No. 785,798. PATENTED MAR. 28, 1905.

F. B. COOK.

SELF SOLDERING HEAT COIL.

APPLICATION FILED MAR. 9, 1904.

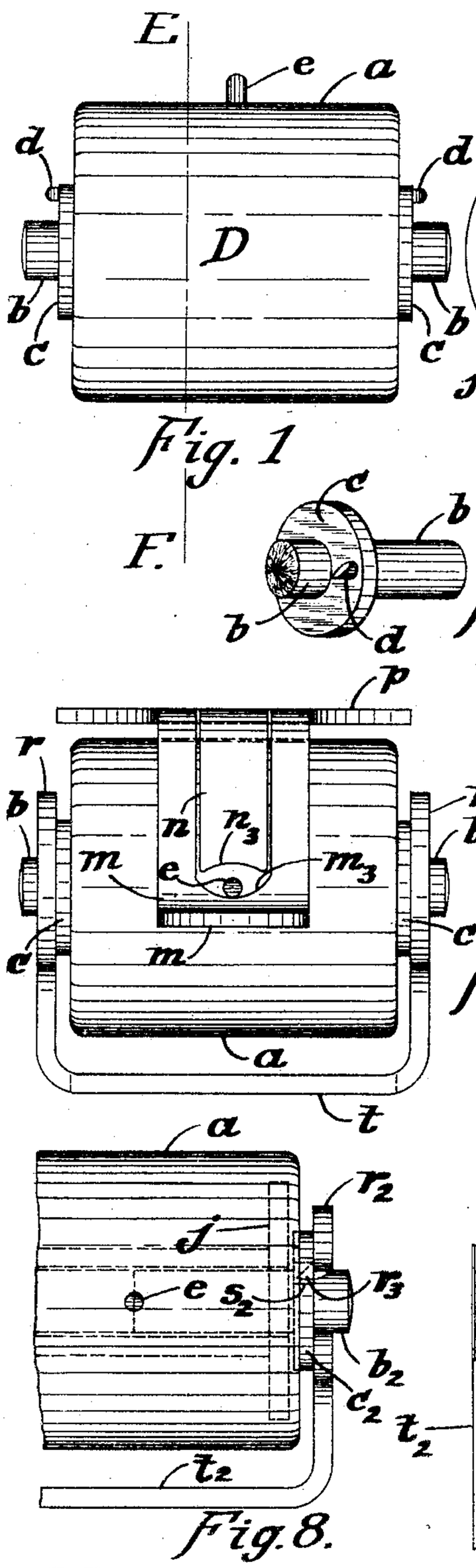

Fig. 1

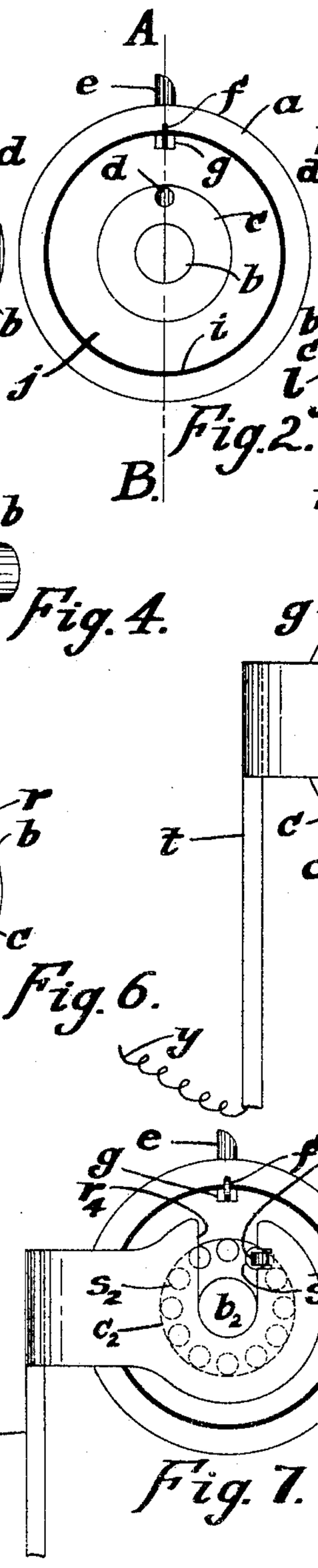

Fig. 2.

