Oct. 28, 1947. J. B. WHITTED ET AL 2,429,784

CIRCUIT BREAKER

Filed Nov. 29, 1944 2 Sheets-Sheet 1

Fig. 1

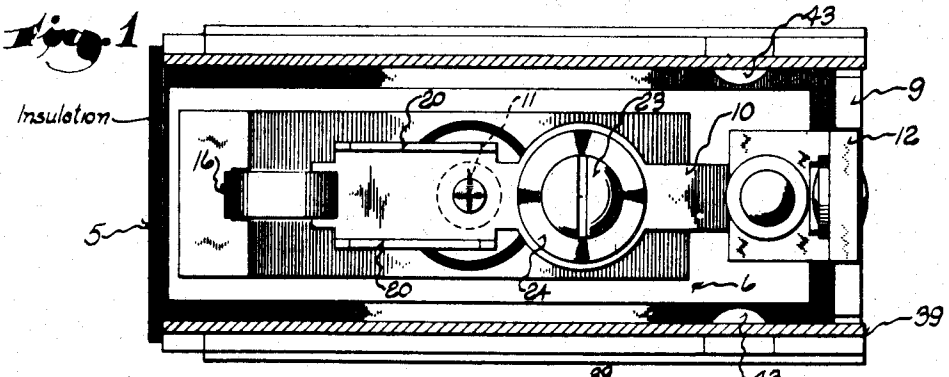


Fig. 2

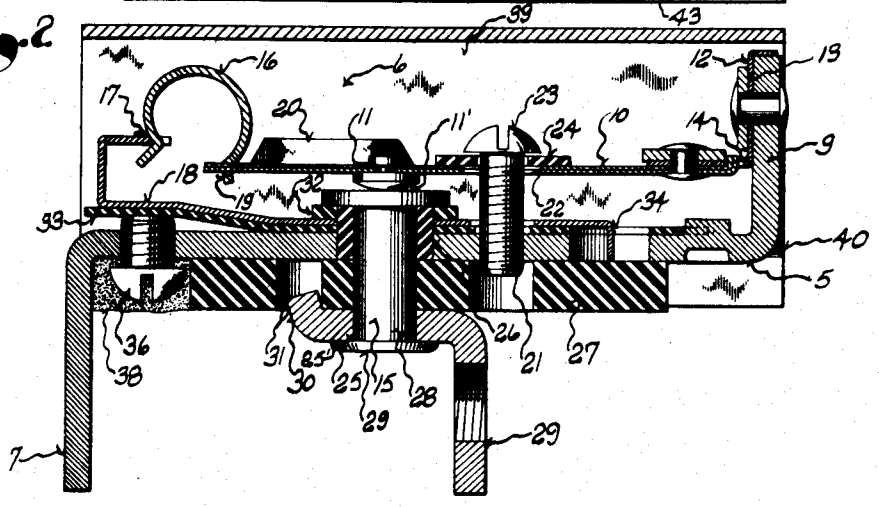
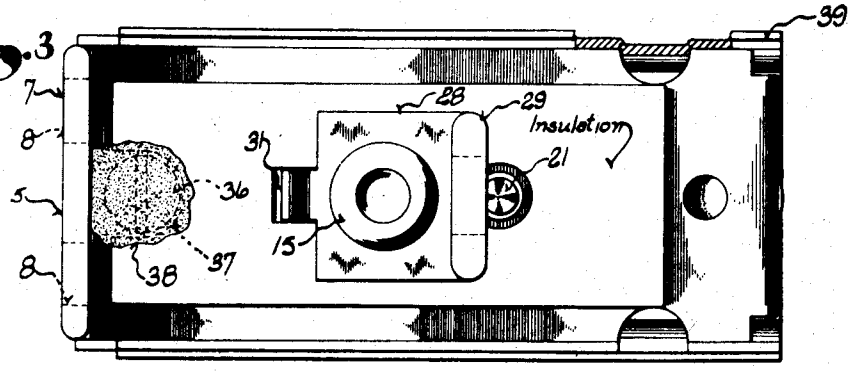


Fig. 3



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Oct. 28, 1947. J. B. WHITTED ET AL 2,429,784

