

May 9, 1939.

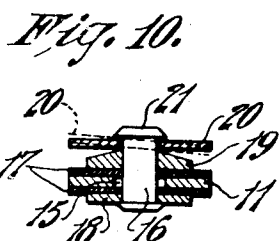
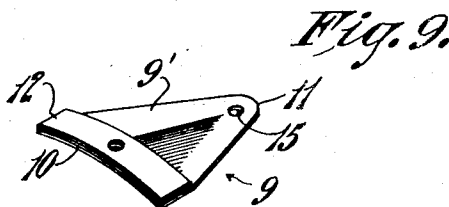
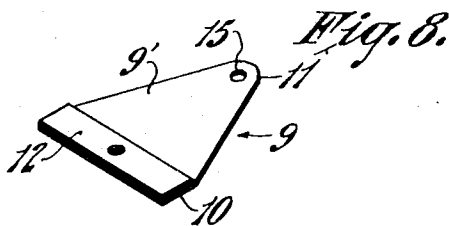
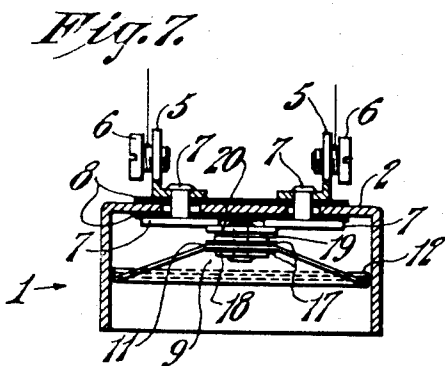
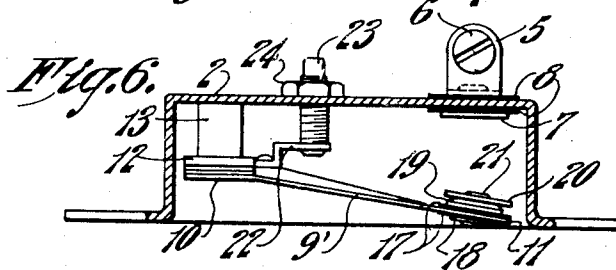
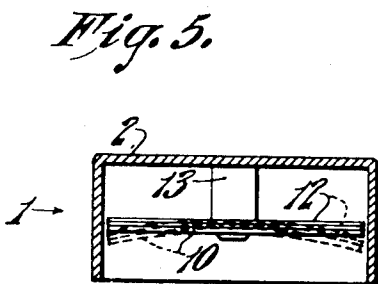
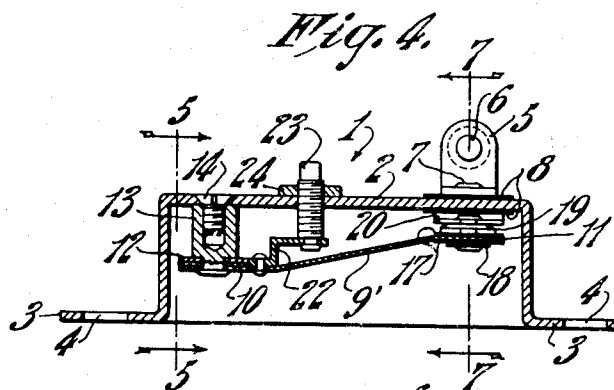
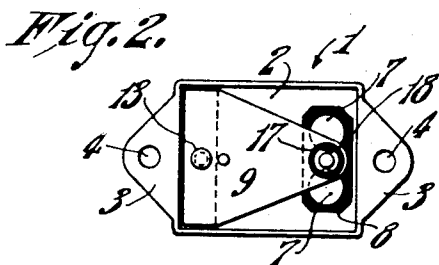
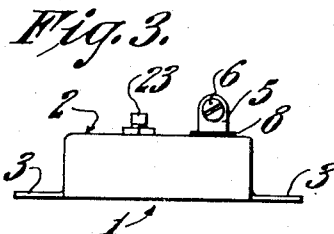
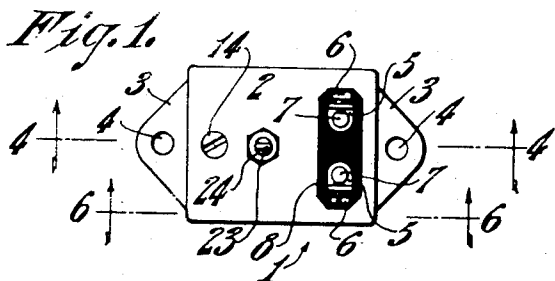
F. J. NEECE

