Jan. 24, 1939. W. REXFORD 2,144,741

OVERLOAD CIRCUIT BREAKER

Filed Dec. 10, 1935

Fig. 1.

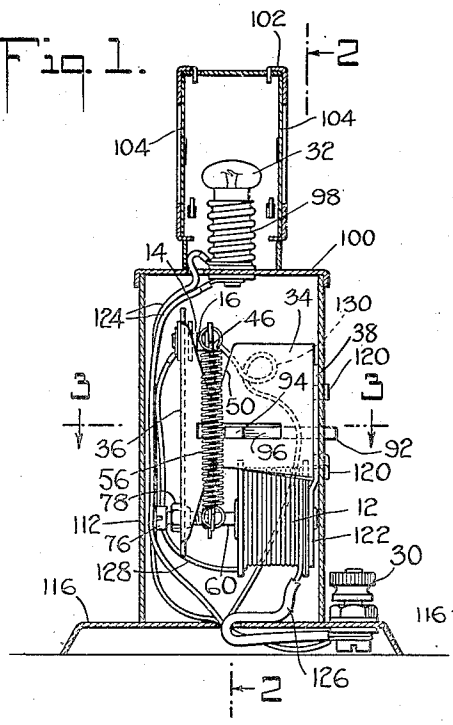


Fig. 3.

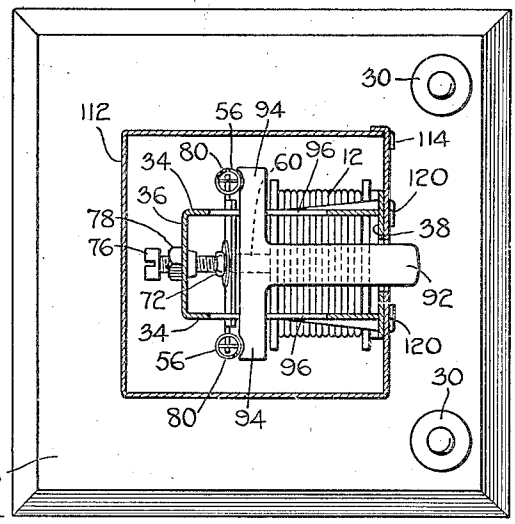


Fig. 2.

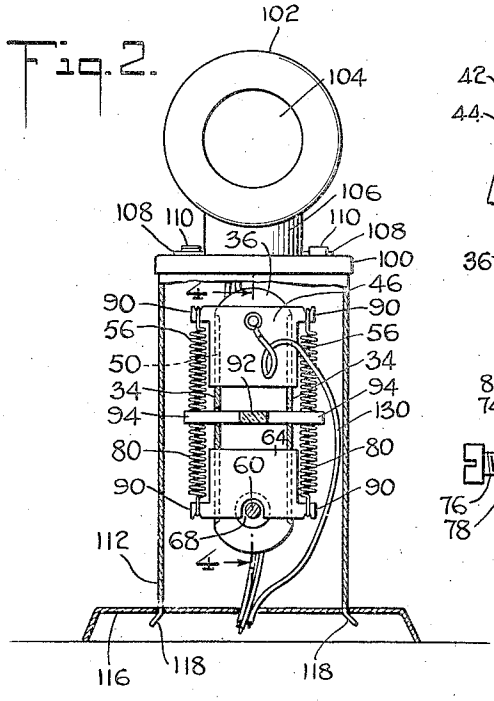


Fig. 4.

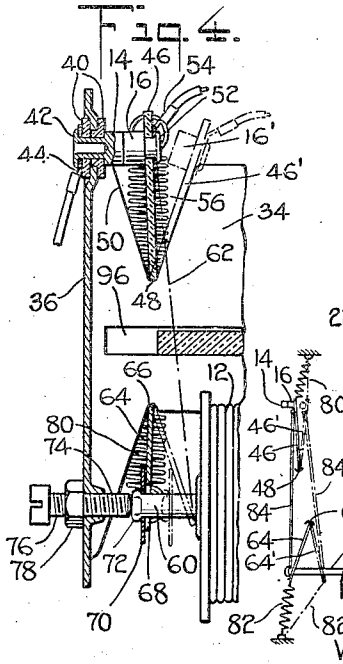


Fig. 5.

