Nov. 17, 1959 R. J. D. ROBERTS 2,913,552

CIRCUIT BREAKER

Filed May 15, 1958

FIG. 1

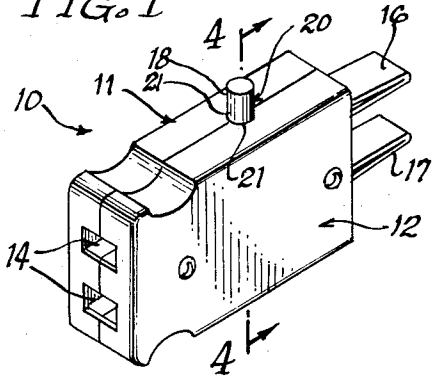


FIG. 2

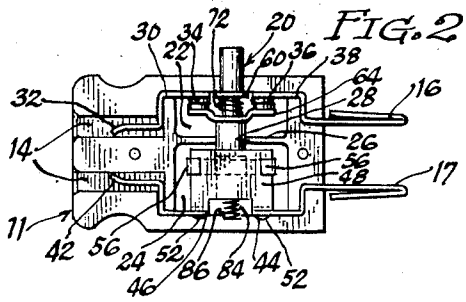


FIG. 3

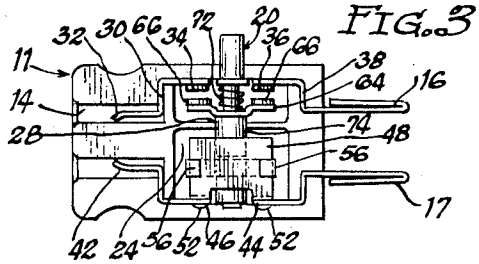


FIG. 4

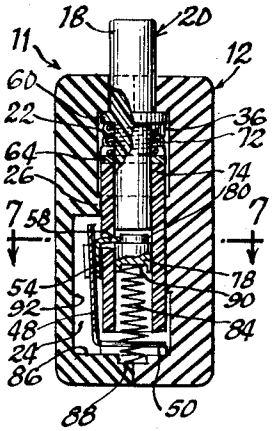


FIG. 5

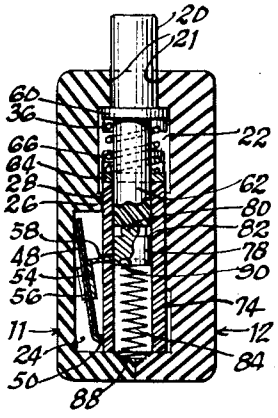


FIG. 6

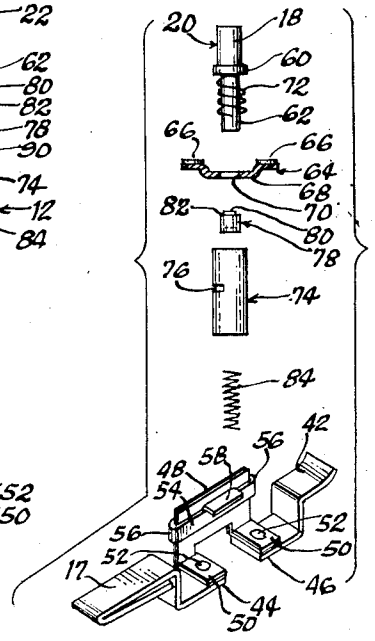
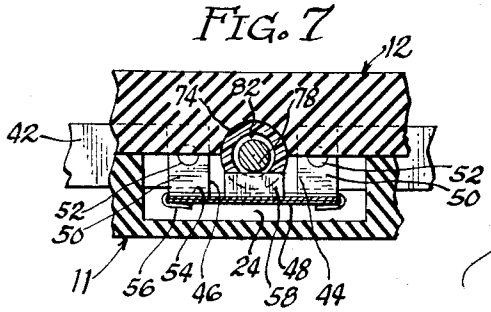


FIG. 7



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CIRCUIT BREAKER

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7 Claims. (Cl. 200—115.5)

My invention relates to an improved circuit breaker and, more particularly, to a trip-free thermostatically operated circuit breaker of compact and rugged structure which is readily insertable into an electric circuit to protect that circuit against overload.

Although the art relating to circuit breakers is extensive, a circuit breaker embodying my invention and constructed in accordance with the principles thereof is singularly effective, sure in operation and yet compact and inexpensive to manufacture. My invention contemplates the use of a switch normally biased to its open position and adapted readily to be connected into an electric circuit, and has a latching mechanism for holding the switch in its closed position until released by heat or excessive current flow.

