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R. R. PITTMAN ET AL

2,097,775

CIRCUIT BREAKER

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Fig. 1

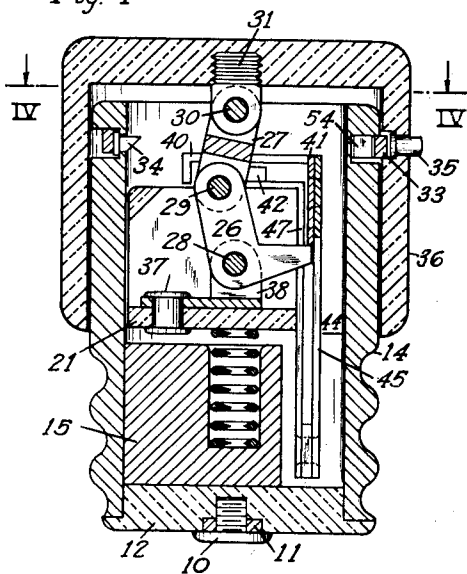


Fig. 2

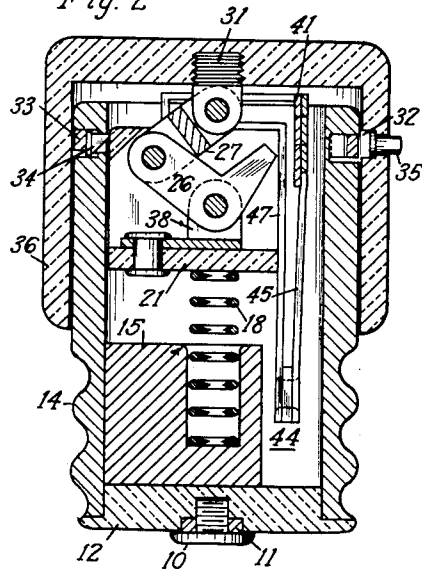


Fig. 4

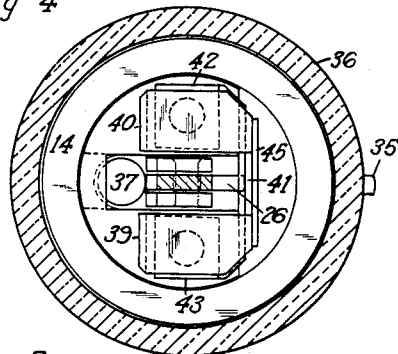


Fig. 3

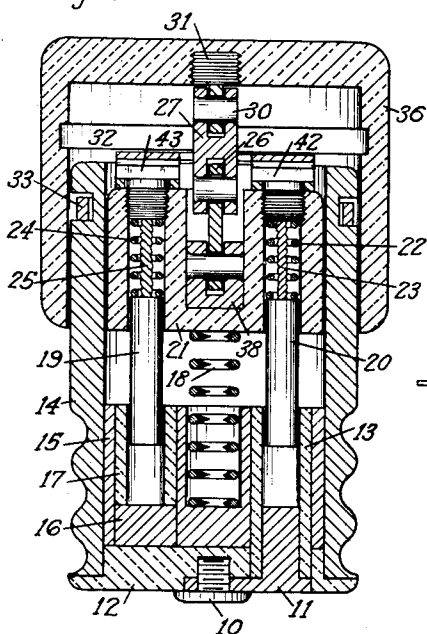


Fig. 5

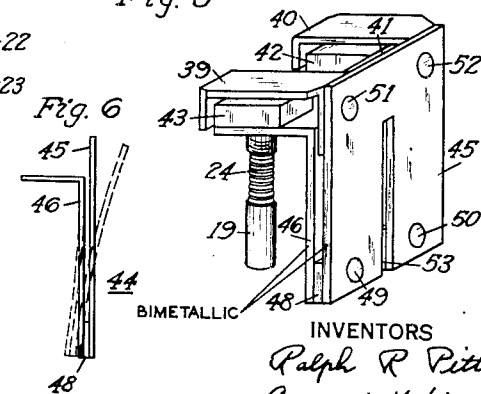
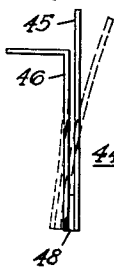


Fig. 6



INVENTORS
Ralph R. Pittman
Carroll H. Walsh

UNITED STATES PATENT OFFICE

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CIRCUIT BREAKER

Ralph R. Pittman and Carroll H. Walsh, Pine
Bluff, Ark.

