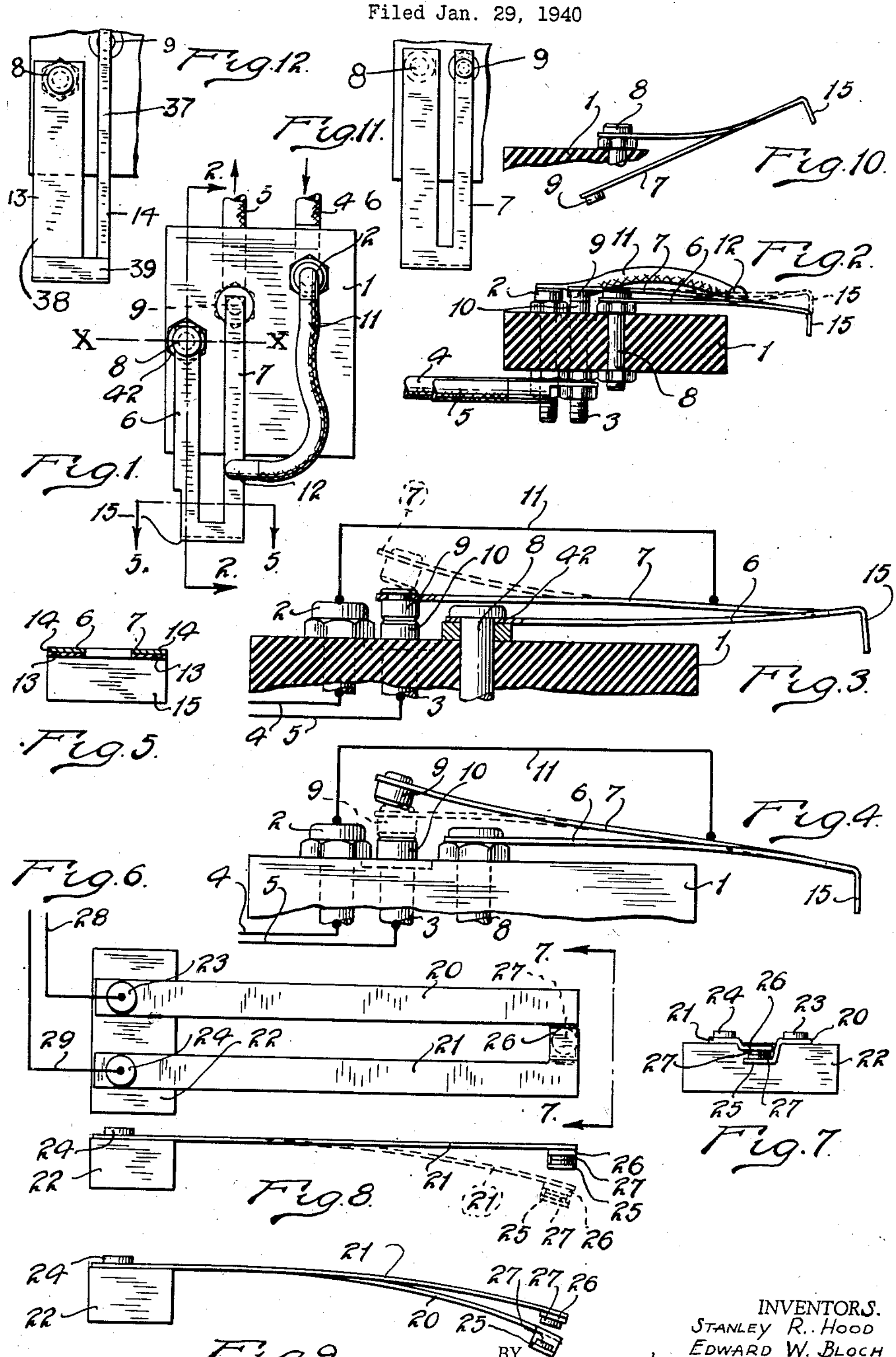
Dec. 23, 1941.