In the disclosed switch, I have provided a temperature responsive latch in which the latching element is movable along the temperature responsive element in the direction of switch contact movement with one of the switch actuating parts and is movable by the temperature responsive element in a direction lateral to that of switch contact movement to and from a latching position, whereby the latching element moves with the switch actuating element when the contacts are manually operated and is held away from the latching position by action of the temperature responsive element.

A circuit breaker constructed in accordance with my invention is well suited to being built into a compact connector unit quickly connectible into the circuit for the protection of household appliances, either to be furnished with an appliance or as a separate component. The structure and arrangement of parts in my circuit breaker is such that it avoids the necessity of a high degree of precision in either the manufacture of parts or the assembly, and, thus, a circuit breaker incorporating my invention may be inexpensive, durable and well suited to household use.

Other objects and advantages of my invention will be apparent from the following description and the several views of the drawings, wherein:

Fig. 1 is a perspective view of a combination electrical connector plug, circuit breaker and receptacle embodying a preferred form of my invention;

Fig. 2 is a side elevation of the device of Fig. 1 as seen with the near half of the housing removed and the circuit breaker in its circuit closing position;

Fig. 3 is a view similar to Fig. 2, but showing the circuit breaker in its open position;

Fig. 4 is a transverse central section through the device taken substantially on the line 4—4 of Fig. 1 looking in the direction of the arrows and illustrating the parts of the circuit breaker in their normal circuit closing positions;

Fig. 5 is a view similar to Fig. 4 showing the circuit breaker in its open position;

Fig. 6 is an exploded view of the circuit breaker latching and trip mechanism; and

Fig. 7 is a fragmentary longitudinal section through

the circuit breaker mechanism and is taken substantially at the position of the line 7—7 of Fig. 4, looking in the direction of the arrows.

The exemplary embodiment of my invention which is disclosed herein for illustrative purposes includes a housing **10** divided longitudinally into two separable parts **11** and **12** and desirably made of an insulating material, such as hard rubber or a strong thermo-setting plastic. The housing is generally rectilinear and has two holes **14** in predetermined spaced relationship to one another in one end to provide for the insertion of connecting prongs of another device, and has prongs **16** extending from the other end of the housing, prongs which are for making electrical connections to a source of power such as an electric outlet, an extension cord or the like. A head **18** of a re-set button **20** extends through appropriate facing channels **21** in the housing parts to protrude outwardly of the housing on one side thereof.

Interiorly, the housing parts are formed to provide, when assembled together, adjacent chambers **22** and **24** separated by a partition **26** which has an aperture **28** therein.

A conductor strip **30** has a contact end **32** in the form of a prong extending into one of the holes **14** to make contact with a prong of a plug-in connector inserted into hole **14** from the end of the housing, the conductor strip following an outwardly offset path in appropriate opposed grooves in the housing parts to terminate at its other end in the chamber **22** on one side of the re-set button **20**, and has a contact **34** mounted thereon and secured thereto at the end within the chamber. On the other side of the re-set button in the chamber **22**, a second contact **36** is secured to the end of the conductor strip which follows a path offset inwardly in appropriate facing grooves in the housing halves to terminate in one of the plug-in prongs **16**.

The other prong **17** and a receptacle contact **42** are parts of a unitary in sub-assembly, as shown at the lower portion of Fig. 6. The prong **17** consists of a conductor strip offset outwardly inside the housing **10** in appropriate grooves and terminates at **44** in the chamber **24**. The receptacle contact **42** is likewise a conductor strip offset outwardly inside the housing **10** and terminating in the chamber **24** of the housing **10** in aligned and spaced relationship to the end **44** of prong **17**. A rectangular bimetallic plate **48** has integral ears **50** extending in right angular relationship from the corner portions of one edge thereof. The ears are secured by means such as rivets **52** to the inner end **44** of the prong **17** and the inner end **46** of the receptacle contact **42**. The bimetallic plate thus stands upright relative to the prong and contact within the chamber **48** and is offset with respect to the longitudinal center line of the housing **10**.

A latching strip **54** extends across the inside face of the bimetallic plate **48** and end portions **56** thereof are bent around the edges of the bimetallic plate and against the outer face thereof to mount the latching strip on the bimetallic plate for vertical sliding movement. The latching strip includes a tongue **58** on the upper edge thereof extending inwardly at right angles thereto.

The re-set button **20** has, inwardly of the head **18** thereof, an integral flange **60** thereon which projects radially of the head **18**, and also includes a shank **62** below the flange **60** and which, in the structure shown, has a diameter less than that of the head **18**. The collar **60**, among other purposes, serves to hold the re-set button **20** within the housing **10**, it being too large to pass through the channels **21** through which the head **18** extends. A bridging contact **64** consists of a strip having contacts **66** at its ends spaced to engage contacts **34** and **36** on strips **30** and **38**. The strip as shown in Fig. 6, has a central portion **68** which is offset downwardly from the end por-

tions thereof, and has a central bore 70 therein through which the shank 62 of the re-set button 20 extends. A coil type compression spring 72 encompasses the shank 62 and is contained between the collar 60 and the bridging contact 64 of the re-set button 20.

