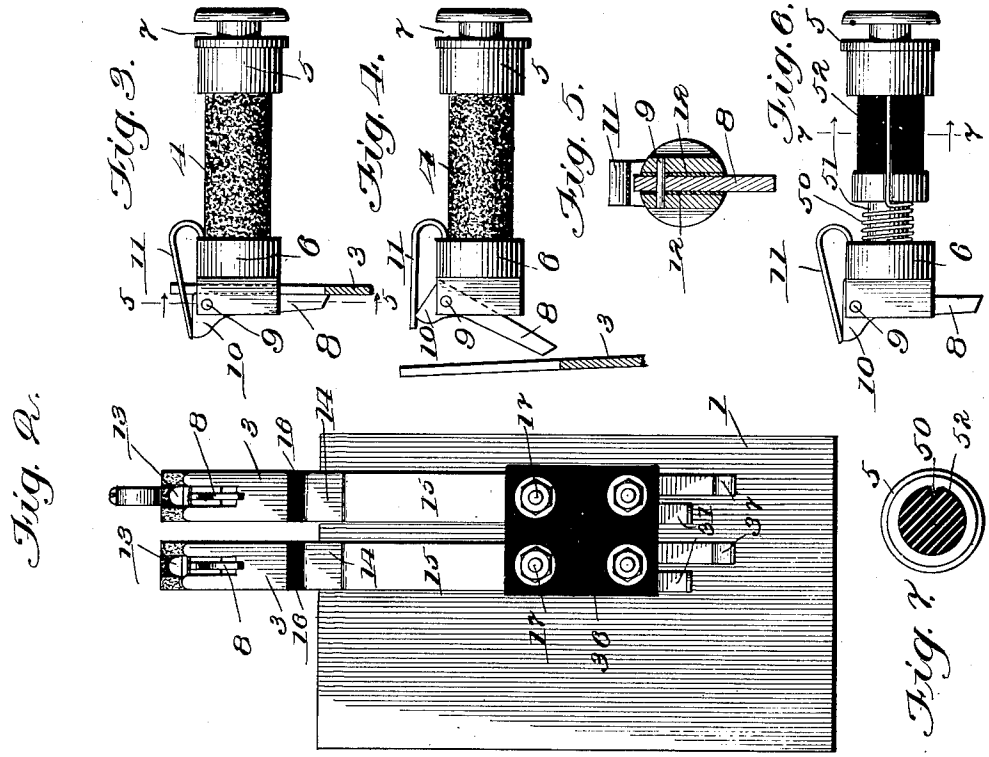
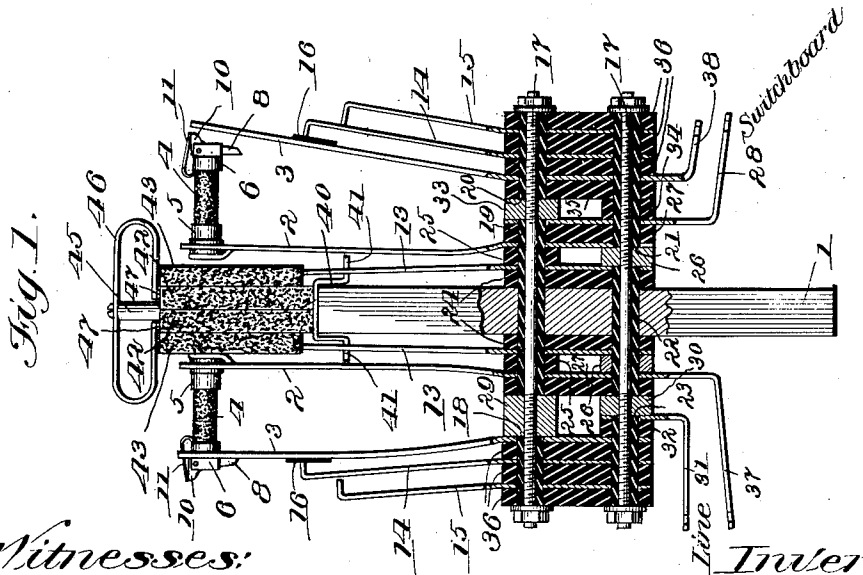
C. A. ROLFE.

ELECTRICAL CIRCUIT PROTECTOR.

