Jan. 13, 1953 R. C. INGWERSEN 2,625,625

FREE TRIP CIRCUIT BREAKER

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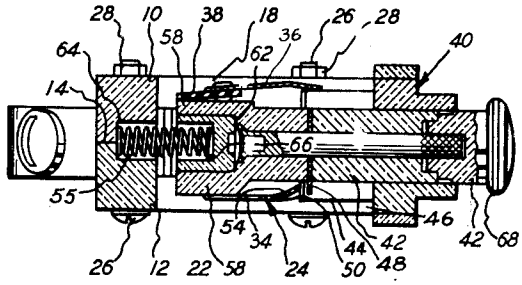

FIG. III.

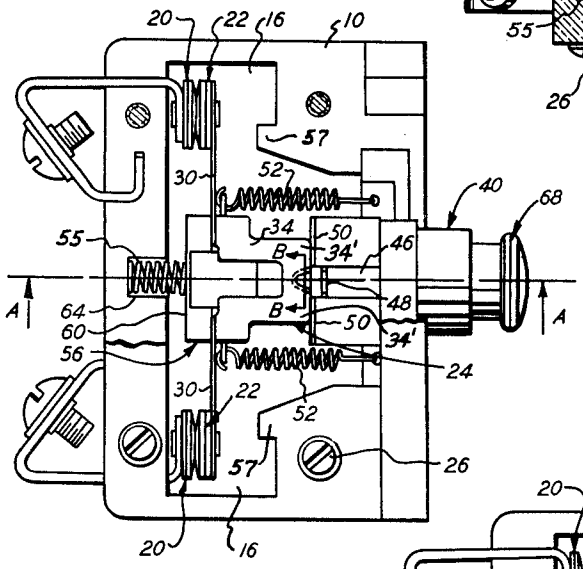

FIG. I.

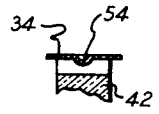

FIG. IV.

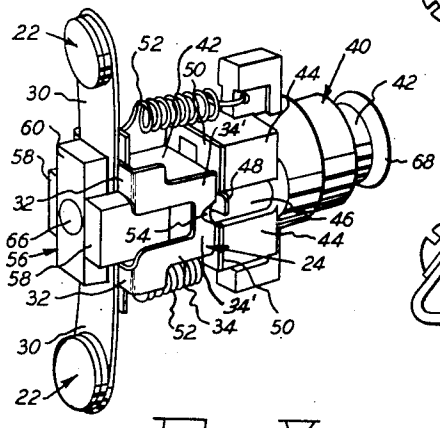

FIG. V.

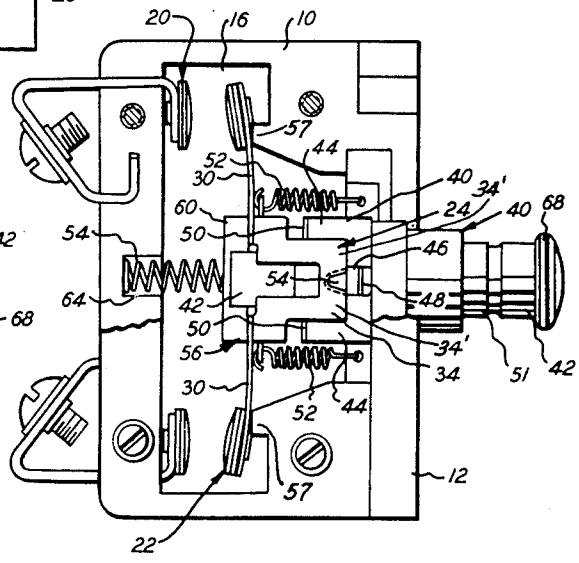

FIG. II.

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FREE TRIP CIRCUIT BREAKER

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9 Claims. (Cl. 200—116)

1

This invention relates to electric circuit breakers which have overload protection and incorporate a thermal latch construction responsive to the temperature of the circuit current to break (or open) the circuit automatically upon the occurrence of a predetermined overload. More particularly, the invention relates to an electric circuit breaker of the same general construction and arrangement is disclosed in United States Patent No. 2,485,736, dated October 25, 1949, but modified to provide a trip-free action, by which the manual holding of the movable contacts against separation is not possible when a predetermined maximum current loading or value has been attained. In the prior construction it is possible to override the overload protection by manually holding the contacts closed through pressure applied to the movable contact actuator button. An object of the present invention is to prevent such overriding action from occurring. Another object of the invention is to provide an electric circuit breaker with which overriding of the overload is possible for a predetermined lower current output, but is impossible for a predetermined higher or maximum current value.