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15 Claims. (Cl. 200—116)

This invention relates to circuit breaking or switching devices primarily for use with low voltage circuits, as 115–230 volt power and lighting circuits. Receptacles for receiving plug fuses are used to considerable extent in connection with such circuits at the present time. It is an object of the present invention to provide a circuit interrupting device adapted to replace plug fuses.

Due to the small space limitations which must be met in devices of this kind, in which usual forms of bimetallic elements are embodied, much difficulty has heretofore been encountered due to heating of the devices under normal load conditions, such heating resulting from losses in the bimetallic strip.

It is an object of the present invention to provide a circuit breaker in which is embodied a novel form of thermally responsive element which is extremely sensitive to heat; that is, one in which the degree of movement per degree of temperature change is relatively large. Such an element permits the operation of the circuit breaker under normal conditions at a relatively low temperature, without sacrifice of definite tripping at a predetermined over-current.

Also, in present available types of circuit breakers embodying bimetallic strip, excessive heating under short circuit conditions during the time interval required for the separation of the contacts often causes fusing or volatilization of the bimetallic element. For this reason, many breakers are now also provided with magnetic devices for instantaneously tripping the breaker on abnormally high short-circuit currents.

It is an object of the present invention to provide means for shunt-circuiting the thermal element substantially simultaneously with the tripping of the breaker, thus avoiding the necessity of passing the current in the circuit interrupting arc through the thermal element. It will be apparent that this arrangement will protect the element from damage due to such current, and the use of instantaneous magnetic trip organizations becomes unnecessary.

Other objects include (a) the provision of a device adapted to open the connected circuit in response to a predetermined over-current in the circuit; (b) the provision of a device which cannot be manually held in the closed position if a predetermined over-current exists in the circuit; and (c) the provision of a small, effective, but inexpensive device embodying the features above mentioned.

With these and other objects in view which will appear from the description, our invention resides in the novel combination, construction, and arrangement of the parts of the device, to the end that a minimum of space is occupied, and its small size enables it to be economically constructed.

In the drawing:

Fig. 1 is a side elevational view of the device, shown in the closed circuit position, and illustrated in section.

Fig. 2 is a similar view, except that the device is shown in the open circuit position.

Fig. 3 is a front elevational view of the device, shown in the open circuit position, and also illustrated in section.

Fig. 4 is a plan view of the device, taken along the line IV—IV in Fig. 1.

Fig. 5 is an oblique view of the thermally responsive element embodied in the device, together with the contacts.

Fig. 6 is a side elevational view of the thermally responsive element.

Referring now in detail to the drawing, the device may be broadly divided into three parts, (1) the stationary contact assembly, (2) the movable contact assembly, and (3) the cap.

The stationary contact assembly includes the hollow tubular metal screw shell housing 14, into the bottom of which is tightly pressed the flanged insulating disk 12. A metal block 15, of the shape of a segment of a cylinder, is pressed into the housing 14 from the top, and abuts the inner surface of the disk 12.

At one side of the center of the housing 14, a vertical opening extends downwardly through the block 15 and the insulating disk 12. A tube of insulating material 13 is pressed into the opening, and the central terminal contact 11 extends vertically upwardly into the tube 13. A portion of the central terminal contact extends laterally over the midpoint of the disk 12, and is secured thereto by the central terminal 10.

At the other side of the center of the housing 14 a similar vertical opening extends downwardly through the block 15, but not through the disk 12. A screw shell contact 16 is positioned at the lower end of the opening, and subsequently a tube of insulating material 17 is pressed into the opening.

It will be apparent from the above description that the central terminal contact 11 is electrically connected to the central terminal 10, and that the screw shell contact 16 is electrically connected to the screw shell 14.