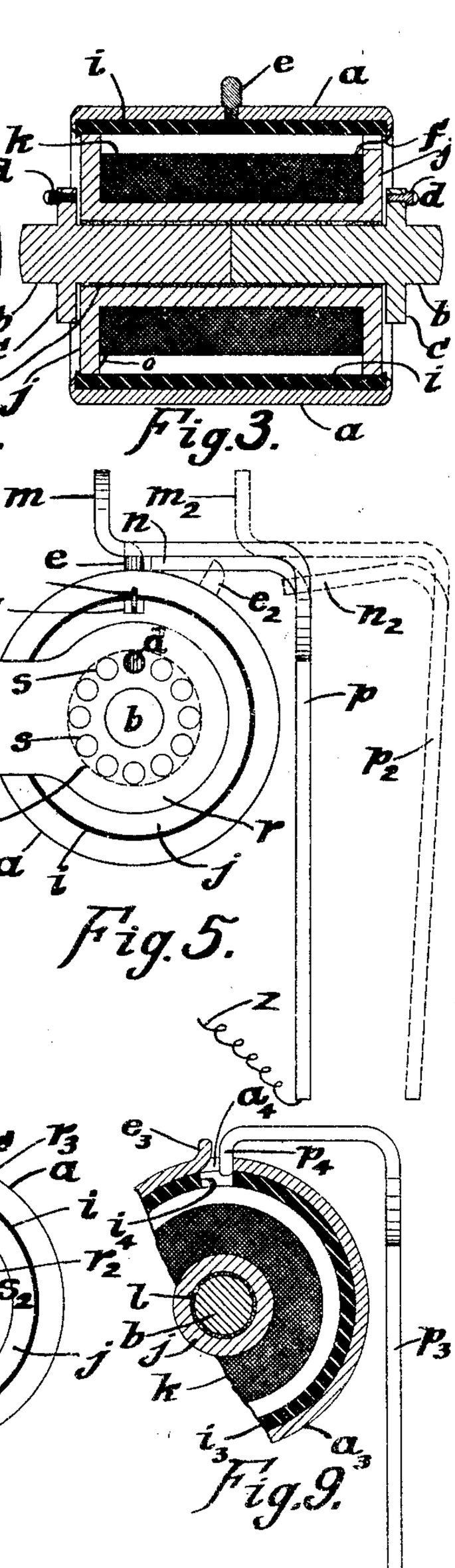

Fig. 3.

Fig. 4.

Fig. 6.

Fig. 5.

Fig. 8.

Fig. 7.

Fig. 9.

Witnesses:

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No. 785,798. Patented March 28, 1905.

UNITED STATES PATENT OFFICE.

FRANK B. COOK, OF CHICAGO, ILLINOIS.

SELF-SOLDERING HEAT-COIL.

SPECIFICATION forming part of Letters Patent No. 785,798, dated March 28, 1905.

Application filed March 9, 1904. Serial No. 197,294.

To all whom it may concern:

Be it known that I, FRANK B. COOK, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented new and useful Improvements in Self-Soldering Heat-Coils, 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.

My invention relates to thermal cut-outs for electric circuits, my object being, first, to provide such a cut-out or protector for use in connection with various electric circuits, which automatically restores itself to operative condition upon the operation of same; second, to provide suitable means whereby the said protector may be readily restored to operative position after operation, and, third, to provide a compact and durable arrangement for the parts of such apparatus which may be readily and economically manufactured.

