member 48 is in its closed-circuit position and normally urges the rod member upwardly into open-circuit position where it is still somewhat compressed. The upper spring 66 is preferably slightly stronger than the lower spring 68 in order to assure that there be a positive pressure between the movable contacts 64 and the stationary contacts 30 during the final and initial movement respectively of the rod member 48 in the making and the breaking of the contacts.

A helically curved bimetallic strip 70 is firmly attached at its outer end to the switch body 10. This attachment is facilitated by providing the body members 11 and 12 with a tongue 72 and a groove 74 which mate between their adjoining surfaces as illustrated in Fig. 3. The outer end 76 of the bimetallic strip 70 is held firmly against the tongue 72 by means of a round-headed metal screw 78, the outer end of which is flush with the bead of the threaded portion 14 of the body 10 so as to provide a firm electrical connection between the bimetallic strip 70 and the threaded shell 16. If desired, this connection may be rendered more secure by means of a lump of solder 81 placed within the upper end of the threaded shell through a slot 82 adjacent the head of the screw 78.

The bimetallic strip 70 is located adjacent the rod member 48 and is electrically connected to the movable contacts 64 by means of a flexible conductor 87, preferably in the form of a braided cable or wire, which is soldered, brazed, or spot-welded at one end to the cross-arm 60 and at the other end to the inner end 84 of the bimetallic strip. When the circuit breaker is closed and is connected in an operating circuit, current flows serially through the terminal 26, the contacts 30 and 64, the conductor 87, the bimetallic strip 70, and the shell 16, heating the bimetallic strip 70.

The bimetallic strip 70 is designed to coil more as it is heated so as to draw the inner end 84 away from the rod member 48. In this manner the bimetallic strip cooperates with a detent 86 secured to the rod member 48 in order to break the contacts 30 and 64 when an overload occurs in the circuit in which the circuit breaker is connected.

The detent illustrated is in the form of a downwardly tapered collar 86 which is press-fit onto the rod member 48 directly about the tubular portion 44 and which is firmly secured thereto by means of internal splines 88 as indicated in Fig. 5. The inclined surface 90 of the detent 86 acts as a cam for outwardly pushing the inner end 84 of the bimetallic strip 70 so as to pass the strip as the rod member 48 is pushed down to close the switch contacts 30 and 64. When the detent 86 passes the bimetallic strip 70 then, if the strip is cool, it springs inwardly to lock the circuit breaker in closed-circuit condition by resting on the upper shoulder 91 of the detent.

Thereafter as current flows through the switch, the bimetallic strip 70 is heated as previously described to a temperature corresponding to the value of the current. If, for any reason, the cir-

cuit in which the circuit breaker is arranged becomes overloaded, the current passing through the bimetallic strip 70 becomes large enough for the resulting temperature rise to cause the bimetallic strip to coil to the point where the inner end 84 thereof is removed from the detent 86, releasing the rod member 48 so that it pops upwardly, breaking the circuit.

A pair of internal bosses 92 project inwardly from the walls of the body members 11 and 12 into positions adjacent the upper portion of the rod member 48 so as to engage the shoulder 91 of the detent 86 to limit its outward movement. The bosses 92 may be omitted if desired. In this case, the spring 68 is preferably extendible to the point where the shoulder 91 engages the inner surface 93 of the head 40 and the ears 52 are made long enough to engage the branch slots 38 even in this outer position.

To assemble this circuit breaker the detent 86 is first fixed onto the rod member 48 and the bimetallic strip 70 is connected to the movable contacts 64 by means of the flexible conductor 87. Then the outer end of the bimetallic strip 70 is rigidly secured to the tongue portion 72 of the body member 12 by means of the screw 78 and then the stationary contact unit 22, the rod member 48, the springs 66 and 68, and the movable contact unit 58 are placed in their proper relative positions in this body member 12 and the assembled group of elements then closed by placing the other body member 11 in position. And then the threaded shell 16 is either screwed onto the body members 11 and 12 or formed directly thereon by pressure in order to secure them together firmly. Then, if desired, a solder connection is made between the upper end of the shell 16 and the screw 78.

Referring to Figs. 6 and 7 there is illustrated a second embodiment of my invention utilizing a single-piece, cup-shaped body member 100 in which the stationary contact unit 22 is integrally cast. In this case the rod member 48 is mounted upon a removable cap member 102 having a non-circular passage 104 therein for guiding the movement of the rod member. The cap member 102 is provided with lugs 106 which fit within complementary recesses 107 in the head 108 of the body member 100 in order to assure registration of the movable contacts 64 with the stationary contacts 30. In this case, stop members 110 which limit the outward movement of the rod member 48 are formed integrally with the cap member 102. The bimetallic strip 70 is secured by means of a rivet 112 within an internal recess 114 in the body member 100 and the threaded shell 16 is arranged on an external threaded portion 116 of the body member in firm electrical contact with the rivet 112.

