Feb. 26, 1929. 1,703,439

O. DREYER

DEVICE FOR PROTECTING ELECTRIC CIRCUITS

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Fig. 1

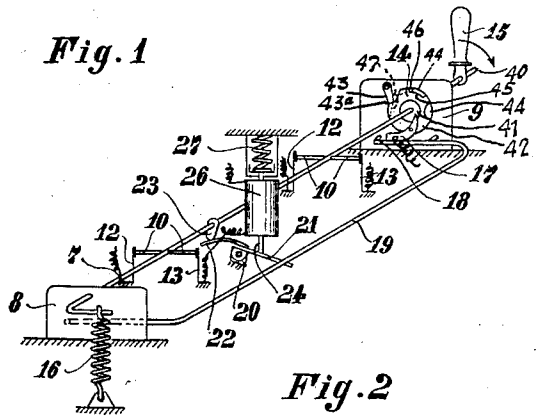


Fig. 2

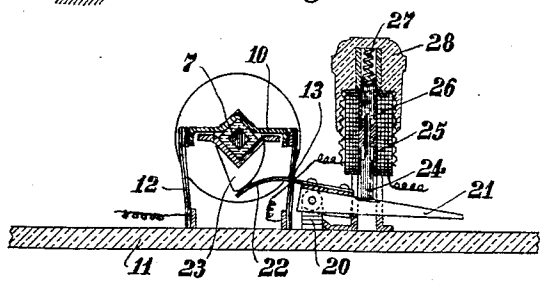
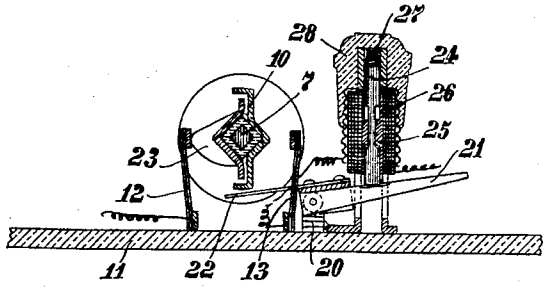


Fig. 3



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DEVICE FOR PROTECTING ELECTRIC CIRCUITS

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Fig. 5

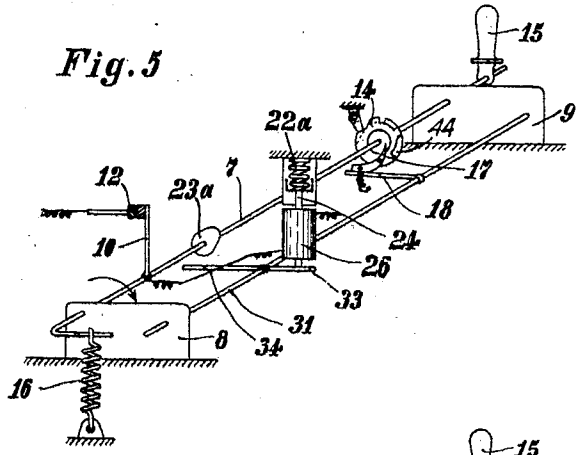


Fig. 4

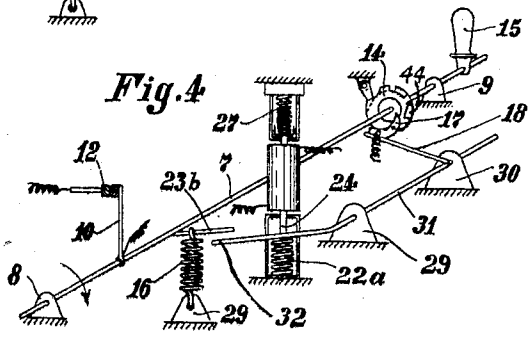
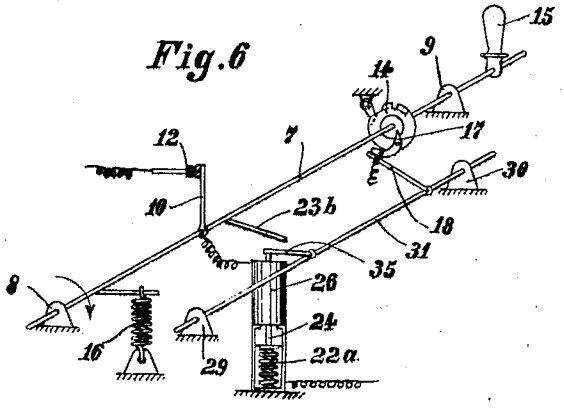