Thermal cut-outs, or more particularly heat-coils, generally in use in telephone central stations to protect the incoming lines from stray electric currents of such a nature that a steady flow thereof heats the central-station apparatus abnormally, and which currents are not intended for use in the said lines, are of such a design that certain members thereof are separated by the action of a circuit-controlling means when the heat-coil is heated abnormally, thus allowing the said members to be separated, the said members remaining in a separated relation after the operation of the device.

Some of the more recent heat-coils embody an arrangement the parts of which are automatically restored to their same relative operative condition after the operation of same, and others embody an arrangement which is automatically restored to a new operative position by the operation thereof. These heat-coils are of the self-soldering type.

The heat-coil constituting my present invention is of the self-soldering type, but is of a type distinctly different from any of the above. It is not automatically restored to a new operative position by the operation thereof, nor are the parts thereof automatically restored to their same relative operative condition. The parts of this heat-coil are automatically restored to a new relative operative condition, the heat-coil as a whole being manually restored to an operative position through the agency of an automatic means.

In this invention I provide a stationary axis upon which is normally secured the other elements of the heat-coil, the said axis being suitably supported in a normally fixed position. A circuit-controlling means is adapted to engage the heat-coil, and by such engagement tend to turn the heat-coil, with its axis, against a catch adapted to hold same from turning. The said catch is adapted to hold the heat-coil against rotation in the direction which the circuit-controlling means normally tends to turn same and to allow the heat-coil to be turned in the opposite direction. When the heat-coil operates, the circuit-controlling means turns the body thereof upon the said axis until the said circuit-controlling means is released from the heat-coil. The parts of the heat-coil are automatically secured to each other in this new position by the cooling action thereof. After the parts are thus secured in their new relative position the heat-coil as a whole may be turned back to its operative position, against the said catch which permits of such turning, by any suitable means applied thereto. I have adapted the circuit-controlling means to engage the heat-coil and turn it back to its operative position, as stated, when the said circuit-controlling means is manually restored to its operative position. With the protector being thus restored to operative position it is evident that it may be operated again the same as originally. The cycle of operations, comprising the operation and restoration of the device, may be repeated again and again as many times as desired.

I will more particularly describe my invention by reference to the accompanying drawings, illustrating same, in which—

Figure 1 is a side elevation of the invention. Fig. 2 is a right-end elevation of Fig. 1. Fig. 3 is a cross-sectional view of the heat-coil, taken on line A B of Fig. 2. Fig. 4 is a perspective view of the pin *b* and catch *d*. Fig. 5 is an end elevation of the heat-coil and its connecting-springs. Fig. 6 is a top view of

Fig. 5. Fig. 7 is an end elevation of a modified form of heat-coil and spring-support. Fig. 8 is a top view of a portion of Fig. 7; and Fig. 9 is a portion of a cross-sectional view of a modified form of heat-coil, taken on a line corresponding to line E F of Fig. 1, with an engagement spring shown in elevation.

Like characters refer to like parts in the several figures.

The heat-producing winding *k* is wound upon the hollow spool *j*, which is secured to the pins *b b* by a heat-susceptible material *l*. Each pin *b* is provided with an annular projection *c* thereon, the said projections *c c* being arranged so that there is a small amount of end play to the spool *j* when the pins *b b* are brought together therein. Each annular projection *c* is provided with a beveled pin *d*, secured thereto and projecting from the outer face of *c*, as shown in Fig. 4. The spool *j* is inclosed by an insulating-sleeve *i*, which is inclosed by a metal sleeve *a*, the said sleeve *a* being turned over at each end so as to secure itself and the insulating-sleeve *i* to the spool *j*. A pin *e* is secured to the sleeve *a* and projects from the surface *a*, as shown. The terminals *o* and *f* of winding *k* are connected to the spool *j* and sleeve *a*, respectively, the spool *j* being cut away at *g* to allow terminal *f* to pass therethrough. Pins *d d* are arranged so that the beveled surfaces thereof are included in respective planes which meet in a line included in a plane passing through the center of the heat-coil perpendicularly to the longitudinal axis of the heat-coil, the said respective planes also meeting a plane including the longitudinal axes of the heat-coil and pins *d d* in respective lines which are parallel to the first-mentioned line.

