Oct. 19, 1937. U. A. COMBI 2,096,608

ELECTRICAL CIRCUIT BREAKER

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Fig. 1.

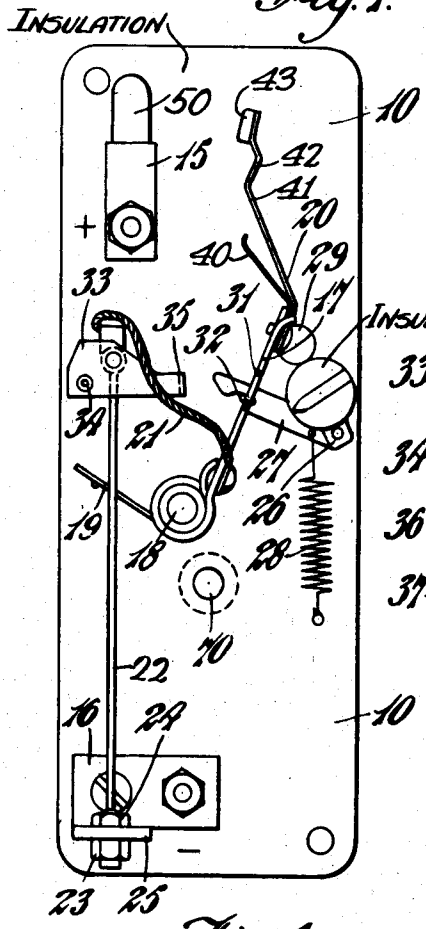


Fig. 2.

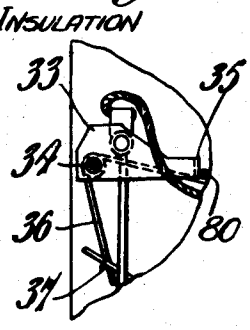


Fig. 3.

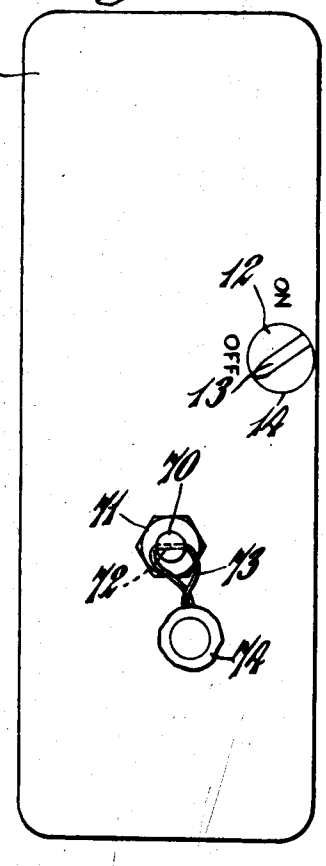


Fig. 4.

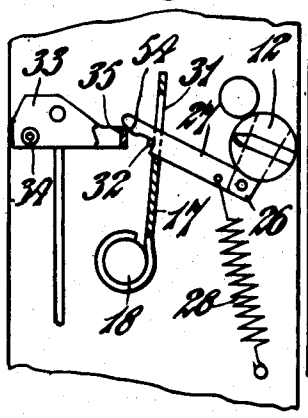


Fig. 5.

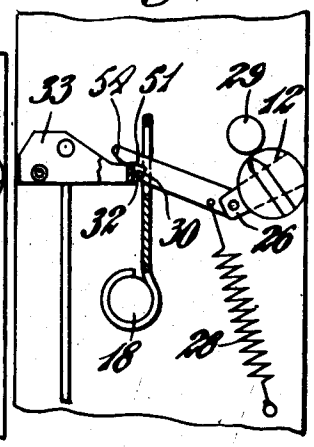
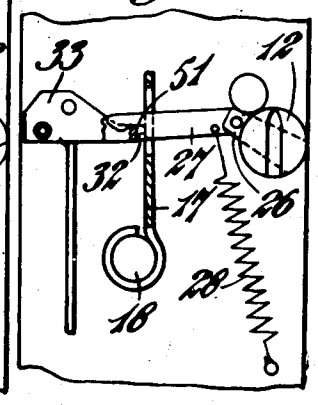


Fig. 6.