S. R. HOOD ET AL

2,267,463

ELECTRICAL CIRCUIT BREAKER

Filed Jan. 29, 1940



INVENTORS.
STANLEY R. HOOD
EDWARD W. BLOCH

BY Barnes, Kisselle, Laughlin & Raisch
ATTORNEYS.

Patented Dec. 23, 1941 2,267,463

UNITED STATES PATENT OFFICE

2,267,463

ELECTRICAL CIRCUIT BREAKER

Stanley R. Hood and Edward W. Bloch, Detroit, Mich., assignors to W. M. Chace Company, Detroit, Mich., a corporation of Michigan

Application January 29, 1940, Serial No. 316,166

3 Claims. (Cl. 200—113)

This invention relates to an electrical circuit breaker and more particularly to an ambient temperature compensated circuit breaker.

It is old to fabricate an electrical circuit breaker from laminated thermostatic metals such as bimetal or trimetal, having predetermined amperage ratings, that is to say, the circuit breaker is designed to carry a given amperage, any excess amperage or overload due to internal resistance heating causing the circuit breaker to react and break the circuit. Such laminated thermostatic metal circuit breakers must be operative over a wide range of atmospheric temperatures, for example, a circuit breaker positioned beneath the engine hood of an automobile. In such case temperatures from 40° below zero F. to 250° above zero F. are encountered. Thus the problem arises of producing a circuit breaker having a given amperage rating which will open and break the circuit upon the passage therethrough of a given amperage regardless of the atmospheric temperature conditions under which the circuit breaker is operating. In a bimetal circuit breaker, for example, the high and low sides expand on a rise in temperature and contract upon a fall in temperature. Thus, unless such a circuit breaker is compensated for ambient temperatures, the circuit breaker would tend to break the circuit at one amperage at low temperatures and at a lower amperage for elevated temperatures.

Since electrical resistance increases as the temperature increases and falls as the temperature falls, the electrical resistivity of any given circuit breaker would vary with the atmospheric temperature conditions under which it is operating. Thus, a circuit breaker calculated to open upon the passage therethrough of 10 amperes at room temperature, unless properly compensated, would break the circuit upon the passage of less than 10 amperes as the atmospheric temperature rose.

It is an object of this invention to produce a circuit breaker which is compensated for variations in the resistivity due to temperature changes so that it will operate to break the circuit at a given amperage irrespective of the atmospheric temperature or the thermal conductivity changes under which it is operating.

In the drawing:

Fig. 1 is a plan view of the principal form of circuit breaker.

Fig. 2 is a section along the line 2—2 of Fig. 1 showing the circuit breaker closed, with a dotted line showing of the position of the arm due to a rise in atmospheric temperature.

Fig. 3 is a vertical section similar to Fig. 2 with a dotted line showing of the position of the circuit breaker arm when the circuit is broken due to the passage of an overload or excess amperage through the circuit breaker.

Fig. 4 is a side elevational view similar to Fig. 3 showing the position of the circuit breaker arm at a lower atmospheric temperature than that shown in Fig. 3 with the circuit broken in full lines and made in dotted lines.

Fig. 5 is an enlarged section along the line 5—5 of Fig. 1.

Fig. 6 is a plan view of a modified form of circuit breaker.

Fig. 7 is an end view along the line 7—7 of Fig. 6.

Fig. 8 is a side elevation of the circuit breaker with full line and dotted line showings of the position of the circuit breaker arms at different temperatures, the circuit being made in each instance.

Fig. 9 is a full line showing similar to the dotted line showing of Fig. 8 except that the circuit is broken.

Fig. 10 is a schematic showing of the action of the breaker legs incident to a rise in temperature.

Fig. 11 is a plan view of the circuit breaker showing the compensating and resistance legs of equal length.

Fig. 12 is a modified form of circuit breaker with the direction of deflection of the compensating leg reversed from that shown in the principal form of the invention.