My device likewise includes a sleeve 74 having an internal diameter sufficient to receive slidably the shank 62 of the re-set button 20. Between its ends the sleeve has a transverse slot 76 therein which extends into the sleeve appreciably further than the thickness of the sleeve wall.

The re-set mechanism further includes a metal insert 78 which has a base portion of cylindrical form and has an upper end portion 80 of smaller diameter so as to provide a shoulder 82 between the portions. The diameter of the base portion of the insert is such as to fit closely but slidably within sleeve 72.

A second coil compression spring 84 serves as another part of the re-set mechanism and is contained between the floor 86 of the lower cavity 24 and the bottom end of the insert 78 within the sleeve 74. The floor 86 of the lower chamber is recessed as at 88 and the insert 78 is recessed as at 90 to contain the ends of the spring 84.

As was stated before, the bimetallic plate 48 is offset from the lateral center line of the switch housing. Housing part 11 which contains the bimetallic plate 48 is recessed appreciably away from the plate surface, as at 92 in the lower chamber 24, in order to permit outward flexing of the plate when heated.

The operation of the disclosed switch is as follows. The normal, current conducting or closed position of the switch is illustrated in Figs. 2 and 4. The bridging contact 64 is closed against contacts 34 and 36 so as to establish an electrical circuit between prong 16 and receptacle contact 32. The device will be mounted to a wall outlet, for instance, by prongs 16 and 17 and the prongs of an appliance cord inserted into the holes 14 to make contact with receptacle contacts 32 and 42. As the appliance is used, a circuit is closed through prong 38 and receptacle contact 32 by the bridging contact 64, and through the associated prong of the appliance cord, the appliance and the other or return circuit is made through receptacle contact 42, the bimetallic plate 48 and prong 44.

Under normal load conditions the bimetallic plate 48 is relatively unheated and, therefore, stands vertically without material flexure. By virtue of this vertical position the tongue 58 of the latching strip 54 extends into slot 76 of sleeve 74 and is hooked over the shoulder 82 of the metal insert 78. The insert is maintained in its uppermost position by the coil spring 84. Therefore, the latching strip has been carried near the upper edge of plate 48, and the tongue, in turn, has carried sleeve 74 upwardly against the underside of the bridging contact 64 to hold the contacts 66 thereof against contacts 34 and 36. The bridging contact so seated acts as a stop for movement of the sleeve.

In the event that the circuit is overloaded, excessive current will flow through the switch parts, including the bimetallic plate 48 and will result in the heating of that plate. The bimetallic plate then flexes or bends outwardly and away from the sleeve 74, as depicted in Fig. 5. The tongue 58 of the latching strip 54 is thus withdrawn from engagement with the shoulder 82 of the metal insert 78, thereby to free insert to be moved upwardly by the spring 84. The sleeve 74 is relieved of the force applied by the spring 84 and subject only to the force of the spring 72 which drives that sleeve downwardly, carrying with it the tongue 58 of the latching strip, which slides downwardly on the plate 48. As the sleeve is thus withdrawn from supporting relation to the bridging contact 64, spring 72 likewise drives the bridging contact along shank 62 of the re-set button 20 to withdraw it from circuit closing relationship with the contacts 34 and 36.

The circuit breaker of my invention cannot be re-set as long as the bimetallic plate remains hot since the tongue 58 will be withheld from possible engagement with shoulder 82 of the metal insert.

When the plate cools and thus urges tongue 58 further into the slot 76, the device may be re-set. The head of the re-set button is depressed, whereupon the end of the shank 62 forces the metal insert 78 downwardly against the force of spring 84 until the tongue 58 again engages shoulder 82 of the insert. Upon release of the force applied to the re-set button, spring 84 forces insert 78 upwardly carrying tongue 58 and, therefore, sleeve 74 with it to restore the bridging contact to circuit closing position. The movement of the insert likewise drives the re-set button 20 back to its normal position.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A combination attachment plug, overload circuit breaker and receptacle comprising a body, a pair of connector prongs at one end of said body, said body including a receptacle portion having contact members therein, means including a switch element movable between open and closed positions for opening and closing a connection between one of said connector prongs and one of said contact members, said switch element being biased to its open position, means including a bimetallic plate providing an electrical connection between the other of said prongs and the other of said contact members, means abutting against said switch element and movable to effect movement of said switch element to said closed position, a latch element having a portion engaging said movable means and slidably mounted on said bimetallic plate for movement with said movable means, a member normally movable relative to the last mentioned movable means and having a portion normally engageable by said portion of the latch element, the last mentioned member being biased to urge said latch element and said movable means in one direction to effect movement of the switch element to said closed position when said portion of the latch element engages said portion of the movable member, said latch element engaging said member during normal current flow through said bimetallic plate, and said bimetallic plate being flexed by an abnormal current flow to effect disengagement of said member by said portion of the latch element from said portion of the movable member to release said movable member and movable means to effect movement of the switch element to said open position.

