Jan. 2, 1951 J. G. JACKSON ET AL 2,536,812

CIRCUIT BREAKER

Filed May 11, 1948 2 Sheets-Sheet 1

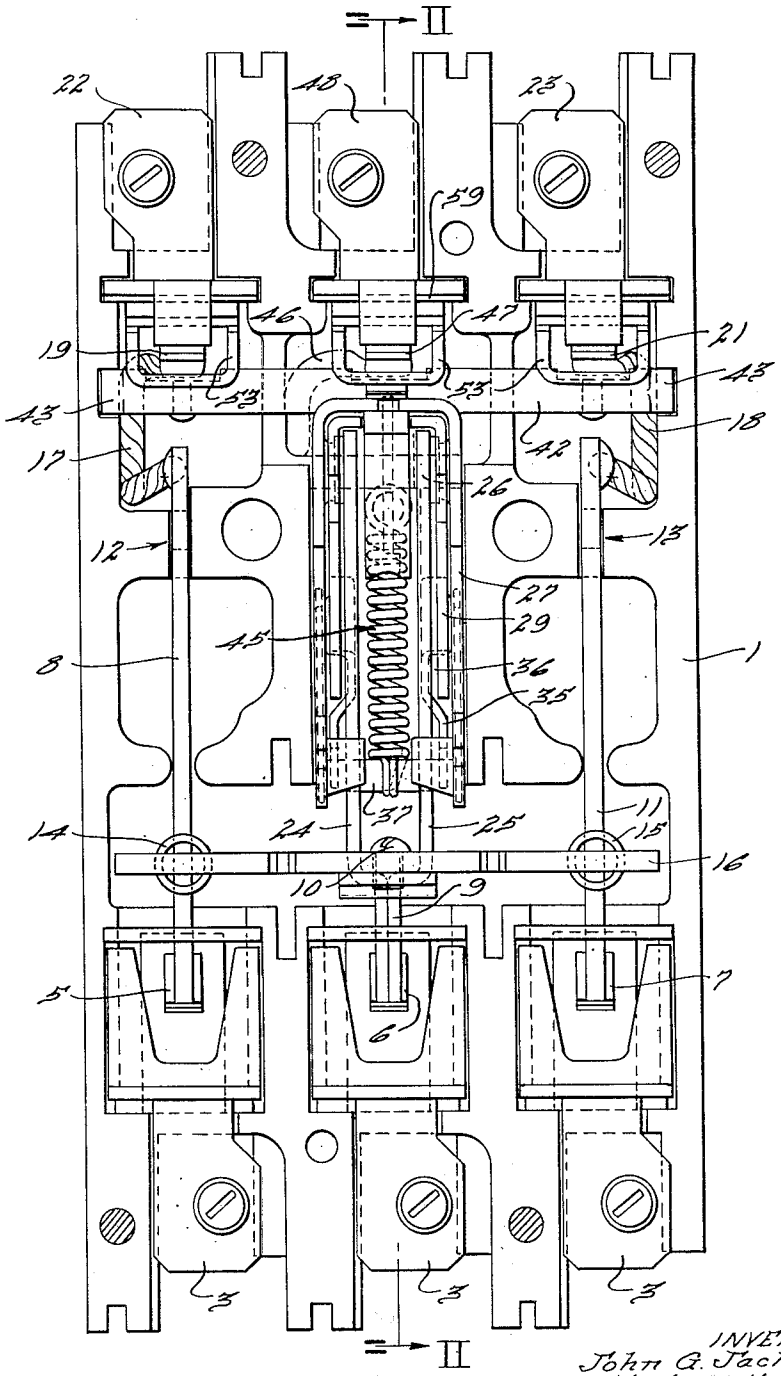


FIG. 1.

