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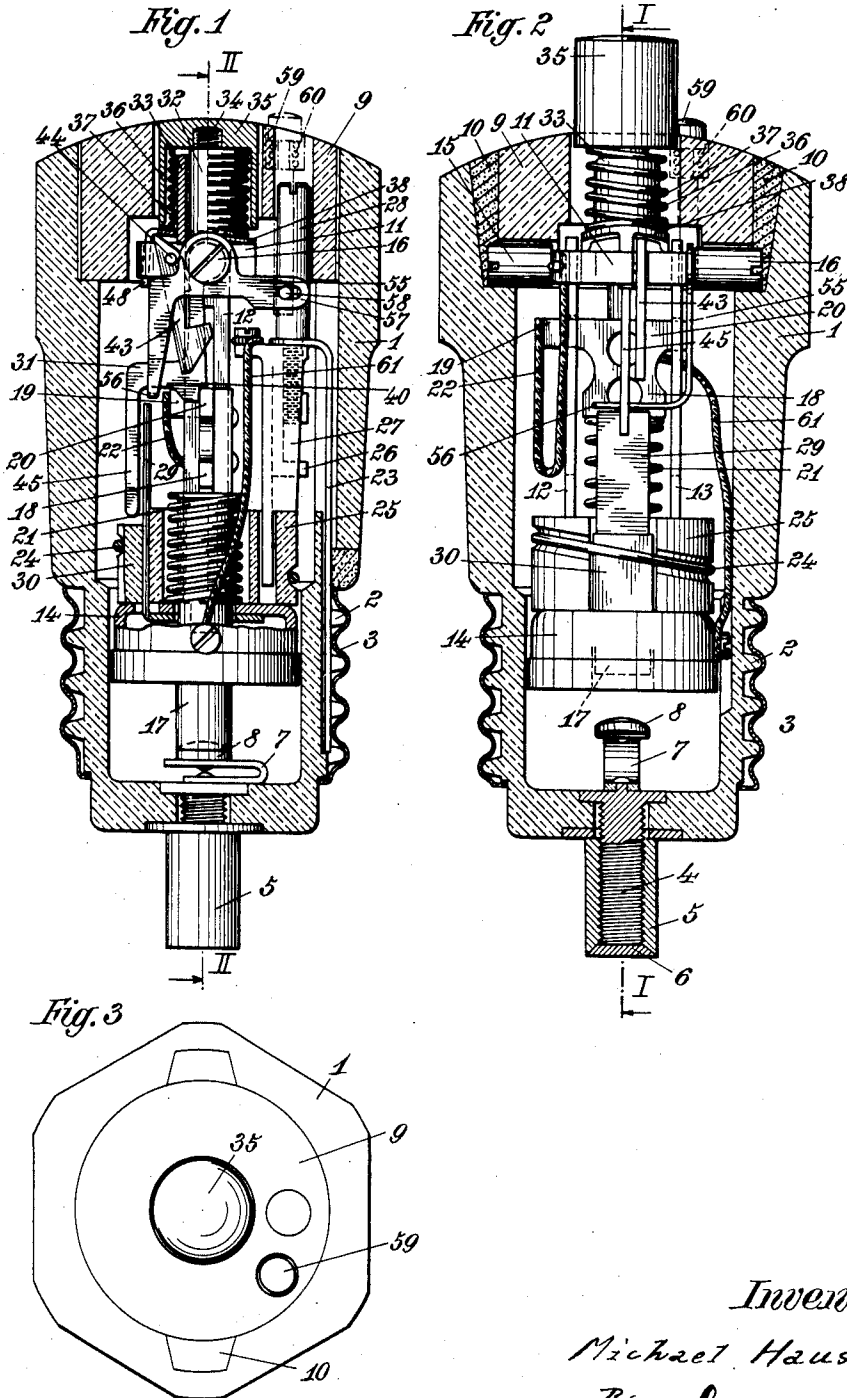
M. HAUSER

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ELECTRICAL OVERLOAD CIRCUIT BREAKER