The above and other objects and advantages residing in the construction, arrangement and combination of parts will be more fully understood and appreciated from a consideration of the following description with reference to the accompanying drawings and from the appended claims.

In the drawings:

Fig. I is a side elevational view of one practical form of the invention, with one-half of the casing structure removed, and showing the contacts and latch parts in closed position,

Fig. II is a similar view to Fig. I but showing the contacts and associated latch parts in open position,

Fig. III is a longitudinal section on the line A—A of Fig. I,

Fig. IV is a detail section on the line B—B of Fig. I, and

Fig. V is a perspective view of the movable contact and latch unit in association with its supporting plunger actuator and guide structure.

Referring to the drawings, the casing structure of the circuit breaker is shown composed of two similar molded sections 10 and 12 of a suitable insulating material assembled together in opposed relation, with a dividing line indicated at the line 14. Each casing section defines an internal cavity 16 which combine, as seen in Fig. III, to provide a common cavity 18 in which the

2

fixed and movable contacts, indicated generally at 20 and 22, respectively, and the thermal latch mechanism, indicated generally at 24, are housed and the sides of which cavity 18 are movably closed by suitable cover plates (not shown).

The fixed contacts 20 are carried upon conductor terminals held embedded in recessed portions of the assembled casing sections 10 and 12, these sections being conveniently held together by transverse screw studs 26 and associated nuts 28 which may also serve to secure the said side plates in position to close the sides of the cavity 18.

The movable contacts 22 are carried at the outer ends of flexible arms 30, which arms, at their inner ends, are secured upon inturned portions 32 (Fig. V) of a U-shape thermal latch part 34 and of an external temperature compensating finger assembly, indicated generally at 36 (Fig. III).

The U-shape latch part 34 is electrically connected in series with the movable contacts and their carrier arms 30, whereby this contact assembly is subjected to the electric current flow when the contacts are held closed, as seen in Fig. I. The compensating finger assembly 36, on the other hand, is electrically insulated from the circuit, as by the insulation 38, seen in Fig. III, whereby this assembly is not influenced by the temperature of the electrical circuit but only by the prevailing external temperatures, substantially as and for the purpose disclosed in my copending application Serial No. 136,969 filed January 5, 1950, now U. S. Patent No. 2,587,162, granted February 26, 1952.

The thermal latch part 34, and the compensator assembly 36, form a unitary assembly, which is guided for rectilinear sliding movement upon a combined fixed insulated guide structure 40 and a plunger actuator 42 mounted within the structure 40.

The structure 40 comprises spaced apart block portions 44 which define an elongated slot 46 between them in which a finger projection 48 on the actuator plunger 42 is guided for movement to actuate the thermal latch 34 for resetting against spaced apart abutment ledges 50 on the inner ends of the blocks 44, much in the same way as, and for the purpose disclosed, in the said prior Patent No. 2,485,736 in my name. In the present instance, however, the structure is such that the plunger actuator cannot be employed to override a maximum and predetermined current overload.

This results from the fact that the combined thermal latch 24 and movable contact unit is

freely slidable upon the actuator 42 and, by the action of the springs 52, will immediately snap to the open contact position, as seen in Fig. II, when the thermal latch has (due to the heat generated in the latch by the current flow therethrough and the attainment of a predetermined maximum current overload) expanded sufficiently outwards as to cause an inwardly directed lateral depression 54 in the latch 24 to leave the projection 48. When this happens the latch and movable contact unit is no longer held against the tension of the springs 52 but comes immediately under the control thereof to cause the contacts to open, as stated and as shown in Fig. II. In so moving, the latch 24 and the compensator finger assembly 36 slide past the opposite and respective blocks 44 of the fixed guide structure, which guides the thermal latch and movable contact unit for its required rectilinear motion into the contact open position; besides guiding the unit back to its reset and contact closed position when the actuator plunger 42 is actuated. Simultaneously with the opening movement of the said unit, the plunger actuator 42 is also moved to the outwardly projected position, as seen in Fig. II, when a collar portion 51 (which may be colored red or, in some other distinctive color) is exposed and thus reveals to the eye that the circuit has been interrupted. This actuator movement results from the action of a spring 55 interposed between the casing and a T-shape block insertion 56 guidably mounted in a fork end portion of the actuator plunger, which fork end portion has the prongs thereof indicated at 58. The insertion 56 has its top portion 60 located opposite the inner ends of the arms 30 of the movable contacts and is constantly biased against the opposed end of the plunger actuator (actually against the base 62 of the fork) by the action of said spring 55, one end of which bears within a recess 64 in the divided casing parts 10, 12, whereas the opposite end bears within the recess 66 defined by the fork prongs 58.

