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CIRCUIT BREAKERS

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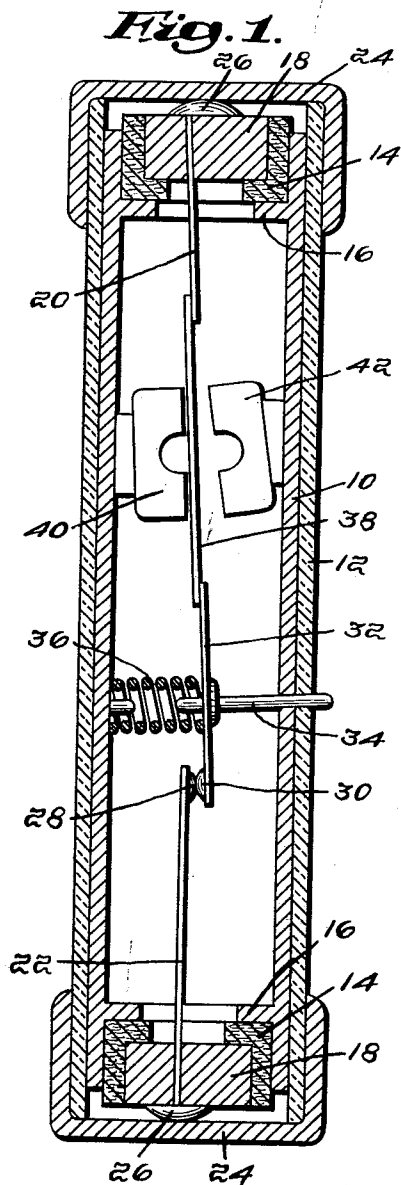


Fig. 2.

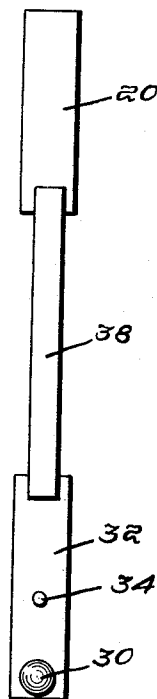
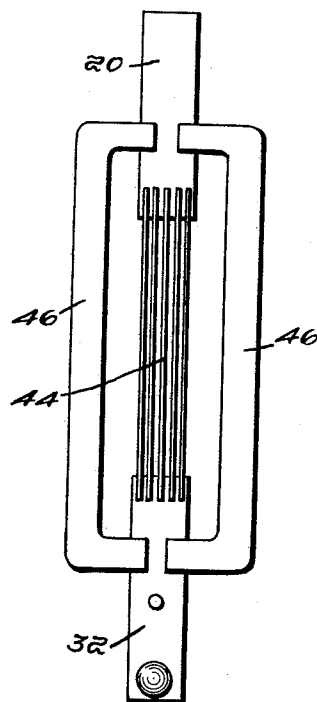


Fig. 3.



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CIRCUIT BREAKERS

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5 Claims. (Cl. 200—88)

This invention relates to improvements in circuit breakers of a type which may be used in place of conventional fuses and electrical relays. My circuit breaker is not a fuse, since it does not employ any fusible link for breaking the electrical circuit. Furthermore, it does not depend on electromagnetic action, as does the usual type of relay, and therefore requires no electrical coils.

It is an object of my invention to provide a circuit breaker which will take the place of customary fuses and relays and which may be physically designed to conform with present fuse practice but which is designed to hold the circuit contacts closed magnetically until the electric current becomes excessive, at which point the contacts will open.

It is an object of my invention to provide an electrical circuit breaker based upon the characteristic properties of certain magnetic nickel-iron alloys becoming non-magnetic when the temperature of the alloy is changed from normal. This may be carried out in a circuit breaker in which the alloy actuating device is magnetic at ambient temperature, but when a pre-determined value of current flows through it, its temperature rises beyond a given value at which it becomes non-magnetic.

Further objects and advantages of my improvements will be more readily apparent from the following description of a preferred embodiment thereof, as illustrated in the accompanying drawings, in which:

Fig. 1 is a longitudinal cross-section of a circuit breaker embodying my invention;

Fig. 2 is a plan view of the movable contact arm; and

Fig. 3 is a plan view similar to Fig. 2 showing a modified construction of the movable contact arm.

My circuit breaker is mounted in a cylindrical casing similar to the casing of a standard electrical fuse. The metal tube 10 is enclosed in a glass or plastic cylindrical sleeve 12. Fiber insulators 14 are fitted into the ends of the metal tube 10 setting against the shoulders 16. Cylindrical copper bushings 18 are fitted into the insulator pieces 14 and serve as mountings for the fixed contact arm 20 at one end and arm 22 at the opposite end. Metal caps 24 are assembled on the ends of the sleeve 12. Contact is made through the caps 24, to the copper bushings 18, through the soldered connections 26 which serve to attach the arms 20 and 22 to the bushings 18.

The contact arm 22 has a contact button 28 which engages a contact button 30 on a movable arm 32. The movable contact arm 32 has a pin 34 fixed thereto which extends outwardly through the casing, through openings in the sleeves 10 and 12. The contact arm 32 is normally urged to move in a direction to break contact between the buttons 28 and 30 by means of the compression spring 36 which extends between the arm 32 and the inner side of the casing 10.