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Filed Nov. 29, 1944 2 Sheets-Sheet 2

Fig. 4

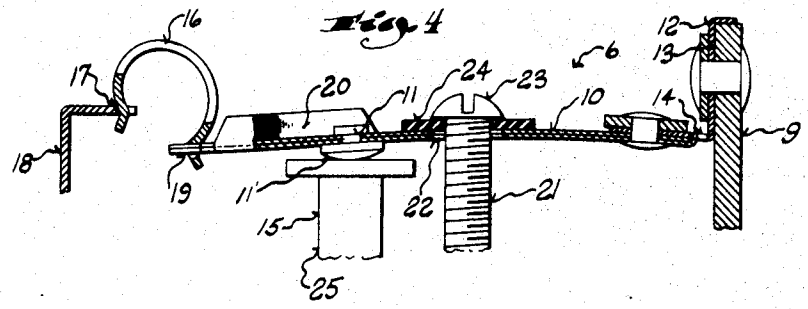


Fig. 5

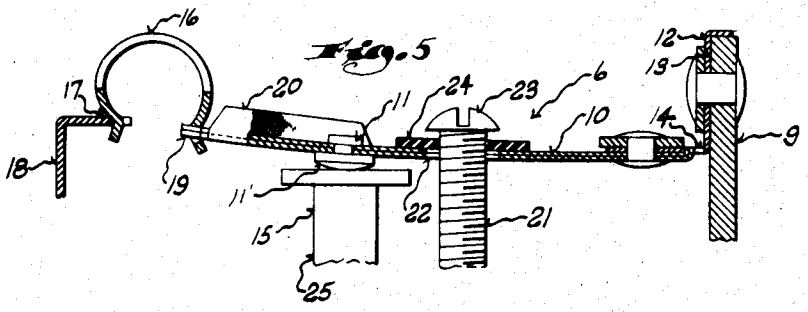


Fig. 6

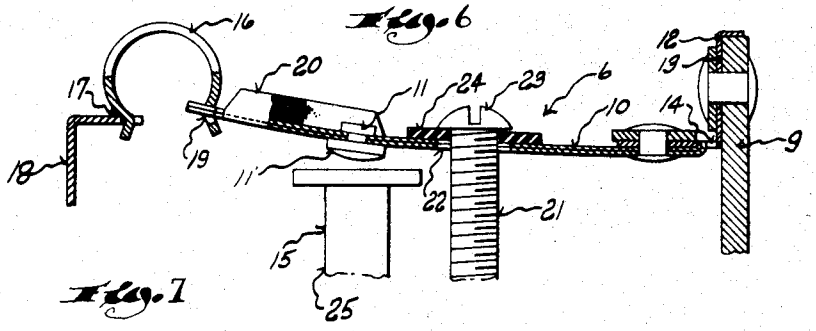
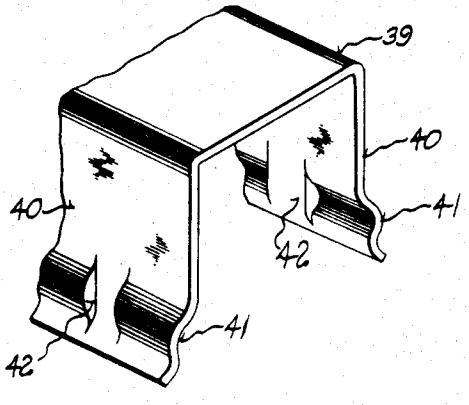


Fig. 7



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Patented Oct. 28, 1947

2,429,784

UNITED STATES PATENT OFFICE

2,429,784

CIRCUIT BREAKER

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Application November 29, 1944, Serial No. 565,597

8 Claims. (Cl. 200—138)

1

The invention relates to circuit breakers and has particular reference to circuit breakers of the thermally responsive type wherein separation of the contacts to interrupt the circuit to an electric motor or the like is effected by means of a bimetallic element through which current normally flows.

In the event of overload, the bimetallic element becomes heated by the increased current flow therethrough and flexes to open the switch and interrupt the circuit for a period of time sufficient to enable the bimetal to cool whereupon the bimetal effects re-engagement of the switch contacts.