2,157,560

THERMALLY-ACTUATED CIRCUIT BREAKER

Filed Aug. 9, 1937

2 Sheets-Sheet 1



BY

INVENTOR,
Frank J. Neece,
BY *Blake Weaver,*
ATTORNEY.

May 9, 1939.

F. J. NEECE

2,157,560

THERMALLY-ACTUATED CIRCUIT BREAKER

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2 Sheets-Sheet 2

Fig. 11.

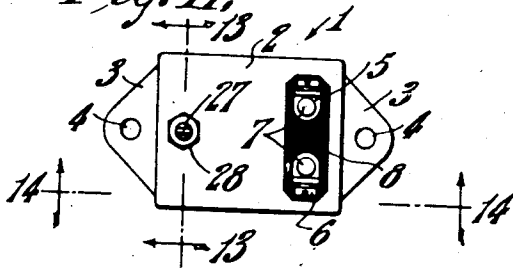


Fig. 12.

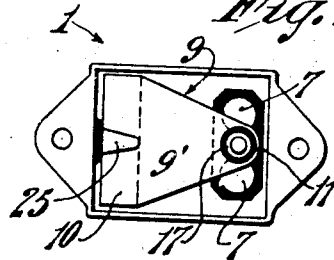


Fig. 13.

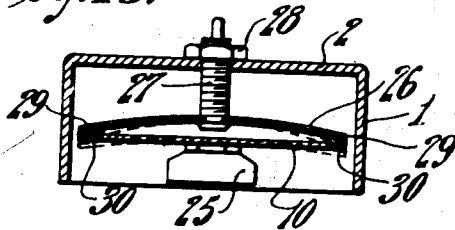
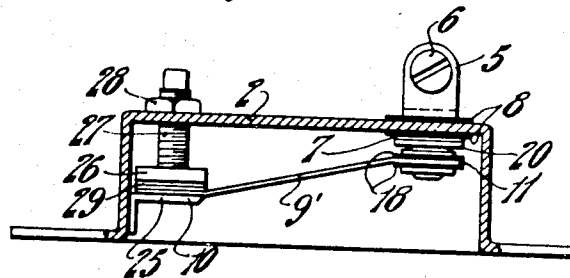


Fig. 14.



BY

INVENTOR,
Frank J. Neece,
Blake & Cleaver,
ATTORNEY.

UNITED STATES PATENT OFFICE

2,157,560

THERMALLY-ACTUATED CIRCUIT
BREAKER

Frank Joseph Neece, Chicopee Falls, Mass.

Application August 9, 1937, Serial No. 158,011

13 Claims. (Cl. 200—138)

An object of this invention is to provide, in a thermally-actuated circuit breaker, a construction by means of which electrical contact is maintained at a uniform pressure until the actual break is made, the break being instantaneous and positive.

A second object of this invention is to provide, in a circuit breaker of this type, means for producing a wide gap between the contacts when the circuit is opened, thus permitting the use of high voltages without arcing, and without fusing of the contacts.

A third object of this invention is to provide, in such a device, an actuated member which operates with an instantaneous snap in both make and break movements.

A fourth object of this invention is to provide, in a thermally operable circuit breaker, means for adjustably controlling the temperature differential required to operate the actuated contact member.

A fifth object of the invention is to provide a thermally operable circuit breaker having a wide operating temperature range, within which range the device may be adjusted for operation within a narrow differential in temperature.

Another object of this invention is to provide, in a device of the character described, means for utilizing a minimum amount of bi-metal for the actuating element. The bi-metallic material used in such devices is expensive of manufacture, and, as practiced in the art at present, these elements are generally in the form of discs. In the manufacture of these discs, waste results from punching the discs from flat sheets of the material. This invention has, for one of its objects, the provisions of a bi-metallic-actuating element rectangular in shape, which may be sheared from a narrow strip or ribbon of the material, without any waste.