APPLICATION FILED APR. 21, 1902.

1,046,860. Patented Dec. 10, 1912.





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UNITED STATES PATENT OFFICE.

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ELECTRICAL-CIRCUIT PROTECTOR.

1,046,860. Specification of Letters Patent. Patented Dec. 10, 1912.

Application filed April 21, 1902. Serial No. 104,021.

To all whom it may concern.

Be it known that I, CHARLES A. ROLFE, a citizen of the United States, residing at Adrian, in the county of Lenawee and State of Michigan, have invented a certain new and useful Improvement in Electrical-Circuit Protectors, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

This invention relates primarily to protectors for telephone, telegraph and fire alarm and similar circuits, although in its useful applications it may be applied to other circuits or for other purposes.

In devices of this character there is such an operation of the device upon the passage of an unduly strong current, as to break or open the circuit, or to ground the same, or both. After such operation the line remains in that condition until the protective device has been restored to its original or normal condition. This restoration of the device usually necessitates either replacing one or more of the parts affected by the operation of the device by a new part or parts of the same kind, or the restoration by hand or tools of one or more of such parts to its or their original condition. This is due to the fact that such part or parts are disintegrated or otherwise rendered unfit for service by the operation of the device. For example, in one form of protective device a circuit breaking spring is held in tension by a ball or mass of wax containing a coil of fine wire. When an unduly strong current passes over the line, this fine wire is heated, thereby softening the adjacent portion of the wax and releasing the spring, which thereupon operates to break the circuit. In such devices it is necessary before the device can be used again, to replace the ball or mass of wax containing the coil and having the hook for engaging the spring, with a new structure of this kind.

In another form of protector a coil of fine wire is associated with a metallic core into which a plug or shank is introduced and soldered by readily softenable solder. When an unduly strong current passes over the line containing one of these devices, the heat generated by the coil softens the solder, thereby allowing the plug or shank to be withdrawn from the core by suitable spring arrangements, thereby to break the circuit between the core shank and solder. When a device of this character operates it is necessary either to replace the combined structure, consisting of the coil, core and soldered shank, with another one, or else to resolder the shank in position in the core with suitable soldering tools or apparatus. It is obvious that the necessity of replacing these certain parts with new ones or resoldering, or otherwise restoring them to their original condition by hand or with tools, is a matter of much expense, annoyance and delay.

I have specifically mentioned two well known forms of protective device, and the specific operation necessary to be performed in each after action, but it will be understood that these are only illustrative of the general practice which, so far as I am aware, involves, in the case of all protective devices of this class, either the replacement of disintegrated or separated parts with new and complete organized structures or the reconstruction of the old parts, either in a shop where they are sent, or at the device itself if the tools are available to the attendant.

The principal objects of my invention are to avoid all of the inconvenience, expense and delay incident to the above practice; and to accomplish this result in a simple, practical and inexpensive manner.

In the arrangement herein shown for carrying out my invention, the part or portion of the protective device operated as a result of the excess current, is automatically restored after each operation to condition for another or subsequent operation, or, in other words, is automatically placed again in condition for another operation. In this way, after each operation, the device is ready to place the circuit at once in its original condition and ready for another operation; and thus the delay, inconvenience and expense of the renewal or reconstruction of parts is avoided.

I also have shown in the present application, an arrangement of lightning arrester particularly adapted for use in connection with a protector and capable of automatically grounding the line upon the intrusion thereon of lightning or a current of high frequency; but I make no claim to this lightning arrester alone herein, having filed a separate application for it, the same hav-

ing issued as Patent No. 768,196, dated August 23, 1904, lightning arrester.

In the accompanying drawing, Figure 1 is a view partly in elevation and partly in vertical section, of a section of electrical circuit protective apparatus comprising a plurality of protectors embodying my present invention, and lightning arresters associated therewith; Fig. 2 is a side elevation of the same; Figs. 3, 4 and 5 are views of certain parts of one of the protectors, Fig. 5 being a section taken on line 5—5 in Fig. 3; Fig. 6 is a view similar to Fig. 3, of a modified form of device; and Fig. 7 is a section taken on line 7—7 in Fig. 6.