Fig. 6



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DEVICE FOR PROTECTING ELECTRIC CIRCUITS

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Fig. 7

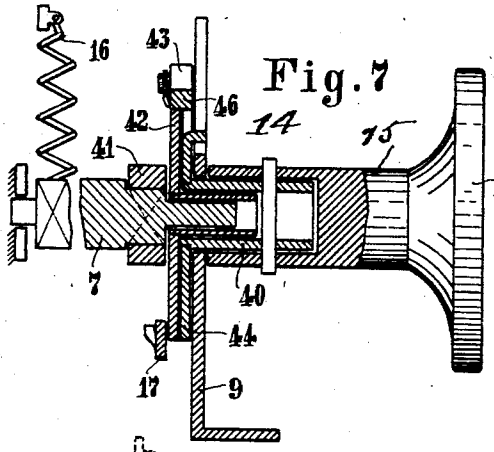


Fig. 8

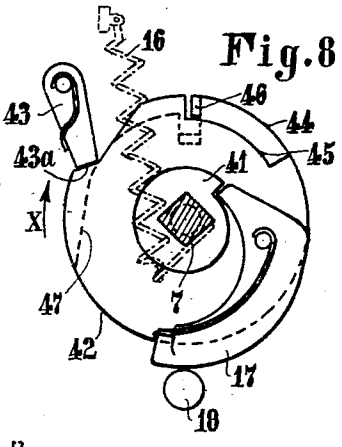


Fig. 9

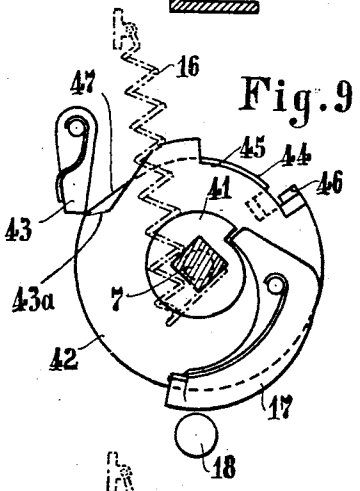


Fig. 10

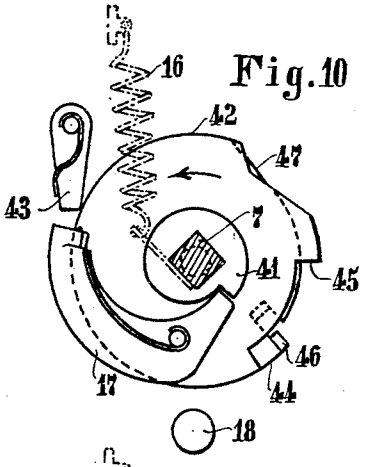


Fig. 11

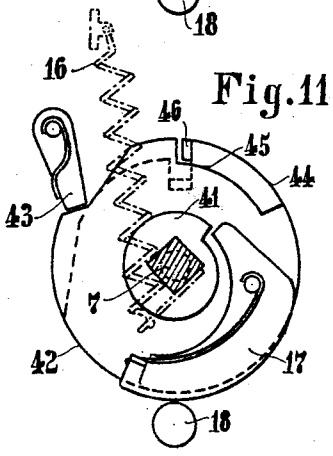
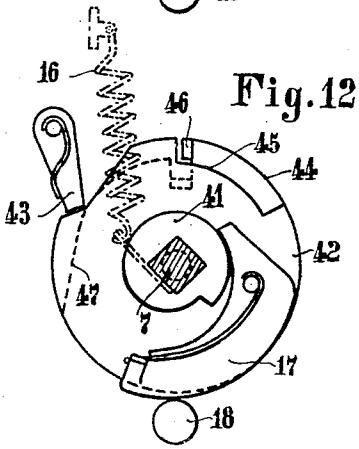


Fig. 12



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Patented Feb. 26, 1929. 1,703,439

UNITED STATES PATENT OFFICE.