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2 Sheets-Sheet 1



Inventor:
Michael Hauser
By *Lucas*
Attorney

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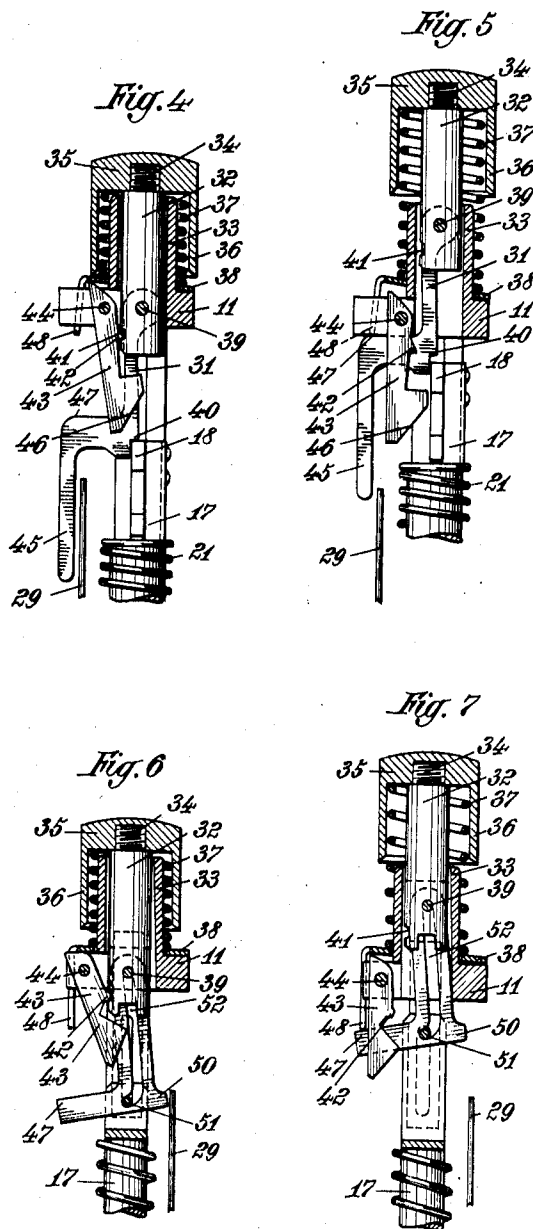
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Inventor:

Michael Hauser

By *Lucas J. J. J.*
Attorney

UNITED STATES PATENT OFFICE

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ELECTRICAL OVERLOAD CIRCUIT BREAKER

Michael Hauser, Augsburg, Germany

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7 Claims. (Cl. 200—122)

The present invention relates to improvements in electrical overload circuit breakers which are used instead of electrical safety fuses in house installations and the like and particularly to improvements in overload circuit breakers with thermal release at which the release member consists of a helically wound heating wire. When thermal release members of this kind are used, it is possible to construct a circuit breaker of exceedingly simple structure and of so small dimensions that it may be arranged within the plug or casing of a safety fuse of the commonly known kind.

The primary object of the invention is to provide a series of improvements in known circuit breakers of the said kind. Each of these improvements are of such a nature, that it increases the reliability of the circuit breakers considerably.

According to the invention the circuit breaker or switch is equipped with a free release device, i. e., the switch mechanism is formed in such a manner that the circuit is interrupted, when the current surpasses the admissible value, also when the switching-in button is held in fixed position. Hereby a better protection for the connected wires and devices is attained, since an arbitrary overloading of the wires is effectively prevented. The high degree of safety in operation obtained by the present invention could hitherto only be obtained with switches of large dimensions.

According to the invention the circuit breakers may also be equipped with a manually operated release device by means of which the switch may be opened by hand in the case of emergency. Also this measure is taken in order to protect the connected wires and devices.

The invention also comprises means for removing another drawback adhering to the hitherto known circuit breakers with thermal release. On account of the particular arrangement and form of the heating wire the same must be placed on a ceramic body. When the heating wire is influenced for a longer time by excess currents which do not reach the intensity of the cut-out current the heat produced by the heating wire has also time to heat the ceramic body which also expands and then the case may occur, that the expansion of the heating wire is not sufficient to initiate the release of the switch. Slight excess currents of long duration are however just as detrimental as heavy excess currents of short duration and for the sake of safety it is therefore required to take special measures which will ensure that the switch is opened also when slight excess currents of long duration occur. According to the present invention this is attained by using a bimetallic cut-out spring of a special form.