In the drawings I have shown a section of an apparatus intended for a telephone exchange or other place where a plurality of lines are assembled, and where it is desirable to group the protectors for the various lines together. The apparatus shown comprises a supporting plate or structure 1 which is conveniently made of metal covered with insulating material as shellac. This plate has a series of protective devices arranged on each side of it. In Fig. 1 the end protectors of the two series appear on opposite sides of the plate, and in Fig. 2 two protectors are shown on one side of the plate, it being understood that there are any desired number in the series, and that the number of protectors in the two series on opposite sides of the plate are desirably the same.

Each protector comprises a pair of spring arms 2, and 3 which tend to swing or separate from one another. The upper ends of each pair of spring arms 2 and 3 support what I shall term a "heat cartridge," in this case conveniently consisting of a graphite stick 4 and caps 5 and 6 soldered to the opposite ends of the graphite stick by hard solder,—that is, solder which melts at a comparatively high temperature. The cap 5 is made with an annular recess 7, as shown in Figs. 3 and 4, which permits it to be slid into a slot formed in the spring arm 2. The cap 6 has its end slotted, as shown in Fig. 5, and a swinging lever 8 is arranged between the slotted portions and pivoted near its upper end by a pivot 9. This lever 8 is constructed with an outwardly extending portion 10 at its upper end, and a spring 11 is secured to the inner end of the cap 6 and extended over the projection 10 of the lever 8 and adapted to press downwardly upon the same so as to tend normally to move the lever so as to swing its lower end inwardly. The lever 8 is longer than the width of the cap so that a portion of it projects below the same, and the spring arm 3 is slotted as shown in Fig. 2 so that the narrowed slotted portion of the cap 6 can fit therein, while the lower end of the lever will engage the arm at the end of the slot. The lever is soldered in position between the forked or slotted portion of the cap 6 by layers 12, 12, of soft solder,—that is, solder which will melt or soften at a comparatively low temperature. The graphite stick 4 is of such internal resistance that it will become sufficiently heated by an unduly strong current to melt or soften the layers 12, 12, of soft solder, but not to melt the solder by which the caps 5 and 6 are secured to its ends. When the device is in normal condition, the spring arm 2 is engaged by the cap 5 and the spring arm 3 by the lower end of the lever 8, whereby these spring arms are held in restraint as shown at the left hand side of Fig. 1.

In between the protectors and the supporting plate 1 are lightning arrester contact springs 13, 13, and on the outer sides of the protectors are local circuit contact strips 14, 14, and 15, 15. The contact strips 14, 14, 15, 15, have their upper ends bent inwardly as shown in Fig. 1, and the strips 14, 14, rest upon insulation pieces 16, 16, on the spring arms 3, 3. The contact strips 13, 13, 14, 14, and 15, 15, and the spring arms 2, 2, 3, 3 are held and supported in proper position by long screws 17, 17, which extend transversely through the plate 1, it being understood that for each set or pair of protectors and coöperating contact strips on opposite sides of the plate 1, there is a set or pair of holding screws 17, 17. These screws 17, 17, are insulated at intervals by insulating tubes 18, 19, 20, 21, 22 and 23. Between the contacts 13, 13, and the plate 1 are insulating strips 24, 24, which are properly perforated for the inclosing tubes 19 and 22. Outside of the contact strips 13, 13, are insulating strips 25, 25, and metal nuts 26, 26. Outside of the spring arms 2, 2, are insulating strips 27, 27. On the outer side of the right hand strip 27 is a switch board strip 28 projecting below the same, and on the outer side of the left hand strip 27 are metallic nuts 29 and 30, the latter being in contact with a line strip 31 which is interposed between the metallic nut 30 and another insulating strip 32. The metallic nut 29 is in contact with the spring arm 3 of the left hand protector. On the outer side of the switchboard strip 28 are a metallic nut 33 and an insulating strip 34, and on the outer side of these is an insulating strip 35. Outside of the spring arms 3, 3, and supporting the same and the local contacts 14, 14 and 15, 15, respectively are insulating strips 36, 36, 36. The nuts for the screws 17, 17, are applied to the outer insulating strips 36, 36, and suitably tightened so as to draw and hold the entire structure securely together. The spring arm 2 of the left hand protector and the spring arm 3 of the right hand protector, are extended below the insulating strips so as to form line and switchboard connectors 37 and 38

respectively. These, together with the line and switchboard connectors 31 and 28 are the terminals for the connecting wires of the circuit.

