Nov. 11, 1941. B. E. SHAW 2,262,344

CIRCUIT CUTOUT

Filed March 5, 1940

Fig. 1.

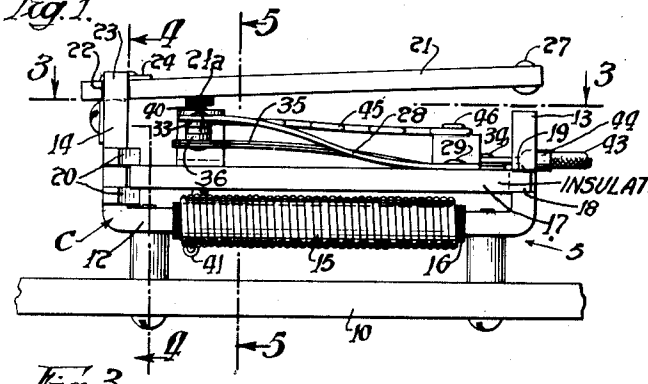


Fig. 2.

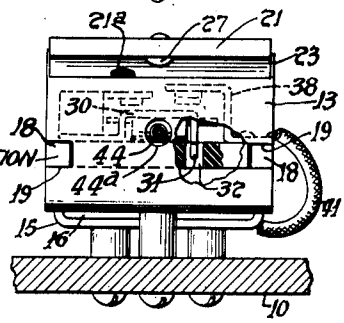


Fig. 3.

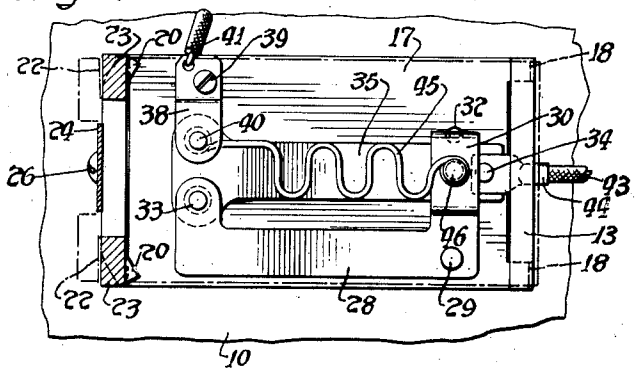


Fig. 4.

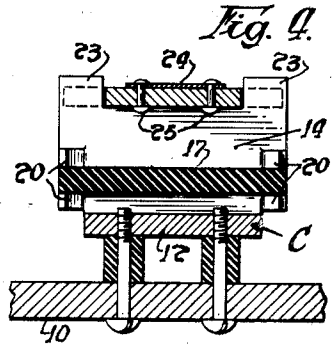


Fig. 6.

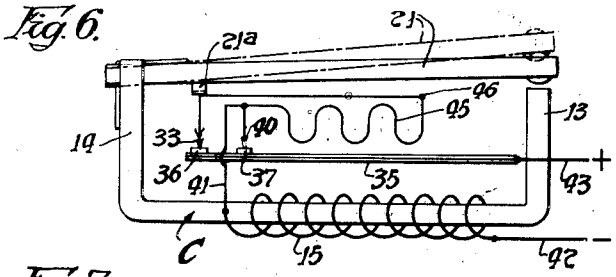


Fig. 5.

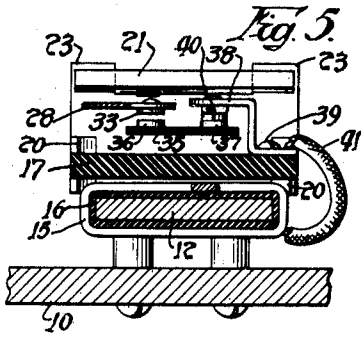
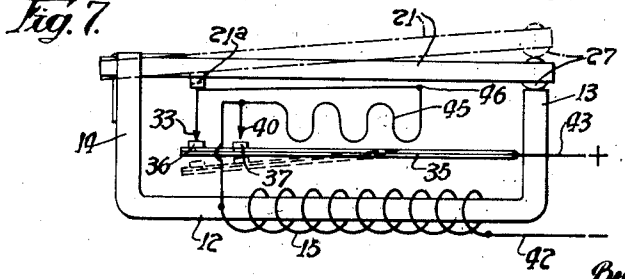


Fig. 7.