The known switches with thermal release can only be used in systems designed for currents of

low intensity, because the heating wire must have a definite minimum length in order that a sufficient expansion is obtained when the wire is heated. The cross-section of the wire increases with increasing nominal current, in order that a prescribed degree of heating of the wire is not surpassed when nominal current is flowing, and therefore also the weight of the wire will augment with increasing nominal current. At short-circuits the time of operation of the switch will therefore be prolonged beyond the admissible length, and the result of this is, that switches of this kind can only be used at nominal currents of relatively low intensity. According to the invention the switch is equipped with a suitable shunt, which makes it possible to use thin heating wires also at high current intensities, whereby the short cut-out time necessary for safe operation is secured.

The invention also comprises means for extinguishing the light arcs frequently occurring within circuit breakers of the fuse plug type and preventing such light arcs from damaging the switching mechanism. The hitherto used extinguishing means are not reliable. According to the invention the light arc is reliably extinguished under all circumstances and in a simple manner by a special arrangement of the conducting strip leading to the threaded sleeve at the base of the switch casing and by forming this sleeve from magnetic material.

A constructional form of the invention is shown by way of example on an enlarged scale in the accompanying drawings.

Fig. 1 is a longitudinal section through the circuit breaker on line I—I of Fig. 2. The switch mechanism is shown partly in section and partly in elevation.

Fig. 2 is a longitudinal section on line II—II of Fig. 1 showing the switch mechanism in elevation.

Fig. 3 shows the circuit breaker in plan view.

Fig. 4 shows the free release device of the switch in closed position.

Fig. 5 shows the free release device in open position.

Fig. 6 shows a modified form of the free release device in closed position.

Fig. 7 shows the same device in open position. 1 denotes the switch casing which is made from ceramic material and has the same form and dimensions as the casing of a safety fuse of the commonly known type. At its lower end the casing is formed with a thread 2 onto which a threaded sleeve 3 is pressed. In the bottom of the casing a current supply contact screw 4 is located which is held in position by a nut 5. The screw 4 and the nut 5 are soldered together at 6. 7 denotes a strap the one arm of which is riveted to the screw 4. To the other arm of this strap

a contact body 8 is attached by means of a rivet.

The switch mechanism is introduced into the casing 1 through a circular opening which when the switch mechanism has been brought into position in the interior of the casing is closed by a member 9 of ceramic material. This member is cemented to the casing at 10 (Fig. 2).

The switch comprises a frame structure which consists of an upper cross piece 11, two bars 12 and 13 and a hollow metal body 14. The upper ends of the bars 12 and 13 rest in apertures in the cross piece 11 and are connected to the same by means of screws 15 and 16. These screws, which also carry the switch structure, rest in notches in the bottom of the circular opening in the casing, whereby a rotation of the switch mechanism within the casing is prevented. When the screws 15 and 16 have been introduced into the said notches the intermediate space 10 is filled with cement, whereby the screws are securely held. The bars 12 and 13 are connected to the metal body 14 by suitable means.

The movable contact piece consists of a cylindrical bolt 17, which is movable in a central bore in the metal body 14. Over a certain length of its upper section half of the bolt 17 is cut away and to the remaining part of the bolt a plate 18 is riveted which possesses two projections 19 and 20. By means of these projections the contact bolt is guided on the rods 12 and 13 which for this purpose are formed with suitable openings. Between the body 14 and the plate 18 the cut-out spring 21 is arranged, which exerts an upwardly directed pressure on the bolt 17. In order to secure an unobstructed flow of current a twined copper wire 22 is provided the one end of which is soldered to the somewhat prolonged and angularly bent projection 19 and the other end of which by means of the screw 15 is attached to the cross piece 11 in such a manner that good conductivity is obtained. The current flows from the contact screw 4 over the contact body 8, the contact bolt 17, the copper wire 22 to the cross piece 11 and from this over the bars 12 and 13 to the metal body 14. From this body the current flows through the release device (which will be described below) and the strip 23 and leaves the circuit breaker through the threaded sleeve 3 which is soldered to the strip 23.

The release device consists mainly of a heating wire 24 which is helically wound on a cylindrical ceramic body 25. The lower end of this wire is electrically connected to the body 14 whereas the upper end is fixed in a sliding piece 26. This sliding piece is arranged in a guide 27 and the height of it can be adjusted by means of a screw 28, whereby the tension of the heating wire can be regulated as desired. The screw 28 projects into an opening in the part 9 which opening usually is filled with cement after the heating wire has been adjusted. The guide 27 is fixed in the ceramic body.