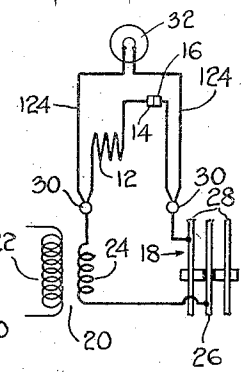


Fig. 6.

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Patented Jan. 24, 1939 2,144,741

UNITED STATES PATENT OFFICE

2,144,741

OVERLOAD CIRCUIT BREAKER

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Application December 10, 1935, Serial No. 53,701

10 Claims. (Cl. 200—111)

This invention relates to circuit breakers, and more particularly to an overload circuit breaker for low voltage circuits, particularly electrically operated toys, for example toy railroads.

The object of the present invention is to generally improve circuit breakers of this character. More particular objects are to insure abrupt instantaneous wide opening of the contacts when the circuit breaker is tripped; to greatly simplify the necessary structure and thereby lessen its manufacturing cost; to insure sensitive response; to make the sensitivity adjustable; and to provide restoring mechanism which is simple, effective and dependable.

To the accomplishment of the foregoing and other objects which will hereinafter appear, my invention consists in the circuit breaker elements and their relation one to the other as hereinafter are more particularly described in the specification and sought to be defined in the claims.

The specification is accompanied by a drawing in which:

Fig. 1 is a section taken in elevation through a circuit breaker embodying features of my invention;

Fig. 2 is a transverse section taken in elevation in the plane of the line 2—2 of Fig. 1;

Fig. 3 is a horizontal section taken in the plane of the line 3—3 of Fig. 1;

Fig. 4 is an enlarged section through the operating mechanism and is taken in the plane of the line 4—4 of Fig. 2;

Fig. 5 is a wiring diagram for the circuit breaker; and

Fig. 6 is a schematic diagram of a modification and is explanatory of the invention.

Referring to the drawing, and more particularly to Fig. 5, the circuit breaker is conventional in comprising a low impedance coil 12 and a pair of relatively movable contacts 14 and 16 which are connected in series with a main or load current, the coil 12 being associated with mechanism adapted to open or separate the contacts 14 and 16 when the current flowing through the coil is excessive. In the present case the circuit breaker is used in connection with an electrically operated toy railroad, a fragment of the track of which is shown at 18. The railroad is energized by a suitable step-down transformer 20, the primary 22 of which is connected to an ordinary household lighting circuit, while the secondary 24 is connected at one end to a third rail 26 and at the other end to the grounded or wheel-bearing rails 28. The circuit breaker is provided with binding posts 30 which are connected in series with either leg of the wiring between the transformer secondary 24 and the track 18. If desired, a warning signal lamp 32 may be connected in parallel with the circuit breaker, that is, between the binding posts 30 as shown, the said lamp being extinguished when contacts 14 and 16 are closed because the resistance of coil 12 is negligible compared with the resistance of the lamp. Upon overload or short-circuit, however, when contacts 14 and 16 are separated, the lamp 32 is energized thus indicating the existence of a short-circuit which should be investigated and eliminated.

Referring now to Figs. 1 through 4 of the drawing, the circuit breaker mechanism is mounted on a frame comprising a piece of sheet metal bent to U-shaped section and thus forming side walls 34 and a front wall 36. The frame is completed by a separate plate or back wall 38. Contact 14 is here shown as a stationary contact and is insulatedly mounted at the upper end of front plate 36. As is best shown in Fig. 4, the outer end of the contact is passed through insulation washers 40 and is riveted at 42 over a connection lug 44. The mating contact 16 is movable, and for this purpose is mounted at the upper end of a lever or vane 46 which is pivoted at 48. For simplicity the desired pivotal relation is obtained by forming V-shaped notches or openings 50 in the upper ends of side plates 34, and vane 46 is made greater in width than the distance between the side plates and is disposed with its lower edge in the V-shaped openings. Contact 16 is insulated with respect to the main frame or structure and this is most readily accomplished by making vane 46 of a slab of insulation such as fibre board, synthetic resinous material or the like. The contact is secured to slab 46 by riveting the same in place at 52 (see Fig. 4), a suitable connection lug 54 being disposed behind the rivet head.