We will now describe the movable contact assembly. A block of insulating material 21 is fitted into the housing 14, and arranged for reciprocatory movement therein. A pair of laterally spaced openings, in alignment with the openings in the stationary contact assembly just described, extend vertically through the member 21.

The member 21 provides a support for the assembly of contacts and thermally responsive members shown in Fig. 5, which will be described in detail later, the assembly being secured to the support by means of threads on the members 42 and 43, which cooperate with internal threads at the upper ends of the vertical openings through the member 21. The contacts 19 and 20 extend downwardly through the vertical openings, and are electrically connected to the members 42 and 43 by means of the flexible conductors 23 and 25. A pair of coiled springs 22 and 24 are disposed within the vertical openings in such a manner as to constantly urge the contacts 19 and 20 away from the members 43 and 42 respectively.

Fig. 5 illustrates the movable contact assembly, together with the thermally responsive element, the latter being designated in its entirety by the numeral 44, and illustrated in Fig. 6.

The thermally responsive element includes the inverted U-shaped member of bimetallic strip 45. Two additional bimetallic strips 46 and 47 are electrically connected and mechanically joined to the lower ends of the arms of the U-shaped member by the rivets 49 and 50. These rivets extend through the metal spacer blocks 48 and 53, and the additional members 46 and 47 extend upwardly from the rivets 49 and 50, in parallel spaced relationship with the arms of the U-shaped member 45, and also with each other. Adjacent the upper ends, the additional strips 46 and 47 are bent normally away from the plane of the member 45, and to the horizontally extending portions are electrically connected to the shunt-circuiting stationary contacts 43 and 42 respectively, the outer ends of the strips 46 and 47 being clamped to the member 21 by the contacts 43 and 42. A U-shaped metal member 41 is rigidly secured, by means of the rivets 51 and 52, to the upper portion of the bimetallic member 45, the arms of which extend first horizontally over and in spaced relationship with the shunt-circuiting contacts 42 and 34, and then bend downwardly at their respective ends in spaced relationship with the outermost sides of these contacts.

Referring now to Fig. 1, the moving contact assembly, together with its insulating support 21, is attached to the insulating cap 36 by means of a linkage arrangement including the latch link 26, and the toggle link 27. A linkage support 31 is secured at the midpoint of the cap 36 and interiorly thereof, by means of cooperating threads, and the toggle link 27 pivotally connected to the lower end of the linkage support 31 by the pivot 30. The lower end of the toggle link 27 is in turn pivotally attached, by means of the pivot 29, to the upper end of the latch link 26, and the lower end of the latter pivoted to the lower linkage support 38 by means of the pivot 28. A rivet 37, extending through a horizontally disposed portion of the lower linkage support 38 and the base of the insulating block 21, rigidly secures the former to the latter. It is desirable, in order to make the device as compact as possible, to slot the insulating block 21 to ac-

commodate the linkage just described, as shown better in Fig. 3.

The cap 36 is latched to the hollow tubular screw shell member 14 by means of an eccentrically positioned ring 33, the latter extending over portions of registering circumferential grooves 32 and 54 in the respective members. An externally extending plunger 35 is arranged so that the ring 33 may be urged inwardly to release the cap; it may also be released through contact of the upper portion of the insulating block 21 with the inwardly extending plunger 34.

A coiled spring 18 is interposed between the metal block 15 and the insulating block 21, so that it constantly biases the latter away from the former. With the cap 36 latched to the hollow screw shell member 14, any movement of the block 21, with its contacts and thermally responsive element, is prevented by the engagement of the upper end of a forwardly extending portion of the latch link 26 with the under side of the shunting member 41. This position of the elements is shown in Fig. 1.

It will be seen that an outward movement of the bimetallic member 45, to which is rigidly secured the shunting bar 41, will permit the latch link 26 to disengage the bar 41, allowing the spring 18 to urge the insulating member 21, together with the contacts and thermal element attached thereto, in an upward direction to the position of the elements illustrated by Fig. 2. This is therefore the "tripped" position of the circuit breaker. To release or reclose the breaker from the "tripped" position, the cap 36 is pulled out until the latch member 26 again engages the bar 41, at which time the breaker may be again latched in the closed position.