The free release device is operated by means of a spring 29, which is located in a rectangular opening in the body 25 and fixed to the metal body 14. Through the intermediary of a ceramic member 30 the heating wire 24 presses against the spring 29 which has a suitable bias. On being heated the heating wire 24 will expand and the spring 29 is forced outward, whereby a coupling lever 31 is moved and the contact bolt 17 released.

This movement of the spring 29 will not take place if also the ceramic body 25 has had time to expand. In order to effect a release also in

this case the spring 29 is made from a bimetallic strip which when being heated for a longer time will be deformed and bend outward, whereby the lever 31 is operated. The circuit will therefore also be opened in the case of relatively low excess currents of long duration.

The contact bolt 17 is operated by means of a free release device, which mainly consists of a bolt 32 arranged within a central bore in the cross piece 11, which for this purpose is equipped with a tubular guide member 33. At 34 the upper end of the bolt is threaded and adapted to receive a press button 35. The press button is formed with a tubular projection 36 in which a spring 37 is located which through the intermediary of a disc 38 is supported by the cross piece 11. The spring 37 tends to force the bolt 32 upward. Within the bolt 32 the coupling lever 31 is pivotally arranged on a pin 39. The coupling lever 31 serves for moving the bolt 17 and rests with a nose 40 against the plate 18, which is fixed to the bolt 17. In order that the bolt 17 may be held in the switching-in position shown in Figs. 1 and 4 the bolt 32 is formed with a notch 41 adapted to receive a nose 42 on the locking lever 43 of the free release device. The lever 43 is by means of a pin 44 pivotally arranged in a slot in the cross piece 11. The disc 38 presses against the lever 43 so that the same is yieldingly held in the position shown.

The coupling lever 31 is equipped with an arm 45 towards which the spring 29 is moved when the device is influenced by excess current. A slight deflection of the lever 31 is sufficient to remove the nose 40 from the plate 18 and to release the bolt 17. Under the effect exerted by the spring 21 the bolt 17 moves upward without at first any movement of the bolt 32 and the press-button taking place. Thus, the cut-out movement will also take place when the press-button is arrested. During its movement the plate 18 contacts with the inclined part 46 of the lever 43. The latter is thereby turned in the direction of the hands of a clock, whereby the nose 42 is removed from the notch 41 and the bolt 32 is released and moved upward by the spring 37.

The bolt 32 takes the coupling lever 31 along with it and the edge 47 of the latter abuts against a nose 48 which is fixed to the disc 38 and projects through a bore in the cross-piece 11. The coupling lever 31 is then again moved to the right under the influence of the spring 37 (Fig. 5) and the nose 42 takes up a position above the plate 18.

Figs. 6 and 7 show another form of the free release device working after the same principle as that described above. Instead of the coupling lever 31 a slotted lever 50 is provided. In this form of the free release device the switch bolt 17 is formed with a slot adapted to cooperate with a pin 51. This pin also guides the bolt in the guide bars, of which one is shown at 52. Moreover, the pin 51 also projects into the slot of the lever 50 and in the switching-in position the pin will rest in a lateral lengthening of the slot. The mode of operations of the free release device will become evident from the drawings. The simplicity of this device is mainly due to the fact, that the spring 37 is utilized for two different purposes, in that it not only serves for forcing the press-button upward but also exerts a yielding pressure on the locking lever and the coupling lever. The special springs, which in known free-release devices are used for the coupling elements and the locking elements, are 75

therefore dispensed with. Thus, in this way a free release device can be arranged also in circuit breakers having as small dimensions as the present one.

5 In order that the switch also may be released by hand a lever 55 is provided. An arm 56 of this lever is arranged behind the lower arm 45 of the coupling lever 31. The lever 55 is pivotally arranged on the screw 16 and possesses another
10 arm 57 which by means of the pin 58 cooperates with the free release press-button 59. The latter is in Fig. 1 shown in dotted lines, because it lies in front of the plane of section. Usually the said button is held out of contact with the other
15 elements by a small spring 60.