Referring more particularly to the drawings the circuit breaker comprises a base 1 of insulating material provided with posts 2 and 3 to which the electrical leads or wires 4 and 5 are connected in electrically conducting relation. A bimetal circuit breaker arm of hairpin form comprising ambient leg 6 and resistance leg 7 is mounted on post 8 by securing the end of leg 6 to post 8. Post 8 is mounted on the insulating base 1. The resistance leg 7 carries an electrically conducting contact point 9 arranged to make contact with contact point 10 carried by post 3. An electrically conducting lead 11 is fixed at one end to resistance leg 7 as at 12 and at the other end to post 2. As shown in Fig. 5, the circuit breaker arm is preferably stamped from an integral piece of bimetal comprising a high expanding lamina 13 and a low expanding lamina 14. The legs 6 and 7 are connected by cross piece 15 which acts in the nature of a cooling fin and dissipates heat conducted from the resistance portion of leg 7, that is, the portion of leg 7 between connection 12 and post 3.

Since the circuit breaker leg 6, 7 will respond to changes in temperature, it is essential to compensate for this so that the circuit breaker will break at any temperature upon the passage of any given amperage through resistance leg 7. To this end it is proposed to make legs 6 and 7 of different lengths. Where it is desired to have the circuit breaker break the circuit at any given amperage, say, 10 amperes at temperatures ranging from 40° below zero to 250° F. above zero, it is essential that the leg 6 be longer than the leg 7. If it is desired to have the circuit breaker break the circuit upon the passage of, say, 20 amperes through leg 7 at, say, 0° F., and at 10 amperes at 100° F., then leg 6 is made shorter than leg 7. If reduction in amperage is not sufficient, then direction of deflection of leg 6 is reversed and length increased until the desired drop in amperage required to break the circuit occurs.

By way of description rather than limitation, leg 7 is shown longer than leg 6 and thus the circuit breaker will open at the same current or overload regardless of the atmospheric temperature within the range of temperature at which the circuit breaker is designed to operate.

The ambient leg 6 mounted on post 8 controls the pressure with which contact 9 bears upon contact 10 because upon a rise or fall of temperature the circuit breaker leg 6 bends or flexes about post 8 as an axis which is designated X—X, Fig. 1. As the change in temperature flexes leg 6, the flexing of leg 6 causes leg 7 to swing with and about cross piece 15 as an axis. In Fig. 2 the circuit breaker legs 6 and 7 are shown in the full lines in the position they assume, say, at 0° F. Leg 7, of course, at all temperatures is under stress so that the contact 9 presses against contact 10 except when an overload or over amperage is passing through the circuit. As the atmospheric temperature rises, say, to room temperature, the high expanding lamina 13, being on the underside of the breaker leg 6, and the low expanding lamina 14, being on the upper side of leg 6, causes the leg 6 to bend upwardly about post 8 to the position shown in Fig. 3, full lines, or the dotted line position, Fig. 2. This swings leg 7 downwardly about cross piece 15 as a center thus tending to increase the pressure of contact 9 on contact 10. In other words, as leg 6 curves upwardly, leg 7 remains approximately tangent to this curve at the point at which it contacts the curve, namely, the cross piece 15. This position is illustrated diagrammatically in Fig. 10. However, leg 7 would only take the position under these conditions illustrated in Fig. 10 provided it were not made of laminated thermostatic metal. However, since leg 7 consists of the same thermostatic bimetal as leg 6 with the high expanding side down, the rise in temperature simultaneously causes leg 7 to bend or flex upwardly about its support, namely, cross piece 15. This upward bending of leg 7 counteracts or compensates for the downward swinging of leg 7 either with or about cross piece 15 so that legs 6 and 7 maintain their same positions one relative to the other regardless of atmospheric temperature change. Thus, when legs 6 and 7 are of equal length and contacts 9 and 10 are positioned on axis X (as shown in Fig. 11), the contact pressure remains the same at all temperatures.