Considerable difficulty has been experienced in the past with circuit breakers of this type inasmuch as flexure of the bimetal in response to heating thereof is inherently slow and consequently causes a slow break of the contacts. This results in objectionable arcing and burning or pitting of the contacts follows.

One of the objects of the present invention, therefore, resides in the provision of a circuit breaker of the character described wherein the contacts of the switch are engaged and disengaged rapidly with a snap action to minimize arcing.

More specifically, it is an object of this invention to provide a circuit breaker of the character described wherein the bimetallic element is actuated by a novel toggle spring arrangement to not only insure the desirable quick make and break of the contacts, but to obtain compactness, simplicity of design, and low cost.

With the above and other objects in view which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described, and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claims.

The accompanying drawings illustrate one complete example of the physical embodiment of the invention constructed in accordance with the best modes so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a top view of the circuit breaker with its cover in section to illustrate the switch arrangement;

Figure 2 is a longitudinal cross sectional view through the circuit breaker;

Figure 3 is a bottom view of the circuit breaker;

Figures 4, 5, and 6 are more or less diagrammatic views in which the conditions existing at different stages of flexure of the bimetallic element during overload are greatly exaggerated to illustrate the action of the switch during opening; and

2

Figure 7 is a fragmentary perspective view of the cover of the circuit breaker.

Referring now more particularly to the accompanying drawings in which like numerals indicate like parts, the numeral 5 designates the base of the circuit breaker upon which the switch, generally indicated by the numeral 6 is mounted. For convenience, it may be assumed that the switch is mounted on the top side of the base.

The base 5 is provided by a relatively flat piece of bar or wire stock and has one end 7 bent downwardly at right angles therefrom and provided with holes 8 to afford means for attaching the device to a stationary support such as the metal frame structure (not shown) of an automobile, where the circuit breaker of this invention is ideally suited for the prevention of overload on an electric wind shield wiper motor or similar low voltage electrical appliance. When so used, the circuit breaker is adapted to be connected serially in the circuit in the customary manner, and the attaching lug 7 upon securement to a metal portion of the vehicle frame provides for conveniently connecting one of the switch contacts to ground.

The opposite end of the base 5 is bent upwardly substantially at right angles thereto to provide a support 9 for a bimetallic element 10 upon which the movable contact 11 of the switch is mounted.

As clearly shown in Figure 2, the bimetallic element 10 overlies the top of the base and is secured to the support 9 by means of a substantially right angular connector 12, one leg 13 of which is riveted to the support 9 while the other leg 14 is riveted or otherwise secured to the bimetallic element 10.

This connector is formed of spring stock and its legs 13 and 14 normally form an angle of less than 90°. Hence, as shown in exaggerated form in Figure 4, the connector tends to lift the bimetal away from the base and cause separation of the movable contact 11 from the stationary contact 15.

This biasing force applied to the bimetallic element 10 by the connector 12 is normally overcome by means of a toggle spring 16 which holds the stationary and movable contacts engaged under pressure. The toggle spring is fulcrumed as at 17 from the bent up free end portion of a resilient strip of metal 18 mounted on the base

at its top side in a manner to be hereinafter more fully described.

The toggle spring 16 acts on the free end of the bimetallic element 10 with which it has an interlocking connection 19 maintained operable by the expansive force of the toggle spring. The spring is thus connected with the bimetal in a more or less positive manner both during switch opening and closing motions of the bimetal.

Flanges 20 bent up from opposite sides of the bimetallic element 10 adjacent to the movable contact and at the free end of the bimetallic element provide for stiffening the same to prevent its flexure in response to pressure of the toggle spring and confine flexure of the bimetallic element to that area thereof lying between the flanges and the leg 14 of the connector 12.

Attention is directed to the fact that by reason of the action of the connector 12, the toggle spring 16 and a convex surface 11' on the movable contact 11, that flexure of the bimetal in response to heat results in a rocking action of the contacts as clearly shown in Figures 4 and 5; and that actual separation of the contacts is effected with a snap action upon flexure of the bimetal past a critical position representing dead center of the toggle.