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Fig. 8.

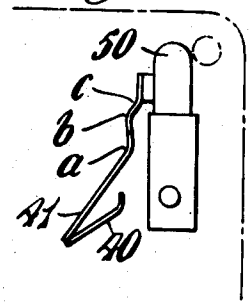


Fig. 9.

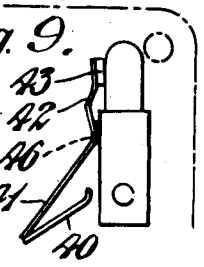


Fig. 10.

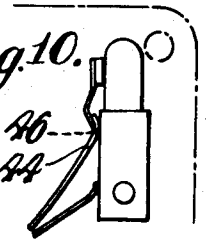
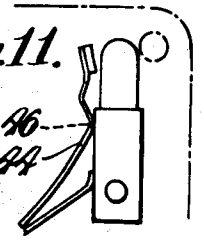


Fig. 11.



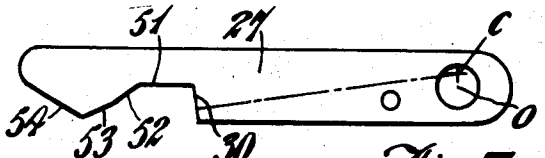


Fig. 7.

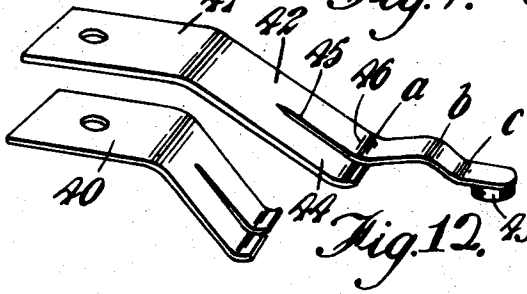


Fig. 12.

Fig. 13.



Fig. 14.



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UNITED STATES PATENT OFFICE

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ELECTRICAL CIRCUIT BREAKER

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Application July 28, 1936, Serial No. 92,970
In Great Britain July 13, 1935

6 Claims. (Cl. 200—116)

This invention relates to electrical circuit breakers and more particularly to circuit breakers wherein the circuit is broken in response to a predetermined current overload.

One object of this invention is to provide circuit interrupting means of a simple, inexpensive and reliable character which, while possessing a desirable time lag on overloads within definite limits, is more critical to an overload of predetermined value than is usual with devices of similar character hitherto known.

Another object of the invention is to provide a construction of circuit breaker which is adapted for use with advantage as a substitute for wire fuse devices in commercial and domestic electrical installations, thus saving time and trouble in re-establishing an electrical circuit which has been interrupted owing to overload.

A further object of this invention is to provide a relatively cheap electrical circuit breaker device which cannot easily be tampered with, nor be rendered inoperative by the user inadvertently during operation, nor be rendered inoperative owing to long periods of inaction.

A still further object of this invention is to provide circuit breaking means capable of limiting consumption in a safe, reliable and practical manner.

In order that the nature of the present invention may be better understood one embodiment shown by way of example in the accompanying drawings will be described hereinafter from which further objects of the invention will be apparent. In the drawings:—

Fig. 1 is a front elevation of a thermally controlled form of the improved circuit breaker with its cover removed.

Fig. 2 is a fragmentary view showing a simple modification of a detail.