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DEVICE FOR PROTECTING ELECTRIC CIRCUITS.

Application filed January 20, 1926, Serial No. 82,468, and in Germany February 4, 1925.

The invention relates to a device for protecting electric circuits from overheating, in which a temperature protector which contains a locking or releasing member which is normally held fast in its position of rest by means of fusible metal or solder is mechanically combined with a so-called automatic switch (that is a circuit breaker having a revoluble shaft which must be closed by hand but, after the disengagement of a catch, is opened automatically) in such a manner that when the temperature protector comes into operation the catch or lock on the automatic switch is released thereby whereupon the latter immediately effects the disconnection of the circuit in danger. The known protecting devices of this kind have the disadvantage that some special manipulation is necessary in order to put the temperature protector, after it has come into operation, into a condition in which it is again ready for use or, in other words, to re-set it. For this purpose either the releasing member of the temperature protector together with the part in which it is contained must be renewed or it is necessary, after taking out these two parts, to return the releasing member by hand into its original position and hold it fast until the solder has re-hardened. In the simplest known device of this kind it is sufficient to remove the releaser which is of similar construction at both ends and is reversible together with the casing in which it is contained and to replace it in the device in the reversed position. In all cases however it is necessary to open the switch box which contains the protecting device and the temperature protector. This not only gives rise to the danger that when the device is attended to by a non-expert person the parts removed may not be properly replaced or reinserted but it also makes it impossible to keep the switch-box permanently locked or sealed which is necessary in order to prevent unauthorized interference with the apparatus contained in the switch box.

The problem underlying the present invention is to construct a protecting device of the aforesaid type, i. e. a device consisting of an automatic switch having a revoluble switch-shaft and a temperature protector, having a heating coil and a locking or releasing member which is normally held in its position of rest by a soldered joint, which coacts mechanically with a locking device of the automatic switch, in such a manner that no interference whatever with the protecting device is necessary in order to reset the temperature protector. In other words the object to be attained is to return automatically into its position of rest the releasing or locking member of the temperature protector after it has come into operation. According to the invention this problem is solved by making the automatic return of the releasing or locking member to its position of rest mechanically dependent upon the rotary disconnecting movement of the shaft of the automatic switch. For example, in those temperature protectors of this type in which the locking or releasing member is loaded, in manner known per se, by two oppositely acting springs of differing strengths, the more powerful spring which loads the locking or releasing member so that it tends to release the automatic switch can coact mechanically with the switch shaft in such a manner that it is only effective when the switch is closed and is on the contrary made ineffective by the opening movement of the switch, so that after the opening of the switch the releasing or locking member can be returned to its position of rest by the other weaker spring. Or, in those constructions in which the locking or releasing member of the temperature protector is only loaded by a spring which tends to release the automatic switch, the return movement of this member can be positively brought about by the rotary disconnecting movement of the switch shaft. No special manipulation whatever is therefore necessary for re-setting the temperature protector after it has come into operation, and the switch only needs to be closed again after the current consuming device which has been disconnected owing to its becoming overheated has cooled down sufficiently. This may be effected by means of a handle which projects out of the switch box containing the protecting device. The switch box is not opened so that it may remain permanently locked and can be sealed, whereby unauthorized interference with its contents is avoided.

Several constructional embodiments of the invention are illustrated by way of example in the accompanying drawings, in which,

Fig. 1 is a pictorial view in simple lines of the first example,

Figs. 2 and 3 are two vertical sections through a practical constructional form of the protecting device in accordance with Fig.

1 with the switch closed and opened respectively, while

Figs. 4 to 6 are pictorial views in simple lines of three further examples.

Fig. 7 is a sectional elevation of the switch lock.

Figs. 8 to 12, inclusive, are cross-sections through the switch lock, showing the coupling elements in the different positions they assume in their locking and releasing actions.