The contact arms 20 and 32 are connected by an alloy strip 38, as shown in Fig. 2. The strip 38 is made of an alloy having special characteristics. Certain nickel-iron alloys, such as Invar and Hypernik, have the characteristic of being magnetic at low temperatures while losing

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their magnetic properties at higher temperatures. The critical temperature at which the alloy becomes non-magnetic depends upon the relative proportion of nickel to iron. I prefer to use alloys with a critical temperature of from 100° C. to 600° C. Such alloys may be described as magnetically reversible or as thermo-magnetic alloys.

I provide a permanent magnet 40 which is fixed in position to the inner surface of the casing 10 in a position to attract the alloy strip 38. This may be a horseshoe magnet and the arms are so designed that when the contact arm, including the elements 20, 38 and 32, is in the position to close the contact buttons 28 and 30 that a small space will remain between the magnet and the alloy strip 38. It is desired to avoid physical contact between the alloy strip 38 and the magnet 40 in order that the heat of the alloy strip 38 will not be dissipated through the body of the magnet. When the electrical circuit is closed, the current flows through the alloy strip 38. If the current flow becomes excessive the alloy strip 38 will become heated and will finally become non-magnetic, at which point the spring 36 will overcome the magnetic attraction and move the contact arm to open the contact buttons 28 and 30. As soon as the electrical circuit is broken, the alloy strip 38 will quickly cool and will again be attracted by the magnet 40 to close the circuit unless some special means is provided to hold the contact arm in open position until the trouble caused by the breaking of the circuit has been rectified.

I, therefore, provide a second magnet 42 fixed to the sleeve 10 which will engage the alloy strip 38 when the circuit is broken and as the alloy 38 cools it will be magnetically held by the magnet 42. When the trouble caused by the overload current has been rectified, the circuit breaker may be reset by pushing the reset pin 34.

It will be understood that the alloy strip will be designed to take care of different values of electrical current. If the alloy connection 38 is designed for very low electric currents, it may be in the form of small wires such as the ribbons 44 in Fig. 3. These small wires 44 will not have the strength to form a rigid connection between the arm pieces 20 and 32, therefore, the reinforcing strips 46 may be used as bridges between the arm pieces 20 and 32. These bridges 46 are placed so that they will not be attracted by the magnet 40 and the bridge pieces 46 may be insulated from the strips 20 and 32 so that all the electrical current flows through the wires 44. The arm in Fig. 3, therefore, will function as the arm in Fig. 2.

I claim:

1. In an electrical circuit breaker, a casing, contacts at its opposite ends, a pair of relatively movable contacts within said casing, a movable arm supporting one of said contacts and mounted at one end of said casing, resilient means normally acting to move said arm in a direction to open said contacts, a pin fixed to said arm and extending through the side of said casing for resetting said arm to closed position, said arm having a strip portion composed of a magnetic alloy which becomes non-magnetic when heated above a critical temperature and said portion constituting a part of the circuit to be interrupted and being so constructed and proportioned as to become heated above said temperature solely by current flowing there-through when said current exceeds a predetermined value, a pair of magnets fixed within said casing at opposite sides of said strip portion, one of said magnets being adapted to hold said arm in closed position against the force of said resilient means until the current flowing through said arm causes said alloy to become non-magnetic and be released from the first of said magnets, the other of said magnets serving to hold said arm in open position as it cools down until said arm is manually reset.

2. In an electrical circuit breaker, a contact arm movable to open or close an electrical circuit said arm having

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a portion composed of a magnetic alloy which becomes non-magnetic when heated above a critical temperature, said portion constituting a part of the circuit to be interrupted and being of such electrical resistance as to become heated above said temperature solely by current flowing therethrough when said current exceeds a predetermined value, a first magnet disposed to attract said portion and hold said arm in a position to close the circuit, resilient means normally urging said arm toward a position to open the circuit, whereby said arm moves to the open circuit position when said portion becomes non-magnetic as the result of excessive current flowing therethrough, and a second magnet disposed to attract said portion when said arm is in the open circuit position, whereby said arm remains in the latter position upon cooling of said portion subsequent to interruption of the circuit.

3. A circuit breaker as described in claim 2 having manual resetting means for overcoming the force of said second magnet and returning said arm to the closed circuit position.

4. In a circuit breaker, a contact arm adapted to constitute a part of the circuit to be interrupted and movable between an open circuit and a closed circuit position, said arm comprising three electrically conductive strips joined rigidly together, end to end in succession in electrical contact, the central strip being made of a magnetic alloy which becomes non-magnetic when heated above a critical temperature and being of such electrical resistance as to become heated above said temperature solely by current flowing therethrough when said current exceeds a predetermined value, a magnet disposed to attract the central strip only and hold said arm in the closed circuit position, and resilient means normally urging said arm toward the open circuit position whereby the arm moves to the latter position when said central strip becomes non-magnetic as the result of excessive current flowing there-through.

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5. In a circuit breaker, a contact arm adapted to constitute a part of the circuit to be interrupted, and movable between an open circuit and a closed circuit position, said arm having two spaced end pieces joined together by a plurality of strips connected in parallel between said end pieces, said strips being composed of a magnetic alloy which becomes non-magnetic when heated above a critical temperature and having such a combined electrical resistance as to become heated above said temperature solely by the passage of current therethrough when said current exceeds a value proportionate to the overload current for the circuit, a magnet disposed to attract said strip, and hold the arm in the closed circuit position, a conductive frame member connecting said end pieces and by-passing said strips, said frame member being spaced from said magnet so as not to be appreciably attracted thereby, and resilient means normally urging said arm toward the open circuit position, whereby said arm moves to the latter position when said strips become non-magnetic as the result of excessive current flowing therethrough.

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