Springs *t* and *p* are adapted to be secured to any suitable support, spring *t* being provided with ears *r r* at its free end, between which is inserted the heat-coil, while spring *p* is provided with a hole m^3 at its free end adapted to engage the pin *e*. Each ear *r* of spring *t* is provided with a hole therein, through which a pin *b* is inserted when the heat-coil is put in place, and with a series of holes *s s* therein each adapted to receive a pin *d*. When the heat-coil D is put in place, the ears *r r* are sprung apart, so as to allow pins *b b* to be inserted through the respective ears *r r* and pins *d d* to be inserted into respective holes *s s*, one in each ear *r*, the said ears then springing together again, and thereby holding the heat-coil in place. The beveled surfaces on pins *d d* allow them to spring the ears *r r* apart and slip out of the respective holes *s s*, in which they are engaged, to the next engaging holes when the heat-coil is turned in one direction; but should a force be applied to the heat-coil, tending to turn it in the opposite direction, the pins *d d* form catches which hold the heat-coil against rotation. The hole m^3 in spring *p* engages pin *e*, so that the tension in spring *p* tends to turn the heat-coil against the catches *d d*, which hold same from turning. Spring *p* is provided with a tongue *n*, cut away, as at n^3, which rests against the surface of *a* when spring *p* is engaged with pin *e*, and with a portion *m*, by which the spring *p* may be placed in operative position. Circuit-conductors *y* and *z* are connected to springs *t* and *p*, respectively.

The circuit through the heat-coil and springs is from conductor *y*, through spring *t*, ears *r r*, pins *b b*, fusible material *l*, spool *j*, winding *k*, sleeve *a*, pin *e*, and spring *p*, to conductor *z*.

The operation of the device is as follows: When an abnormally large current traverses the winding *k* of the heat-coil, it produces heat therein due to the resistance of the winding, which heat is conducted by the spool *j* to the heat-susceptible material *l*. When the heat is sufficient, the heat-susceptible material *l* is softened, thereby allowing the spring *p* to turn the body of the heat-coil upon the pins *b b*. The tension in spring *p* turns the body of the heat-coil until pin *e* takes the position e^2, (shown in dotted lines in Fig. 5,) when the pin *e* releases spring *p*, which takes the position p^2, (also shown in dotted lines,) and thereby breaks the circuit through the heat-coil. When the heat-susceptible material cools, the spool *j* is resoldered to the pins *b b* in a new position relatively to pins *b b*. When the heat-coil is reset to an operative position, the spring *p* is brought from the position p^2, Fig. 5, to the position *p*, the tongue *n* engaging the pin *e*, and thereby turning it with the heat-coil as a whole back to the normal engaging position. As the heat-coil is thus turned back, the pins *d d* slip from one set of holes *s s*, respectively, to the next set, and so on until the body of the heat-coil is restored to its normal position, when the hole m^3 of spring *p* slips over pin *e* and again engages same and pins *d d* catch in respective holes *s s*, one in each ear *r*, and thereby prevent spring *p* from turning the heat-coil. Portion *n* presses against the heat-coil, thereby insuring good contact between *p* and *a*. It will be readily seen that the heat-coil is now in operative position and may be operated again and reset, the same as described above.

In the modified form of the invention shown in Figs. 7 and 8 the ears r^2 r^2 are each provided with a catch r^3, adapted to engage any one of a series of holes s^2 s^2 in the portion c^2 of pin b^2. In this form the ears r^2 r^2 are slotted at r^4 r^4 to permit the heat-coil to be put in place from the tops of the said ears. When the heat-coil is operated, the catches r^3 r^3 prevent the pins b^2 b^2 from turning with the body of the coil, and when the device is reset the holes s^2 s^2 slide past the respective beveled surfaces of the catches r^3 r^3 until the device is restored to operative position, when the catches r^3 r^3 catch in respective holes s^2 s^2, one in each portion c^2 of pin b^2, and thereby hold the

heat-coil against the rotative tendency of spring p.