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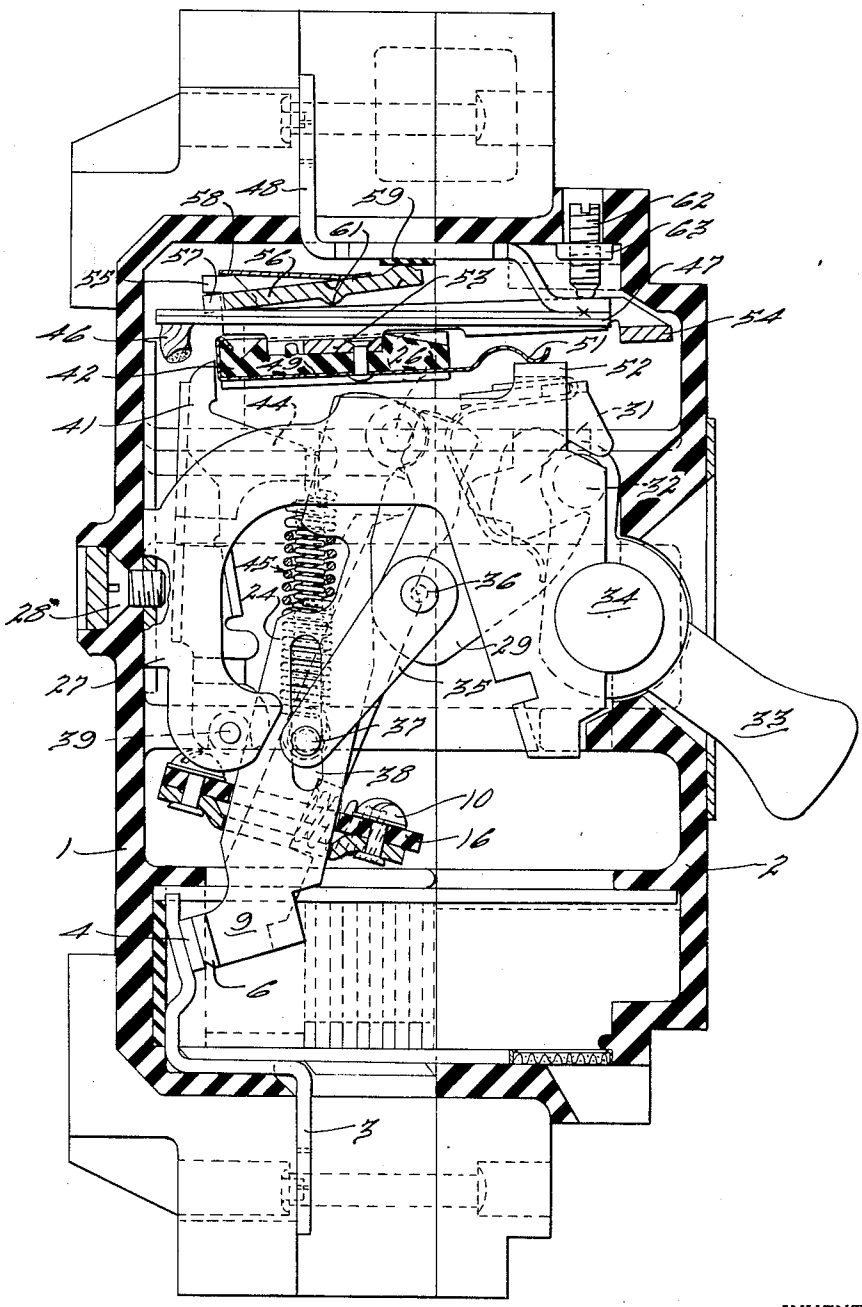


FIG. 2.

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UNITED STATES PATENT OFFICE

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CIRCUIT BREAKER

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10 Claims. (Cl. 200—88)

1

This invention relates to circuit breakers and more particularly to the current responsive automatic tripping mechanism for automatic electric circuit breakers.

An object of the invention is the provision of an automatic tripping mechanism for an electric circuit breaker of combined thermal and magnetic type and of economical and reliable construction for both thermal and magnetic responses.

Another object of the invention is the provision of automatic tripping means for an electric circuit breaker employing both thermally and magnetically responsive elements in which the magnetically responsive elements are bodily movable by the thermal to effect tripping on sustained overloads and in which the magnetic elements are independently movable with a substantially prying action to increase the unlatching force in the magnetic response for heavy short circuit currents.

Another object of the invention is the provision of an automatic tripping means for an electric circuit breaker in accordance with the preceding object in which there is provided a common cross bar for a plurality of poles with thermal and magnetic elements individual to the poles cooperating therewith to effect an unlatching movement of the common cross bar and in which cooperating magnetic elements are carried by the common cross bar with one magnetic element engaging an abutment in its movement to effect a prying or force multiplying movement of the interengaging ends of the cooperating elements.