It will also be apparent that the breaker cannot be manually held in the closed position if the bimetallic element 44 is deformed in the direction to trip the breaker. The device is therefore "trip free".

The current path through the device is normally from the central terminal 10 to the central terminal contact 11, thence through the movable contact 20 and the flexible conductor 23 to the stationary shunting contact 42, thence downwardly through the bimetallic member 47, then upwardly and back downwardly through the bimetallic member 45, thence upwardly through the bimetallic member 46 to the stationary shunting contact 43, then downwardly through the flexible conductor 25 and the movable contact 19 to the screw shell breaker contact 16, and thence to the shell member 14.

Since the thermally responsive element 44 is in series circuit relation with the contacts 19 and 20, it carries the current in the circuit in which the device is connected, as is common in all devices of this kind which employ current-conducting bimetallic elements. The bimetallic members 46, 47, and 45, embodied in the thermally responsive element 44, are so arranged that, in response to heating, the members deform to assume the position illustrated by the broken lines in Fig. 6; that is, so that the heating of either the member 45, or the members 46 and 47, will cause outward motion of the upper portion of the member 45. The movement of the upper portion of the member 45 is much greater than would be that of a single piece occupying the same vertical space, consequently a low resistance thermal strip may be used, since only a small amount of heat is necessary to produce the small movement required to trip the breaker. The losses, together with the

heating due to such losses, under normal conditions are very low. The breaker therefore operates at a low temperature, which is one of the objects of the invention.

Referring again to Fig. 5, the movable shunting contacts 39 and 40 are arranged to respectively engage the stationary shunting contacts 43 and 42 when the upper portion of the member 45 has moved outwardly a sufficient distance to trip the breaker. At this instant the thermally responsive element is shunted or bridged by the shunting bar 41, which is of low resistance material. The thermally responsive element 44 carries circuit current only until its temperature reaches the predetermined value necessary to trip the breaker, so that it is automatically protected from excessive rise in temperature due to heavy currents passing through it during the time interval necessary for the mechanism to open the circuit by extinguishing the circuit interrupting arc. Relatively slower movement of the contacts is thus possible, and advantage may be taken of the full travel of the movable contacts 19 and 20 for arc interruption. The interrupting capacity of the device is not dependent upon the thermal capacity of the thermal element, but only on the contact arrangement.

As is well known, the resistance of bimetallic strip increases with temperature rise. When the strip has attained a temperature sufficient to trip the breaker, the heating loss is greater than when the strip is cooler. The effect is a cumulative one, a higher temperature resulting in greater loss, and vice versa. For this reason, magnetic devices which operate instantaneously to open the breaker are widely used along with thermal elements in present day breakers to prevent damage to the thermal element. Obviously no such devices are necessary with the organization herein disclosed.

While we have herein described the embodiment of the invention here presented in specific language for the purpose of facilitating an understanding of its construction and operation, it will be understood that various changes in the specific construction may be made without departing from the principles of the invention.

What we claim is new, and desire to secure by Letters Patent is:

1. In a circuit breaker, movable contacts for opening and closing the circuit, resilient means biasing said contacts to the open circuit position, a thermally responsive element movable with said contacts, means electrically connecting said thermally responsive element in series circuit relation with said contacts, means including said element for normally latching said contacts in the closed position and for unlatching said contacts in response to a movement of said element, and means responsive to said movement for shunt-circuiting said element.

2. In a circuit breaker, longitudinally reciprocable contacts for opening and closing the circuit, resilient means biasing said contacts to the open circuit position, a thermally responsive element movable with said contacts, means electrically connecting said thermally responsive element in series circuit relation with said contacts, means including said element for normally latching said contacts in the closed position and for unlatching said contacts in response to a movement of said element, and means responsive to said movement for shunt-circuiting said element.