The circuits for the two protectors can be traced as follows: For the right hand protector connection is made from the spring arm 3 to whose lower end a switchboard wire is connected, to the cap 6, graphite stick 4, cap 5, spring arm 2, metallic piece 21, lower screw 17, metallic piece 30, and line connector 31. For the left hand protector the circuit is from the switchboard connector 28, to metallic piece 33, upper screw 17, metallic piece 29, spring arm 3, cap 6, graphite 4, cap 5, and spring arm 2, to whose lower end 37 connection is made with a line wire.

A ground connection with each of the two protectors is provided by a metallic piece 40 arranged on top of the plate 1 and having outwardly projecting ends 41, 41, located in the rear of the spring arms 2, 2, but at a slight distance away from the same. In this arrangement it is understood that the plate 1 is connected with the ground, so that the ground contact 40 by resting upon and being connected with the plate 1 makes the proper ground connection.

The lightning arrester arrangement is located above the plate 1 and between the upper ends of the two protectors constituting each pair. The lightning arrester comprises two ground electrodes 42, 42, desirably in the form of carbon plates, and two line electrodes 43, 43, also desirably carbon plates. These two electrodes 43, 43, are understood to be suitably insulated from the ground electrodes 42, 42, by a layer of mica, silk or other insulating material arranged between them in the usual manner. The line electrodes 43, 43 are held in position against the ground electrodes 42, 42, by the lightning arrester contact strips 13, 13, which also serve to connect such line electrodes with the lines, through metallic strips 26 26, the electrodes 43, 43, being grooved, as shown in Fig. 2, so as to accommodate the contacts 13, 13. A post 45 is extended up from the ground plate 1 between the ground carbons 42, 42, which are suitably grooved for it. A spring 46 is secured to the upper end of the post 45 and made in the form of a loop, so that its ends are located above the electrodes 42, 42, and 43, 43. They are held out of contact with electrodes 43, 43, by small masses 47, 47, of readily softenable material, preferably solder. The ends of the spring 46 tend to become depressed so that when one or both of the small masses 47, 47, become softened or melted, the ends of the spring 46 again come into contact with either or both of the line electrodes 43, 43.

The operation of the apparatus thus constructed, is as follows: When an unduly strong current passes through one of the circuits, one or both of the protective devices which that circuit contains will be operated. As the operation of both is the same that of but one will be here described. The unduly strong current causes the graphite stick of the heat cartridge of the device which operates, to become so heated as to melt or soften the solder 12, whereupon the lever 8 will be released or uncemented as it were by the softening of the solder, thereby allowing the spring arm 3 to move outwardly. This spring arm will thereupon proceed to move or spring outwardly and will continue such motion until it passes the lower end of the lever 8 and thereby becomes freed from such lever and from the heat cartridge of which the lever forms a part. This opens or breaks the circuit by the formation of an opening or gap between the end of the lever 8 and the spring arm 3, as shown in Fig. 4. The spring arm 3 comes to rest in an outward position free or disconnected from its coöperating heat cartridge, as well shown in Fig. 1, but the lever 8 of the heat cartridge is immediately returned or restored to its original or normal position by the spring 11 coöperating with said lever. This is permitted because the solder is still in a melted or softened condition. The release of the spring arm 3, the freeing of the same from the lever 8, and the swinging of the latter back to its original condition, all take place in an exceedingly short period of time, so short that the graphite stick and solder do not have time to cool. In a few moments the graphite 4 and layer of solder 12, will cool sufficiently to allow the solder to become hardened, whereupon the lever 8 is again held rigidly in position to engage and restrain the spring arm 3. It is only necessary, therefore, to place the arm 3 in engagement with the lever 8 to put the entire protective device in its normal condition, assuming that only one heat cartridge has operated. Another unduly strong current passing the line will again heat the graphite 4 of one of the cartridges to an extent to melt or soften the solder thereof, whereupon the lever 8 will again be swung by the spring 3 so as to cause the release of the latter, and the consequent breakage of the circuit, and immediately after this, the lever 8 will be again restored to its original condition and held there by the hardening of the solder. Sometimes both heat cartridges will operate at the same time, on the passage of an excessive current, in which case both of the levers 8, 8, are reset and resoldered preparatory for another operation. In this way the device can be operated time after time without any replacement or substitution of parts or without manual or machine labor to repair the same.