To obtain rapid opening of contacts 14 and 16 the vane is placed in unstable equilibrium by resilient means 56, the force of which is exerted generally in the direction of vane 46 and toward fulcrum 48. Contacts 14 and 16 are closed when the vane is on one side of dead center and are abruptly opened when the vane is moved to the other side of dead center.

This result is accomplished by means of a solenoid 12 which influences an axially reciprocable core 60. The lower end of resilient means 56 is connected to core 60 and the parts are so proportioned that when the solenoid is sufficiently energized, the core is shifted from the solid to the

dotted line position shown in Fig. 4, thereby shifting the line of force of resilient means 56 to the broken line position 62 which, it will be noted, falls outside the fulcrum 48, thereby tripping the vane 46 past dead center. Because of the influence of resilient means 56, the vane is abruptly tripped to the fully opened position shown in broken lines in Fig. 4. The limiting position when open is readily determined by the walls of V-shaped opening 50. The limiting position when closed is of course determined by meeting of contacts 14 and 16, and is preferably such that the vane is beyond dead center and in stable condition but only slightly beyond dead center so that it is readily tripped.

In order to take the reaction of resilient means 56 and in order to assist operation of solenoid 12, and most importantly, in order to obtain an exceedingly sudden opening of contacts 14 and 16, thereby minimizing arcing at the contacts, I find it desirable to place the lower end also in unstable equilibrium. To this end I provide a second pivoted lever or vane 64 which as here illustrated is generally in alignment with the primary vane or lever 46 but is pointed in opposite direction. The side walls 34 of the frame are cut away at the lower end to form notched openings 66 which receive the upper or inner edge of vane 64. This vane may be and preferably is made of metal. Its lower or outer edge is recessed at 68 (Fig. 2) to receive the solenoid core 60. The end of the core is preferably provided with a thin sheet metal washer 70 (Fig. 4) held in place by riveting or upsetting the end of the core, as shown at 72. The forward limiting position of secondary lever 64 and core 60 is determined by a stop 74 which is preferably adjustable as by using a screw 76 threadedly received in the front wall 36 of the frame and locked in adjusted position by a suitable lock nut 78. Secondary lever 64 is itself placed in unstable equilibrium at dead center by the use of a secondary resilient means 80 which in the present case is the lower end of the same pull spring which acts as the primary resilient means 56 for primary lever 46.

It will be understood that the forward limiting position of vane 64 is at one side of dead center and that solenoid 12 when overloaded draws vane 64 to and slightly beyond dead center, whereupon it is abruptly pulled all the way over to the broken line position shown in Fig. 4 by secondary resilient means 80, at which time the line of connection 62 between secondary and primary vanes falls beyond fulcrum 48, thereby moving vane 46 beyond dead center, the movement of vane 46 then being completed by means of the primary resilient means 56. It is necessary to understand that in the present embodiment of the invention, a single pull spring 56 fulfills three entirely separate and independent functions: it acts as a trip spring for the upper or primary vane 46; it also acts as a trip spring for the lower or secondary vane 64; it further acts as a connecting link between the two vanes, for which last-named function it would not be essential to use resilient means. These three functions will be made clear by reference to Fig. 6 which schematically illustrates a modified form of the invention in which separate trip springs and connecting link are employed. For clarity the springs have been changed from pull springs to push springs.

Referring to Fig. 6, it will be seen that movable contact 16 is mounted on a primary lever 46 pivoted at 48 and that the solenoid core 60 is connected to a secondary lever 64 pivoted at 66 much as previously described. In the present case, however, primary lever 46 has associated with it a separate resilient means 80, while secondary lever 64 has associated with it secondary resilient means 82. Levers 46 and 64 are connected by a suitable link 84. The springs 80 and 82 are shown as push springs, but could of course be separate pull springs anchored between pivots 48 and 66. When solenoid coil 12 is overloaded it attracts core 60 thereby moving lever 64 beyond dead center, whereupon it is quickly tripped by spring 82 to the dotted line position 64' at which time the link 84' lies outside of pivot 48 and consequently moves primary lever 46 to and beyond dead center. The preliminary opening of the contacts is abrupt because of the suddenness with which the movement of secondary lever 64 is completed, and the full or wide opening of the contacts is ensured by the primary trip spring 80.

