No. 817,160. PATENTED APR. 10, 1906.

F. B. COOK.

HEAT COIL.

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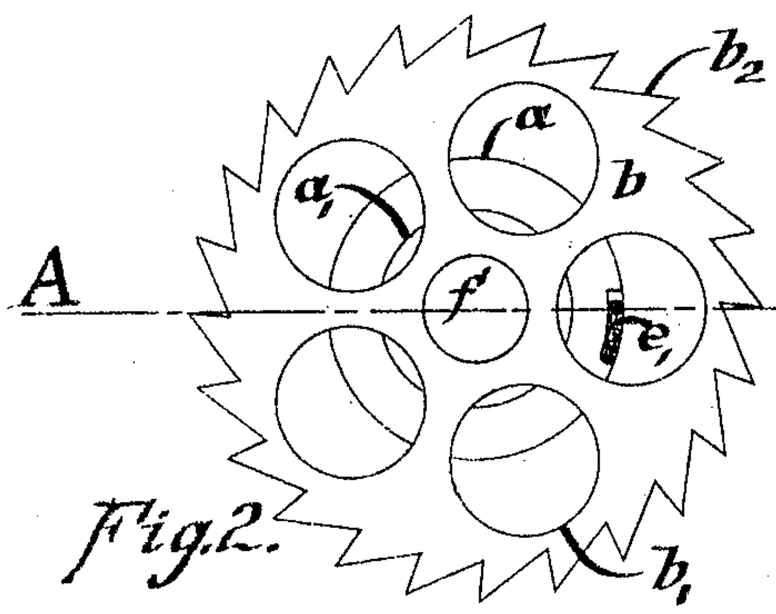


Fig. 2.

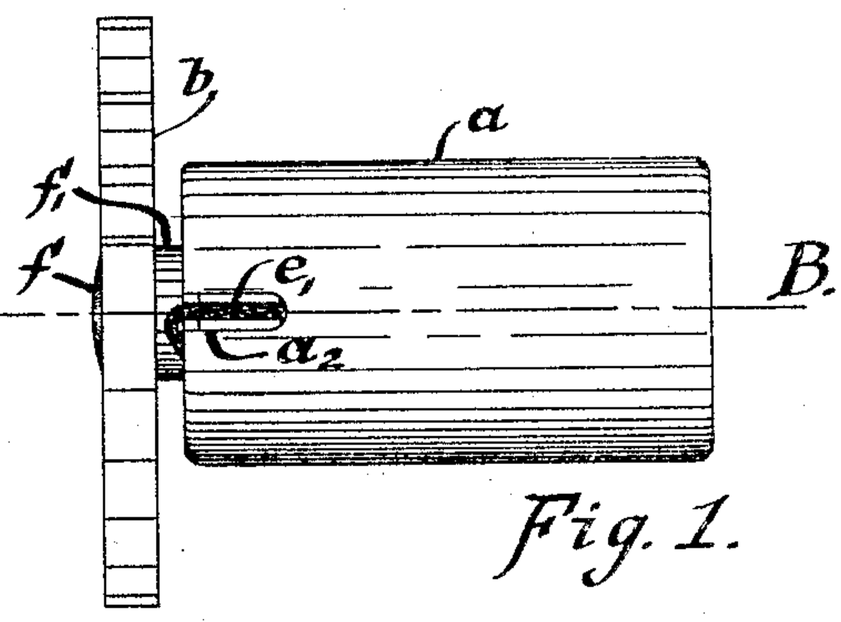


Fig. 1.

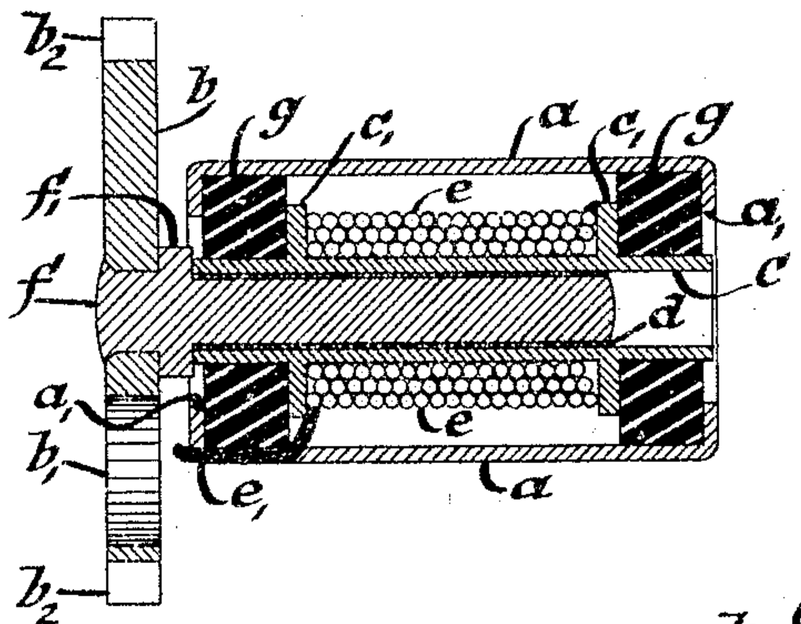


Fig. 3.