A further object of the invention is to provide, in a device of the character described, adjustable means for controlling the operating differential in such a manner that the differential decreases as the device is adjusted for operation at low temperatures.

A still further object of this invention is to provide a thermally operable circuit breaker that is compact, comprises a minimum number of parts, is simple in design, and economical of manufacture and assembly.

These, and other objects and advantages of this invention, will be more completely described and disclosed in the following specification, the

accompanying drawings, and the appended claims.

Broadly, this invention comprises a casing, a pair of spaced electrical contacts secured in the casing and insulated therefrom, a substantially triangular snap-acting member secured to said casing at a point midway of its base portion, a contact-button secured at the apex of the member and insulated therefrom, the contact member normally connecting the spaced contacts to close an electrical circuit, and a bi-metallic thermally operable strip superposed over the base portion of the triangular member, whereby action of the bi-metallic strip will cause the triangular member to snap away from the spaced contacts, and means for adjustably exerting pressure against the triangular member in the direction of distortion, whereby the required operating range of the bi-metallic strip, relative to its effect on the triangular member, may be adjustably varied.

Preferred embodiments of this invention are illustrated in the accompanying drawings, in which:—

Fig. 1 is a top plan view of the circuit breaker.

Fig. 2 is an underside plan view.

Fig. 3 is a side elevational view.

Fig. 4 is an enlarged longitudinal sectional view, taken on the line 4—4 of Fig. 1, with the circuit closed.

Fig. 5 is an enlarged cross sectional view, taken on the line 5—5 of Fig. 4.

Fig. 6 is a view similar to Fig. 4, with the circuit open.

Fig. 7 is an enlarged cross sectional view, taken on the line 7—7 of Fig. 4.

Fig. 8 is a perspective view of the snap-acting member and bi-metallic actuating strip in the normal, or circuit closing position.

Fig. 9 is a view similar to Fig. 8, showing the parts in open circuit position.

Fig. 10 is an enlarged sectional view of the contact construction on the snap-acting member.

Fig. 11 is a top plan view of a modified form of circuit breaker.

Fig. 12 is an under side plan view of the circuit breaker, shown in Fig. 11.

Fig. 13 is an enlarged cross sectional view, taken on the line 13—13 of Fig. 11, and

Fig. 14 is an enlarged longitudinal sectional view, taken on the line 14—14 of Fig. 11.

Referring now to the drawings in detail, in which like numerals refer to like parts throughout:—

In the preferred form of circuit breaker illus-

trated in Figs. 1-10 inclusive, a substantially rectangular box-like casing 1 is formed with a top portion 2 and projecting tabs 3 perforated at 4 to receive fastening screws, (not shown), by means of which the device may be attached to any desired surface. Terminal posts 5, provided with attaching screws 6, are secured on the upper surface of the portion 2 by spaced contact rivets 7, and the posts 5 and rivets 7 are insulated from the casing 1 by strips or plates 8 of insulating material, secured on the top and bottom surfaces of the portion 2 by the rivets 7. A substantially triangular snap-acting member 9 is formed with a base portion and an apex portion 11. A bi-metallic actuating strip 12 is superposed on the base portion 10 and secured thereto on the longitudinal axis of the member 9 by a stud 13.

The member 9 and strip 12 are removably secured in the casing 1 by screw 14 engaged in the stud 13. The apex 11 of the member 9 is pierced at 15, and a rivet or stud 16 is secured in the opening 15 and insulated from the member 9 by means of insulating washers 17 and metallic washers 18 and 19, as best illustrated in Fig. 10. A contact washer 20 is freely supported between the washer 19 and the head 21 of the rivet 16, so that it may pivot or tip slightly, as indicated in Fig. 10, to compensate for any inequalities in the positioning of the contact rivets 7, thereby insuring a firm contact.