Referring to Figs. 1 to 3, 7 is the shaft of the switch which is supported in the two bearing plates 8, 9 and carries one or more double-armed contact-levers 10, according as unipolar or multipolar disconnection is to be effected, which, when the switch is closed, make contact between two spring contacts 12, 13 which are fixed to the insulating base plate 11. The switch shaft 7 is connected on the one hand through a switch-lock 14 with a hand-lever 15, for the purpose of closing the switch, and is on the other hand acted upon by a powerful opening-spring 16. The freeing of the switch for the automatic opening movement is effected by disengaging a pawl or catch 17 from the switch-lock 14. The handle 15 is mounted on a shaft 40 supported independently of and not connected to the switch shaft 7 except through the switch lock 14 which is formed as a free-wheel coupling or clutch device. The switch lock consists of the following parts: On the shaft 7 is fixed a small click disk 41 having a notch or recess which is adapted to be engaged by a spring actuated locking pawl 17. The pawl 17 is fulcrumed on an intermediate or motion transmitting disk 42, loose on the switch shaft 7. A spring operated pawl 43 mounted on a suitable stationary support, such as bearing 9, is provided to engage a shoulder 43^a on the disk 42 to hold said disk in its normal operative position. On the side of the disk 42 opposite the disk 41 is a primary operating disk or resetting disk 44, which disk 44 is fixed on the hand lever shaft 40. This disk 44 is provided with a lug or projection 46 engaging a recess or depression 45 in the disk 42, and said disk 44 is also provided with an inclined, eccentric or cam face 47 for cooperation with the pawl 43 for releasing said pawl from engagement with shoulder 43^a when the hand lever shaft 40 is rotated in the direction of the arrow, Figure 1. The pawl 17 is acted upon by a lever 18 which is formed by an extension of one arm of a U-shaped wire rod 19 or rock shaft which is carried by the plates 8, 9. A double-armed lever 21, 22 which is revolubly mounted upon a support 20 also coacts with this rod 19. This lever possesses a rigid arm 21 and a flexible arm 22 which latter consists of a powerful flat spring. The rigid arm 21 engages under the rod 19, while the spring arm 22 lies below a cam or eccentric 23 which is fixed on the switch shaft 1, and, when the switch is closed, presses the free end of the lever-arm 22 downwards and thereby stresses the flat spring. Therefore, when the switch is closed, the flat spring 22 tends to rotate the rod 19 through the agency of the rigid arm 21 and in this manner to disengage the pawl 17 of the switch-lock 14. The spring, however, is normally prevented from doing so by means of the locking-pin 24 of a temperature protector against which the rigid lever-arm 21 abuts. This pin 24 is fitted in known manner so as to be movable up and down in the central tube 25 of a heating coil 26, which is connected in the circuit to be protected, and, in its lower end position illustrated in Figs. 1 and 2, is soldered fast by means of a solder having a definite melting point, for example, a metal alloy. It is also simultaneously acted upon by a spring 27 which is fitted in the head of the element containing the temperature protector and presses upon the upper end of the pin 24 and tends to hold it in its lower end position. The spring 27 is however weaker than the flat spring 22, so that when the fusible solder softens the latter spring is able to displace the rod 24 and compress the spring 27.

With the parts in the position illustrated in Figs. 1 and 2 the switch is closed and its shaft 7 is locked in the connected position by means of the pawl 17 so that current passes both through the current consuming device to be protected and also through the heating coil 26. If, owing to an overload, the current consuming device heats-up to an unpermissible extent the heating coil 26, which is adapted to have the same characteristics as regards heating-up, causes the fusible metal by which the pin 24 is held fast to soften. The flat spring 22 is now able by displacing the pin 24 and compressing the weaker spring 27 to disengage the pawl 17 through the agency of the lever arm 21 and the rod 19 whereby the catch on the switch is disengaged. The switch shaft 7 now rotates under the action of the opening spring 16 into the open position of the switch (Fig. 3) and thereby breaks the circuit which is in danger. Owing to the rotation of the switch shaft 7 into the open position the cam 23 slides off the flat spring 22. This spring, therefore, which is thus deprived of its support, is un-stressed and the spring 27 which was previously compressed now presses the pin 24 back into its original position, in which position it is again held fast owing to the re-hardening of the fusible metal which takes place as the current consuming device and the heating coil cool down. When the current consuming device has cooled down sufficiently the switch can again be closed and the current again supplied to the current consuming device. If, however, the switch should be closed before the device has cooled down sufficiently it will be immediately re-opened owing to the disengagement of the

catch 17 which will occur because the soldered joint will not have re-hardened and the pin 24 can therefore be moved out of its position of rest by the spring 22 which is again placed under stress when the switch is closed.