However, since upon an increase in temperature, the electrical resistivity of leg 7 increases and therefore its rate of heating increases, it is essential to compensate for this. To this end leg 7 is extended beyond axis X—X as shown. As the leg 6 bends upwardly, Fig. 3, contact 9 tends to swing downwardly about axis X. However, this downward movement of contact 9 is resisted by contact 10 so that the net result is that as leg 6 swings upwardly about post 8 the pressure of contact 9 on contact 10 is increased. The distance that leg 7 extends to the left of post 8, Fig. 3, will depend on the length of leg 6 and the contact pressure between contacts 9 and 10 desired at any given temperature.

When the circuit is closed as current flows through lead 11, leg 7, and lead 5, the temperature of leg 7 rises due to internal resistance and it tends to swing upwardly to the dotted line position, Fig. 3, about cross member 15 as an axis. At an atmospheric temperature of 0° F. a greater quantity of heat must be created in resistance leg 7 to break the circuit than where the atmospheric temperature is, say 100° F. Further, the electrical resistivity of leg 7 at 0° F. is less than at 100° F. so that the same amount of current passing through leg 7 at 0° F. will generate less heat than the same amount of current passing through at 100° F. For this reason at 0° F. contact pressure between contacts 9 and 10 should be less than at 100° F. To put it another way, at 0° F. leg 7 should be under less stress than at 100° F. This exact condition is achieved by arranging leg 7 so that it is longer than leg 6 and projects beyond axis X. Thus, as shown in Fig. 2, full lines and in dotted lines Fig. 4, leg 7 is under less stress at 0° F. than at 100° F., Fig. 3, and the contact pressure is correspondingly less so that the same amperage flowing through resistance leg 7 at 0° F. or at 100° F., for example, will break the circuit by causing the leg 7 to swing upwardly to the dotted line position, Fig. 3, full line position, Fig. 4.

In Figs. 6 through 9 a modified form of circuit breaker is shown comprising legs 20 and 21 which are anchored to insulating base 22 by screws 23, 24. The legs 20 and 21 are made from laminated thermostatic metal, such as bimetal, positioned on block 22 so that the high expanding side is on top. Thus upon a rise in temperature the legs bend downwardly from block 22 as shown in Fig. 9. Leg 20 is made from a bimetal having a relatively higher coefficient of electrical resistivity than leg 21. Thus leg 20 acts as the resistance leg. Preferably leg 21 is a sufficiently good conductor that it will conduct more amperage than the amperage rating of the breaker without an increase in temperature due to internal electrical resistance. The outer end of leg 20 is offset as at 25 and overlies offset 26 in leg 21. Offsets 25 and 26 carry contact points 27. The bimetal legs 20 and 21 are made from thermostatic bimetal having substantially the same temperature coefficients of deflection. Thus at 0° F., for example, the legs 21 will take the position shown in the full lines, Fig. 8, with contacts 27 engaged and the circuit completed through lines 28, leg 20, contacts 27, leg 21, line 29. Upon a rise of atmospheric temperature, say, 100° F., both legs 21 will bend downwardly at the same rate about block 22 as an axis or anchor to the dotted line position shown in Fig. 8, and the circuit will remain made. However, as soon as the calculated amperage or overload passes through the circuit leg 20, due to its higher electrical resistivity, it will heat faster than leg 21 and thus deflect at a greater rate than leg 21, thus causing contacts 27 to separate and break the circuit. As soon as the circuit is broken, leg 20 upon cooling tends to straighten or return to its initial pre-overload position and again make the circuit. Thus leg 20 acts as a resistance leg and leg 21 as an ambient temperature compensating leg.