A clip 22 is secured on the member 9 adjacent the bi-metallic strip 12, and a stud 23 is secured in the clip 22 and threadably secured in the top portion 2 of the casing 1, as best shown in Figs. 4 and 6, and a lock nut 24 is provided for locking the stud 23 in adjusted position.

The snap-acting member 9 is formed so that in its normal position the base portion 10 is flat and the remaining portion 9' is bent upwardly relative to the plane of the base portion 12, as indicated in Figs. 4 and 8. In the position, indicated in Fig. 4, engagement of the contact washer 20 with the contact rivets 7 prevents the portion 9' from assuming its normal position, and results in a steady and uniform pressure of the washer 20 against the contacts 7, thus bridging the contacts 7 and closing the electrical circuit. As the temperature to which the device is subjected rises, the bi-metallic strip curls downwardly, as indicated in Fig. 5, forcing with it the ends of the base portion 10 of the member 9. As the ends of the portion 10 move downwardly, the member 9 is distorted, until the buckling stage, or limit of stability, is reached, at which point the portion 9' of the member 9 snaps downwardly into the position shown in Figs. 6 and 9, thus instantaneously breaking or opening the circuit between the contacts 7. It should be noted that no movement of the portion 9' occurs until the snap, and that uniform pressure is maintained on the contacts 7 until the actual break. The purpose of the adjusting screw 23 is to adjustably vary the differential in temperature required to operate the member 9. As the screw 23 is raised, relative to the casing 1 and stud 13, a stress is exerted on the member 9 tending to arch the member 9 on its longitudinal axis, adjacent the portion 10, and bi-metallic strip 12. In such a position of the screw 23, a very slight movement of the bi-metallic member 12 will cause the member 9 to snap downwardly. As the adjusting screw 23 is moved downwardly relative to the casing 1 and stud 13, more relative movement of the member

12 is required to actuate the member 9. Thus, at the upper limit of adjustment of the screw 23, a very narrow differential in temperature is required to actuate the member 9, whereas, at the lower limit of adjustment of the screw 23, a relatively much greater differential in temperature is required to actuate the member 9. By means of this adjusting feature, the device may be set to operate within a narrow differential in temperature at low temperatures and a relatively wide differential in temperature at high temperatures. This ability to increase the operating differential as the temperature at which the device is intended to operate increases is important and desirable. For instance, this device has been adjusted to operate with a differential of 10 degrees at an operating temperature of 250 degrees, and with a differential of 40 degrees at an operating temperature of 500 degrees.

The device is efficiently operable within a wide range of operating temperatures, for example, this range may approximate 250 degrees, such as between 250 and 500 degrees, and has been operated efficiently under such conditions. The operating range of the device may be easily and simply controlled by the relative thickness of the bi-metallic strip 12 and snap-acting member 9.

For purposes of illustration, the movement of the bi-metallic strip 12 and portion 10 of the member 9 have been greatly exaggerated in Figs. 5 and 6. In practical operation, this movement may be limited to approximately .007 of an inch.

In the modified form of circuit breaker, illustrated in Figs. 11-14, inclusive, the construction is the same with the exception of the triangular snap-acting member, the bi-metallic strip, and the adjusting screw. In this construction, the portion 13 of the member 9 is secured, at a point in the longitudinal axis of the member 9, on a bracket 25 which is secured in any suitable manner on the inside of the casing 1. A bi-metallic strip 26 is secured on and supported by an adjusting screw 27 which is threadably engaged in the top 2 of the casing 1 and locked in adjusted position by a lock nut 28. The strip 26 is slightly arched, and assembled with its ends 29 engaged on the ends 30 of the base portion 10 of the member 9, as indicated in Fig. 13. The operation is the same as that described above for the construction illustrated in Figs. 1-10. As the temperature to which the device is subjected rises, the strip curls downwardly, exerting pressure on the ends of the member 9 and bending these ends downwardly, until the point of stability of the member 9 is passed, thus snapping the portion 9' of the member 9 downwardly. As the screw 27 is moved downwardly from its uppermost position, a preliminary pressure on the ends 30 of the member 9 is exerted, resulting in a preliminary depression of the ends 30, thus requiring less movement of the bi-metallic strip 26 to reach the buckling point of the member 9. Thus, as the adjusting screw 27 is moved downwardly, the temperature differential required to operate the device is decreased.