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Patented Nov. 11, 1941

2,262,344

UNITED STATES PATENT OFFICE

2,262,344

CIRCUIT CUTOUT

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Application March 5, 1940, Serial No. 322,286

10 Claims. (Cl. 200—88)

The circuit cut-out contemplated in the present application is particularly designed for breaking a circuit when the current therethrough exceeds a predetermined amount and recloses the circuit after a predetermined time period, the cut-out again operating in its cut-out capacity if the circuit still remains in an overloaded condition.

One object of the invention is to provide a circuit cut-out which includes a thermal relay and a magnetic relay so associated that a predetermined timing period can be secured without having to compensate the heat responsive element for ambient temperature.

A further object is to provide a magnetic relay which attracts an armature when current in excess of a predetermined amount flows through the relay coil and the armature then effects the establishment of a circuit through a heating element, whereupon the heating element heats a heat responsive element such as one made of bimetal and warps it to a position where it opens the circuit to both the magnetic relay and the thermal relay, thereby breaking the circuit supplied to the cut-out.

A further object is to provide for re-establishment of the circuit through the cut-out only after a time period has expired, such time period being determined by the return warping of the bimetal element as it cools down from its heated condition toward atmospheric temperature, the bimetal element eventually re-establishing the circuit through the cut-out and thereby the circuit through the magnetic relay, whereupon if the overloaded condition is still present the cut-out recycles.

More particularly, it is my object to provide a cut-out including a magnetic relay and a thermal relay having circut connections which are normally in a position to shunt out the thermal relay and effect energization of the thermal relay only when current in excess of a predetermined amount flows through the magnetic relay coil, an armature of the magnetic relay being thereby attracted and operating to establish a circuit through the thermal relay so that it in turn can operate to connect the heating element of the thermal relay in series with the coil of the magnetic relay and thereby break the circuit through the cut-out, by operation of the thermal relay.

Although the invention is susceptible of a variety of embodiments, it is unnecessary to fully describe and illustrate more than one in order to give a full understanding of the invention both from its structural and functional standpoints. Accordingly, I have illustrated a preferred and desirable embodiment of the invention in the accompanying drawing forming a part of this specification and throughout the views of which like reference characters refer to the same parts.

In the drawing:

Figure 1 is a side elevation of a circuit cut-out embodying my invention;

Figure 2 is an end elevation thereof;

Figure 3 is a sectional view on the line 3—3 of Figure 1 showing a plan view of the circuit cut-out with the exception of the armature, which is shown in dash lines;

Figure 4 is a vertical sectional view on the line 4—4 of Figure 1;

Figure 5 is a vertical sectional view on the line 5—5 of Figure 1;

Figure 6 is an electrodiagrammatic view showing the parts of the circuit cut-out in an intermediate position, and

Figure 7 is a similar view showing the parts in another intermediate position.

On the accompanying drawing, I have used the reference numeral 10 to indicate generally a panel or other support, on which my cut-out is mounted. The cut-out itself includes a core member C having a center leg 12 and a pair of end legs 13 and 14. Wound on the center leg 12 is a magnetic coil 15, insulation 16 being provided to insulate the coil from the core.

A base 17 of insulating material is mounted on the core member C by means of a pair of lugs 18 at one end of the base, being received in notches 19 of the core leg 13. The other end of the base 17 is held in position by pairs of lugs 20 formed on the leg 14 and bent to overlap two of the corners of the base 17.

An armature 21 is pivotally mounted on the core leg 14 by means of notches 22 in the armature receiving projections 23 of the leg 14. A leaf spring 24 of L shape has one flange secured to the armature 21 as by rivets 25, and its other flange secured to the core leg 14 as by a screw 26. The spring 24 is so shaped initially that it tends to hold the armature 21 in the elevated position shown in Figure 1, with the side of the notches 22 engaging the extensions 23 to serve as a stop. The end of the armature opposite the pivoted end is adapted to be attracted by the core leg 13 when it is sufficiently magnetized. A non-magnetic rivet 27 is provided in the armature 21 to prevent it from sticking to the core leg 13.