Other objects and features of the 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 plan view of the circuit breaker according to the present invention, with the cover removed.

Figure 2 is a longitudinal sectional view on the line II—II of Figure 1.

The circuit breaker mechanism with which the automatic tripping means of this invention is specifically shown conforms in general to that disclosed and claimed in the patent to Jackson et al. 2,426,880 granted September 2, 1947, for Circuit Breaker, and the mechanism forms no specific part of the present invention as the automatic tripping means will obviously function with any form of releasable circuit breaker mechanism.

The breaker is sealably enclosed within complementary cup-shaped base and cover members 1 and 2 of insulating material. The circuit breaker is specifically illustrated in three-pole form with the lower end of the base carrying three terminal connectors 3 suitably mounted in slots within the base and carrying at their internal end stationary contacts 4. Cooperating with the stationary contacts 4 are movable contacts 5, 6 and 7 mounted at the ends of contact blades 8, 9 and 11. The blades 8 and 11 are suitably pivoted in the base at 12 and 13 and have a resilient connection by means of springs 14 and 15 to a common insulating contact cross bar 16. The upper ends of the blades 8 and 11 are connected by flexible leads 17 and 18 to the movable ends of bimetallic elements 19 and 21 mounted on the forward ends of conducting connectors 22 and 23.

The contact blade 9 has its upper end formed of two arms 24 and 25 pivotally mounted on a pin 26 disposed in opposite side walls of a metallic supporting frame 27 supported in the base by means of a stud 28. Also pivotally mounted on the pin 26 is an operating member 29 of U-shape having its opposite sides provided with cutout portions indicated at 31 and engaged by hubs 32 on a manually operable handle 33 pivoting about 34 within suitable grooves in the base 1 and cover 2. To the free end of the operating member 29 are pivoted a pair of lever arms 35 by means of pins 36 with the ends of lever arms 35 connected by a pin 37 extending through slots 38 in the arms 24 and 25 of the contact blade 9.

Pivoted to the frame 27 by means of a pin 39 is a releasable member 41 normally engaging a latching surface on a common cross bar 42 extending across the three poles of the breaker and pivoted by means of hubs 43 in grooves in the opposite side walls of the base 1, being maintained therein by engagement with the back portion of the cover 2. The releasable member 41 is formed to provide a hook portion 44 between which and the pin 37 are disposed a pair of tension springs indicated generally at 45 and being shown more particularly in Figure 2 at the cutaway portion of the arm 24 of the blade 9. The flexible lead 46 interconnects the upper end of the arm 24 with the free end of the bimetallic element 47 mounted upon the forward end of a terminal connector 48 supported in slots in the base 1 and cover 2.

The central portion of the common cross bar 42 is provided with a resilient spring strip 49 forming a smooth latching surface at its back end for the latching end of the releasable member 41

and extending at its forward end to provide a biasing portion 51 engaged with a stationary part 52 on the frame 27 so as to bias the cross bar 42 into latching position. Upon the upper side of the cross bar 42 are mounted a plurality of magnetic yokes 53, one for each pole of the breaker, and having side portions substantially embracing the bimetallic members 19, 21 and 47. These magnetic yokes have forward extensions terminating at 54 serving to counterweight the cross bar 42 about its rotative axis. The back ends of the yokes 53 terminate in hook portions 55 within which are received complementary groove portions of armature members 56 with the lower retaining ears shown at 57. Spring sheets 58 mounted on the armature members 56 retain them in engagement with the portions 55 of the yokes 53 and bias the armatures 56 away from the yokes into the position shown in Figure 2 and against insulating sheets 59 disposed against the connectors 22, 23 and 48 to insulate the armatures 56 therefrom. The armature members 56 are provided with pressed out portions 61 adapted to engage the bimetallic members 19, 21 and 47 in the magnetic tripping operation of the breaker to exert a substantially prying action to provide a force multplying movement for the magnetic untripping.

Adjusting screws 62 threaded in bridging elements 63 carried by the cover 2 engage the forward ends of the connectors 22, 23 and 48 to effect the thermal calibration of the breaker by locating the position of the free end of the bimetal through bending of the forward end of the connector.