In the modified form shown in Fig. 9 the spring p^3 is provided with an end portion p^4, adapted to engage the sleeve a^3 in a hole a^4 therein, a portion of the insulating-sleeve i^3 being cut away at i^4 to allow the free insertion of portion p^4 into hole a^4. The portion e^3 cut from the hole a^4 may be turned out, as shown, thus forming a catch against which p^4 presses when the device is reset, and thereby turns the heat-coil back to an operative position.

I have shown and described particular details of construction in this invention, but do not wish to limit myself to such details. In manufacturing the device many modifications may be made without departing from the principles of the invention. I therefore wish it to be understood that the invention as herein set forth includes any arrangement of parts which are adapted to carry out the operations and principles of the particular device herein described.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In apparatus of the class specified, the combination of means for controlling a circuit, a device operable upon an excess of current and adapted to engage the circuit-controlling means, and a plurality of engaging devices each adapted to normally hold the excess-operable device against rotation, the latter device disengaging the circuit-controlling means when operated.

2. In apparatus of the class specified, the combination of means for controlling a circuit, a device operable upon an excess of current in the circuit and adapted to engage the circuit-controlling means, and a plurality of engaging devices each adapted to engage a catch and thereby hold the excess-operable device against rotation, the circuit-controlling means being adapted to bring said engaging devices into engaging position one after another, upon each resetting of the excess-operated device after operation.

3. In apparatus of the class specified, the combination of a heat-concentrating device, a conducting portion, a plurality of engaging devices adapted to hold said conducting portion against rotation, a heat-susceptible material securing the heat-concentrating device to the said conducting portion, and a circuit-controlling means adapted to engage the heat-concentrating device and to open the circuit through same when the heat-susceptible material is softened.

4. In apparatus of the class specified, the combination of a heat-concentrating device, a conducting portion provided with a plurality of engaging devices adapted to hold the said device and conducting portion against rotation, the said conducting portion being secured within the heat-concentrating device by a heat-susceptible material, a circuit-controlling means adapted to engage the heat-concentrating device and to turn same when the latter is released by the softening of the heat-susceptible material, the said circuit-controlling means being also adapted to bring the said engaging devices successively into engaging position when the apparatus is reset.

5. In a cut-out or protector for electric circuits, a resistance-body for inclusion in the circuit, a rotary detent electrically connected with the resistance-body, means acting upon the said detent and holding the cut-out against rotation, and means for turning the resistance-body under abnormal circuit conditions.

6. In a cut-out or protector for electric circuits, a resistance-body for inclusion in the circuit, a rotary detent electrically connected with the resistance-body, means for holding the said detent against rotation, and a circuit-controlling means electrically connected with the resistance-body and tending to break the circuit and cementing material for holding the resistance-body against rotation under normal circuit conditions, the cementing material becoming softened under abnormal circuit conditions to permit the circuit-controlling means to turn the said resistance-body and break the circuit, the said circuit-controlling means turning the rotary detent into a new engaging position when the cut-out is reset.

7. In apparatus of the class specified, the combination of a device operable upon an excess of current, a rotary detent for holding the device against rotation in one direction, and means for turning the whole in the opposite direction and thereby bringing the rotary detent into a new holding position.

8. In apparatus of the class specified, the combination of a device operable upon an excess of current, a portion provided with a plurality of engaging devices, means for engaging an engaging device and thereby holding the excess-operable device against movement in one direction, and means for bringing the said engaging devices into successive engaging position with their engaging means when the apparatus is reset.