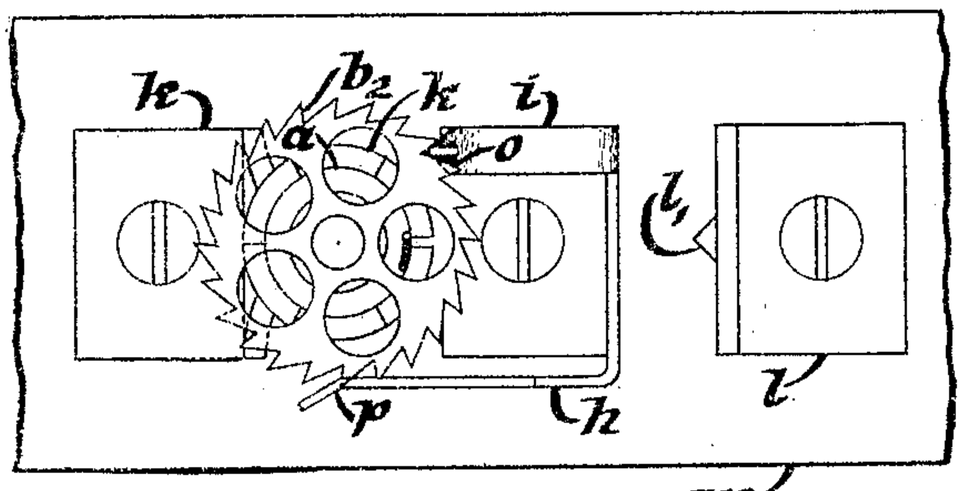


Fig. 5.

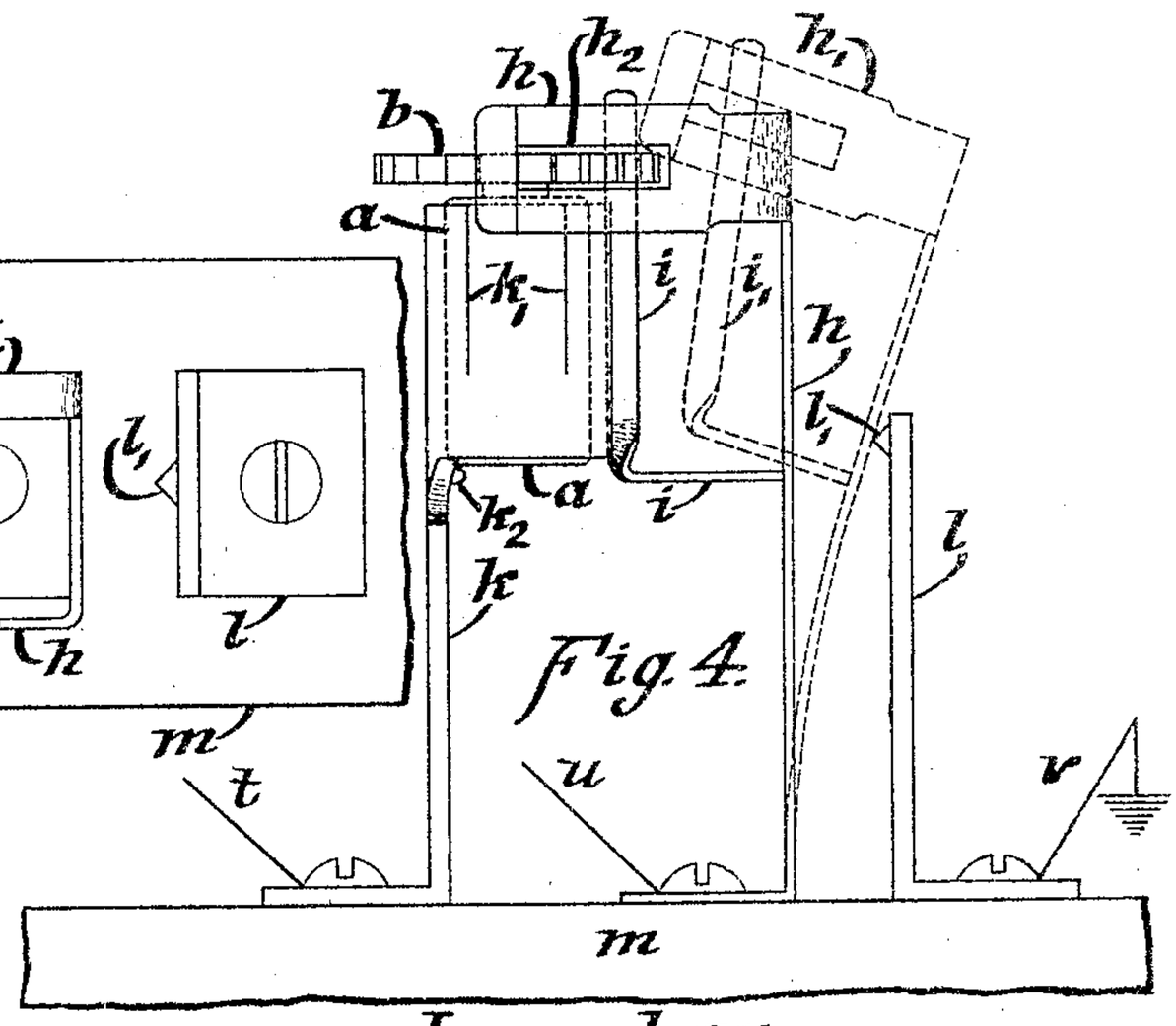


Fig. 4.