In assembling this modification of the circuit breaker the rod member 48 is first inserted in the cap member 102 and the detent 86 then pressed thereon. Thereafter the bimetallic strip 70 with the cross-arm 60 already electrically connected thereto is riveted in position. Then the threaded shell 16 and the remaining portions of the circuit breaker are assembled in a manner which is obvious from the construction, the cap member 102 being pressed tightly into a central recess 118 at the upper end of the body member 100.

In a modification of this form of the circuit breaker the threaded shell 16 is installed on the body member 100 and then the bimetallic strip 70 is secured in place by means of a flatheaded metal

machine screw 119 passing through the shell 16 as indicated in Fig. 8.

Referring now to Figs. 9 and 10, there is illustrated a third embodiment of the circuit breaker in which the switch body 120 comprises an inverted cup-shaped body member 122 and a removable base member 124. The base member 124 is provided with a central bore 126 through which a rivet 128 extends to hold a stationary U-shaped contact unit 130 firmly in place. The rivet 128 has an external head 132 which serves as the central electric terminal. A washer 129 having the switch rating imprinted thereon is held against the bottom of the base member 124 by means of the rivet head 128. The base member 124 fits snugly in a recess 133 at the bottom side of the body member 122 and is provided with two ears or lugs 134 at the outer sides thereof which fit within corresponding lateral recesses 136 in order to assure registration of the contacts 30 and 64. The switch body member 122 and the removable base member 124 are firmly secured together by an inwardly directed flange 138 at the lower side of the shell 16.

Referring now to Figs. 11, 12, and 13, there is illustrated a fourth form of the invention, the main distinguishing feature of which resides in the fact that the bimetallic strip 140 is mounted on the rod member 48 and the detent 142 which holds the switch closed is arranged on the internal wall of the switch body 144. The particular form of this embodiment of the invention illustrated, employs a split fuse body having two body members 145 secured together by means of a threaded shell 16 as previously illustrated in Figs. 1, 2, and 3. In this case the bimetallic strip 140 is rigidly secured to the stem member 48 by means of a hollow rivet 146 above the cross-arm 60. The inner end 148 of the bimetallic strip lies over a terminal lug 150 at one end of a flexible conductor 152, the other end of which is soldered or otherwise electrically connected to the cross-arm 60. The outer end 153 of the bimetallic strip 140 is soldered or otherwise electrically connected to one end of a second flexible conductor 154 and the other end of this conductor is secured to a terminal lug 156 which is secured to one of the body members 145 by means of a hollow rivet extending through a lateral bore 157 therein. The outer head 159 of this hollow rivet preferably lies in the surface of the shell 16 and is electrically connected thereto in any suitable manner.

The detent 142 comprises two triangular segments 160 arranged in side-by-side relation on the two body members 145, the base of the triangular sections being upon the lower sides thereof to form a shoulder 162 upon which the outer end 153 of the bimetallic strip rests while it is cool and the stem member 48 is in its closed-circuit position.

In this instance a circular flange 164 is incorporated in the stem member 48 directly beneath the guide ears 52, to limit the outward movement of the rod member 48 by engaging the upper wall of the switch body.

In this circuit breaker a bimetallic strip is used which is designed to draw its outer end 153 inwardly as it is heated. Thus, with the stationary contacts 30 in contact with the movable contacts 64, closing the circuit as indicated in Fig. 11, the bimetallic strip 140 stands in its outermost position in engagement with the shoulder 162. Thereafter, if the circuit becomes overloaded to a predetermined amount, the outer end of the bi-

metallic strip moves inwardly to the point where it disengages the detent 142 and releases the rod member 48, thus opening the contacts 30 and 64 and breaking the circuit. Thereafter, when the bimetallic strip 140 has cooled sufficiently, the circuit may be closed again by pressing the rod member 48 inwardly, permitting the bimetallic strip 140 to pass the detent 142 and to lock itself in position again beneath the detent.

In an alternative form of this embodiment of my invention a switch body having a removable cap member such as that illustrated in Figs. 6 and 7, or even a switch body having a removable base (not illustrated), may be employed. In any event the procedure of assembling the completed fuse is adapted to the particular form of body member employed, it being understood that the body member may be designed in various alternative ways to facilitate assembly and for other purposes to suit the convenience of the manufacturer.

While my invention has been described in detail with particular reference to four embodiments thereof, it is to be understood that many changes may be made therein without departing from the true scope and spirit of my invention. Such changes are too numerous to describe in detail. However, of the more important changes it is to be particularly understood that other types of thermally responsive elements than bimetallic strips may be utilized in circuit breakers while still employing some of the features of my invention. It is also to be further understood that other means than those illustrated may be readily provided for assuring registration of the movable and the stationary contacts. And also it is to be particularly understood that other setting means may be readily provided for making and breaking the contacts of the circuit breaker. I therefore do not wish to be limited to the details of the specific embodiments illustrated but only by the scope of the appended claims.