What I claim is:—

1. A thermally-actuated circuit breaker comprising a casing, a pair of spaced electrical contacts secured in the casing and insulated therefrom, a substantially triangular snap-acting member secured in said casing at a point midway of its base portion, a contact button secured at the

apex of said member and insulated therefrom, said contact button normally bridging and connecting said spaced contacts to close an electric circuit, a bi-metallic thermally operable strip superposed over the base portion of said triangular member, whereby distortion of said bi-metallic member will cause said triangular member to snap away from said spaced contacts, and means for adjustably exerting pressure against the triangular member in the direction of distortion, whereby the required operating range of the bi-metallic strip, relative to its effect on the triangular member, may be adjustably varied.

2. A thermally-actuated circuit breaker comprising a casing, a pair of spaced contacts secured in said casing adjacent an end thereof and insulated therefrom, a substantially triangular snap-acting member having a base portion and an apex portion and preformed with the apex portion located in a plane above the plane of the base portion, means for securing said triangular member to said casing at a point midway of said base portion and opposite said spaced contacts with the apex of said triangular member located below and between said spaced contacts, a contact button secured at the apex of said triangular member and insulated therefrom, said contact button being normally held in engagement with said spaced contact by said triangular member, a rectangular bi-metallic strip superposed over said base portion, whereby downward movement of the ends of said bi-metallic strip will cause said triangular member to snap downwardly, thereby spacing said contact button and said spaced contacts.

3. In a thermally operable circuit breaker, a snap-acting member substantially triangular in shape and having a base portion and an apex portion, the body of said member being transversely bent adjacent said base portion to normally position said apex portion above said base portion, means for fixedly securing and supporting said member at a single point midway of said base portion, a flat bi-metallic strip superposed over said base portion, a support for said strip midway of its length, whereby as the said strip curves downwardly under the influence of a rising temperature, said strip will distort said triangular member beyond the buckling stage, and the body portion of said triangular member will snap downwardly, positioning said apex below said base portion.

4. In a thermally operable circuit breaker, a snap-acting member substantially triangular in shape and having a base portion and an apex portion, the body of said member being transversely bent adjacent said base portion to normally position said apex portion above said base portion, means for fixedly securing and supporting said member at a single point midway of said base portion, a flat bi-metallic strip superposed over said base portion, a support for said strip midway of its length, whereby as the said strip curves downwardly under the influence of a rising temperature, said strip will distort said triangular member beyond the buckling stage, the body portion of said triangular member will snap downwardly, positioning said apex below said base portion, and adjustable means for providing a preliminary distortion in said triangular member for reducing the degree of movement required of said bi-metallic strips.

5. In a thermally actuable circuit breaker, a substantially triangular snap-acting member preformed to normally position the apex of said

member above the base portion of said member, said member being capable of buckling to position said apex portion below said base portion, a bi-metallic strip member superposed on the base portion of said triangular member and secured thereto at a point midway of said base portion, whereby downward movement of the ends of said strip member will cause said triangular member to buckle.

6. A thermally-actuated circuit breaker comprising a casing, a substantially triangular snap-acting member having a base portion and an apex portion, a bi-metallic strip superposed on said base portion, a post in said casing to which said base portion and said bi-metallic strip are fixedly secured at a common point midway of their length, spaced contacts secured on said casing and insulated therefrom, a contact button secured on said apex portion and insulated therefrom, said contact button being normally engaged on said spaced contacts, an adjusting screw threadably supported in said casing, connecting means between said adjusting screw and said triangular snap-acting member, whereby preliminary buckling stresses may be exerted upon said triangular member independent of the action of said bi-metallic strip.