In the preferred form of the invention shown in Figs. 1 through 4, the functions of trip springs 80 and 82 and of connecting link 84 are all combined in a single pull spring, the upper and lower ends of which may be thought of as separate trip springs, while the entire spring acts as a connecting link between the primary and secondary levers. Of course, these functions may be separated even when using pull springs, and conversely, may be combined when using a push spring, as for example, by inverting the levers shown in Fig. 6 to place the pivots at the outer ends, and disposing a single compression spring between the movable inner ends, the levers then preferably being disposed on opposite sides of dead center rather than on a common side of dead center.

Reverting now to Figs. 1 through 4, the common pull spring is preferably made in duplicate, one spring being disposed on each side of the frame. The vanes 46 and 64 are provided with outwardly projecting arms 90 at their outermost ends over which the pull springs are hooked. The arrangement is thus made symmetrical, and there is no interference with transverse or bodily movement of the springs from one side to the other of dead center, for the vanes and fulcrum points thereof are disposed entirely between the springs. The springs incidentally operate to hold the vanes on their fulcrum seats and thus function to hold movable parts in assembled relation. To restore the parts to closed circuit condition after the circuit breaker has been tripped, I provide a manually operable plunger 92 which is T-shaped as is best shown in Fig. 3, the inner end being provided with a pair of sidewardly extending arms 94. These pass through appropriate guide slots 96 in the side walls of the frame. The ends of arms 94 are disposed at the sides of the springs 56, 80, and it will be evident that by pushing plunger 92 forwardly, the springs are moved bodily forwardly and carry the upper and lower vanes past dead center to the stable initial or closed circuit position. The slots 96 in the side walls of the frame are preferably carried forwardly a sufficient distance so that plunger 92 can actually bend the springs forwardly a substantial distance further than the limiting positions of the vanes, thus insuring movement beyond dead center. When the circuit breaker is tripped or opened, the resulting transverse or bodily movement of the springs causes the plunger to be moved outwardly and this may itself be used as an indication that the circuit breaker has been tripped.

However, as a further indication, the lamp 32

previously referred to may be employed, this lamp preferably being received in a socket 98 mounted at the center of a top wall 100 of the circuit breaker casing. Lamp 32 is preferably surrounded by a housing 102 having transparent windows 104. The neck 106 of housing 102 may be provided with outwardly extending arms 108 slidably received beneath retained lugs 110. The housing may be oscillated to free arms 108 and then removed for replacement of the lamp should it become burned out.

The circuit breaker mechanism is housed within a square upright casing comprising a side 112 made of a single piece of sheet metal, the meeting edges of which are connected by suitable tongue and slot joints 114 (Fig. 3). Side wall 112 is secured to an appropriate base 116 by suitable tongue and slot connections 118 (Fig. 2) and the top wall 100 is similarly secured to the side wall 112 by tongue and slot connections or equivalent construction.

The circuit breaker frame is secured to one face of side wall 112 preferably by using tongue and slot connections 120 (Figs. 1 and 3), the tongues preferably passing through slots in the back wall 38 of the frame and thence through the housing wall after which they are bent sidewardly. The back wall 38 of the frame is not essential but it is preferred to use the same in order to mount solenoid 12 thereon. As will be seen by reference to Fig. 1, the lower end of back wall 38 is displaced inwardly slightly as shown at 122, and the rear end of the solenoid spool is passed through wall 122 and riveted in place. With this construction the circuit breaker mechanism is a complete unit removable from the housing and it is thus readily possible to mount the circuit breaker in any desired form of housing and in any desired position. It should be understood that the circuit breaker may be disposed horizontally instead of vertically, for example, in which case plunger 92 will project vertically from the top of the casing and may itself be used as the sole warning signal to indicate that the circuit breaker has opened.

Binding posts 30 are mounted on base 116, and the manner in which the wiring within the unit duplicates the arrangement shown in Fig. 5, will be clear from examination of the drawing, the lamp 32 being connected by relatively light flexible leads 124 to binding posts 30; one end of solenoid 12 being connected to one of the binding posts 30 by a lead 126; the other end of solenoid 12 being connected to stationary contact 14 by a lead 128; and movable contact 16 being connected to the other binding post by a lead 130.

It is believed that the mode of constructing and using, as well as the operation and many advantages of my improved overload circuit breaker, will be apparent from the foregoing detailed description thereof. It will also be apparent that while I have shown and described the invention in a preferred form, many changes and modifications may be made in the structure disclosed, without departing from the spirit of the invention defined in the following claims.