The mechanical operation of the circuit breaker mechanism on both manual and automatic is in general substantially the same as that described in more detail in the previously mentioned patent to Jackson et al. 2,426,880.

Briefly, the parts as shown in Figure 2 are in the "on" or circuit made position. If the handle 33 is rotated counterclockwise, it will rotate the operating member 29 in a clockwise direction to move the pin 36 toward the back of base 1 and when the pin 36 passes through the line joining the pins 26 and 37 the line of force will pass through center and will move the arms 24 and 25 and blade 9 in a counterclockwise direction as viewed in Figure 2 to move the movable contact 6 toward cover 2 to separate the contacts and open the circuit through the breaker. With the contacts open a reverse or clockwise movement of the handle 33 will effect a reverse movement through center to again move the arms 24 and 25 and blade 9 into contacts engaged position. As blade 9 moves the contact cross bar 16, to which it is attached by means of stud 10, will also move and carry the outer contact blades 8 and 11 therewith to separate and engage the contacts 5 and 7 with their respective stationary contacts 4.

Upon automatic tripping, either thermal or magnetic, as will be more fully explained hereinafter, the bridging cross bar 42 will be rotated in a clockwise direction as viewed in Figure 2 by any one or all of the thermal and magnetic elements of the plurality of breaker poles into a position where it unlatches the end of the releasable member 41. When unlatched, the releasable member 41 moves in a clockwise direction under the action of springs 45 to place the line of force over center with respect to the operating elements of the breaker and effect the movement of the blade 9, the bar 16 and associated blades 8 and 11 into their disengaged position. In effecting both manual and automatic movements, the pin 37 slides within the slot 38 of the arms 24 and 25. The breaker is reset by moving the handle to the "off" position whereupon the releasable member 41 is again placed in relatching position in back of the cross bar 42.

With respect to the automatic tripping of the circuit breaker for straight thermal trip upon sustained moderate overloads, one or more of the bimetallic elements 19, 21 and 47 flex upwardly at their free ends and, by their engagement with the back edges of the armature member or members 56, directly rotate the cross bar 42 about its hubs 43.

Upon the occurrence of heavy overload or short circuit currents, one or more of the armatures 56 will be attracted to yokes 53 by the magnetic flux caused by the single turn loops of the bimetals through the yokes. As an armature 56 moves toward its yoke 53, the pressed out portion 61 will engage the upper side of the respective bimetallic element as an abutment and thereafter the armature 56 substantially rotates about the engagement of the pressed out portion 61 with the bimetal to exert a prying and force multiplying action upon the engagement of the armature 56 with the yoke at the ears 57 and hook portion 55. This prying or force multiplying movement also rotates the cross bar 42 about its hubs 43 to effect unlatching of the releasable member 41.

Upon overloads of certain values, it will, of course, be understood that the releasing motion of the cross bar 42 may be a combined effect of the thermal and magnetic actions.

One of the principal features of the invention lies in the provision of a sensitive, reliable and effective magnetic tripping by the prying or force multiplying movement which results from the engagement of the pressed out portion 61 of the armature 56 with an abutment, specifically illustrated as the bimetallic element 47, so that the required force for the automatic tripping of the circuit breaker magnetically may be brought about with relatively small and light elements of the armature and yoke and with the single turn provided by the looping of the bimetallic element with the yoke.

Another important feature of the invention resides in the mounting of both of the cooperating magnetic elements upon the cross bar and the association of the bimetallic elements with the magnetic elements so that the location of the cross bar latch and its latching overlap with the releasable member 41 is determined in the thermal calibration by movement of the cross bar latch through engagement by the bimetallic elements with the magnetic elements. This arrangement of parts particularly contributes to the reliability and uniformity of the automatic tripping and renders the construction less susceptible to variation due to manufacturing tolerances.

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. In an automatic electric circuit breaker having separable contacts and means releasable to effect automatic separation of said contacts, current responsive latching means for said releasable means comprising a latching surface engaging said releasable means, a bimetallic member

heated in response to flow of current through the breaker and connected to move said latching surface to unlatching position upon the occurrence of a sustained, moderate current overload, a magnetic yoke connected to said latching surface, a magnetic armature pivoted on said magnetic yoke, the magnetic circuit being energized in accordance with the current flowing through the breaker, and an abutment engageable by the armature as it is attracted toward the yoke so as to effect movement of the yoke thereafter from the pivotal mounting of the armature thereon.