Fig. 3 is a front elevation of the device of Fig. 1 with all the parts enclosed by a cover which can be sealed in place;

Figs. 4, 5 and 6 are fragmentary views showing progressive stages of operation of the toggle mechanism;

Fig. 7 is a detail view of one of the toggle elements drawn to an enlarged scale;

Figs. 8, 9, 10 and 11 are fragmentary rear views showing progressive stages of operation of the contacts while the mechanism is being "set";

Fig. 12 is a detail rear perspective view of the compound contact blade showing the parts relatively displaced to facilitate description.

Figs. 13 and 14 are detail views showing the application of a luminous signal to the improved circuit breaker.

In the form of circuit breaker shown in the accompanying drawings the parts are mounted on a base 10 of insulating material and enclosed by a cover 11, also of insulating material. A rotatable operating knob 12 for the device is suitably in the form of an indicator 13, which projects through an aperture 14 in said cover and which is operable manually between positions indicated by "on" and "off", respectively.

Mounted on the base 10 are stationary terminals 15, 16 which are connected with the conductors of the circuit to be controlled. Terminal 15 is in the form of a contact, as hereinafter described.

Co-operating with the two terminals 15, 16 is a movable contact arm 17 mounted to pivot about a pin 18, said arm tending to be held in an inoperative circuit breaking position by means of a spiral spring 19.

The actual contact blade assembly denoted generally by 20 is of compound character so as to be self-cleaning in action and so as to avoid deleterious arcing or sparking. This will be more fully described later.

Contact arm 17 is connected by a flexible conductor 21 with the free end of a bar or rod 22, the other end of which is in turn electrically connected to terminal 16. Bar 22 in this embodiment is substantially rigid and for adjustment of its length it is threaded at the end connected to terminal 16 and is adapted for longitudinal displacement by means of adjusting nut 23 and lock nut 24 co-operating with a lug 25 on terminal 16.

The operating knob or handle 12 is rotatably mounted on base 10 and carries within cover 11 a crank arm 26 pivotally connected to a link 27 to form a toggle mechanism. Toggle link 27 constantly tends to assume its collapsed position because of a spring 28, while a stop 29 is provided to limit the upward movement of crank arm 26 above its dead centre.

Toggle link 27 is at its free end formed as a detent provided with a shoulder 30 adapted to contact with switch arm 17. The said end of link 27 passes through a slot 31 formed in arm 17 so as to locate said link in its proper position relatively to the switch arm 17 and its shoulder 30 abuts against a cross-bar 32 disposed transversely of slot 31.

From the above description it will be clear that rotation of operating handle 12 will extend the toggle mechanism formed by crank arm 26 and link 27 and that shoulder 30 of said link will

move contact arm 17 about its pivot 18 to cause contact between the contact blade assembly 20 and contact 15. Under normal operating conditions contact arm 17 is held in its contact making position by said toggle mechanism 26, 27 with the detent end of link 27 disposed adjacent a trigger element 33, which is mounted on base 10, to pivot about a pin 34. The trigger 33 is maintained in its adjacent position by the rod 22 which is hingedly connected to said trigger at a point intermediate the pivot 34 and the operative edge 35 of the trigger.

In the embodiment shown in Figs. 1, 4, 5 and 6 the rod 22 forms an electro-thermal overload control device in conjunction with trigger 33. Rod 22 is for this purpose made of a metal or alloy having a suitable specific electrical resistance for example, nickel or alloys thereof, such as nickel-chrome or nickel manganese and is adapted by its known expansion due to the load current carried thereby to determine the position of trigger element 33.

In Fig. 1 the rod 22 connected directly to trigger 33 acts when heated so as to expand in an upward direction and due to mechanical and frictional resistance of the toggle components, said rod will be in compression when displacing trigger 33 around its pivot 34 against said resistance. As the rod will be at relatively high temperature in the case of overload it might tend to bend slightly and, therefore, it may be advisable in practice to utilize the modification shown in Fig. 2, which increases the sensitivity of the control and is particularly adapted for overload controls operative by small overload currents wherein the diameter of the bar or wire 22 is relatively small. In Fig. 2, trigger 33 is stressed by a torsional spring 36 which tends to rotate trigger 33 about its pivot 34 in a counter-clockwise direction. To this end spring 36 wound around pivot 34 abuts with one end against a stationary pin 37 and with the other against the underside of the operative edge 35 of trigger 33. The rod 22, hingedly connected to trigger 33 as in the construction of Fig. 1, limits the pivotal movement of the trigger element and is thus in slight tension. A stop 80 is provided to limit the movement of the spring 36 after actuation of trigger 33 in order to relieve the rod 22 if very hot of any stress due to the action of the spring 36.