Hence, there is no arcing at the time of separation or engagement of the contacts, and maximum contact pressure is assured for the full period of flexure of the bimetallic element up until the time the toggle spring 16 becomes effective to snap the contacts open.

A screw 21 threaded into the base 5, and projecting through a hole 22 in the bimetallic element has its head 23 disposed above the element to act as a stop limiting flexure of the element in response to heating thereof. An insulating washer 24, however, is interposed between the head of the screw and the bimetallic element to minimize heat transfer therebetween which would tend to hasten cooling of the element after switch opening.

As will be apparent, the screw adjustably limits flexure of the bimetallic element so as to enable regulation of the period for cooling of the bimetallic element and reclosure of the switch. If the head of the screw is substantially close to the bimetallic element to limit flexure thereof to a minimum, resetting of the switch takes place in a relatively short period of time while if the screw is backed out to provide a larger space between its head and the bimetallic element a correspondingly increased length of time will be required for resetting of the switch.

The stationary contact 15 is, of course, mounted on the base in insulated relationship therewith in the customary manner. In the present instance this is effected by having the shank 25 of the stationary contact project through a bushing 26 of insulating material received in a suitable hole in the base, and through aligned holes in a terminal insulator 27 and terminal 28 which in turn are secured to the base by riveting over the shank 25 as at 25'.

The terminal 28 is substantially right angularly shaped so as to have a depending lug 29 parallel to the attaching lug 7 and likewise exposed at the bottom of the base. The terminal is securely held against rotative movement about the axis of the stationary contact by means of a lug 30 bent from the terminal and directed into a suitable hole 31 formed in the terminal insulator 27.

It will also be noted that the terminal insulator 27 is provided with a hole 31' in line with the adjusting screw 21 of larger diameter than the screw to enable proper adjusting motion of the screw.

The spring strip 18 which provides a fulcrum for the toggle spring is likewise secured to the base 5 by the stationary contact 15. This is effected by having the stationary contact clamp the spring strip 18 between an insulating washer 32 directly under the contact portion of the stationary contact and an insulating strip 33 overlying the top surface of the base, it being understood that the spring strip 18 is suitably apertured to receive the insulating bushing 26 as shown.

Rotative movement of the spring strip about the axis of the stationary contact is effectively precluded by engagement of a lug 34 bent downwardly from the inner end of the spring strip into an aperture 35 in the base.

The elevation of the fulcrum 17 on the outer free edge of the spring strip with respect to the point of attachment of the bimetal 10 to its support 9 determines the extent of flexure of the bimetallic element before the same reaches its critical position representing dead center of the toggle.

Hence, by raising or lowering the fulcrum 17 with respect to the attached end of the bimetallic element the time interval over which flexure of the bimetallic element in response to excessive current flow therethrough effects switch opening or switch closing may be regulated. This is accomplished in the present instance by an adjusting screw 36 threaded into the base from its underside and having its end bearing against the insulating strip 33 and consequently the spring strip 18.

When this screw is turned upwardly into the base the fulcrum is correspondingly elevated and a longer period of flexure of the bimetallic element required for switch opening. Conversely, if the screw is backed out of the base to cause lowering of the fulcrum by the tendency of the spring strip 18 to assume parallel relationship with the base a shorter period of flexure of the bimetallic element is required to effect switch opening.

This adjustment of the fulcrum is extremely important in that it determines the amount of excess current necessary to heat up the bimetal and cause flexure thereof past its critical position and consequently switch opening. Because of this fact, the terminal insulator 27 is preferably extended forwardly toward the mounting lug 7 and has a slot 37 cut therein to embrace the head of the adjusting screw 36. Sealing wax 38 or other suitable sealing material is filled into the slot over the head of the screw after its adjustment at the factory to discourage unauthorized tampering therewith.

The switch structure 6, which it should be noted is jointly carried by the base 5 and its upstanding portion 9, is conveniently enclosed by means of a substantially U-shaped cover 39 extending for the full length of the base 5 between its ends 7 and 9. The walls 40 of the cover have longitudinal grooves 41 formed in their extremities to receive the side edges of the base 5 and by which the cover is detachably held assembled on the base. The side walls of the cover are spaced so as to require the same to be snapped over the side edges of the base and its accidental detachment by motion thereof parallel to the base is prevented by means of indents 42 struck inwardly from the sides of the groove 41 to engage

in notches 43 cut into the side edges of the base.