2. In an automatic electric circuit breaker having separable contacts and means releasable to effect automatic separation of said contacts, current responsive latching means for said releasable means comprising a latching surface engaging said releasable means, a bimetallic member heated in response to flow of current through the breaker and connected to move said latching surface to unlatching position upon the occurrence of a sustained, moderate current overload, a magnetic yoke connected to said latching surface, a magnetic armature pivoted on said magnetic yoke, the magnetic circuit being energized in accordance with the current flowing through the breaker, and an abutment engageable by the armature as it is attracted toward the yoke so as to effect movement of the yoke thereafter from the pivotal mounting of the armature thereon, the yoke movement occurring with a substantially prying action about the armature-abutment engagement to effect movement of the latching surface to unlatching position.

3. In an automatic electric circuit breaker having separable contacts and means releasable to effect automatic separation of said contacts, current responsive latching means for said releasable means comprising a latching surface engaging said releasable means, a bimetallic member heated in response to flow of current through the breaker and connected to move said latching surface to unlatching position upon the occurrence of a sustained, moderate current overload, a magnetic yoke connected to said latching surface, a magnetic armature pivoted on said magnetic yoke, the magnetic circuit being energized in accordance with the current flowing through the breaker, said bimetallic member being disposed in the path of movement of the armature as it is attracted toward the yoke so that the armature engages the bimetallic member as an abutment to effect movement of the yoke thereafter from the pivotal mounting of the armature thereon, the yoke movement occurring with a substantially prying action about the armature-bimetallic member engagement.

4. In an automatic electric circuit breaker having separable contacts and means releasable to effect automatic separation of said contacts, current responsive latching means for said releasable means having a latching surface engaging said releasable means, a bimetallic member heated in response to the flow of current through the breaker, a magnetic yoke connected to said latching surface, a magnetic armature pivoted on said magnetic yoke, the magnetic circuit being energized in accordance with the current flowing through the breaker, said bimetallic member being mounted to move said magnetic yoke and armature bodily upon flexing of the bimetallic member through heating upon the occurrence of a sustained moderate current overload and moving the latching surface with the yoke to disengage the releasable means, the armature engaging said bimetallic member in its magnetically attracted movement toward the yoke so as to effect movement of the yoke thereafter from the pivotal mounting of the armature thereon, the yoke movement occurring with a substantially prying action about the armature-bimetallic member engagement to effect movement of the latching surface to unlatching position.

5. In an automatic electric circuit breaker having separable contacts and means releasable to effect automatic separation of said contacts, current responsive latching means for said releasable means having a latching surface engaging said releasable means, a bimetallic member connected in series circuit with the contacts so as to be traversed by the current passing through the breaker, a magnetic yoke connected to said latching surface and embracing the bimetallic member so as to be energized by the current flowing through the bimetallic member, a magnetic armature pivoted on said magnetic yoke, said bimetallic member flexing on being heated by a sustained moderate current overload to move the yoke and armature bodily to move the latching surface to unlatching position, said armature engaging said bimetallic member as an abutment in its magnetically attracted movement toward the yoke upon the occurrence of heavy overload and short circuit currents so as to effect movement of the yoke thereafter from the pivotal mounting of the armature thereon, the yoke movement occurring with a substantially prying action about the armature-bimetallic member engagement in the magnetic tripping operation.

6. In an automatic electric circuit breaker having separable contacts and means releasable to effect automatic separation of said contacts, current responsive latching means for said releasable means comprising a pivotally mounted latching member having a latching surface engaging said releasable means, a bimetallic member heated in response to the flow of current through the breaker and connected to rotate said latching member to move the latching surface to unlatching position upon the occurrence of a sustained moderate current overload, a magnetic yoke supported on said latching member for rotation therewith, a magnetic armature pivoted on said magnetic yoke, the magnetic circuit being energized in accordance with the current flowing through the breaker, and an abutment engageable by the armature as it is magnetically attracted toward the yoke upon the occurrence of heavy overload and short circuit currents so as to effect rotation of the yoke and latching member thereafter from the pivotal mounting of the armature on the yoke, the yoke rotation occurring with a substantially prying action about the armature-abutment engagement to effect rotation of the latching surface on the latching member into unlatching position.

