June 19, 1945. O. MASENG 2,378,648

ELECTRIC SWITCH

Filed Oct. 29, 1943

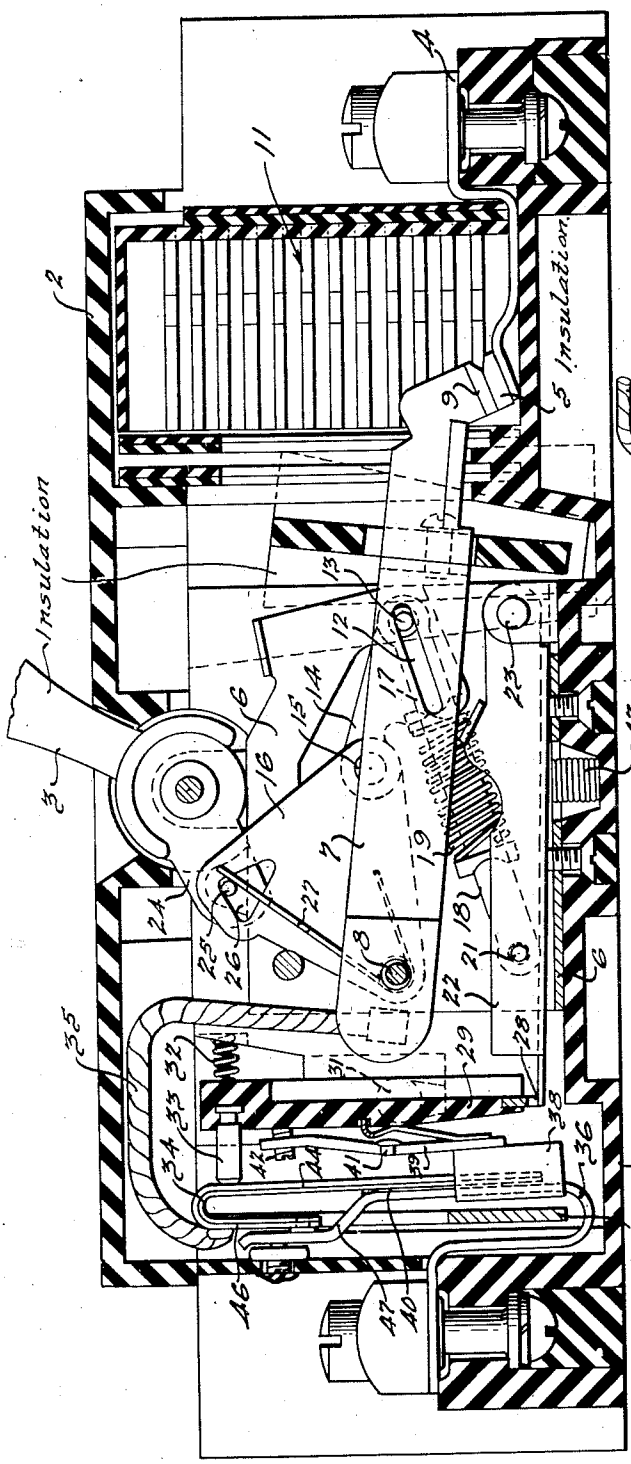


FIG. 1

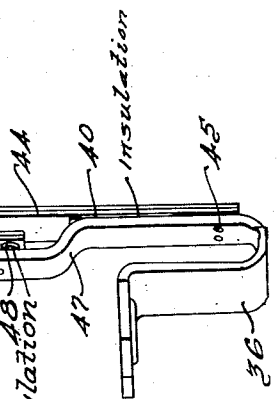


FIG. 2

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Patented June 19, 1945 2,378,648

UNITED STATES PATENT OFFICE

2,378,648

ELECTRIC SWITCH

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Application October 29, 1943, Serial No. 508,138

8 Claims. (Cl. 200—113)

This invention relates to electric switches automatically operable in response to current overload and more particularly to a current responsive bimetallic element utilized to effect automatic opening of such switches.