3. In a circuit breaker, a pair of contacts relatively movable with respect to cooperating con-

tacts for opening and closing the circuit, resilient means biasing said pair of contacts to the open circuit position, a thermally responsive element movable with said pair of contacts, means electrically connecting said thermally responsive element in series circuit relation between the movable contacts, means cooperating with said element for normally latching said contacts in the closed position and for unlatching said contacts to open the circuit in response to a movement of said element, and means responsive to said movement for shunt-circuiting said element.

4. In a circuit breaker, a pair of longitudinally reciprocable contacts relatively movable with respect to cooperating contacts for opening and closing the circuit, resilient means biasing said pair of contacts to the open circuit position, a thermally responsive element movable with said pair of contacts, means electrically connecting said thermally responsive element in series circuit relation between the movable contacts, means associated with said element for normally latching said contacts in the closed position and for unlatching said contacts to open the circuit in response to a movement of said element, and means responsive to said movement for shunt-circuiting said element.

5. In a circuit breaker, movable contacts for opening and closing the circuit, resilient means urging said contacts to the open circuit position, a thermally responsive element movable with said contacts, means electrically connecting said thermally responsive element in series circuit relation with said contacts, means including said element for normally latching said contacts in the closed position and for unlatching said contacts to open the circuit in response to a movement of said element, and means responsive to said movement for shunt-circuiting said element, said shunt-circuiting means being movable with said contacts and said thermally responsive element.

6. In a circuit breaker, a pair of contacts relatively movable with respect to cooperating contacts for opening and closing the circuit, resilient means urging said pair of contacts to the open circuit position, a thermally responsive element movable with said pair of contacts, means electrically connecting said thermally responsive element in series circuit relation between the movable contacts, means associated with said element for normally latching said contacts in the closed position and for unlatching said contacts to open the circuit in response to a movement of said element, and means responsive to said movement for shunt-circuiting said element, the shunt-circuiting means being movable along with said pair of contacts and said thermally responsive element.

7. In a circuit breaker, separable contacts for opening and closing the circuit, resilient means biasing said contacts to the open position, a thermally responsive element movable with said contacts, means electrically connecting said element in series circuit relation with said contacts, and latch means combined with said element for normally maintaining said contacts in the closed position and for releasing said contacts to open the circuit in response to a movement of said element, said thermally responsive element including two spaced substantially parallel members of a bimetallic strip which bends in response to temperature change thereof, one end of one member being electrically connected and mechanically joined to the adjacent end of the other member, the arrangement being such that

the bending movement due to rise in temperature of either of the members increases the distance separating the remaining ends of the parallel members, the thermally responsive element cooperating with means for shunt-circuiting the element in response to the bending movement due to rise in temperature thereof.

8. In a circuit breaker, separable contacts for opening and closing the circuit, resilient means biasing said contacts to the open position, a thermally responsive element movable with said contacts, means electrically connecting said element in series circuit relation with said contacts, and latch means combined with said element for normally maintaining said contacts in the closed position and for releasing said contacts to open the circuit in response to a movement of said element, said thermally responsive element including two spaced substantially parallel members of a bimetallic strip which bends in response to temperature change thereof, one end of one member being electrically connected and mechanically joined to the adjacent end of the other member, the arrangement being such that the bending movement due to rise in temperature of either of the members increases the distance separating the remaining ends of the parallel members, the thermally responsive element cooperating with means for shunt-circuiting the element in response to the bending movement due to rise in temperature thereof, and the shunt-circuiting means being movable with said element.

9. In a circuit breaker, separable contacts for opening and closing the circuit, resilient means biasing said contacts to the open position, a thermally responsive element movable with said contacts, means electrically connecting said element in series circuit relation with said contacts, and latch means combined with said element for normally maintaining said contacts in the closed position and for releasing said contacts to open the circuit in response to a movement of said element, said thermally responsive element including two spaced substantially parallel members of a bimetallic strip which bends in response to temperature change thereof, one end of one member being electrically connected and mechanically joined to the adjacent end of the other member, the arrangement being such that the bending movement due to rise in temperature of either of the members increases the distance separating the remaining ends of the parallel members, the separable contacts being relatively longitudinally reciprocable.

