Nov. 28, 1961 J. W. WELSH 3,011,037

THERMOSTATIC AND MAGNETICALLY ACTUATED FLASHER

Filed Jan. 7, 1960 2 Sheets-Sheet 1

FIG. 1

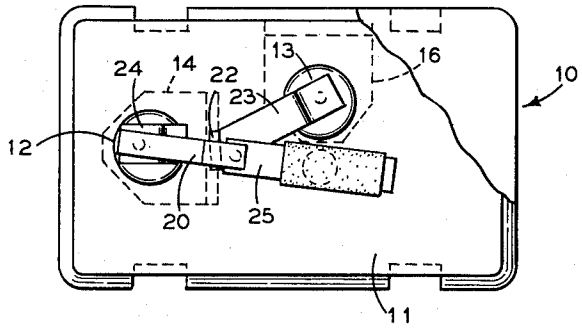


FIG. 2

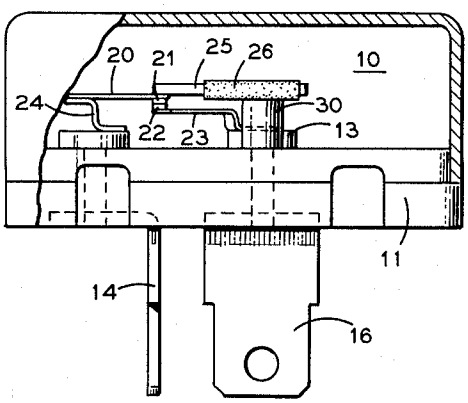


FIG. 3

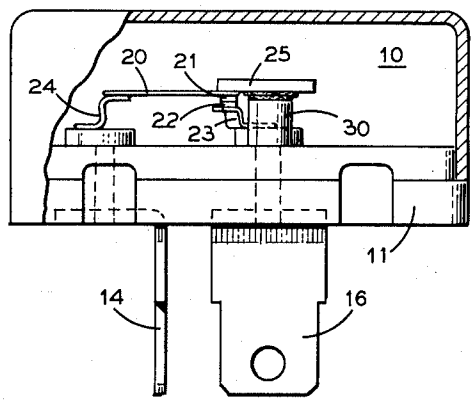
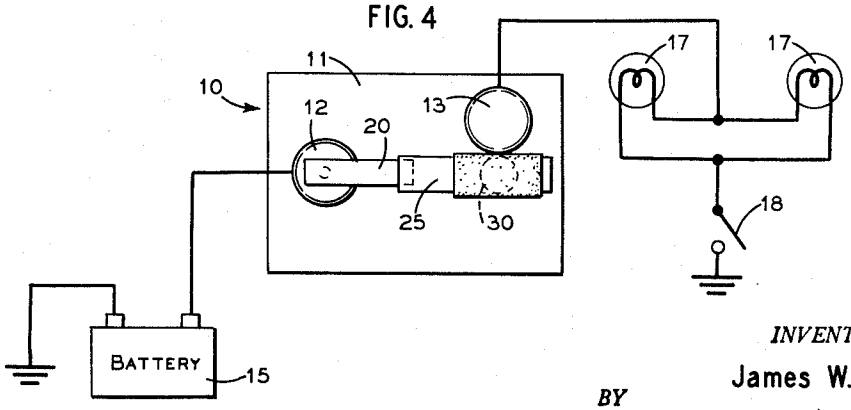


FIG. 4



INVENTOR.