Mounted on the base 17 is a contact spring 28. The spring 28, as shown in Figure 3, is secured to the base by a rivet 29. The spring 28

has a yoke portion 30 (see Figure 2) terminating in a lug 31 entering an opening 32 of the base to prevent turning of the spring 28 on the rivet 29. The free end of the spring 28 carries a contact 33 which, for convenience, I will term a fourth contact.

Secured to the base 17 as by a rivet 34 is a bimetal element 35. The bimetal element 35 has a pair of contacts 36 and 37 which, for convenience, I will call first and second contacts.

A bracket 38 is mounted on the base 17 by means of a screw 39. The bracket 38 carries a third contact 40. A wire 41 connects the bracket 38 electrically with one end of the coil 15, a current supply wire 42 being connected with the other end thereof. A current supply wire 43 is soldered into a connector lug 44 and the lug in turn is connected to the rivet 34, so that current is supplied to the bimetal element 35. An enlarged opening 44a is provided for the lug 44 to pass through the core member C.

A heating element 45 is connected at one end to the contact rivet 40 and at its other end to the yoke 30 of the leaf spring 28 by a rivet 46. The circuit connections resulting from the foregoing described arrangement are shown in Figures 6 and 7.

Practical operation

In the operation of my circuit cut-out, as long as the current supplied to the wires 42 and 43 is below a predetermined amount, the coil 15 energizes the core C insufficiently to attract the armature 21. The circuit connections may be traced in Figure 6 as follows: From the wire 43 through the bimetal element 35 and the contacts 37, 40, the wire 41 and the coil 15 back to the wire 42. Normally, the armature is elevated to the dotted position of Figure 6, so that the first and fourth contacts 33 and 36 are separated from each other, as shown in Figure 5.

When the current flowing through the cut-out exceeds a predetermined value, determined by the size of the coil 15, the spacing of the armature 21 from the core leg 13, etc., the armature is attracted, first assuming the intermediate position shown by full lines in Figure 6. All of the contacts are now engaged with each other, but there is no change in operation from the position as illustrated in Figure 5. As soon as the armature 21 starts to move, however, it moves all the way, because it is immediately in a stronger magnetic field and therefore will move to the position of Figure 7. In this position, the second contact 37 has been separated from the third contact 40 by the insulating button 21a of the armature 21 having pressed the fourth contact into engagement with the first contact 36, as shown in Figure 6, and then depressed the bimetal element 35 as shown in Figure 7 by solid lines.

The circuit connections through the cut-out are now change to the extent that the circuit is also flowing through the heating element 45. This raises the temperature of the heating element and the heat is radiated to the bimetal element 45 so that it warps to the dotted line position and thereby opens the circuit across the first and fourth contacts 36 and 33. The circuit is now completely opened through the cut-out and the armature returns due to the spring 24 to its initial position shown in Figure 5, which position is indicated by dotted lines in Figure 7. It will now take some time for the heating element to cool down sufficiently to re-establish the circuit across the contacts 33 and 36, which gives a timing period during which the overload condition might be removed from the line. If so, the armature 21 will not be reattracted, whereas if the overload condition still prevails, such attraction will occur and the cut-out will re-cycle.

The magnetic relay of my cut-out determines the point at which cut-out operation occurs. Whenever the current is sufficient to cause attraction of the armature, then the thermal relay is thrown into operation. The thermal relay is designed so that it operates promptly and radiates enough heat to the bimetal element 35 so that it will remain warped out for a substantial period of time. This period may vary anywhere from several seconds to a few minutes, if desired.

Due to my arrangement, wherein the timing period is determined by the rate of return of the bimetal element 35, it is unnecessary to provide for ambient temperature compensation, as in many types of thermal relays. My cut-out is particularly adaptable for automobile radio installations. Automobile radios usually include a vibrator, with which trouble is experienced sometimes, especially in the winter-time, as the vibrator contacts sometimes stick together and thereby throw a dangerously high overload on the circuit. This overload, although usually insufficient to immediately blow a fuse, will do so after a period of time because of the prolonged flow of current through the fuse. Thereby much trouble has been experienced in blowing fuses with automobile radios.