It is to be noted that the latch part 34 is made from springy metal and that this part is initially formed so that it springs inwards at its outer end (as defined by the base of the U-shape latch part) so that upon this end of the latch part arriving at the abutment ledges 50 it will immediately spring inwards into edgewise engagement with the ledges by the engagement of the edges of its end portions 34' with these ledges, which portions 34' lie upon opposite sides of the depression 54, and which depression, it is to be noted, lies within the confines of the slot 46 and in the path of the finger projections 48 on the plunger 42.

It is also to be noted that the T-shape block insertion 56 is slidably mounted in the forked end portion of the plunger 42 and has its end portion 60 disposed on the side of the inner ends of the movable contact arms 30 remote from the thermal latch part 34. It should also be borne in mind that, in the outwardly projected condition of the plunger 42 there is clearance between the finger projection 48 and the latch depression 54.

In operation, with the parts as seen in Fig. II, to set the circuit breaker for operation, it is merely necessary to push in the plunger 42 by applying inward pressure to the plunger button 68. This causes the finger projection 48 on the plunger to be brought into engagement with the outer edge of the base of the U-shape latch part 34 in the region of the inwardly directed edge presented by the depression 54. It will be appreciated that with the latch part 34 positioned in the contact-open position, as seen in Fig. II, the latch part is in an outwardly sprung condition, in which its outer end presses against the side surfaces of the blocks 44 so that the said end portions 34' are outwardly disposed with respect to the edges of the abutment ledges 50 an extent corresponding substantially to the thickness of the metal of the latch part 34. At the same time the outer edge of the finger projection 48 lies substantially flush with, or within, the outer edges of the abutment ledges 50. By providing the latch part with the inwardly directed depression 54 lying within the slot 46 it is ensured (with the extent of the finger projection 48 as stated, and the latch part outwardly sprung, also as above stated) that the finger projection is able to engage the inwardly directed edge of the depression as the plunger 42 is pushed inwards. Accordingly, as the plunger is pushed inwards, the finger projection 48 will, by engagement with the inwardly directed edge presented by the depression 54, push the latch part 34 inwards, and with it, the entire unit constituted by the parts 34, 36, 30, 22. At the same time, the springs 52 will be tensioned and the spring 55 will be compressed. Upon the outer edges of the end portions 34' of the latch part 34 arriving opposite the abutment ledges 50 they will immediately snap inwards into engagement with these ledges. The said unit will then be held in the contact closed position, as seen in Fig. I, in which position the circuit breaker is set for operation, with the springs 52 tensioned and the spring 55 compressed. During the time that the plunger 42 is being pressed in to take up the clearance between the finger projection 48 and the latch depression 54 the end portion 60 of the plunger insertion 56 will be pushed away from the latch part a distance corresponding to the extent of this clearance with the important result that at the time when the latch part is positioned to engage the ledges 50 it will not be subjected to the pressure of the compressed plunger spring 55 and will be free to spring into engagement with the abutment ledges. Normally, upon the circuit breaker being thus set, the pressure applied to the plunger to push it inwards will be removed, so that the plunger is left free to be projected outwards by the action of its spring 55. Upon current being conducted through the thermal latch part 34, this part, being of bi-metallic construction, will be distorted and will distort outwardly at its outer end. The construction and arrangement, and the calibration of the thermal latch part 34, is such that upon the latch part being heated to an extent corresponding to a predetermined current value, the edge portions of the latch part defined by the latch portions 34' will leave the abutment ledges 50. When this happens (with the plunger 42 free as stated) the said unit will immediately and suddenly move outwards to the contact-open position, by the action of the springs 52. At the same time, the plunger 42 will move outwards by the action of its spring 55. The outward movement of said unit, into the contact open position, will be arrested when the unit arrives at the interior casing portions 57, which act as stops. Thus, in the normal operation of the circuit breaker the finger projection 48 will remain located adjacent the outer edge defined by the depression 54 and will be correctly positioned for engagement with said depression edge for re-setting the said unit.