In the operation of automatically opening electric switches, relays, and circuit breakers, the bimetallic element is often used to provide the force and motion required to effect the automatic tripping of the mechanism, such bimetal being connected either in series with the device to be directly heated by the current passing therethrough, or being heated externally by a resistor through which the current passes and in which the flexing of the bimetal and its movement as it is heated results in a motion effecting the automatic tripping operation.

The object of this invention is to provide a bimetallic element which shall have a greater working force and/or a greater movement in response to a given temperature and/or current.

Another object of the invention is to provide a bimetallic element which shall be so supported as to lessen its tendency to take a permanent set.

Other objects and features of this invention will be readily apparent to those skilled in the art from the specification and appended drawing illustrating certain preferred embodiments in which:

Figure 1 is a sectional view of an automatic electric circuit breaker utilizing the bimetallic trip element according to the present invention.

Figure 2 is a perspective detail view of the bimetallic element and its supporting connector.

The drawing shows the circuit breaker mechanism described and claimed in the copending application of John G. Jackson and Reinhold Mueller, Serial No. 435,850, filed March 23, 1942, for Circuit breaker, although it is understood that the invention is not limited to any particular circuit breaker mechanism, the one shown being simply illustrative of the invention as incorporated in a manually and automatically operable circuit breaker.

The mechanism, which will be only broadly described, comprises a base 1 and a cover 2 having an opening therein through which projects an operating handle 3. At one end ledge on the base 1 is mounted a connector 4 extending inside the circuit breaker interior and there carrying the stationary contact 5. A generally U-shaped mounting bracket 6 is attached to the bottom wall of the base 1 and has pivotally supported thereon contact arm 7 as at pivot 8. The contact arm 7 carries a movable contact 9 cooperating with stationary contact 5, and about the stationary contact and the path movement of the movable contact 9 is disposed an arc suppressor structure indicated generally at 11. The contact arm 7 is provided with a slot 12 in which is disposed a slidable pin 13 on which is pivoted one end of a link 14, whose other end is connected at the pivot 15 to a link 16, the link 16 being pivotally supported upon the pivot 8. Also pivotally mounted on the pin 13 is a spring guide 17 which, in conjunction with the opposite spring guide 18, carries an operating spring 19 which supplies a tensile force upon the pin 13. The spring guide 18 is pivoted at 21 to a trip lever 22 mounted on a fixed pivot 23. The operating handle has an interior arm 24 carrying a pin 25 which is disposed within an opening 26 in a wall of the link 16. A light spring 27 bearing against the pin 25 biases the handle in a clockwise direction. The trip lever 22 is latched at 28 to a latch 29 rotatively mounted adjacent a mid point at 31 and normally maintained thereby in the position shown in Figure 1. At its upper end, the latch 29 is provided with a spring 32 biasing it in a counterclockwise direction to latched position and is provided with a pin 33 adapted to be engaged by the bimetallic element 34 to rotate the latch into unlatched position. A flexible lead 35 interconnects a point on the bimetal 34 and the switch arm 7. The bimetallic element 34 is rigidly mounted at its lower end on a connector 36 which extends to the exterior of the breaker and is mounted upon the end ledge at the left end thereof. A magnetic tripping device is supplied to supplement the action of the bimetallic element 34 and this embodies a stationary magnetic piece 37 and a U-shaped armature 38 carried on an arm 39 pivoted at 41 and carrying an adjustable screw 42 which engages latch 29 and is adapted to effect movement thereof on heavy overloads and short circuits when the armature is attracted to the plate 37.

The action of the circuit breaker mechanism will now be broadly described. The parts are shown in contacts engaged position. To manually move the parts to "off" position, the handle is moved to a counterclockwise direction which effects rotation of the link 16 in a clockwise direction to move the pivot 15 downwardly. When pivot 15 passes the centerline between the pivot 8 and the pin 13, the linkage formed by the links 16 and 14 will lapse downwardly, and the switch arm 7 will be moved in a counterclockwise direction to move the contact 9 upwardly and disengage it

from the stationary contact 5. The manual operation to move the contacts to engaged position is the reverse of this action.