In order that the light arc between the contact 8 and the bolt 17 may be quickly and safely extinguished the strip 23 through which the outgoing current leaves should suitably be introduced very deep into the sleeve 3, and the latter should be made from magnetic material. In this case the current will flow into the socket of the device (not shown) only in the place in which the strip 23 is located. At short circuits the currents in the light arc and the strip 23 will
25 flow in opposite directions, whereby a considerable mechanical force is exerted on the light arc, so that the same is driven outward, stretched and extinguished.

30 In order that a thin heating wire may be used also in the case of currents of high intensity a shunt 61 is arranged parallel to the heating wire. This shunt is by means of screws fixed to the metal body 14 and the guide bar 27. In this arrangement the greater part of the current will
35 pass through the shunt 61 and not through the heating wire, and it is therefore possible to use a thin wire with a short cut-out time.

By short-circuits the heating wire is more quickly heated than the shunt, which latter usually has a much larger cross-section. It is therefore advantageous to make the heating wire from a material having a low coefficient of temperature and to make the shunt from a material the resistance of which increase rapidly with rising temperatures. When these materials are correctly
45 chosen the time within which the heating wire comes into action can be reduced so far, that the part of the current which at short circuits passes through the heating wire is larger than under
50 normal conditions.

I claim:—

1. In an overload circuit breaker with thermal release, a heating wire wound on an insulating body and adapted to initiate the switching operation on being deformed, a fixed contact member, a spring-influenced movable contact member, a spring-influenced switching-in-button for bringing both contact members together, a bolt member rigidly connected to said switching-in-button, a coupling lever pivotally arranged within said bolt member and rotatable in a plane parallel to the direction in which the movable contact member is moved, said coupling lever being adapted to be actuated by the switching-in-button and to lock the movable contact member in switched-in position, and means for moving said coupling lever out of locking position also when the switching-in-button is held arrested.

2. In an overload circuit breaker with thermal release, a heating wire wound on an insulating body and adapted to initiate the switching opera-

tion on being deformed, a fixed contact member, a spring-influenced movable contact member, a spring-influenced switching-in-button for bringing both contact members together, a bolt member rigidly connected to said switching-in-button, a coupling lever pivotally arranged within said bolt member and rotatable in a plane parallel to the direction in which the movable contact member is moved, said coupling lever being adapted to be actuated by the switching-in button and to lock the movable contact member in switched-in position, a locking lever for said coupling lever and means operable by the ascending movable contact member for bringing the locking lever out of locking position and releasing the switching-in-button.

3. An overload circuit breaker according to claim 2, in which the spring influencing the switching-in-button is equipped with a member adapted to actuate the locking lever.

4. An overload circuit breaker according to claim 2, in which the spring influencing the switching-in-button is equipped with a member adapted to serve as an abutment for the coupling lever.

5. An overload circuit breaker according to claim 2, in which the spring influencing the switching-in-button is equipped with a member adapted to actuate the locking lever and to serve as an abutment for the coupling lever by means of an additional intermediate element.

6. In an overload circuit breaker with thermal release, a heating wire wound on an insulating body and adapted to initiate the switching operation on being deformed, a fixed contact member, a spring-influenced movable contact member, a spring-influenced switching-in-button for bringing both contact members together, a bolt member rigidly connected to said switching-in-button, a coupling lever pivotally arranged within said bolt member and rotatable in a plane parallel to the direction in which the movable contact member is moved, said coupling lever being adapted to be actuated by the switching-in-button and to lock the movable contact member in switched-in position, and a bimetallic spring adapted to actuate the coupling lever and to open the circuit when being deformed by heat from the heating wire.

7. In an overload circuit breaker with thermal release, a heating wire wound on an insulating body and adapted to initiate the switching operation on being deformed, a fixed contact member, a spring-influenced movable contact member, a spring-influenced switching-in-button for bringing both contact members together, a bolt member rigidly connected to said switching-in-button, a coupling lever pivotally arranged within said bolt member and rotatable in a plane parallel to the direction in which the movable contact member is moved, said coupling lever being adapted to be actuated by the switching-in-button and to lock the movable contact member in switched-in position, means for moving said coupling lever out of locking position also when the switching-in-button is held arrested, a conducting magnetic sleeve connecting the switch with its socket and a member lying parallel to the path of the light arc and serving for leading away the outgoing current, the arrangement being so designed, that the path of the light arc lies within said sleeve.

MICHAEL HAUSER.