Whenever one of the heat cartridges operates and its spring arm 3 is released the

arm 2 also moves inwardly a little and comes into contact with the ground connection 40, thereby grounding one side of the circuit, and the arm 3 swings the contact 14 against contact 15, thereby closing the local circuit, which is understood to be connected in any suitable or usual manner with these contacts 14 and 15.

The lightning arrester normally remains in the condition shown in Fig. 1. When, however, lightning intrudes upon one of the lines, one of the balls or masses of softenable material 47 is softened, whereupon the end of the spring 46 resting upon it, descends, making connection with the corresponding line carbon 43 thereby grounding that side of the line and allowing the lightning to escape to ground. The lightning arrester is restored to condition by inserting a new ball or mass of softenable material 47.

In Figs. 6 and 7 I have shown a modified form of heat cartridge for use in the form of protector illustrated. In the form shown in these figures, I employ a coil of fine wire 50 as a heat concentrating device, instead of the graphite stick 4. This coil of wire 50 is wound upon a suitable core 51 which is desirably an extension of the cap 6. The two ends of the device are connected by an insulating cylinder 52 provided with a groove through which the wire of the coil 50 is extended to connect with the cap 5. The cap 6 is provided with a lever 8 soldered in place and with the spring 11 as before.

It will be seen that the structure which I have called the heat cartridge and which comprises the graphite stick 4, the caps 5 and 6, the lever 8, spring 11, and solder 12, 12, in the construction shown in Figs. 3 and 4, and the coil 50, core 51, cylinder 52, caps 5 and 6, lever 8, spring 11, and solder 12, in the construction shown in Figs. 6 and 7, comprises what may be termed a heat responsive device; for it is a structure affected by or responsive to the heat developed by the unduly large current.

It will further be seen that the spring arm 3 serves as a circuit governing or controlling device, in that it governs or controls the circuit, holding it closed when it is engaged by the heat responsive device, and opening it when disengaged from or released by that device. Also the spring arm 2 and ground connection 40 may be considered as a circuit governing device as they govern the circuit, grounding it or not as controlled by the heat responsive device.

Thus it will be seen that by my invention the operating members or parts are automatically resecured, preferably by resoldering them together, so that the protector is automatically restored to operative condition, to prepare it for another operation; and so I consider that this action in an electrical circuit protector lies within my invention, even though the protector differs in character, form, construction and method of operation, from the one herein set forth.

Considering the device more specifically, it will be seen that the spring arm 3 constitutes a circuit opening device and that the graphite stick 4 or heat coil 50 and associated parts constitute a device for holding the spring arm 3 in restraint, in which view the protector may be said to involve a circuit opening device, and a restraining device therefor responsive to heat, which, after operation, automatically restores itself to condition in which it can exercise its restraining action. Considered thus specifically, I feel the automatic restoration of a restraining device, irrespective of its character and of the character of the protector containing it, is included in the scope of the invention.

With reference to the advantages of the specific form of device herein set forth, it will be noted that the solder in the form of the layers 12, 12, is practically inclosed, so that it is not subject to the cooling influence of the air to any appreciable extent. This allows the ready concentration of heat on the solder and gives ample opportunity for the movable lever of the heat cartridge, in the form of device shown, to be returned to its original position before the solder can be chilled and hardened. It will further be noted that the circuit is not opened at the solder but is opened by the separation of the circuit breaking spring from the heat cartridge.

It will be understood that I do not intend to confine myself to the specific construction of electrical circuit protector herein set forth, for it is obvious that many changes and modifications may be made therein without departing from the spirit of my invention. Nor do I intend to confine myself even to the general form of protector herein shown and described, that is, to a thermal protector having its heat-concentrating device and heat susceptible body combined in a unitary structure which may be termed a "heat cartridge"; nor to the general arrangement or plan by which the automatic restoration of the device occurs. For the invention contemplates the resecuring of the part or parts released on the passage of an excessive current, automatically in condition or position for successive operations. Hence, by the term "normal condition" as used herein, especially in the claims, I mean, in condition for operation; I do not mean necessarily to the identically same condition or position.