I claim:

1. A resettable circuit breaker comprising a hollow body member including a threaded metallic shell forming a first external electric terminal and being adapted to be screwed into a fuse plug socket, a pair of stationary contacts arranged on opposite sides of an axis within said body member, said stationary contacts being electrically connected with a second external electric terminal, a rod member movable along said axis relative to said body member between an inner position and an outer position, the inner end of said rod member being tubular and said tubular end being provided with two longitudinal slots, a metallic cross-arm arranged to slide in said slots, a pair of movable contacts on opposite sides of said cross-arm, guide means for guiding said rod member in its movement whereby said movable contacts contact said stationary contacts only when said rod member is in said inner position, a spring arranged between said cross-arm and the base of said body member for normally urging said rod member from said inner position toward said outer position, a bimetallic element carried by one of said members, one end of said element being electrically connected to said cross-arm and the other end thereof being electrically connected to said metallic shell, and a detent on said other member adapted to engage said element for holding said rod member in said first position only as long as said element is relatively cool.

2. A circuit breaker as defined in claim 1 wherein said guiding means includes a non-circular section on said rod member movable in a non-circular passage in said body.

3. A circuit breaker as defined in claim 1 wherein said bimetallic element is rigidly attached at one end to said body member and a flexible conductor provides a connection between the other end of said element and said cross-arm to provide the electrical connection to said movable contacts.

4. In a resettable circuit breaker, a hollow body member including a threaded metallic shell forming a first external electric terminal and being adapted to be screwed into a fuse plug socket, a plurality of mutually spaced stationary contacts arranged about an axis within said body member, said stationary contacts being electrically connected with a second external electric terminal, a rod member movable along said axis relative to said body member between a first position and a second position, the inner portion of said rod member being of tubular shape and provided with longitudinal slots, a cross-arm arranged to slide in said slots, said cross-arm carrying movable contacts, a first resilient member mounted within said inner portion between said rod member and the base of said body member, a second resilient member arranged between said cross-arm and said rod member, said two resilient members bearing upon said cross-arm in mutual opposition whereby said cross-arm is floated on said rod member, said first resilient means normally urging said setting member from said first position toward said second position, guide means for guiding said rod member in its movement whereby said movable contacts contact said stationary contacts only when said rod member is in said first position, a thermally responsive element carried by one of said members, and a detent on said other member adapted to engage said element for holding said rod member in said first position only as long as said element is relatively cool, said element being adapted to be heated by current passing through a circuit completed by closure of said stationary contacts and said movable contacts.

5. A circuit breaker as defined in claim 4 wherein said thermally-flexible element comprises a bimetallic strip which is rigidly attached at one end to said body member and a flexible conductor provides a connection between the other end of said strip and said cross-arm to provide the electrical connection to said movable contacts.

6. A resettable circuit breaker comprising a hollow body member including a threaded metallic shell forming a first external electric terminal, said shell being adapted to be screwed into a fuse plug socket, a stationary contact arranged within said body member and electrically connected with a second external electric terminal, a longitudinally slotted rod member movable relative to said body member from a first position to a second position, a cross-arm extending outwardly through the slot on said rod member, a first spring arranged between said cross-arm and said body, and a second spring mounted between said rod member and said cross-arm, said two springs acting to float said cross-arm on said rod member, said first spring normally urging said rod member from said first position toward said second position, a movable contact carried by said cross-arm and arranged to contact said stationary contact only when said rod member is in said first position and to be pressed thereagainst by said second spring, a bimetallic ele-

ment carried by one of said members, one end of said bimetallic element being electrically connected to said movable contact and the other end thereof being electrically connected to said metallic shell, and a detent on said other member adapted to engage said bimetallic element to hold said setting member in said first position whereby said movable contact engages said stationary contact to complete an electric circuit only as long as said electric circuit is not overloaded.

7. A circuit breaker as defined in claim 6 wherein flexible conductors are employed to provide the electric connections between the respective ends of said bimetallic element and said movable contact and said metallic shell.

8. A circuit breaker as defined in claim 6 wherein said bimetallic element is firmly secured at one end to said body member and said detent comprises a tapered element mounted on said body member, said tapered element being tapered in a direction to pass said bimetallic element during movement of said rod member from said second position to said first position, which circuit breaker also comprises stop means arranged on said body member for engaging said detent to limit movement of said rod member to said second position.

9. A circuit breaker as defined in claim 6 wherein said bimetallic element is firmly secured at one end to said plunger member and said detent comprises a tapered element mounted on said body member, said tapered element being tapered in a direction to pass said bimetallic element during movement of said rod member from said second position to said first position, which circuit breaker also comprises stop means arranged within said body member and on said rod member between the outer end thereof and said bimetallic element for limiting movement of said rod member to said second position.

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