In order to reset the switch again, it is necessary to turn hand lever shaft 40 and its disk 44 in the direction of the arrow, Figure 1. On the first part of this movement projection 46 moves sufficiently in the recess 45 to cause the cam face 47 to release the pawl 43 from engagement with shoulder 43^a, at which time projection 46 engages an end wall of the recess 45 and couples the disks 42 and 44 together for movement in unison. The parts are rotated until pawl 17 comes opposite the notch in disk 41 and again engages said notch and locks the disks 41 and 42 and the shaft 7 together, whereupon by a reverse motion of the hand lever 15 the shaft 7 will be returned to the switched-in position, at which time shoulder 43^a is again brought into position to be engaged by the pawl 43. Spring 16 will thereby again be tensioned and the arm 18 of control shaft 19 brought into position for coaction with the dog 17, in which operation cam 23 tensions spring 22 as previously described. In the set position of the switch, the switch shaft 7, on being actuated by the operation of the heat releaser, is rotated into the "off" position independently of the shaft 40, so that it is impossible to prevent the switching off operation by holding down the lever 15. The switching-off operation may, however, be manually effected by turning the handle 15 in the direction of the arrow, Figure 1, so as to release pawl 43, whereby switch shaft 7 will be freed, when it will rotate, aided by spring 16, and this time together with the disk 42, the pawl 17 intercoupling the shaft and disk, the latter, after a certain idle movement, carrying around with it the shaft 40. Since in this instance the coupling between shaft 7 and disk 42 is kept up, the switch can readily be thrown in again by turning the lever 15 in a counter-clockwise direction.

In the example illustrated in Fig. 4 the lever-arm 18 which influences the pawl 17 of the switch-lock 14 is mounted on a shaft 31 which is journalled in bearings 29, 30. This shaft carries a second lever-arm 32 which is supported on its upper side against the locking-pin 24 of the temperature protector, while its lower side presses against the spring 22^a fitted in the foot of the temperature protecting element, which spring tends to rotate the shaft in such a direction as to release the pawl 17. The spring 22^a is again stronger than the spring 27 which presses the pin 24 into its position of rest. It is normally prevented from rotating the shaft 31 owing to the fact that the pin 24 is soldered fast by means of fusible metal in its lower end position, that is in its position of rest. The switch-shaft 7 which is loaded by means of a spring 16 which tends to open the switch and of which the power is again greater than the power of the spring 22^a carries a lever arm 23^b, the purpose of which is to coact with the lever 32 on the switch being opened in such a manner that the lever 32 is rotated in a downward direction and compresses the spring 22^a.

With the parts in the position illustrated in Fig. 4 the switch is closed. If, owing to excessive heating, the fusible metal of the temperature protector softens the spring 23^a rotates the lever 32 upwards moving the pin 24 upwards and compressing the weaker spring 27, whereby through the agency of the shaft 31 and the lever-arm 18, the pawl 17 of the switch-lock 14 is disengaged. The switch shaft 7, which is thus freed, itself rotates into the open position under the action of the spring 16. The lever-arm 23^b mounted on it thereby presses the lever 32 of the shaft 31 downwards into its original position whereby the spring 22^a is compressed and remains in a state of compression until the switch is again closed. The pin 24 is thus relieved from the pressure of the spring 22^a so that the weaker spring 27 can press it back into its position of rest. If, after the fusible metal has re-hardened, the switch is again closed the lever 23^b again frees the lever 32 and the spring 22^a so that the temperature protector is again ready for action.