James W. Welsh

BY

Blum, Moscovitz, Friedman & Blum

ATTORNEYS

Nov. 28, 1961 J. W. WELSH 3,011,037

THERMOSTATIC AND MAGNETICALLY ACTUATED FLASHER

Filed Jan. 7, 1960 2 Sheets-Sheet 2

FIG. 5A

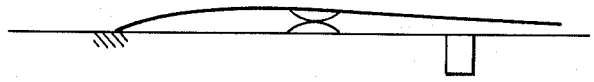


FIG. 5B

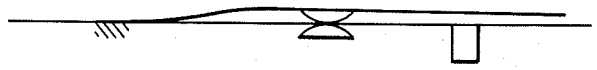


FIG. 5C

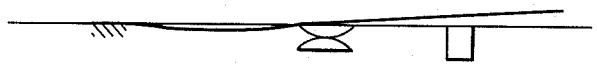


FIG. 5D

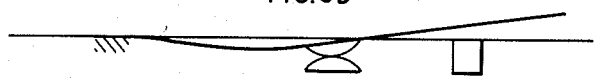


FIG. 5E

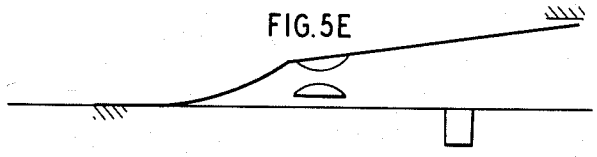


FIG. 5F

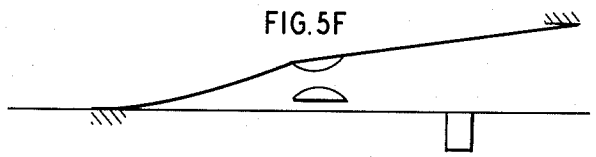


FIG. 5G

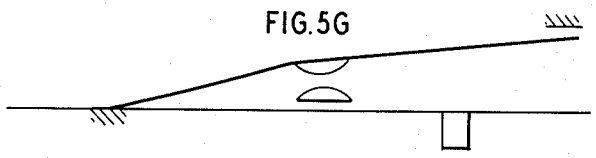
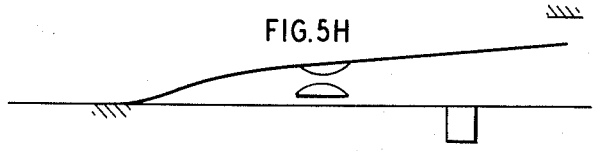


FIG. 5H



INVENTOR.

James W. Welsh

BY

Blum, Moscovitz, Friedman & Blum

ATTORNEYS

United States Patent Office 3,011,037
Patented Nov. 28, 1961

3,011,037
THERMOSTATIC AND MAGNETICALLY ACTUATED FLASHER

James W. Welsh, Summit, N.J., assignor to Signal-Stat Corporation, Brooklyn, N.Y., a corporation of New York

Filed Jan. 7, 1960, Ser. No. 1,064
5 Claims. (Cl. 200—113)

This invention relates to thermomotive circuit breakers and, more particularly, to an improved form of circuit breaker employing a novel combination of thermal and magnetic forces to effect full pressure engagement of contacts up to the instant they are snapped apart, together with snap re-engagement of the contacts under full pressure.

In most known types of thermally operated circuit breakers, the contact pressure decreases, during the opening cycle, until actual separation of the contacts. The decreasing contact pressure increases the contact resistance and decreases the life of the contacts. Recognizing this problem, many attempts have been made to rearrange the circuit breaker parameters to improve the maintenance of contact pressure during the opening cycle.

In most such switches or circuit breakers, a wiping action is provided to improve the contact life. However, the mechanical resistance characteristic of wiping action greatly increases the power requirements of the circuit breaker. To keep power losses at a minimum, the wiping action must be sacrificed with consequent more rapid deterioration of the contacts greatly decreasing the contact life.

The aforementioned contact deteriorating conditions can be overcome by a switch design in which full contact pressure is maintained during building of contact separating pressure to a value exceeding the holding pressure, with consequent snap action separation of the contacts, and in which the gradually increasing contact closing force is suddenly and greatly augmented by a second closing force to snap the contact closed. Under these two conditions, arcing of the contacts is substantially eliminated and the contact life indefinitely prolonged. However, providing these two conditions in a simple contact unit, such as an automotive flasher, and in a circuit breaker having an acceptably long life of its operating parts, has been a difficult problem to solve.

In my co-pending application Serial No. 734,471, filed May 12, 1958, and now Patent No. 2,900,474, issued August 18, 1959, there is shown and described an automotive type flasher utilizing a combination of thermal and magnetic forces to meet the foregoing conditions. More particularly, a magnetic armature is mounted to extend from a thermomotive member or bimetallic strip, and carries a contact engageable with another contact on a base of the flasher. This magnetic armature is operatively associated with a long life permanent magnet mounted in the base. By virtue of the fact that the magnetic attraction varies inversely as the square of the distance between a magnet and an armature operated thereby, a holding action can be maintained on the two contacts while the thermomotive member is heating. As the thermomotive member heats, it builds up pressure in a contact separating direction, but until such pressure exceeds the magnetic force holding the contacts engaged, there will be no separation of the contacts. When, however, the kinetic energy stored in the thermomotive member exceeds the holding force exerted by the magnet, the armature and its contact are carried rapidly away from the fixed contact on the base, the separation being accelerated due to the fact that the magnetic holding force decreases as the square of the distance of the armature

from the magnet. Also, in re-closing of the contacts, as the thermomotive member cools, the armature again approaches the magnet. When the armature enters the effective field of the magnet, it is accelerated in its movement toward the magnet, and thus the closing speed of the two contacts is accelerated. This results in a snap closing action of the contact.