9. In apparatus of the class specified, the combination of a heat-concentrating device, a wheel provided with a plurality of engaging devices and secured to the heat-concentrating device by a heat-susceptible material, means for engaging one of the engaging devices of said wheel and thereby holding the wheel normally in position, a circuit-controlling spring arranged to engage the heat-concentrating device and adapted to turn the said wheel so as to bring another engaging device thereof into engaging position, after the operation of the apparatus permitted by the heat-susceptible material becoming softened.

10. In a cut-out or protector for electric

circuits, a resistance-body for inclusion in the circuit, a rotary detent conductively connected with said resistance-body, a catch adapted to engage the said detent and hold it against rotation in one direction, and means for turning the detent in the opposite direction to a new engaging position with the catch, when the protector is reset.

11. In apparatus of the class specified, the combination of a device operable upon an excess of current, a plurality of engaging devices adapted to hold the excess-operable device against rotation in one direction, and means for turning the whole in the opposite direction and thereby bringing the said engaging devices into new engaging positions.

12. In apparatus of the class specified, the combination of a device operable upon an excess of current, a rotary detent at each end of the said device, means for engaging the rotary detents to hold the said device against a force tending to rotate same in one direction, and to permit the said device to be rotated in the opposite direction, for the purposes substantially as described.

13. In apparatus of the class specified, the combination of a device operable upon an excess of current, a plurality of engaging devices at opposite ends of the said device, means for engaging the said engaging devices to hold the said excess-operable device against a force tending to rotate same in one direction, and to permit the said excess-operable device to be rotated in the opposite direction, for the purposes substantially as described.

14. In apparatus of the class specified, the combination of a heat-concentrating device, conducting portions each provided with a plurality of engaging devices adapted to hold the said device and conducting portions against rotation, the said conducting portions being secured within the heat-concentrating device by a heat-susceptible material, a circuit-controlling means adapted to engage the heat-concentrating device and to turn same when the latter is released by the softening of the heat-susceptible material, the said circuit-controlling means being also adapted to bring the said engaging devices successively into engaging positions when the apparatus is reset.

15. In a cut-out or protector for electric circuits, a resistance-body for inclusion in the circuit, rotary detents electrically connected with the resistance-body, means for normally holding the resistance-body and detents against rotation, and means for turning the resistance-body under abnormal circuit conditions.

16. In a cut-out or protector for electric circuits, a resistance-body for inclusion in the circuit, rotary detents electrically connected with the resistance-body, means for holding the device as a whole against rotation, and a circuit-controlling means electrically connected with the resistance-body and tending to break the cementing material for holding the resistance-body against rotation under normal circuit conditions, the cementing material becoming softened under abnormal circuit conditions to permit the circuit-controlling means to turn the said resistance-body and break the circuit, the said circuit-controlling means turning the rotary detents into new engaging positions when the cut-out is reset.

17. In apparatus of the class specified, the combination of a device operable upon an excess of current, rotary detents for holding the device against rotation in one direction, and means for resetting the device after operation and thereby bringing the rotary detents into new engaging positions.

18. In apparatus of the class specified, the combination of a device operable upon an excess of current, conductive portions each provided with a plurality of engaging devices, means for engaging an engaging device of each conductive portion and thereby holding the excess-operable device against movement in one direction, and means for bringing the said engaging devices into successive engaging positions with their engaging means.

19. In apparatus of the class specified, the combination of a heat-concentrating device, wheels each provided with a plurality of engaging devices and secured to the heat-concentrating device by a heat-susceptible material, a suitable support for the device, means for engaging the said wheels and thereby holding the device normally in position, a circuit-controlling spring arranged to engage the heat-concentrating device and adapted to turn the said wheels so as to bring other engaging devices thereof into engaging positions, after the operation of the apparatus permitted by the heat-susceptible material becoming softened.

20. In a cut-out or protector for electric circuits, a resistance-body for inclusion in the circuit, rotary detents conductively connected with said resistance-body, means for holding the said detents against rotation in one direction, and means for turning the detents in the opposite direction to new engaging positions with their engaging means, when the protector is reset.