In the example illustrated in Fig. 5, the separate return spring for the locking member of the temperature protector which must be weaker than the spring which effects the opening of the switch is eliminated by causing the return of the locking member 24 to its position of rest to be effected mechanically by the disconnecting movement of the switch. The pin 24, which is soldered in the central tube of the heating coil 26 in its upper end position, and which in this case simultaneously serves as the releasing member is only acted upon by a spring 22^a which is arranged in the head of the temperature protecting element and tends to push it downwards. At the lower end of the pin there is located one arm 33 of a double-armed lever 33, 34 which is fitted on the controlling shaft 31 of the switch-lock 14 and of which the other arm 34 lies in the plane of an eccentric or cam 23^a which is fixed on the switch-shaft. When the fusible metal melts the spring 22^a presses the pin 24 downwards so that the latter rotates the controlling shaft 31 through the agency of the lever-arm 33 and thereby disengages the pawl 17. On the rotary disconnecting movement of the switch-shaft 7 which now takes place the cam 23^a presses on the lever-arm 34 whereby the locking and releasing pin 24 is returned to its upper end position, the spring 22^a being compressed and the controlling shaft 31 being rotated back-

wards simultaneously. The pin 24 is again held fast in this position owing to the hardening of the solder. On re-closing the switch the cam 23^a is withdrawn from the lever 33, 34 so that the temperature protector is again ready for operation. This arrangement possesses the advantage on the one hand that the number of springs of which the tension must be definitely fixed relatively to one another is reduced to two. Further, since the return of the pin is effected by means of the very powerful opening spring 16 of the switch, it is possible for the pin 24 to be displaced when the solder is not completely liquid but is only in a semi-fluid condition when in moving the pin a relatively great amount of friction has to be overcome. The movement of the pin, which always need only be comparatively small is then effected as it were by percussion, which is advantageous in order to easily overcome the resistance.

It may prove advisable in many cases to insert a resilient member between the member which effects the return of the locking or releasing pin 24 and the pin itself. An example of this is illustrated in Fig. 6. Here the shaft 31 which carries the releasing lever 18 for the switch-lock 14 is connected with the releasing pin 24 by a flexible, elastic lever 35 which consists for example of a strong flat spring and is supported on the upper end of the pin 24, while the switch-shaft 7 carries another lever-arm 23^b instead of a cam as in Fig. 5. The lever 23^b is so arranged that on the rotary disconnecting movement of the shaft 7, which takes place after the temperature protector has come into operation, it presses on a point which lies between the two ends of the flat spring 35 and thus returns the releasing pin 24 through the agency of the flat spring 35 into its position of rest. This has the advantage that there is no resistance, due to the resistance to movement of the pin, to the opening movement of the switch, which with direct current must take place instantaneously. Even if the displacement of the pin 24 should proceed rather slowly the switch can rotate instantaneously and completely into the open position whereby it stresses the flat spring which forms the lever 35 and which itself moves the pin 24 into its position of rest while compressing the spring 22^a. Obviously in this case the flat spring which effects the return movement must be more powerful than the releasing spring 22^a which, however, is without effect upon the release of the switch-lock 14 since the flat spring only serves then as a simple connecting lever.

I claim:—

1. A protecting device for electric circuits comprising an automatically movable rotary switch shaft, a temperature protector provided with a locking and releasing member normally held fast in its position of rest by fusible material, a spring for automatically moving said member out of its position of rest when the temperature protector comes into action, locking and releasing means including a lock controlling element independent of said member and governed thereby for holding the shaft in switch closing position and against switch opening movement, and mechanical means governed by the shaft for holding said element in engagement with said member for releasing action thereby when the protector comes into action, said means acting in opposition to said spring on the switch disconnecting motion of the shaft to automatically reset said member and element.

2. A protecting device for electric circuits comprising an automatically movable rotary switch shaft, a temperature protector provided with a locking and releasing member normally held fast in its position of rest by fusible material and automatically movable out of its position of rest when the temperature protector comes into operation, locking and releasing means including a lock controlling element independent of and governed by said member for holding the shaft in switch closing position and against switch opening movement, mechanical means governed by the shaft and including a spring tensioned by the shaft for holding said element in engagement with said member and for imparting releasing motion to said element and member when the fusible material is softened, and means acting on the switch disconnecting motion of the shaft to automatically reset said member and element.