Flashers of this type when operated using alternating current or pulsating direct current have very satisfactory life. However, the satisfactory life cannot be maintained under abnormal high surge direct current conditions. The reason for this is that the switch or flasher of my co-pending application did not provide continuous high contact pressure during the opening movement of the contacts, or the "break" cycle.

In accordance with my present invention, I have found that the life of a flasher of this type can be very substantially improved by redesigning the parameters of the flasher to take into account the bending of a bi-metallic strip into a circular arc when it is heated uniformly. By proper design of the parameters, and using this bending effect, the contact pressure can be made to actually increase, during the "break" cycle, up to the point where the kinetic energy stored in the bi-metallic element overcomes the force exerted by the magnet so that the contacts are rapidly snapped apart. Correspondingly, with the arc shape of the thermal or bi-metallic member being maintained but increasing in radius during cooling of the thermal member, as during the "make" cycle, this assists in maintaining a high pressure during the make cycle after the contacts are snapped into engagement when the force exerted by the permanent magnet overcomes the kinetic energy stored in the bi-metallic strip.

For an understanding of the invention principles, reference is made to the following description of typical embodiments thereof as illustrated in the accompanying drawings. In the drawings:

FIG. 1 is a plan view of an automotive type flasher embodying the invention;

FIG. 2 is a side elevation view thereof;

FIG. 3 is a plan view of another embodiment of the flasher incorporating the present invention;

FIG. 4 is a schematic wiring diagram of an electrical circuit using the flashers of the present invention; and

FIGS. 5A through 5H are diagrams illustrating the action of the flasher during a "make" and "break" cycle.

Referring to FIGS. 1, 2 and 3, the circuit breaker or flasher **10** comprises a dielectric base **11** on which are rivets **12**, **13** electrically and mechanically connected to or integral with prongs **14**, **16** engageable in a suitable receptable to connect flasher **10** in circuit. For example, and referring to FIG. 4, prong **14** (rivet **12**) may be connected to the ungrounded terminal of a battery **15**, and prong **16** (rivet **13**) may be connected to a lamp load **17**, **17** which may be connected to ground through a switch **18**. When switch **18** is closed, a load circuit is completed including flasher **10** in series therein.

In accordance with the invention, a relatively elongated bi-metallic strip **20** has one end brazed or welded to an adjusting arm **24** brazed or welded to rivet **12**, and a magnetic armature **25** is secured to extend longitudinally from the free end of strip **20**. Armature **25** may be a relatively rigid bar of cold rolled steel or may be a permanent magnet. It is preferably a bar of cold rolled steel or other suitable paramagnetic material.

A high strength permanent magnet **30** is mounted in or on base **11** as by being welded or brazed to rivet **13**, and is located beneath armature **25**. Magnet **30** is selected so that it retains its magnetic strength substantially unimpared due either to ageing or relatively high temperature environment. For example, permanent mag-

net 30 may be one of the series of "Alnico" magents manufactured by the General Electric Company.

In the embodiment of FIGS. 1 and 2, armature 25 has a wrapping 26 of dielectric or insulating material so that it will not make electrical contact with magnet 30. In the embodiment of FIG. 3, the armature 25 and magnet 30 are plated with dielectric material so that again there is no electrical contact between these elements.

A relatively movable first contact 21 is secured to the undersurface of strip 20 at the free end thereof, and is normally engaged under pressure with a relatively fixed contact 22 on the upper surface of a spring 23 having one end welded or brazed to rivet 13.

The operation of the flasher will be best understood from reference to FIGS. 4 and 5A through 5H. Referring first to FIG. 4, when switch 18 is closed current flows from battery 15 to prong 14 and rivet 12. The current then flows through arm 24, bi-metallic strip 20, contacts 21 and 22, spring arm 23, rivet 13, prong 16, lamps 17, and switch 18 to ground.

Referring to FIGS. 5A through 5H, in FIG. 5A the relative positions of strip 20, armature 25, and contacts 21 and 22 are shown at the start of the cycle. As current flows through strip 20, the latter heats and starts to deflect as shown in FIG. 5B. This arcuately bowed deflection of strip 20 continues as shown in FIGS. 5C and 5D so that armature 25 is gradually turned upwardly away from magnet 30. Finally, and as shown in FIG. 5E, the kinetic energy stored in strip 20 overcomes the magnetic force attracting armature 25 toward magnet 30 and the contacts 21 and 22 snap apart.