10. In a circuit breaker, a thermally responsive element comprising an inverted U-shaped bimetallic strip, a pair of additional bimetallic strips secured to said U-shaped strip at the lower ends of its respective arms and extending upwardly therefrom in spaced parallel relation therewith and with each other, supporting means for said additional strips at the upper ends thereof, and means for connecting said upper ends in the circuit, the arrangement being such that the bending movement in response to heating of the element increases the distance between the upper ends of said additional strips and the upper portion of said inverted U-shaped strip.

11. In a circuit breaker, a thermally responsive element comprising an inverted U-shaped bimetallic strip, a pair of additional bimetallic strips secured to said U-shaped strip at the lower ends of its respective arms and extending upwardly therealong in spaced parallel relation

therewith and with each other, supporting means for said additional strips at the upper ends thereof, and means for connecting said upper ends in the circuit, the arrangement being such that the bending movement in response to heating of the element increases the distance between the upper ends of said additional strips and the upper portion of said inverted U-shaped strip, and means combined with said element for shunt-circuiting the bimetallic members in response to said bending movement.

12. In a circuit breaker, a thermally responsive element comprising an inverted U-shaped bimetallic strip, a pair of additional bimetallic strips secured to said U-shaped strip at the lower ends of its respective arms and extending upwardly therealong in spaced parallel relation therewith and with each other, supporting means for said element at the upper ends of said additional strips, and means for electrically connecting said upper ends in series relation with the circuit, the arrangement being such that the upper portion of said inverted U-shaped strip moves away from the upper ends of said additional strips in response to heating of either the additional strips or the U-shaped strip, and means including contacts secured to the upper portion of the U-shaped strip for shunt circuiting said element upon the occurrence of a predetermined movement thereof.

13. A circuit breaker comprising a pair of stationary contacts and a pair of relatively reciprocable contacts for opening and closing the circuit, resilient means biasing said reciprocable contacts to the open circuit position, a thermally responsive element reciprocable with said reciprocable contacts, means electrically connecting said thermally responsive element in series circuit relation with said pair of reciprocable contacts, means cooperating with said element for normally latching said contacts in the closed circuit position and for releasing said contacts to open the circuit in response to a movement of said element, said thermally responsive element comprising an inverted U-shaped bimetallic strip, a pair of additional bimetallic strips secured to said U-shaped strip at the respective lower ends of its arms and extending upwardly therealong in spaced parallel relation therewith and with each other, and supporting means for said element at the upper ends of said additional strips, the arrangement being such that the upper portion of said inverted U-shaped strip moves away from the upper ends of said additional strips to release said reciprocable contacts in response to heating of either the additional strips or the U-shaped strip, and means including shunt-circuiting contacts secured to the upper portion of the U-shaped strip for shunt-circuiting said element upon the occurrence of a predetermined movement thereof in a direction to open the circuit.

14. A circuit breaker comprising separable contacts for opening and closing the circuit, resilient means biasing said contacts to the open position, a thermally responsive element movable with said contacts, means electrically connecting said element in series circuit relation with said contacts, and latch means combined with said element for normally maintaining said contacts in the closed position and for releasing said contacts to open the circuit in response to a movement of said element, said thermally responsive element including at least two spaced substantially parallel members of a bimetallic strip which bends in response to temperature change

thereof, one end of one member being electrically connected and mechanically joined to the adjacent end of the other member, the arrangement being such that the bending movement due
5 to rise in temperature of either of the members effects a change in the distance separating the remaining ends of the parallel members.

15. In a circuit breaker having an open and a closed position, a bimetallic element, means for
10 connecting said element in the circuit, means responsive to the attainment of a predetermined temperature of said element due to passage of

current therethrough for actuating said breaker from the closed to the open position, and means for connecting a relatively low resistance member in parallel circuit relation with said element in response to its attainment of said predetermined temperature, and for disconnecting said relatively low resistance member when the temperature of the element falls below said predetermined temperature.

RALPH R. PITTMAN. 10
CARROLL H. WALSH.