3. A protecting device for electric circuits comprising an automatically movable rotary switch shaft, a temperature protector provided with a locking and releasing member normally held fast in its position of rest by fusible material, locking and releasing means including a lock controlling element independent of and governed by said member for holding the shaft in switch closing position and against switch opening movement, mechanical means governed by the shaft and including a spring tensioned by the shaft for holding said element in engagement with said member for releasing action thereby when the protector comes into action, and a spring acting on the switch disconnecting motion of the shaft to automatically reset said locking and releasing member.

4. A protecting device in accordance with claim 3, in which the switch shaft controlled spring acting on the locking and releasing member of the temperature protector is of normally greater strength than the spring directly acting on the locking and releasing member and is mechanically acted upon by the switch shaft in such a manner that it is only effective when the switch is closed and is made ineffective by the opening movement.

5. A protecting device for electrical current consuming apparatus having an auto-

matic circuit breaker, comprising an automatically rotatable switch shaft, a locking device for holding said shaft from rotation, a controlling element acting on said locking device, a temperature protector provided with a locking and releasing member which is normally held fast in its position of rest by fusible material and is automatically movable out of its position of rest when the temperature protector comes into operation, said member acting on said controlling element to normally maintain the locking device in locking position, means governed by the motion of the switch shaft and acting on said controlling element to release said locking device when said locking and releasing member is released by fusion of the fusible material, and means for automatically returning the locking and releasing member into its position of rest on opening of the switch.

6. A protecting device for electrical current consuming apparatus having an automatic circuit breaker, comprising an automatically rotatable switch shaft, a locking device for holding said shaft from rotation, a controlling element acting on said locking device, a temperature protector provided with a sliding locking and releasing pin which is normally held fast in its position of rest by fusible material and is automatically movable out of its position of rest when the temperature protector comes into operation, said member acting on said controlling element to normally maintain the locking device in locking position, means governed by the motion of the switch shaft and acting on said controlling element to release said locking device when said locking and releasing member is released by fusion of the fusible material, and means for automatically returning the locking and releasing member into its position of rest on opening of the switch.

7. A protecting device for electrical current consuming apparatus having an automatic circuit breaker, comprising an automatically rotatable switch shaft, a locking device for holding said shaft from rotation, a controlling element in the form of a rock shaft acting on said locking device, a lever carried thereby, a temperature protector provided with a locking and releasing member which is normally held fast in its position of rest by fusible material and is automatically movable out of its position of rest when the temperature protector comes into operation, said member acting on said lever of said controlling element to normally maintain the locking device in locking position, means acting on said lever of said controlling element and governed by the motion of the switch shaft to release said locking device when said locking and releasing member is released by fusion of the fusible material, and means for automatically returning the locking and releasing member into its position of rest on opening of the switch.

8. A protecting device in accordance with claim 3, characterized by the feature that on closing the switch the shaft controlled spring is stressed by a lever acted upon by a control member fitted on the switch shaft and is relieved from stress by the disconnecting movement.

9. A protecting device in accordance with claim 3, characterized by the feature that on closing the switch the shaft controlled spring is stressed by a lever acted upon by an eccentric fitted on the switch shaft.

10. A protecting device in accordance with claim 3, in which the locking or releasing member of the temperature protector is loaded by a spring for moving it in one direction, characterized by the feature that a reverse movement of the locking and releasing member is mechanically brought about by a lever operated by a member carried by the shaft of the automatic switch on the rotary releasing movement of said shaft.

11. A protecting device in accordance with claim 3, characterized by the feature that the shaft controlled spring comprises an elastic coupling member interposed between a controlling member fitted on the switch shaft and the lock controlling element governed by the movable locking and releasing member of the temperature protector.

12. A protecting device in accordance with claim 3, in which the locking or releasing member of the temperature protector is located in the interior of a heating coil which is held in position by means of a screw head or cover, characterized by the feature that the spring (27) which loads the locking or releasing member (24) so that it tends to move back into its position of rest is arranged in a recess in the screw head or cover (28).

In testimony whereof I affix my signature.

OTTO DREYER.