7. In an automatic electric circuit breaker having separable contacts and means releasable to effect automatic separation of said contacts, current responsive latching means for said releasable means comprising a pivotally mounted latching member having a latching surface engaging said relasable means, a bimetallic member heated in response to the flow of current through the breaker and connected to rotate said latching member to move the latching surface to unlatching position upon the occurrence of a sustained moderate current overload, a magnetic yoke supported on said latching member for ro-

tation therewith, a magnetic armature pivoted on said magnetic yoke, the magnetic circuit being energized in accordance with the current flowing through the breaker, said bimetallic member being positioned to be engaged by the armature in its magnetically attracted movement toward the yoke upon the occurrence of heavy overload and short circuit currents so as to effect rotation of the yoke and latching member thereafter from the pivotal mounting of the armature on the yoke and the rotation of the armature about its engagement with the bimetallic member.

8. In a multipole automatic electric circuit breaker having separable contacts in each of the breaker poles and means releasable to effect automatic separation of said contacts, current responsive latching means for said releasable means comprising a pivotally mounted latching member common to all the breaker poles and having a latching surface thereon engaging said releasable means, a plurality of bimetallic members each heated individually in accordance with the flow of current through one of the breaker poles and each connected to rotate the latching member and latching surface into unlatching position upon the occurrence of a sustained, moderate current overload to its respective pole, a plurality of magnetic yokes mounted upon said common latching member and each energized in accordance with the current flow through one of the breaker poles, a magnetic armature pivoted on each of the magnetic yokes and an abutment engageable by each of the armatures in its magnetically attracted movement toward its associated yoke so as to effect rotation of the associated yoke and of the common latching member as the attracted armature rotates about its engagement with the abutment.

9. In a multipole automatic electric circuit breaker having separable contacts in each of the breaker poles and means releasable to effect automatic separation of said contacts, current responsive latching means for said releasable means comprising a pivotally mounted latching member common to all the breaker poles and having a latching surface thereon engaging said releasable means, a plurality of bimetallic members each heated individually in accordance with the flow of current through one of the breaker poles and each connected to rotate the latching member and latching surface into unlatching position upon the occurrence of a sustained, moderate current overload to its respective pole, a plurality of magnetic yokes mounted upon said

common latching member and each energized in accordance with the current flow through one of the breaker poles, a magnetic armature pivoted on each of the magnetic yokes, each of said bimetallic elements being associated with one of the magnetic armatures so as to be engaged thereby as an abutment as the associated armature is magnetically attracted toward the yoke upon the occurrence of heavy overload and short circuit currents, the yoke associated with the attracted armature and the latching member being rotated into unlatching position as the attracted armature rotates about its engagement with its associated bimetallic member.

10. In a multipole automatic electric circuit breaker having separable contacts in each of the breaker poles and means releasable to effect automatic separation of said contacts, current responsive latching means for said releasable means comprising a pivotally mounted latching member common to all the breaker poles and having a latching surface thereon engaging said releasable means, a bimetallic member connected in series circuit with each pole of the circuit breaker so as to be heated in response to the flow therethrough, a magnetic yoke for each of the breaker poles, all mounted upon the common latching member and each embracing one of the bimetallic members so as to be magnetically energized in accordance with the current flowing therethrough, a magnetic armature pivotally mounted on each of said magnetic yokes, said bimetallic members being connected to rotate the magnetic yokes, armatures and the common latching member bodily into unlatching position upon the occurrence of sustained, moderate current overloads causing flexing of the bimetallic members by the heat developed therein, said bimetallic members being positioned in the paths of movement of the armatures as they are magnetically attracted toward their associated yokes so as to effect rotation of the yokes and common latching member as an attracted armature rotates about its point of engagement with its associated bimetallic member so that the yoke and latching member movement occurs with a substantially prying action as an armature is magnetically attracted to its associated yoke upon the occurrence of heavy overload or short circuit currents.

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RALPH H. KINGDON.

No references cited.

Certificate of Correction

Patent No. 2,536,812 January 2, 1951

JOHN G. JACKSON ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 2, line 2, after the reference numeral "2" insert *formed*; line 27, after the word "about" insert *hubs*; column 8, line 26, after "flow" insert *of current*;

and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 20th day of February, A. D. 1951.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.

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