It may happen, however, that pressure is applied to the plunger 42 to hold it in at the time when the edges of the thermal latch portions

34' leave the abutment ledges 50. If this occurs the finger projection 48 will be held in engagement with the inwardly directed edge defined by the latch depression 54. It is then necessary, therefore, that the latch part should be distorted further than the amount needed to enable the edges of the latch parts 34' to leave the abutment ledges 50 and that the amount of distortion should be sufficient to cause the trailing edge defined by the depression 54 to leave the finger projection 48. When this happens, the said unit will be immediately freed to move to the contact-open position, by the action of the springs 52, even if pressure is still applied to the plunger, which plunger is then no longer capable of actuation to prevent the said unit from moving automatically to the contact-open position. If, however, the plunger continues to be held in at the time when the trailing edge of the depression 54 leaves the finger projection 48, the base of the U-shape latch part, in moving with the said unit to the contact-open position, will pass by the finger projection with the result that the finger projection 48 will then become located adjacent the inside edge of the base of the latch part; that is the edge remote from the depression 54. It is necessary, of course, that the finger projection 48 should be located adjacent the depression 54 in order that the plunger can be actuated to re-set the thermal latch unit in the contact closed position. It is also necessary that the plunger 42 should be allowed to return to its re-setting position, by the action of its spring 55, in order that the latch unit can be re-set. Bearing in mind that the depression 54 travels in the slot 46 and is always located in the path of the finger projection 48, if inward pressure is removed from the plunger 42 to allow it to return to its re-setting position (as seen in Fig. II) after the latch depression 54 has moved past the finger projection, due to the plunger being held in, as above stated, the finger projection, by engaging behind the depression, will automatically deflect the base of the U-shape latch part outwards from the side surfaces of the blocks 44, as the plunger is restored to its re-setting position by the action of its spring 55, with the result that the plunger comes to rest with its finger projection 48 correctly located adjacent the latch depression 54.

It is to be noted that the T-part 58 is mounted on the plunger for movement therewith and that only the portion 60 thereof lies in the path of the movable contact arms 30. However, this part 60 lies on the side of the arms 30 remote from the thermal latch part 34 and, thus, can have no restraining influence whatever upon the ability of the said unit to move automatically to the contact-open position when freed to do so by disengagement of the latch part 34 as above described. This plunger part, by bearing against the inner ends of the contact arms 30 will hold the plunger 42 in its pushed-in position, when the latch part is held engaged with the abutment ledges 50, and the plunger is left free as above stated.

With the parts positioned as shown in Fig. I it is possible to release the said unit to move to the contact-open position by exerting a pull on the plunger 42. This will cause the sides of the plunger containing the fork prongs 58 to slide past the inside of the thermal latch part 34 and force the same outwards to release it from engagement with the abutment ledges 50. This action is independent of the automatic circuit breaker action and permits the circuit breaker to be employed in the manner of a manually actuable "on" and "off" switch.

The structure heretofore described provides a maximum separation of the contacts 20, 22, with snap action upon overload opening of the circuit breaker, and permits the breaker action to be finely calibrated due to the thermal latch construction, which normally involves a bi-metallic structure. The construction has the advantage that the breaking of the controlled circuit is positive at a maximum predetermined current overload and cannot be overridden at the will of an operator, since holding the button 68 depressed will serve no such purpose when once the latch depression 54 has cleared the projection 48. At the same time smaller current overload, such as falls within the range of the depression 54, is possible of being overridden by the operator holding the actuator button 68 depressed.

Having thus described my invention, what I regard as novel and wish to cover by Letters Patent is:

1. In an electric circuit breaker having overload protection, casing structure, fixed contact means in said casing, movable contact means in said casing in opposed relation to said fixed contact means, a thermal latch connected for movement with said movable contact means, said thermal latch being responsive to the heat of the electric current flow, abutment structure in said casing with which said thermal latch engages to hold the movable contact means in closed relation to said fixed contact means, spring means operatively associated with said movable contact means, said spring means being tensioned when the latch is engaged, and a manual actuator adapted to cooperate with said thermal latch to set the latch in engagement with said abutment structure, means mounting said movable contact means and the associated thermal latch for movement as a unit relatively to said actuator in the contact opening direction, due to distortion of the thermal latch upon the occurrence of a predetermined current overload, whereby to free the latch from said actuator and abutment structure and permit said movable contact means to be moved to open position by the tensioned spring means.

2. In an electric circuit breaker having overload protection, casing structure, fixed contact means in said casing, movable contact means in said casing in opposed relation to said fixed contact means, a thermal latch connected for movement with said movable contact means, said thermal latch being responsive to the heat of the electric current flow, abutment structure in said casing with which said thermal latch is adapted to engage to hold the movable contact means in closed relation to said fixed contact means, actuator means on said casing adapted to set the thermal latch in latched engagement with said abutment structure, means mounting said latch and movable contacts for movement as a unit relatively to said actuator upon the occurrence of a predetermined maximum overload, said actuator being incapable of actuation to hold the movable contacts closed against said maximum overload, said actuator being capable of actuation to hold the thermal latch and movable contact unit against such relative movement in overriding relationship to a lower current overload.