Vibrators of the type mentioned usually become operative after the car is warmed up somewhat from driving it, and therefore a re-cycling cut-out of the kind I have described is a convenience as a means to avoid blowing out of the fuse. Sometimes after one or two recycling operations, the vibrator will operate satisfactory, whereas if the contacts of the vibrator are so firmly stuck together that they cannot be dislodged, my cut-out will continue to recycle without blowing the fuse.

When the operator of the automobile finds that the cutout continues to recycle when he turns on his radio, and that the recycling does not stop, then it is an indication that the condition of the vibrator should be examined.

I have illustrated and described my improvement in an embodiment which I have found very satisfactory. I have not attempted to illustrate or describe certain adaptations or modifications which I contemplate, or the various uses and adjustments possible, as it is believed that the foregoing disclosure will enable those skilled in the art to which this invention appertains to embody or adapt my improvements as may be desired.

Having thus described my invention, I now claim and desire to secure by Letters Patent:

1. A circuit cut-out of the character described comprising a relay including a coil and an armature, said armature being moved from normal position only when current through said coil exceeds a predetermined amount, a heating element, a bimetal element responsive to heat therefrom, and circuit connections including a pair of switches between said bimetal element and said relay coil to energize the heating element by opening one of said switches and closing the other when said armature moves from normal position, said bimetal element thereupon opening the circuit through said relay by responding to heat from said heating element and

opening said other switch and maintaining the circuit open until said bimetal element cools sufficiently to return to closed circuit position of said first switch.

2. A circuit cut-out for a pair of circuit connections comprising a magnetic relay and a thermal relay including a heating element, one of said circuit connections being with one end of the coil of said magnetic relay, and said coil, the heating element of said thermal relay and the temperature responsive element of said thermal relay being connected in series, the other of said circuit connections being with said temperature responsive element which normally makes contact with the circuit between said heating element and said coil, said temperature responsive element being movable by the armature of said magnetic relay upon energization of the coil of said magnetic relay by current in excess of a predetermined amount to break said contact with the circuit between said heating element and said coil and thereby effect said series connection of said coil, said heating element and said temperature responsive element, said temperature responsive element thereupon breaking contact in the circuit through said cut-out at a point between said heating element and said temperature responsive element and returning to circuit restoring position after a time period determined by dissipation of heat from said temperature responsive element to atmosphere.

3. A cut-out for a circuit having two wires comprising a magnetic relay and a thermal relay including a heating element, the coil of said magnetic relay having one end connected to one wire of the circuit and the coil and the heating element of said thermal relay being connected in series, the temperature responsive element of said thermal relay including a pair of contacts, one of which normally shunts said heating element out of the circuit by contact with a point thereof intermediate said coil and said heating element and being movable by the armature of said magnetic relay upon energization of the coil of the relay by current in excess of a predetermined amount to open said one of said contacts, said temperature responsive element thereupon effecting breaking of the cut-out circuit through the other of said contacts with a point intermediate the outer end of said heating element and the other wire of said circuit.

4. In a circuit cut-out of the character described, a core, an armature, a relay coil on said core, said armature being attracted by said core when said coil is energized with current in excess of a predetermined amount, a heat responsive element, a heating element therefor, said relay coil and said heating element being connected in series, a pair of contacts controlled by the position of said heat responsive element, a third contact connected between said relay coil and said heating element and coactable with one of said pair of contacts, a fourth contact connected with the free end of said heating element and coactable with the other of said pair of contacts, said third contact being normally engaged with said one of said pair of contacts, said fourth contact being normally separated from said other of said pair of contacts and engageable therewith by movement of said armature when attracted by said core, and supply circuit connections with the free ends of said heat responsive element and said relay coil.