I claim:

1. An overload circuit breaker comprising a stationary contact, a movable contact mounted on a pivoted lever, a pull spring having one end connected to said lever and exerting a force in a direction along the lever toward the pivot thereof thereby placing the lever in unstable equilibrium, and means including a series-connected solenoid having a core movable for a substantial distance in a direction transverse of the lever and spring, said core being located at and connected to the other end of said pull spring for moving the other end of said spring from a position where its line of force lies along one side of the pivot to a new position where its line of force falls on the other side of the pivot, whereby the movable contact is abruptly moved from closed to open position, and manually operable means bearing against said spring at an intermediate point for restoring the parts to initial position.

2. A circuit breaker comprising a stationary contact, a movable contact mounted on a pivoted lever, a pull spring connected to said lever and exerting a force directed generally in the direction of the lever toward the pivot in order to place the lever in unstable equilibrium, means including a solenoid core movable for a substantial distance in a direction transverse of the lever and spring, said core being located at and connected to the other end of said pull spring and being operated by a solenoid for shifting the other end of said pull spring transversely of the lever to either side of dead center, said means itself including a pivoted lever pointed in generally opposite direction and itself placed in unstable equilibrium by the aforesaid pull spring, and manually operable restoring means including a member movable against said pull spring to restore the parts to the normal or closed circuit position.

3. An overload circuit breaker for electrically operated toys or like low voltage circuits, said circuit breaker comprising a stationary contact, a movable contact mounted on a pivoted lever, a secondary pivoted lever approximately in alignment with the primary lever, resilient means interconnecting said pivoted levers and normally urging the same toward the fulcrums thereof and thereby placing the same in unstable equilibrium at dead center, a series-connected solenoid having a movable core connected to said secondary lever but not connected to said primary lever, the parts being so arranged that when the solenoid moves the seondary lever from normal position past dead center to overload position the aforesaid resilient means abruptly moves the primary lever past dead center thereby changing the contact from closed to open position, stop means to determine the normal position of the secondary lever in order to control the sensitivity of the circuit breaker, and manually operable means bearing against said pull spring to restore the parts to initial position.

4. An overload circuit breaker for electrically operated toys or like low voltage circuits, said circuit breaker comprising a stationary contact, a movable contact mounted on a pivoted lever, a seondary pivoted lever approximately in alignment with the primary pivoted lever but pointed in opposite direction with the pivots toward one another, a pull spring interconnecting said pivoted levers and normally urging the same toward the fulcrums thereof and thereby placing the same in unstable equilibrium, a series-connected solenoid having a movable core connected to said secondary lever but not connected to said primary lever, the parts being so arranged that when the solenoid moves the secondary lever past dead center the aforesaid pull spring abruptly moves the primary lever past dead center thereby changing the contact from closed to open position, and manually operable means bearing against said pull spring to restore the parts to initial position.

5. An overload circuit breaker for electrically

operated toys or like low voltage circuits, said circuit breaker comprising a stationary contact, a movable contact mounted on a pivoted lever, a secondary pivoted lever approximately in alignment with the primary pivoted lever but pointed in opposite direction, resilient means interconnecting said pivoted levers and normally urging the same toward the fulcrums thereof and thereby placing the same in unstable equilibrium at dead center, a series-connected solenoid having a movable core connected to said secondary lever but not connected to said primary lever, the parts being so arranged that when the solenoid moves the secondary lever past dead center the aforesaid resilient means abruptly moves the primary lever past dead center thereby changing the contact from closed to open position, and means to adjust the sensitivity of the circuit breaker by determining the limiting position of the secondary lever.

6. A circuit breaker comprising spaced frame plates having oppositely directed V-shaped openings at opposite ends thereof, a flat vane of insulation material disposed in one of said openings and oscillatable therein, a stationary contact on the frame, a movable contact on said vane, a secondary vane disposed at the opposite end of the frame and oscillatable in the opening at that end, a pair of pull springs extending between the outer ends of the vanes at opposite sides of the frame, a solenoid having a movable core connected to the secondary vane and adapted to move the same from a position at one side of dead center to a position at the opposite side of dead center, the latter limiting position being such that the line of force of the aforesaid springs falls beyond the fulcrum point of the primary vane, whereupon said primary vane is very abruptly pulled from a position at one side of dead center to a position on the other side of dead center in order to open the aforesaid contacts, said pull springs being the sole means for moving said primary vane from closed circuit position to open circuit position.