It is important to note that the open ended cover cooperates with the support 9 of the base and the supporting frame (not shown) to which the device is attached to completely enclose the switch structure.

From the foregoing description taken in connection with the accompanying drawings, it will be readily apparent that the circuit breaker of this invention provides highly desirable switch action and that the novel manner of tensioning the bimetallic element results in a simple low cost but extremely efficient and compact design.

What we claim as our invention is:

1. In a circuit breaker of the character described: a substantially flat base having one end portion bent downwardly therefrom to provide for attachment of the device to a stationary support and having an upstanding portion at its opposite end; a substantially U-shaped readily detachable cover for the device open at its ends and having the extremities of its side walls shaped for interengagement with the side edges of the base and tensioned to clamp the same with a spring force, said cover having its bottom spaced a distance above the top of the base; and thermally responsive switch mechanism carried by the base inside the cover, said cover cooperating with the upstanding portion of the base and a support upon which the device is mounted to completely enclose the switch mechanism.

2. In a circuit breaker of the character described: a substantially flat metal base having one end portion bent downwardly therefrom to provide for attachment of the device to a grounded stationary support and having an upstanding portion bent therefrom at its opposite end; a substantially U-shaped readily detachable cover for the device open at its ends and having the extremities of its side walls shaped for interengagement with the side edges of the base and tensioned to clamp the same with a spring force, said cover having its bottom spaced a distance above the top of the base; thermally responsive switch mechanism carried jointly by the base at its top side thereof and the upstanding portion of the base whereby the cover cooperates with said upstanding portion and a support upon which the device is mounted to completely enclose the switch mechanism; and a terminal exposed on the under side of the base and electrically connected with one of the contacts of the switch mechanism.

3. In a circuit breaker of the character described: a base provided by a relatively flat strip of metal having one end bent downwardly to provide an attaching lug for mounting the device on a stationary supporting surface and having its opposite end bent upwardly; a thermally responsive switch carried by the base at the top side thereof; a terminal on the base at the side thereof opposite the switch electrically insulated from the base, but electrically connected with one of the switch contacts; a substantially U-shaped cover for the switch having the extremities of its side walls provided with longitudinal grooves to receive the side edges of the base, said cover extending the entire distance of the base between the downwardly and upwardly bent portions of the base and cooperating with said upwardly bent portion and a support to which the device is attached to completely enclose the switch; and interengaging means on the base and cover for preventing relative movement between the cover and base lengthwise of the base, said means permitting ready detachment of the cover from the base upon spreading of the side walls of the cover to disengage the side edges of the base from the grooves in the side walls of the cover.

4. In a circuit breaker of the character described: a metallic base adapted to act as a ground terminal; a hot terminal; an insulating terminal head overlying one side of the base and positioned between the hot terminal and the base; a rivet-like stationary contact passing through aligned apertures in the base, terminal, and terminal head but insulated from the base to secure said parts together with the terminal electrically connected therewith; a bimetallic thermally responsive element carried by the base at its opposite side having a movable contact cooperating with the stationary contact to provide a switch structure; an adjustable resetting screw threaded into the base to one side of the stationary contact and engaged by the bimetallic element to limit flexure thereof; a toggle spring for causing switch opening and closing motion with a snap action; a fulcrum for the toggle spring; and means for adjusting the fulcrum including a screw threaded into the base at the side of the stationary contact opposite said reset screw and having its head disposed on the terminal head side of the base; said terminal head having a recess therein to receive the head of the adjusting screw to be held thereby against rotative movement about the axis of said rivet-like stationary contact; and said terminal head having another recess therein automatically aligned with said reset screw by the engagement of the head of said adjusting screw in the first named recess to enable adjustment of said reset screw without interference from the terminal head.