The compound contact assembly 20 of switch 17 comprises a current carrying contact 40 and an arcing extension 41. Contact 41 is bifurcated by a slot 45 (see Fig. 12) to form an arm 42 carrying a metal contact brush 43 and an auxiliary contact brush 44. The arm 42 is bent as indicated at *a*, *b* and *c* to form a contact face 46 in tandem with the brush 43.

The progressive stages of contact effected during operation is shown in Figs. 8, 9, 10 and 11 and is as follows:—

When the contact arm 17 is moved from the "off" position shown in Fig. 1 the first contact takes place between the metal brush 43 and a carbon or other extension 50 of fixed contact 15 as shown in Fig. 8. Further movement of contact arm 17 brings the auxiliary brush 44 into engagement with the fixed contact 15 without, however, any engagement between the contact area 46 and contact 15 firstly taking place since the upward pressure due to the contact of brush 43 and extension 50 flexes the arm 42 and raises the area 46 away from the plane of the brush 44, as shown in Fig. 9. Continued closing movement brings the area 46 into contact with fixed contact 15 and subsequent movement carries the current carrying brush 40 into engagement with the fixed metal contact 15, as shown in Fig. 10. Finally the completed movement of arm 17 causes the end of arm 42, carrying the brush 43 to rock about the bend *a* and to raise the brush 43 out of contact with the extension 50, as shown in Fig. 11, the slit 45 rendering the arm 42 sufficiently flexible to effect such separation.

When the contact arm 17 moves from the closed position to the "off" position the above described sequence of movements takes place in the reverse order. It will thus be seen that all pitting and burning of the metal due to sparking or arcing takes place at the auxiliary contacts 43, 44 and 46 and leaving the main contact 40 continuously clean and smooth to carry the normal load current. During normal operation with the contact arm 17 closed the brush 43 does not contact the carbon or other extension 50, thus avoiding all risk of abnormal rise in temperature due to faulty contact and the need for careful facing of the contacts 43 and 50. The arrangement provided is thus capable of use for considerable periods without attention and has the further advantage of allowing the main current carrying brush 40 to comprise as many laminations at necessary.

The formation of the toggle link 27 at the detent end is of considerable importance if maximum sensitiveness is to be obtained. Fig. 7 shows the link 27 on an enlarged scale and beyond the shoulder 30 are formed faces 51, 52, 53 and 54. The shoulder 30 itself is formed as an arc of a circle struck from a centre "C" located on a vertical line through the centre "O" comprising the pivotal axis of link 27 but displaced upwardly from said centre. This allows a reduction of the frictional effect of the shoulder against the cross-bar 32 and thus lessens the releasing effort.

The surface 51 which is intended to bear directly against the operative edge 35 of trigger 33 when the contact arm is in its closed position is located in the horizontal plane through the centre "O". The face 54 is inclined for the purpose of allowing displacement of the link 27 upwardly when the link is being moved during extension of the toggle according to the normal path of movement of the detent end of the link without, however, contacting with the operative edge 35 of the trigger 33 during normal load to an extent sufficient to release shoulder 30 from cross-bar 32.

The face 53 is formed so that it passes over the operative edge 35 of the trigger without affecting the relative positions of the cross-bar 32 and shoulder 30. For this purpose the face 52 is bevelled off to prevent cooperation between link 27 and the operative edge 35 at this stage.