If it is desired to have the circuit breaker break the circuit at a relatively high amperage at a low temperature and at a relatively much lower amperage at a relatively higher temperature, this can be accomplished by the modified form shown in Fig. 12. As shown in Fig. 12, the resistance leg 37 is fabricated the same as in the principal form of the invention, that is, with the high expanding lamina on the bottom and the low expanding lamina on the top, but the ambient temperature compensating leg 38 has the position of the high and low expanding lamina reversed, that is, the high expanding lamina 13 is positioned on top and the low expanding lamina 14 on the bottom. Thus as the temperature rises, the leg 38 will bend or flex downwardly about post 8 just the opposite from leg 6, as illustrated in Fig. 3. As leg 38 bends downwardly upon a rise in temperature, leg 37 will be swung upwardly about cross piece 39 to decrease the contact pressure so that at elevated temperatures a lower amperage will be required to break the contact. Upon a rise of temperature due to electrical resistance of leg 37 and upon a rise in atmospheric temperature, this leg will flex or bend upwardly about cross bar 39 the same as leg 7.

As is evident from the above, the contact pressure determines the temperature rise necessary to break the circuit. Thus by varying the contact pressure one varies the temperature rise necessary to break the circuit which is the equivalent to changing the amperage rating of the circuit breaker. By varying the relative lengths of the compensating and resistance legs, the circuit breaker will break the circuit at different amperages at different temperatures or at the same amperage at different temperatures, as desired.

We claim:

1. An electrical circuit breaker comprising in combination an integral piece of laminated thermostatic metal in the form of a hairpin comprising a pair of legs and an interconnecting cross member, one of said legs acting principally as an electrical resistor and the other leg acting principally as an ambient temperature compensating leg, support means for supporting the hairpin shaped member at the end of the ambient temperature compensating leg, a pair of electrical contacts in electrical circuit with the resistor leg, one of said contacts being carried by the resistor leg at the free end of said resistor leg and movable relatively away from the other contact to break the circuit whenever an over amperage passes through said resistor leg, each of said breaker legs responding to change in atmospheric temperature whereby the flexing or bending of the ambient leg compensates for the flexing or bending of the resistor leg to determine the amperage necessary to break the circuit.

2. An electrical circuit breaker comprising in combination a U-shaped member having its two legs in the form of flat strips of laminated thermostatic metal, one of said legs acting principally as an electrical resistor and the other leg acting principally as an ambient temperature compensating leg, support means for supporting the U-shaped member at the end of the ambient temperature compensating leg, the said legs being positioned side by side with the flat side of each leg facing the support and an edge of one leg facing and spaced from an edge of the other leg whereby the ambient temperature compensating leg is practically unaffected by the radiant heat from the resistance leg, a pair of electrical contacts in electrical circuit with the resistor leg, one of said contacts being carried by the resistor leg at the free end of said resistor leg and movable relatively away from the other contact to break the circuit whenever an over amperage passes through said resistor leg, each of said breaker legs responding to change in atmospheric temperature whereby the flexing or bending of the ambient leg compensates for the flexing or bending of the resistor leg to determine the amperage necessary to break the circuit.

3. An electrical circuit breaker comprising in combination a U-shaped member with two legs in the form of flat strips of laminated thermostatic metal, and an interconnecting cross member, one of said legs acting principally as an electrical resistor and the other leg acting principally as an ambient temperature compensating leg, support means for supporting the U-shaped member at the end of the ambient temperature compensating leg, the said legs being positioned side by side with the flat side of each leg facing the support and an edge of one leg facing and spaced from an edge of the other leg whereby the ambient temperature compensating leg is practically unaffected by the radiant heat from the resistance leg, a pair of electrical contacts in electrical circuit with the resistor leg, one of said contacts being carried by the resistor leg at the free end of said resistor leg and movable relatively away from the other contact to break the circuit whenever an over amperage passes through said resistor leg, each of said breaker legs responding to change in atmospheric temperature whereby the flexing or bending of the ambient leg compensates for the flexing or bending of the resistor leg to determine the amperage necessary to break the circuit, said interconnecting cross member having a depending flange approximately perpendicular to said legs for preventing said U-shaped element from curving transversely and for radiating heat from the resistor leg thereby preventing conduction of said heat to the ambient leg.

STANLEY R. HOOD.
EDWARD W. BLOCH.