In automatic operation, the latch 29 is moved in a clockwise direction under the action either of the bimetal 34 or the magnetic armature 38, or by a combination of both their movements until it unlatches the trip lever 22. This trip lever then rotates in a clockwise direction, under the action of both the operating spring 19 and a trip spring 43 which biases it in a direction for clockwise movement. Such movement both moves the contact arm 7 directly and finally effects collapse of the linkage 14—16 as the spring 19 passes through their center of operation. To reset the breaker after automatic operation, the handle 3 is moved to the "off" position to again move the trip lever 22 to its latched position after which the contacts may be engaged by moving the handle to the position shown in Figure 1. The breaker mechanism and its operation have been only generally shown and described because it is disclosed and claimed in the application previously named.

The bimetallic element 34 shown in Figures 1 and 2 is of strip form and comprises an elongated arm 44 connected at one end at 45 to the connector 36. A thin sheet 40 of mica or other insulating material insulates the arm 44 from the connector 36 except adjacent the point 45 where they are electrically and mechanically connected. The arm 44 is return bent to form a smaller arm 46, the structure being then of U shape with one leg elongated. The flexible lead 35 is connected to the short arm 44 so that the curved portion is heated by the current passing through the bimetallic element. The connector 36 is extended to form the abutment arm 47 and the end of the arm 46 is provided with an insulating button 48 adapted to engage the arm 47 as an abutment. As the bimetallic element 34 is heated by the passage of an overload current therethrough, the arm 44 bends to flex in a clockwise direction in the normal manner of a straight bimetal. However, the curved portion at which the strip is return bent is also heated and this tends to straighten out, forcing the arm 46 against the abutment 47. As this abutment is a rugged stationary piece the resultant force thereon works by reaction to effect a further movement of the bimetallic element; or, if this movement is restricted, it results in a greater force being exerted by the bimetallic element on the member against which it presses. With the bimetal constructed as shown, the result is either to produce a greater movement of the latching surface of the latch 29 due to the passage of any given current or the attainment of any given temperature than would be the case with a straight bimetallic strip; or, for the same movement, a greater force will be exerted by the bimetallic element at the said given current or given temperature. This is particularly desirable in the automatic operation of the switch or other device to be controlled by the bimetallic element where the resistive force to the movement of the bimetal may be considerable or where a relatively large movement for a relatively heavy and inflexible element is desired. For example, in the construction of an automatic circuit breaker for relatively heavy currents, it may be necessary to use a bimetal of considerable cross-section so as to avoid burning thereof on short circuit. Such a bimetal is usually relatively inactive and does not have a high degree of movement on small overload currents. With the bimetal of this invention, the movement of the bimetal on such small overload currents is greatly increased and, hence, a greater movement of the latch 29 is produced and a larger overlap at latch 28 may be provided so that the operation of the circuit breaker is more reliable. Similarly, with the bimetal having the same movement as in a normal bimetal, considerably greater force may be exerted upon the working part due to the combination of the force produced by the flexing of the long arm 44 and the reaction force from the pressing of the point 48 on the arm 47 caused by the straightening of the curved portion of the bimetal.

Another feature of the invention lies in the function of the bimetallic element in resisting the taking of a permanent set which might destroy its calibration. In the carrying of heavy short circuit currents, the current traversed bimetal can be heated to relatively high temperatures at which its resistance to permanent set is relatively low. When the bimetallic element is in the form of a straight strip attached at one end and applying force at the other end, it acts as a cantilever beam and at temperatures experienced on heavy short circuit it is possible that a permanent set will be taken which will destroy the proper calibration of the breaker. According to the present invention, the return bent arm of the bimetal engages its abutment to change the character of the beam formed by the bimetallic element and by this additional support adjacent the force-applying end substantially overcomes the tendency of the bimetal to take its permanent set. Thus, the calibration upon the occurrence of short circuit current becomes more reliable.

While certain preferred embodiments of the invention have been specifically disclosed, it is understood that the invention is not limited thereto, as many variations will be readily apparent to those skilled in the art and the invention is to be given its broadest possible interpretation within the terms of the following claims.