During the closing movement of the contact arm 17, face 54 first contacts with edge 35, more or less, according to the length of rod 22 occasioned by the load and its original adjustment as shown in Fig. 4. Then the surface 35 travels across the edge 53 of the trigger without disturbing the relative positions of the cross-bar 32 and the shoulder 30, as shown in Fig. 5, while the axis of the crank arm 26 is in alignment with the axis of link 27 and edge 35. Continued movement of crank arm 26 then forces the face 51 into contact with the edge 35 as shown in Fig. 6 so that in the final set position face 51 bears against the edge 35 with the cross-bar 32 and shoulder 30 in sensitive engagement.

In operation the circuit breaker is moved to the closed or "set" position by rotating handle 12 to

the "on" position, thus spreading the toggle 26, 27 and causing the shoulder 30 to engage the cross-bar 32. This displaces the contact arm 17 and brings the contact 43 into engagement with the extension 50, with the subsequent movements of the auxiliary arm 44 and the contact area 46, as previously described, until the current carrying brush 40 contacts with the fixed contact 15 and the contact brush 43 moves out of contact with the extension 50. At this moment the circuit is established and the toggle is held extended. During this movement the faces of the detent end of link 27 have taken part in their responsive movements already described with the cross-bar 32 engaging that part of shoulder 30 according to the desired overload-time factor.

If an overload occurs through any cause trigger 33 is raised in consequence of the expansion of rod 22 and its operative edge 35 raises the link 27 until shoulder 30 is disengaged from cross-bar 32 when the contact arm is released and is moved to the right by the action of spring 19, thus breaking the circuit in the successive movement shown in Figs. 11, 10, 9, and 8, respectively. If the over load is comparatively small and persists for only a short period of time, the trigger edge 35 will not lift the link 27 sufficiently far to disengage shoulder 30 from cross-bar 32 owing to the time taken for the rod 22 to expand and operate the trigger, since the releasing action is dependent on the multiple function of the value of the overload and the duration thereof and can be adjusted by the setting of the adjusting nuts 23 and 24.

The device of the invention has been described in connection with single pole circuit breakers but obviously the invention can be applied to breakers having two or more poles by mere multiplication of the devices already described in connection with a single pole circuit breaker.

When the circuit breaker is of the single pole type it is immaterial whether the contact 17 and trigger 33 are formed of insulating material with the necessary electrical connection between the contact assembly 20 and the conductor 21 or otherwise and it is preferred in this case to use an all-metal construction, but when the device is provided with two or more control devices in a multipolar arrangement the said devices and their cooperating parts must obviously be electrically insulated from one another.

It is to be understood that if an attempt is made to reset the circuit breaker during the continuance of an overload, short circuit, or the like, the toggle link 27 is automatically tripped by the trigger edge 35 on the resetting movement, so that manual resetting cannot be effected until the current reaches normal value on closing the circuit.

In order to retain the cover 11 in position on the base 10, the cover is apertured so as to fit over a stud 70 mounted on the base 10 and having a holding nut 71 for securing the cover. The stud is preferably provided with a transverse channel 72 through which a wire 73 can be passed and have its ends secured by a seal 74 to prevent undesired tampering.

Further, the operating handle 12 of the circuit breaker may be coated on one side, as at 75, with a luminous paint as shown in Figs. 13 and 14 so that the position of setting of each individual device may readily be ascertained in the dark. In the case of an inoperative circuit breaker with its circuit opened the operating handle in the "off" position can be more readily observed due to the presence of the luminous paint which is clearly visible with the handle in that position.