21. In apparatus of the class specified, the combination of means for controlling a circuit, a device operable upon an excess of current in the circuit and adapted to engage the circuit-controlling means, and a plurality of engaging devices each adapted to engage a catch and thereby hold the said device against rotation, the circuit-controlling means being adapted to produce successive engaging positions between the engaging devices and catch, upon each resetting of the excess-operated device after operation.

22. In apparatus of the class specified, the combination of an excess-current-operable device for inclusion in the circuit, a plurality of engaging devices each adapted to engage a

catch and thereby hold the excess-operable device against rotation, and means for producing successive engaging positions between the engaging devices and catch.

23. In apparatus of the class specified, the combination of an excess-current-operable device for inclusion in the circuit, a plurality of catches adapted to engage respective series of engaging devices and thereby hold the excess-operable device against rotation in one direction and means for rotating the excess-operable device in the opposite direction and thereby producing successive engaging positions between the said catches and their respective series of engaging devices.

24. The combination of mechanism for controlling a circuit, a heat-producing means operable upon an excess of current, said means being arranged to govern the circuit-controlling mechanism and being arranged to be turned upon its support by such mechanism when the latter is operated, and a portion of the latter adapted to turn such excess-current-operated device upon its support to operative position after operation.

25. In a thermal protector for electric circuits, an excess-current-operable device comprising a heat-concentrating means, a heat-conducting means, and an engaging means, an axis to which the excess-operable device is normally secured, holding devices adapted to prevent the axis from being turned in one direction but allowing it to be turned in the opposite direction, a suitable support for the axis, and a circuit-controlling means adapted to engage the said engaging means and to operate the excess-operable device upon an excess of current in same.

26. In a thermal protector for electric circuits, an excess-current-operable device comprising a heat-concentrating means, a heat-conducting means and an engaging means, an axis to which the whole is secured by a heat-susceptible material, a plurality of engaging devices adapted to prevent the axis from being turned in one direction but allowing it to be turned in the opposite direction, a suitable support for the axis, and a circuit-controlling spring adapted to engage the said engaging means and to operate the excess-current-operable device when the heat-susceptible material is softened.

27. In a thermal protector for electric circuits, the combination of an excess-current-operable device comprising a heat-concentrating means, a hollow heat-conducting means and an engaging means, pins inserted into the respective opposite ends of the heat-conducting means and secured thereto by a heat-susceptible material, a plurality of engaging devices for each pin and adapted to prevent the said pins from being turned in one direction but allowing them to be turned in the opposite direction, a spring-support formed so as to engage both said pins and adapted to coöperate with the said pins and thereby make effective the plurality of engaging devices, and a circuit-controlling spring adapted to engage the said engaging means and to operate the excess-operable device when the heat-susceptible material is softened.

28. In a thermal protector for electric circuits, the combination of a hollow heat-conducting spool, a heat-producing winding wound upon the spool, an insulating-sleeve inclosing the said spool and winding and secured to the said spool, a conducting-sleeve inclosing the insulating-sleeve and secured thereto, the terminals of the said winding being conductively connected to the said spool and conducting-sleeve, respectively, a conducting-pin for each end of the hollow spool and inserted therein, a heat-susceptible material normally securing the said spool to the said pins, but being softened by the heat produced in the said winding by an abnormally large current therein and thereby permitting the spool to turn upon the said pins, an annular projection on each pin, between which projections the said spool is placed, a series of holes in each annular projection, a spring-support formed with ears thereon at its free end, the said ears being adapted to engage the respective pins, a projection on each ear adapted to engage respective holes in the respective series of holes and thereby prevent the said pins from being turned in one direction but permitting them to be turned in the opposite direction, a circuit-controlling spring adapted to engage the said conducting-sleeve, tending to turn the device as a whole against the projections on the said ears which hold the device from turning, and turning the device upon the said pins when the heat-susceptible material is softened, and means whereby the circuit-controlling spring turns the device as a whole back to an operative position when the heat-susceptible material has cooled, the said projections on the said ears slipping from their respective engaging holes and engaging other holes of the said series, to hold the device in its reset operative position.