The electric circuit is now broken so that bi-metallic strip 20 begins to cool as shown in FIG. 5F and thus begins to re-straighten. This moves armature 25 toward magnet 30 and contact 21 toward contact 22. The movement is illustrated in FIGS. 5G and 5H. After a given amount of movement of armature 25 toward magnet 30, the attractive force of the magnet on the armature overcomes any residual kinetic energy in strip 20 so that armature 25 is snapped toward magnet 30. This effects snap engagement of contacts 21 and 22 under full pressure.

It will be noted that the conditions illustrated take full advantage of the uniform arc of bowing of strip 20 as shown in FIGS. 5A through 5H. This bowing first "tilts" armature 25 and eventually, due to the build up of kinetic energy in strip 20 in a contact separating direction, the contacts are snapped apart as the kinetic energy of strip 20 overbalances or exceeds the magnetic attraction of magnet 30 for armature 25. It will thus be noted that full contact pressure is maintained right up to the point where the contacts are snapped apart, and also that the contacts are snapped together in the re-closing direction and maintained under full pressure. This is due to the taking advantage of the bowing action of the bi-metallic strip 20, plus the spring action of spring arm 23.

Arm 23 is so designed and positioned that, when the contacts 21 and 22 are engaged, the arm 23 is bent inwardly from its normal position so that it tends to "follow" strip 20 as the free end of the latter deflects. However, the following by spring 23 of the movement of bi-metallic strip 20 is limited to a posittion in which spring arm 23 attains its normal unstressed relation.

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the invention principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A thermostatic circuit breaker comprising, in combination, a first fixed terminal; a relatively elongated electrically conductive bi-metallic strip having one end electrically and mechanically fixed relative to said first terminal; a relatively rigid and elongated paramagnetic armature electrically and mechanically secured to and extending longitudinally in alignment from the free end of said bi-metallic strip; a first contact electrically and mechanically fixed to the underside of said bi-metallic strip at its free end; a permanent magnet fixed beneath said armature to attract the latter toward said magnet; a second fixed terminal; an electrically conductive spring arm having one end electrically and mechanically fixed to said second terminal and a free end extending beneath the free end of said bi-metallic strip; a second contact electrically and mechanically secured to the free end of said spring arm and normally engaged with said first contact, said spring arm, when said bi-metallic strip is cool and said contacts are engaged, being depressed so as to maintain pressure on said first and second contacts, and said pressure engagement of said contacts being augmented by the attractive force of said magnet on said armature; said bi-metallic strip, when heated by the passage of electric current therethrough, bowing in a uniform arc inwardly to increase the pressure on said first and second contacts by deflecting the free end of said spring arm further inwardly; said relatively rigid armature, during such bowing of said bi-metallic strip, tending to be moved away from said permanent magnet; the kinetic energy built up in said bi-metallic strip, and resulting in bowing thereof while its free end is restrained against outward movement by attraction of the armature toward said magnet, eventually exceeding the attractive force of said magnet on said armature so that said armature is snapped away from said magnet with a resultant rapid decrease in the magnetic force acting on said armature; the contacts being thereby snapped apart from a position of full pressure engagement to a substantially separated position breaking an electric circuit; said bi-metallic strip, upon cooling due to the breaking of the electric circuit, gradually reassuming its normal orientation and thereby moving said armature toward said magnet and said first contact toward said second contact; the magnetic attraction between the magnet and the armature increasing rapidly during such movement and overcoming the deflecting force present in said bi-metallic strip so that said armature is snapped toward said magnet to re-engage said first and second contacts under full pressure.

2. A thermostatic circuit breaker as claimed in claim 1 including dielectric material on said armature preventing electric connection of said armature with said magnet.

3. A thermostatic circuit breaker as claimed in claim 2 in which said dielectric material comprises a wrapping of dielectric around said armature.

4. A thermostatic circuit breaker as claimed in claim 2 in which said dielectric material comprises a plating of dielectric material on said armature and on said magnet.

5. A thermostatic circuit breaker as claimed in claim 1 in which the fixed end of said bi-metallic strip is electrically and mechanically secured to an adjusting arm which is, in turn, electrically and mechanically secured to said first terminal.

References Cited in the file of this patent

UNITED STATES PATENTS

1,981,934	Werner	Nov. 27, 1934
2,467,018	Eggleston	Apr. 12, 1949

FOREIGN PATENTS

551,613	Canada	Jan. 14, 1958