What I claim is:

1. An electrical circuit breaker which includes a stationary contact having a metal contact block and an extension, a movable switch arm carrying contacts adapted to co-operate with said stationary contact to close the circuit and comprising a main current carrying brush co-operating with said metal contact block and an arcing brush, said latter brush being bifurcated to form an auxiliary brush and a flexible arm, a metal contact at the free end of said flexible arm adapted initially to contact said extension on closing movement of said switch arm and to flex said flexible arm and a projection intermediate the axis of said flexible arm adapted to contact said metal contact block on continued movement of said switch arm in order to rock said arm and to separate said metal contact from said extension when said main brush contacts said metal contact block, manually operable means for moving said switch arm and including a detent releasably engaging said arm, electrical overload motive device and means for transmitting movement of said overload device to said detent to cause disengagement of said detent from said arm and a consequent opening of said circuit.

2. An electrical circuit breaker which includes a stationary contact, a movable switch arm carrying at least one contact adapted to co-operate with said stationary contact to close the circuit, manually operable means for moving said switch arm and including a detent releasably engaging said arm, an electrical overload motive device comprising a rod in said electrical circuit adapted to expand longitudinally due to the heating effect of the current in said circuit and a pivoted element mounted to pivot in the direction of the longitudinal dimension of said rod in engagement with said rod and with said detent and positively actuated by the expansion of said rod responsive to an overload current to release said detent from said switch arm and to cause opening of said circuit.

3. An electrical circuit breaker which includes a stationary contact, a movable switch arm carrying at least one contact adapted to co-operate with said stationary contact to close the circuit, manually operable means for moving said switch arm and including a detent releasably engaging said arm, an electrical overload motive device comprising a rod in said electrical circuit adapted to expand longitudinally due to the heating effect of the current in said circuit, a pivoted element engaging said detent and in contact with said rod, said rod on expansion positively moving said pivoted element, spring means assisting the force of expansion of said rod to cause said pivoted element to release said detent from said switch arm, spring means moving said switch arm on said release into a position separating said contacts and means to relieve the tension of said first mentioned spring from said pivoted element immediately after release of said detent.

4. An electrical circuit breaker, which includes a stationary contact, a movable switch arm carrying at least one contact adapted to cooperate with said stationary contact to close the circuit, manually operable means for moving said switch arm into and out of its circuit closing position, and means to release automatically said switch arm from its circuit closing position in response to an electrical overload, including an electrical overload motive device comprising a rod in said electrical circuit adapted to expand longitudinally due to the heating effect of the current in said

circuit and arranged so that said expansion responsive to an overload current provides a positive actuating force for releasing said switch arm, said rod at the moment of release acting as a strut member and means to provide unconstrained expansion of said rod subsequent to said release.

5. An electrical circuit breaker, which includes a stationary contact, a movable switch arm carrying at least one contact adapted to cooperate with said stationary contact to close the circuit, manually operable means for moving said switch arm, comprising toggle mechanism including a crank and a detent pivotally connected to said crank and releasably engaging said arm and means to release automatically said detent from said switch arm in response to an electrical overload, including an electrical overload motive device comprising a rod in said electrical circuit adapted to expand longitudinally due to the heating effect of the current in said circuit and arranged so that said expansion responsive to overload current provides a positive actuating force for releasing said switch arm, said rod at the moment of release acting as a strut member and means to provide unconstrained expansion of said rod subsequent to said release.

6. An electrical circuit breaker, which includes a stationary contact, a movable switch arm carrying at least one contact adapted to cooperate with said stationary contact to close the circuit, manually operable means for moving the said switch arm, comprising toggle mechanism including a crank and a link formed as a detent pivotally connected to said crank and releasably engaging said arm at a point remote from its connection to said crank, a pivoted element engaging said detent at a point on the side of its point of engagement with said arm remote from its connection to said crank, an overload motive device comprising a rod in said electrical circuit, said rod being adapted to expand longitudinally due to the heating effect of the current in said circuit and being connected at one end to said pivoted element and having its other end fixed, the expansion of said rod in response to a predetermined overload providing a positive actuating force for moving said pivoted element sufficient to disengage said detent from said arm, means to provide unconstrained expansion of said rod subsequent to said release, and spring means to move said arm out of its circuit making position on disengagement of said detent.

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