3. In an electric circuit breaker having overload protection, fixed contact means, movable contact means in opposed relation to said fixed contact means, guide structure guiding said movable contact means for rectilinear movement to-

ward and away from said fixed contact means, spring means connected with said movable contact means to urge the movable contact means to open position, a thermal latch electrically connected with the said contact means and movable as a unit with said movable contact means, abutment structure adapted for engagement by the thermal latch to hold the latch in latched condition with the contacts closed, and actuator means for setting the latch in its latched condition, means mounting said latch and movable contact unit for free sliding movement with respect to said actuator means, said unit being free to move to open position upon the occurrence of a predetermined overload condition irrespective of the actuation of said actuator means.

4. In an electric circuit breaker with overload protection, fixed contact means, movable contact means in opposed relation to said fixed contact means, structure supporting said movable contact means for movement toward and away from said fixed contact means, said structure including a thermal latch carried for unified movement with said movable contact means, said latch being in electrical series connection with the contact means, abutment structure for said thermal latch to hold the latch in latched condition with the contact means closed, spring means for moving the movable contact means to open position when the latch is disengaged from the said abutment structure under thermal action, due to the occurrence of a predetermined overload condition, manual actuator means for setting said latch in the latched condition to hold the contacts closed, and means mounting said movable contacts and latch for sliding movement upon said actuator means by said spring means, when the latch is disengaged, irrespective of the actuation of said actuator means.

5. In an electric circuit breaker having overload protection, casing structure, fixed contact means in said casing, movable contact means in said casing in opposed relation to said fixed contact means, a thermal latch in electric series connection with said movable contact means, said thermal latch and the movable contact means being of unitary construction, abutment structure in said casing with which said thermal latch is adapted to cooperate to hold the movable contact means in closed relation to said fixed contact means, actuator means on said casing adapted to set the thermal latch in latched engagement with said abutment structure and to close the movable contact means, means slidably mounting said latch and movable contact unit upon said actuator for unified movement thereon upon the occurrence of a predetermined maximum overload and means on said actuator and latch cooperable to hold the thermal latch against such relative movement in overriding relationship to a lower current overload.

6. In an electric circuit breaker having overload protection, casing structure, fixed contact means in said casing, movable contact means in said casing in opposed relation to said fixed contact means, a thermal latch connected for movement with said movable contact means as a unit, said thermal latch being responsive to the heat of the electric current flow, abutment structure in said casing with which said thermal latch is adapted to engage to hold the movable contact means in closed relation to said fixed contact means, actuator means on said casing adapted to set the thermal latch in latched engagement with said abutment structure, means mounting said movable contact means and thermal latch for unified sliding movement upon said actuator upon the occurrence of a predetermined current overload, and spring means for restoring the actuator means to initial position with respect to said movable contact and latch unit.

7. In an electric circuit breaker having overload protection, fixed contact means, said movable contact means being adapted to be mounted in opposed relation to fixed contact means, a thermal latch, structure supporting said movable contact means and latch to form a unit, said thermal latch being in electrical conductive relationship to said movable contact means, abutment structure with which said thermal latch engages to hold the movable contact means in position corresponding to closed contact position, actuator means guidingly mounted with respect to said abutment structure, said actuator means being adapted to set the thermal latch in latched engagement with said abutment structure, means mounting said unit for free sliding movement upon said actuator in the direction corresponding to open contact position, and spring means constantly urging said unit in the contact opening direction.

8. In an electric circuit breaker having overload protection, insulated supporting structure, insulated plunger structure slidably mounted on said insulated supporting structure, said supporting structure providing abutment means, a unified thermal latch and contact structure slidably mounted upon said plunger structure and guided for rectilinear movement with respect to the plunger structure, said latch being engageable with said abutment means, means on said plunger structure engageable with said latch by movement of the plunger structure in one direction only to set the latch in engagement with said abutment means, spring means constantly urging the said latch and contact structure into open position, and spring means for restoring the plunger to initial position for resetting the latch.

9. An electric circuit breaker as claimed in claim 9, said latch having a protruding ledge portion for location against said means on the plunger structure, said plunger structure being capable of being manually held to override disengagement of the latch from the said abutment means until the latch ledge portion has cleared said means on the plunger, when the plunger structure is no longer capable of holding the latch against disengagement from said abutment means.

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