What is claimed is:

1. A heat-responsive bimetallic element comprising a bimetallic strip return bent about a transverse axis parallel to its flat surfaces to form two generally parallel legs, means rigidly securing one leg of said bimetallic strip to a support to mount the same, a force-applying point on said element adjacent to the looped portion thereof, and a fixed abutment surface engageable by the second leg of said bimetallic element as the element flexes upon heat application.

2. A heat-responsive bimetallic element comprising a bimetallic strip return bent about a transverse axis parallel to its flat surfaces to form two generally parallel legs, means rigidly supporting one of said legs adjacent the end thereof, means forming an abutment surface against which the second leg may press when flexed, and a member to be moved by said bimetallic element and having its point of force reception located adjacent to the looped portion of said element.

3. A heat-responsive bimetallic element comprising a bimetallic strip of substantially U shape, with the flat surface of the strip at right angles to the plane of the U, and with the high expansion side of the strip at the interior of the U, means securing one leg of said U to a support to mount the element, a force-applying point on said element adjacent to the bight of the U, and a fixed abutment surface engageable by the

second leg of the U as the element flexes upon heat application.

4. A heat-responsive bimetallic element comprising a bimetallic strip of substantially U shape, with the flat surface of the strip disposed at right angles to the plane of the U and with the high expansion side of the strip at the inside of the U, the legs of said U being of unequal length, means supporting the longer leg of the U adjacent to the end thereof, means forming an abutment surface against which the shorter leg of the U may press when flexed, and a force-applying point on said bimetallic element adjacent to the bight of the U.

5. An electric switch having a thermally responsive element for effecting automatic operation thereof, comprising stationary and movable contacts and means for effecting movement of said movable contacts including a movable member and a bimetallic element for effecting movement of said member, said element comprising a bimetallic strip return bent about a transverse axis parallel to its flat surfaces to form two generally parallel legs, means rigidly supporting one of said legs adjacent to the end thereof, and means forming an abutment surface against which the second leg may press when flexed, said bimetal engaging said movable member adjacent to the free looped portion thereof.

6. In an electric switch, stationary and movable contacts, means for effecting automatic separation of said contacts including a movable member and a current responsive element for moving the same, said current responsive element comprising a bimetallic strip return bent about a transverse axis parallel to its flat surfaces to form two generally parallel legs, an electrical connector in the circuit of said switch, means mounting one of the legs of said bimetallic element upon said connector in conducting relation, means providing an abutment surface against which the second leg of the bimetallic element may press when flexed, said bimetallic element engaging the movable member adjacent to its free looped portion, and a flexible lead interconnecting a point on said second leg with the movable contact so as to include the looped portion of the bimetallic element in the circuit through the switch.

7. In an electric switch, stationary and movable contacts, means for effecting automatic separation of said contacts including a movable member and a current responsive element for moving the same, said current responsive element comprising a bimetallic strip return bent about a transverse axis parallel to its flat surfaces to form two generally parallel legs, an electrical connector in the circuit of said switch, means mounting one of the legs of said bimetallic element upon said connector in conducting relation, an extension on said connector forming an abutment surface against which said second leg may press when flexed, means electrically insulating the point of engagement of said second leg with said abutment surface, said bimetallic element engaging the movable member adjacent to its free looped portion, and a flexible lead interconnecting a point on said second leg with the movable contact so as to include the looped portion of the bimetallic element in the circuit through the switch.

8. In an electric switch, stationary and movable contacts, means for effecting automatic separation of said contacts including a movable member and a current responsive element for moving the same, said current responsive element comprising a bimetallic strip of U shape with the flat surface of the strip disposed at right angles to the plane of the U, and with the high expansion side of the strip at the inside of the U, the legs of said U being of different lengths, an electrical connector in the circuit of said switch, means mounting the longer leg of said U-shaped element upon said connector in conducting relation, a fixed abutment disposed adjacent the end of the shorter leg of the U-shaped element and against which it presses when flexed, said element engaging the movable member adjacent to the bight of the U, and a flexible lead interconnecting a point on said shorter leg with the movable contact so as to include the bight of the U-shaped element in the electrical circuit through the switch.

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