7. A circuit breaker comprising spaced frame plates having oppositely directed V-shaped openings at opposite ends thereof, a flat vane of insulation material disposed in one of said openings and oscillatable therein, a stationary contact on the frame, a movable contact on said vane, a secondary vane disposed at the opposite end of the frame and oscillatable in the opening at that end, a pair of pull springs extending between the outer ends of the vanes at opposite sides of the frame, a solenoid having a movable core connected to the secondary vane and adapted to move the same from a position at one side of dead center to a position at the opposite side of dead center, the latter limiting position being such that the line of force of the aforesaid springs falls beyond the fulcrum point of the primary vane, whereupon said primary vane is very abruptly pulled from a position at one side of dead center to a position on the other side of dead center in order to open the aforesaid contacts, said pull springs being the sole means for moving said primary vane from closed circuit position to open circuit position, and restoring means to restore the circuit breaker to closed condition, said restoring means including a member movable against the aforesaid springs to move both primary and secondary vanes to one side of dead center.

8. A circuit breaker comprising spaced frame plates having oppositely directed V-shaped openings at opposite ends thereof, a flat vane of insulation material disposed in one of said openings and oscillatable therein, a stationary contact on the frame, a movable contact on said vane, a secondary vane disposed at the opposite end of the frame and oscillatable in the opening at that end, a pair of pull springs extending between the outer ends of the vanes at opposite sides of the frame, a solenoid having a movable core connected to the secondary vane and adapted to move the same from a position at one side of dead center to a position at the opposite side of dead center, the latter limiting position being such that the line of force of the aforesaid springs falls beyond the fulcrum point of the primary vane, whereupon said primary vane is very abruptly pulled from a position at one side of dead center to a position on the other side of dead center in order to open the aforesaid contacts, said pull springs being the sole means for moving said primary vane from closed circuit position to open circuit position, and means to adjust the sensitivity of the circuit breaker by determining a limiting position of the secondary vane.

9. A circuit breaker comprising spaced frame plates having oppositely directed V-shaped openings at opposite ends thereof, a flat vane of insulation material disposed in one of said openings and oscillatable therein, a stationary contact on the frame, a movable contact on said vane, a secondary vane disposed at the opposite end of the frame and oscillatable in the opening at that end, a pair of pull springs extending between the outer ends of the vanes at opposite sides of the frame, a solenoid having a movable core connected to the secondary vane and adapted to move the same from a position at one side of dead center to a position at the opposite side of dead center, the latter limiting position being such that the line of force of the aforesaid springs falls beyond the fulcrum point of the primary vane, whereupon said primary vane is very abruptly pulled from a position at one side of dead center to a position on the other side of dead center in order to open the aforesaid contacts, said pull springs being the sole means for moving said primary vane from closed circuit position to open circuit position, restoring means to restore the circuit breaker to closed condition, said restoring means including a member movable against the aforesaid springs intermediate their ends, to move both primary and secondary vanes to the closed side of dead center, and adjusting means to determine the sensitivity of the circuit breaker.

10. A circuit breaker comprising spaced frame plates having oppositely directed V-shaped openings at opposite ends thereof, a flat vane of insulation material disposed in one of said openings and oscillatable therein, a stationary contact on the frame, a movable contact on said vane, a secondary vane disposed at the opposite end of the frame and oscillatable in the opening at that end, a pair of pull springs extending between the outer ends of the vanes at opposite sides of the frame, a solenoid having a movable core connected to the secondary vane and adapted to move the same from a position at one side of dead center to a position at the opposite side of dead center, the latter limiting position being such that the line of force of the aforesaid springs falls beyond the fulcrum point of the

primary vane, whereupon said primary vane is very abruptly pulled from a position at one side of dead center to a position on the other side of dead center in order to open the aforesaid contacts, said pull springs being the sole means for moving said primary vane from closed circuit position to open circuit position, restoring means to restore the circuit breaker to closed condition, said restoring means including a member movable against the aforesaid springs to move both primary and secondary vanes to the closed side of dead center, and adjusting means to determine the sensitivity of the circuit breaker, said adjusting means including a screw determining the limiting position of the secondary vane on the closed side of dead center.

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