While in this specification I have described thermal protectors as containing the preferred embodiment of the invention, yet it is to be understood that the invention is not necessarily limited in its useful applica-

tion to thermal protective devices, as other constructions may be made wherein the principle of the invention can be employed.

What I claim is:—

1. A heat responsive device for thermal electrical protective apparatus, comprising a heat concentrating device, a quantity of solder associated therewith, and a movable device held in position by the solder, and means for operating said movable device in combination with automatic means for restoring said movable device to normal position.

2. A heat responsive device for thermal electrical protective apparatus, comprising in combination a heat concentrating device, a small quantity of solder, a lever held in position by the solder, and a spring for restoring the lever to its initial position after operation and when the solder is still melted, substantially as set forth.

3. A restraining device for thermal electrical protective apparatus, comprising in combination a heat concentrating device, a fixed engaging device, a movable engaging device, a small quantity of solder holding the movable engaging device normally in engaging position, means for operating said movable device, and means for restoring the movable engaging device to normal position.

4. A restraining device for thermal electrical protective apparatus, comprising in combination a heat concentrating device, a fixed engaging device, a movable engaging device, a small quantity of solder holding the movable engaging device normally in engaging position, means for operating said movable device, and a spring arranged to act upon the movable engaging device to restore the same to engaging position.

5. In thermal protective apparatus for electric circuits, the combination with a pair of supporting arms, one of which tends to separate from the other, of a restraining device for holding said spring arm in restraint, said device comprising a heat concentrating device, means for engaging the supporting arm, a movable engaging device for engaging the spring arm, a small quantity of heat susceptible material adapted to hold said movable engaging device against the strain imposed upon it by the spring arm, and means for restoring said movable engaging device to normal position after the same is released by the softening of the heat susceptible material and moved by the spring arm, substantially as set forth.

6. In thermal protective apparatus for electric circuits, the combination with a pair of supporting arms, one of which is a spring and tends to separate from the other, of a restraining device for holding said spring arm in restraint, said device comprising a heat concentrating device, means for engaging the supporting arm, a movable engaging device for engaging the spring arm, a small quantity of heat susceptible material adapted to hold said movable engaging device against the strain imposed upon it by the spring arm, and a spring for restoring said movable engaging device to normal position after the same is released by the softening of the heat susceptible material and moved by the spring arm, substantially as set forth.

7. A heat responsive device for thermal electrical protective apparatus, comprising in combination a heat concentrating device, a small quantity of heat susceptible material, a movable device subject to said heat susceptible material, means for inclosing or substantially inclosing the heat susceptible material, means for operating said movable device, and automatic means for restoring said movable device to normal position.

8. In thermal electrical protective apparatus, the combination of a heat concentrating device, a small quantity of solder softenable by the heat developed in the heat concentrating device by an unduly strong current, a movable part held by the solder, a spring tending to move said part, and means for automatically restoring said part to normal position while the solder is still soft, substantially as described.

9. The combination of a heat concentrating device, a body or mass of material susceptible to heat, a part controlled by said body or mass of material, means for moving said part when the body or mass of material is affected by the heat, and means for returning said part to its original position while said body or mass is still affected, substantially as described.

10. The combination with a heat concentrating device, of a body or mass of material susceptible to heat associated therewith, a part controlled by said body or mass of heat susceptible material, means for moving said part when the heat susceptible material is affected by heat, and means for restoring said part to normal condition.

11. The combination of a heat concentrating device, a body or mass of material susceptible to heat and associated with said heat concentrating element, a device controlled by said body or mass of material, means for operating said element and means for actuating said element after operation and while said material is still in affected condition.

12. The combination of a body or mass of heat susceptible material, a heat concentrating device associated therewith, a part controlled by said material, means for actuating said part when said material is affected, and supplemental means for additionally actuating said part after operation and while said material is still affected, substantially as described.

13. A cartridge for thermal electrical pro-

tective apparatus, consisting of a body part, a movable part, a small quantity of heat-susceptible material restraining the movable part, and means for automatically restoring the movable part to initial position while the heat-susceptible material is still affected, substantially as described.

14. In an electrical circuit protector, the combination of a movable part, a quantity of solder normally holding said part against movement, means for softening said solder on the passage of an unduly strong current, means for opening the circuit controlled by said part and operated on the release thereof and in turn moving said part, and means for returning said part to its original position, said part being associated with said solder after such circuit opening and return movements whereby after operation it is resoldered preparatory for another operation.