5. In a circuit cut-out of the character described, a core, an armature, a relay coil on said core, said armature being attracted by said core when said coil is energized with current in excess of a predetermined amount, a heat responsive element, a heating element therefor, said relay coil and said heating element being connected in series, a pair of contacts controlled by the position of said heat responsive element, a third contact connected between said relay coil and said heating element and coactable with one of said pair of contacts, a fourth contact connected with the free end of said heating element and coactable with the other of said pair of contacts, said third contact being normally engaged with said one of said pair of contacts, said fourth contact being normally separated from said other of said pair of contacts and engageable therewith by movement of said armature when attracted by said core, and said other of said pair of contacts being disengaged from said fourth contact when said bimetal element warps in response to heat from said heating element.

6. A circuit cut-out of the character described comprising an armature, a relay coil, said armature being moved by energization of said coil with current in excess of a predetermined amount, a heat responsive element, a heating element therefor, said relay coil and said heating element being connected in series, a pair of contacts controlled by the position of said heat responsive element, a third contact connected between said relay coil and said heating element and coactable with one of said pair of contacts, a fourth contact connected with the free end of said heating element and coactable with the other of said pair of contacts, said third contact being normally engaged with said one of said pair of contacts, said fourth contact being normally separated from said other of said pair of contacts and engageable therewith by movement of said armature when attracted by said core, and supply circuit connections with the free ends of said relay coil and said heat responsive element, said element returning to initial position after a time period due to dissipation of heat therefrom after the circuit of said heating element is opened.

7. In a circuit cut-out, a core, an armature, a relay coil on said core, said armature being attracted by said core when said coil is energized with current in excess of a predetermined amount, a bimetal element, a heating element therefor, said relay coil and said heating element being connected in series, a pair of contacts on said bimetal element, a third contact connected between said relay coil and said heating element and engageable with one of said pair of contacts, a fourth contact connected with the free end of said heating element and engageable with the other of said pair of contacts, said third contact being normally engaged with said one of said pair of contacts, said fourth contact being normally separated from said other of said pair of contacts and engageable therewith by movement of said armature when attracted by said core and said other of said pair of contacts being disengaged from said fourth contact when said bimetal element warps in response to heat from said heating element, and supply circuit connections with the free ends of said relay coil and said heat responsive element.

8. In a circuit cut-out, a relay including a coil and an armature, said armature being responsive to and thereby moved only when current through said coil exceeds a predetermined amount, a heating element, means movable in response to

heat therefrom, a first circuit connection between said means and said relay coil including contacts, a second circuit connection between said means and said heating element including second contacts, said armature opening said first contacts and closing said second contacts to energize said heating element when said armature moves in response to current through said relay coil in excess of said predetermined amount, said means thereupon opening said second contacts and thereby the circuit through said relay and maintaining it open until said means cools sufficiently to return to closed circuit position.

9. In a circuit cut-out, the combination of a magnetic relay including a coil and an armature, and a thermal relay including a heating element and heat absorbing means movable in response to heat therefrom, a circuit connection including contacts between said heat absorbing means and said relay coil, a circuit connection between said heating element and heat absorbing means, the last circuit connection including contacts, said armature moving in response to current through said relay coil in excess of a predetermined amount and thereby opening said first contacts and closing said second contacts, said heating element being thereby heated and heating said heat absorbing means to thereby cause it to open the circuit through said relay by separating said second contacts and maintaining said circuit open until the heat has been dissipated from said heat absorbing means sufficiently for it to return to closed circuit position.

10. A circuit cut-out comprising a magnetic relay and a thermal relay including a heating element, the coil of said magnetic relay and the heating element of said thermal relay being connected in series, a contact between said heating element and said coil, the temperature responsive element of said thermal relay being engageable therewith, one circuit connection with said coil and another circuit connection with said temperature responsive element, a second contact at the free end of said heating element and engageable with said temperature responsive element, said temperature responsive element normally engaging said first contact and being movable by said armature of said magnetic relay to effect separation thereof from said first contact and close said second contact with relation to said temperature responsive element to effect current flow through said heating element, said temperature responsive element thereupon disengaging from said second contact and thereby effecting breaking of the circuit through said relay coil and said heating element.

BURTON E. SHAW.