5. In a circuit breaker of the character described: cooperating stationary and movable contacts one of which has a convex surface engaged by the other of said contacts; a bimetallic element upon which the movable contact is mounted; means for attaching one end of the bimetallic element remote from the movable contact to a stationary support so that its movable contact is positioned in cooperating relationship with the stationary contact and so that flexure of the bimetallic element in response to heat causes separation of the contacts, said means including a yieldable spring connector for biasing the entire bimetallic element in a direction tending to cause separation of the contacts; a spring acting on the free end of the bimetallic element in opposition to said spring connector and with a toggle action to maintain the contacts engaged under pressure but operable to quickly snap the bimetallic element and the movable contact carried thereby away from the stationary contact after flexure of the bimetallic element past a critical position representing dead center of the toggle, said spring causing the movable contact to rock on the stationary contact during flexure of the bimetallic element toward its critical position; and means on the bimetallic element adjacent to said movable contact for stigening and preventing flexure of the free end of the bimetallic element.

6. In a circuit breaker of the character described: cooperating stationary and movable contacts one of which has a convex surface engaged by the other of said contacts to permit rocking of one upon the other; a bimetallic element upon

which the movable contact is mounted; means for attaching one end of the bimetallic element remote from the movable contact to a stationary support so that flexure of the bimetallic element in response to heat causes separation of the contacts; means adjacent to the attached end of the bimetallic element at all times biasing the same away from the stationary contact; and a spring engaging the free end of the bimetallic element with a toggle action to maintain the contacts engaged under pressure and the portion of the bimetallic element outwardly of its support tilted in one direction about a fulcrum defined by the point of engagement between the contacts, said spring cooperating with said biasing means to quickly snap the bimetallic element and the movable contact carried thereby away from the stationary contact after flexure of the bimetallic element to tilt said portion thereof in the opposite direction about the fulcrum defined by said contacts past a critical position representing dead center of the toggle, the combined action of the biasing means and said spring causing the movable contact to rock on the stationary contact with a progressive motion throughout the entire period of flexure of the bimetallic element toward said critical position.

7. In a circuit breaker of the character described: cooperating stationary and movable contacts one of which has a convex surface engaged by the other of said contacts; a bimetallic element upon which the movable contact is mounted; means for attaching one end of the bimetallic element remote from the movable contact to a stationary support so that flexure of the bimetallic element in response to heat causes separation of the contacts; means adjacent to the attached end of the bimetallic element for biasing the same away from the stationary contact; a spring engaging the free end of the bimetallic element with a toggle action to maintain the contacts engaged under pressure in opposition to said biasing means but cooperating with said biasing means to hold the bimetallic element bowed in one direction with respect to the stationary contact and to quickly snap the bimetallic element and the movable contact carried thereby away from the stationary contact after flexure of the bimetallic element toward an oppositely bowed condition and past a critical position representing dead center of the toggle, such flexure of the bimetallic element toward said oppositely bowed condition causing relative rocking motion between the contacts up until separation thereof; and means on the bimetallic element adjacent to said movable contact for stiffening and preventing flexure of the free end of the bimetallic element so that all bowing thereof takes place between said stiffening means and the point of attachment of the bimetallic element to the stationary support.

8. In a circuit breaker of the character described: a metallic base; a stationary contact on the base electrically insulated therefrom; a bimetallic element; a movable contact carried by the bimetallic element adjacent to one end thereof; means for attaching the opposite end of the bimetallic element to the base with its movable contact in cooperating relationship with the stationary contact including a spring element acting on the bimetallic element to yieldingly urge the same away from the stationary contact and induce separation of the contacts; a spring acting on the free end of the bimetallic element with a toggle action to hold the bimetallic element bowed in one direction with respect to the stationary contact and to maintain the contacts engaged under pressure in opposition to said spring element to thereby establish a path for an electric circuit leading from the base through the bimetallic element and stationary contact so that an increase in current flow in said circuit in excess of a predetermined maximum effects flexure of the bimetallic element toward an opposite bowed condition past a critical position representing dead center of the toggle and at which said springs cooperate to quickly snap the bimetallic element and the movable contact carried thereby away from the stationary contact, flexure of the bimetallic element in such a manner causing rocking of the movable contact on the stationary contact; and stiffening means on the bimetallic element adjacent to the movable contact for preventing flexure of the free end of the bimetallic element and for confining flexure of the element to that portion thereof lying between said stiffening and attaching means.

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