29. In a thermal protector for electric circuits, the combination of a hollow heat-conducting spool, a heat-producing winding wound upon the said spool, an insulating-sleeve inclosing the said spool and winding and secured to the said spool, a conducting-sleeve inclosing the insulating-sleeve and secured thereto, a conducting-pin for each end of the hollow spool and inserted therein, a heat-susceptible material normally securing the said spool to the said pins, but being softened by an abnormally large current traversing the device and thereby permitting the spool to be turned upon the said pins, an annular projection on each pin, a series of engaging devices associated with each annular projection, a spring-support formed with slotted ears thereon, the said ears being adapted to receive the respec-

tive pins and thereby support the device, an engaging device on each ear adapted to engage the respective series of engaging devices and thereby prevent the said pins from being turned in one direction but permitting them to be turned in the opposite direction, a hole in the said conducting-sleeve, a circuit-controlling spring adapted to engage the said hole, tending to turn the device as a whole against the engaging devices of the said ears which hold the protective device from turning, and turning the protective device upon the said pins when the heat-susceptible material is softened, and a projection on the said conducting-sleeve against which the circuit-controlling spring presses to reset the protective device to an operative position, the said engaging devices of the said ears slipping from their respective engaging devices of the said pins and engaging other engaging devices of the said pins, to hold the protective device in its reset operative position against the tension of the circuit-controlling spring.

30. In apparatus of the class specified, the combination of an electrothermally-operable device, means for holding same in operative position, and means for turning the device back to operative position after operation.

31. In apparatus of the class specified, the combination of an electrothermally-operable device, means for holding same in operative position, and a circuit-closing means adapted to turn the device to operative position and thereby close the circuit.

32. In a device of the character described, means operable upon an abnormal current, means adapted to hold the abnormally operable means against rotation in one direction but allowing same to turn in the opposite direction, and a circuit-controlling means adapted to turn the abnormally operable means in either direction, under favorable circuit conditions.

33. In a cut-out or protector for electric circuits, a resistance-body for inclusion in the circuit, a rotary detent connected therewith, means adapted to hold the detent against rotation in one direction but allowing same to turn in the opposite direction, and means adapted to turn the resistance-body in either direction, under favorable circuit conditions.

34. In a cut-out or protector for electric circuits, a resistance-body for inclusion in the circuit, a rotary detent connected therewith, means adapted to hold the detent and resistance-body against rotation in one direction but allowing same to turn in the opposite direction, and a circuit-controlling means adapted to turn the resistance-body in one direction, under favorable circuit conditions, and the resistance-body and detent in the opposite direction to reset the device.

35. In apparatus of the class specified, the combination of a device operable upon an abnormal current, a portion provided with a plurality of engaging devices, means for engaging an engaging device and thereby holding the excess-operable device against movement in one direction, and means for moving the excess-operable device in the opposite direction, when the apparatus is reset, and thereby bringing the said engaging devices successively into engaging position with their engaging means.

36. The combination in an excess-current-operable device, of means engaging same and tending to break the circuit, a series of engaging devices adapted to hold the excess-operable device in operative position, and means for bringing the engaging devices successively into engaging position for holding the excess-operable device.

37. The combination of mechanism for controlling a circuit, and an excess-current-operable device arranged to govern the circuit-controlling mechanism and to be turned upon its support by such mechanism when the latter is operated, the latter being also adapted to turn the excess-operated device to operative position after operation.

In witness whereof I hereunto subscribe my name this 7th day of March, A. D. 1904.

FRANK B. COOK.

Witnesses:

JNO. F. TOMPKINS,

FREDERICK R. PARKER.