7. A thermally-actuated circuit breaker comprising a casing, spaced contacts secured on said casing adjacent an end thereof and insulated from said casing, a triangular snap-acting member having a base portion and an apex portion, said base portion being fixedly secured to said casing at a point midway of its length and opposite said spaced contacts, a contact button pivotally secured on said apex portion and insulated therefrom and normally engaged on said spaced contacts, an arcuate bi-metallic strip positioned above said base portion with its ends normally engaged on the ends of said base portion, an adjusting screw secured on said bi-metallic strip midway of its length, said adjusting screw being threadably engaged in said casing, whereby adjustment of said screw will determine the degree of preliminary pressure exerted upon the ends of said base portion.

8. As an article of manufacture, a thermostatic snap-acting device comprising a substantially triangular, thin, metallic member having a triangular body portion and a rectangular base portion, the body portion being bent upwardly relative to the base portion, and a rectangular bi-metallic strip superposed transversely on said base portion and secured thereto, said bi-metallic strip being adapted to curl downwardly under the influence of a rising temperature, thereby depressing the ends of said base portion to snap said body portion downwardly relative to said base portion.

9. In a thermostatic circuit breaker, a substantially triangular snap-acting member having a base portion and an apex portion, means for anchoring said member at a point midway of its base, a bi-metallic strip superposed over said base portion and adapted to curl downwardly under the influence of a rise in temperature, a casing in which said member is supported, spaced electrical contacts secured on said casing above and on each side of said apex portion and insulated from said casing, a contact washer loosely and pivotally secured on said apex portion and insulated therefrom, whereby said washer will automatically adjust itself to compensate for inequalities in the position and plane

of said contacts to provide a positive engagement between said contacts and said contact washer.

10. A thermostatic circuit breaker comprising a casing, spaced contact studs secured in said casing adjacent an end of said casing and insulated therefrom, an adjusting screw threadably secured in said casing opposite said spaced contacts, an arcuate bi-metallic strip secured on said screw and adapted to curl downwardly under the influence of a rise in temperature, a substantially triangular snap-acting member having a base portion, and an apex portion, said base portion being anchored in said casing at a point midway of its width with the ends of the bi-metallic strip engaged on the ends of said base portion, and a contact washer pivotally secured on said apex portion and insulated therefrom, said washer being normally engaged on said contact studs for closing an electric circuit.
11. In a thermostatic circuit breaker, a substantially triangular snap-acting member having a base portion and a body portion, said body portion being normally bent upwardly relative to said base portion, a bi-metallic strip superposed over said base portion with the side of said strip having the least coefficient of expansion against said base portion, whereby action of said strip under the influence of a rise in temperature will force the ends of said base portion downwardly until, at a predetermined temperature, a point of instability in the triangular member is attained and the body portion of said member will snap downwardly, and means for adjustably controlling the predetermined temperature at which the said member will snap by imparting an initial stress in said triangular member independently of said bi-metallic strip.
12. In a thermostatic circuit breaker, a substantially triangular snap-acting member having a base portion and a body portion, said body portion being normally bent upwardly relative to

said base portion, a bi-metallic strip superposed over said base portion with the side of said strip having the least coefficient of expansion against said base portion, whereby action of said strip under the influence of a rise in temperature will force the ends of said base portion downwardly until, at a predetermined temperature, a point of instability in the triangular member is attained and the body portion of said member will snap downwardly, and means for adjustably controlling the predetermined temperature at which the said member will snap by imparting an initial stress in said triangular member independently of said bi-metallic strip, said means comprising an adjusting screw operatively connected to said triangular snap-acting member at a point midway of its length and adjacent said bi-metallic strip.

13. In a thermostatic circuit breaker, a substantially triangular snap-acting member having a base portion and a body portion, said body portion being normally bent upwardly relative to said base portion, a bi-metallic strip superposed over said base portion with the side of said strip having the least coefficient of expansion against said base portion, whereby action of said strip under the influence of a rise in temperature will force the ends of said base portion downwardly until, at a predetermined temperature, a point of instability in the triangular member is attained and the body portion of said member will snap downwardly, and means for adjustably controlling the predetermined temperature at which the said member will snap by imparting an initial stress in said triangular member independently of said bi-metallic strip, said means comprising an adjusting screw operatively connected to said bi-metallic strip for imparting an initial pressure on the ends of the base portion of said snap-acting member.

FRANK JOSEPH NEECE.