2. The combination as set forth in claim 1, and including additional means operable from the exterior of the body and engageable with said movable member to move said member against the bias thereof to effect reengagement of said portion of the latch element and said latch engaging portion of the movable member.

3. A circuit breaker comprising a switch having separable contacts biased to an open position, means for connecting said switch in an electrical circuit, a bimetallic plate normally connected in series relationship to said contacts for the transmission of current, contact actuating means movable to effect closure of the contacts of said switch, a latch continuously engaged with said movable contact actuating means, said latch being mounted on said bimetallic plate for sliding movement relative thereto as said contact actuating means is moved, a member normally movable relative to said contact actuating means and having a portion normally engageable by said latch, means normally biasing said member in a direction to move said latch and said movable contact actuating means to effect closure of the separable contacts when the latch is engaged with said member, said latch being engageable with said member during normal current flow through said plate, and said bimetallic plate being flexed to disengage said latch from said member by excessive current flow through said plate.

4. The combination as set forth in claim 3, additionally including manually operable means engageable with said

member to move said member against the force of said biasing means thereon to effect re-engagement of said latch and said member when said bimetallic plate is in its normal unflexed position.

5. A circuit breaker comprising a switch having relatively movable contact elements biased to an open position, means for connecting said switch in an electrical circuit, actuating means movable to close said contact elements, a bimetallic plate normally having a position substantially parallel to the direction of movement of said movable actuating means, a latch continuously engaged with said movable means and slidably mounted on said bimetallic plate for movement along the bimetallic plate with said movable actuating means, a member normally movable relative to the movable actuating means and having a latch engaging portion, means biasing said member in a direction to move said latch and said movable actuating means to effect closure of the contact elements when the latch is engaged with said member, said latch being normally disposed to engage said member when the bimetallic plate is in its normal position, said bimetallic plate being flexed by excessive heat to effect withdrawal of said latch from engagement with said member.

6. A circuit breaker comprising a housing, a switch in said housing having a movable contact element biased to open position, means for connecting said switch in an electrical circuit, a tubular member having one end abutting against said movable contact element and supported in said housing for axial movement in a direction corresponding to the directions of movement of said movable contact element, a bimetallic plate having a normal position substantially parallel to the direction of movement of said tubular member, a latch engaged with said tubular member and carried on said bimetallic plate for sliding movements in the direction of movement of said tubular member, a latch engaging member slidably mounted in said tublar member for axial movement therein, said latch engaging member having a latch engaging portion, means biasing said latch engaging member axially of said tubular member and in the direction for effecting movement of the movable contact element to a closed position, a re-set button operable from outside the housing and having a portion thereof within said tubular member, said re-set

button being movable into contact with said latch engaging member to move said latch engaging member against the biasing force acting thereon, said latch having a normal position when the bimetallic plate is normally unflexed by heat for engaging the latch engaging member to support said tubular member and latch engaging member in positions for holding the movable contact element in the closed position, and said bimetallic plate being flexed by heat to withdraw said latch from said latch engaging member to release said latch engaging member, said tubular member and said movable contact element from movement to the open position by the biasing force on the contact element.

7. A circuit breaker for connection in an electrical circuit comprising contact means having open and closed positions, a sleeve longitudinally movable to close said contact means, said sleeve having a transverse slot therein, means biasing said contact means and said sleeve to positions for opening of the contact means, a bimetallic element normally extending in a direction generally parallel to the direction of movement of said sleeve, a latch slidably mounted on said bimetallic element and having a portion normally extending into said slot in the sleeve and into the interior of said sleeve, a shouldered element in said sleeve, said latch normally engaging the shoulder of said element, means biasing said shouldered element oppositely to and more strongly than first mentioned biasing means to move said latch and said sleeve to positions for closing said contact means, said bimetallic element being oriented to withdraw said latch from engagement with the shoulder of said shouldered element upon flexure resulting from the heating thereof, and means operable to move said shouldered element against said second biasing means to effect re-engagement of said latch with said shouldered element.

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