15. As an article of manufacture, a heat cartridge having a lever pivoted thereto.

16. An electrical circuit protector comprising a pair of metallic strips, and a heat cartridge supported thereby, said protector having means whereby the circuit is protected on the passage of an unduly strong current and also having provisions whereby said cartridge is automatically restored to operative condition.

17. An electrical circuit protector comprising a pair of metallic strips, and a heat cartridge supported thereby, said protector having means whereby the circuit is opened on the passage of an unduly strong current through the heat cartridge, and said heat cartridge having provisions whereby it is automatically restored to operative condition.

18. An electrical circuit protector comprising a pair of line springs and a heat cartridge supported thereby, and arranged to hold one of said springs in restraint, said spring being released on the operation of the device by the passage of an unduly strong current through the heat cartridge, and said cartridge having provisions whereby it is automatically restored to operative condition preparatory for another operation.

19. An electrical circuit protector comprising a pair of supporting strips, and a solder joint heat cartridge supported thereby, said heat cartridge having provisions for automatically resoldering itself in operative condition.

20. An electrical circuit protector comprising a pair of metallic supporting strips, one of which is a spring, and a self-soldering heat cartridge supported by said strips and restraining said spring, said cartridge having provisions for automatically resoldering itself in operative condition.

21. In an electrical circuit protector, a heat cartridge having provisions whereby it is automatically reset for operation and resoldered in such condition.

22. A spring-actuated electrical circuit protector held in restraint by a device having a movable part held normally against movement by a solder joint, and also having provisions whereby said part is automatically returned to its original position, whereby said device is automatically reset and resoldered or self-soldered in its original condition.

23. In an electrical circuit protector, a heat cartridge having a bifurcated end, and a spring-engaging device soldered between the parts of said end, in combination with means for holding said spring-engaging device against bodily removal.

24. A solder joint heat cartridge for electrical protectors, having provisions for automatically resoldering itself in operative condition.

25. In a device of the class described in combination, a pair of spring arms, a member connecting said arms and a lever pivoted to said member normally engaging one of said arms.

26. An electrical circuit protector comprising means for controlling the circuit, and means for closing a local circuit upon operation, said protector having provisions whereby upon operation to control the circuit it is simultaneously reset in condition for resoldering for another operation.

27. In an electrical circuit protector in combination, a pair of spring elements, and a heat cartridge carried between said elements, said cartridge comprising a body of heat insulating material, electrical contact members for coöperating with said springs, one of which is provided with a self-soldering element, and means for electrically connecting said contact members including a heating coil carried by said heat insulating body.

28. An electrical circuit protector, comprising two metallic strips or circuit elements and a removable heat cartridge mounted on said strips, said cartridge being provided with a self-soldering element.

29. An electrical circuit protector, comprising a mounting element, a self soldering cartridge carried on said mounting element, and a circuit opening spring normally restrained by said self soldering cartridge.

30. An electrical circuit protector, comprising two metallic strips or circuit elements and a removable heat cartridge mounted on said strips, said cartridge being provided with a self-soldering element cooperating with one of said metallic strips.

31. An electrical circuit protector, comprising a mounting element, a self soldering cartridge carried on said mounting element,

and a circuit opening spring normally restrained by the self soldering mechanism of said self soldering cartridge.

32. A self soldering heat cartridge for use in electrical circuit protectors, comprising a body of heat insulating material, a pair of electrical connecting elements carried by said heat insulating body, one of said elements being of the self soldering type and electrical connections between said elements including a heating coil carried on said heat-insulating body.

33. A heat responsive device for thermal electrical protective apparatus, comprising a heat concentrating device, a small quantity of solder, a lever held in normal position by the solder, and a spring for restoring the lever to its initial position after operation and when the solder is still melted, substantially as set forth.

34. In an electrical circuit protector, a heat cartridge having provisions whereby after operation it is automatically resoldered preparatory for another operation.

In witness whereof, I hereunto subscribe my name this 7th day of April A. D., 1902.

CHARLES A. ROLFE.

Witnesses:

A. MILLER BELFIELD,

I. C. LEE.