**Witnesses:**

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# UNITED STATES PATENT OFFICE.

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## HEAT-COIL.

No. 817,160. Specification of Letters Patent. Patented April 10, 1906.

Application filed November 14, 1903. Renewed February 6, 1905. Serial No. 244,318.

*To all whom it may concern:*

Be it known that I, FRANK B. COOK, a citizen of the United States, and a resident of Chicago, in the county of Cook and State of Illinois, have invented new and useful Improvements in Heat-Coils, of which the following is a specification, reference being had to the accompanying drawings, illustrating the same.

My invention relates to thermal protectors, or more particularly to heat-coils, for protecting electrical circuits and apparatus against abnormal electric currents, my object being, first, to provide an automatic self-soldering heat-coil in which the parts are immediately restored to operative condition after operation, thus allowing the heat-coil to be operated again and again, and, second, to provide a simple, substantial, and efficient construction in such a device.

In older forms of heat-coils generally in use certain elements thereof are separated by the action of the heat generated in the coil. These heat-coils are not automatically put in condition for another operation after the device has cooled. In more recent forms of heat-coils certain elements thereof have their relative position changed by the action of the heat generated in the coil and are then restored to their normal relative position immediately after the device has operated. Such heat-coils may be reset and operated again and again.

In my present invention I have provided a heat-coil in which the heat generated therein causes one element thereof to move with respect to another element thereof, the said elements remaining in this new relative position after the operation of the device, in which position they are secured by the cooling of the latter. This heat-coil may be reset and operated again and again as many times as desired. Unlike the other heat-coils above mentioned the elements of the device of my present invention are not entirely separated by the operation thereof nor are they required to return to their normal relative position. They simply move one on another and are then secured in their new relative position by the cooling of heat-susceptible material.

In this present invention I preferably employ a hollow heat-conducting member in the form of a spool, a pin secured therein by heat-susceptible material, and a heat-producing winding wound upon the said spool. The heat generated in the said winding by an abnormally large current therein is conducted to the heat-susceptible material by the said heat-conducting member, and when this heat is sufficient the heat-susceptible material becomes softened, and thereby allows the said pin to move in the said hollow member. I also provide the said pin with means, preferably a toothed wheel, adapted to be operated by circuit-controlling means, and thereby turn the said pin within the hollow member when the heat-susceptible material is softened, the said pin being again secured within the hollow member after the operation of the device by the heat-susceptible material becoming cool.

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

Figure 1 is a side elevation of the heat-coil of the invention. Fig. 2 is an end elevation of the heat-coil of the invention, showing the toothed wheel in front of the body of the heat-coil. Fig. 3 is a cross-sectional view of the heat-coil, taken on line A B of Figs. 1 and 2. Fig. 4 is a side elevation of the heat-coil in connection with its supporting and operating springs, and Fig. 5 is a top view of Fig. 4.

Like characters refer to like parts in the several figures.

The heat-producing winding *e* is wound upon a hollow cylindrical heat-conducting element *c* between two annular projections *c' c'* thereon, which are preferably a part of *c*. Insulating-washers *g g* are placed upon the respective ends of *c* to carry a metal shell *a*, which incloses the winding *e*. The ends of the shell *a* are turned over, as at *a' a'*, to firmly clamp the washers *g g* therein. One end of winding *e* is conductively secured to one annular projection *c'*, and the other end *e'* extends through a hole $a^2$ in the casing *a* and is conductively secured to the latter. A pin *f* is inserted into the hollow cylindrical element *c* and is normally secured therein by heat-susceptible material *d*. A wheel *b*, provided with teeth $b^2$ therearound, and preferably cut away, as shown at *b'*, is rigidly secured to one end of pin *f* against a shoulder *fi'* thereon.

In Figs. 4 and 5, *m* is a suitable insulating-base, which carries spring members *k* and *h* and ground member *l*. Springs *k* and *h* are conductively connected with line conductors *t* and *u*, respectively, and member *l* is preferably conductively connected with a ground-conductor *v*. Spring *k* is formed into a

thimble at its free end, in which the casing *a* of the heat-coil is inserted, the thimble being split at *k'* to enable it to firmly grasp the casing *a* to hold the heat-coil from turning. Spring *k* is provided with a lip $k^2$, used as a stop for the casing *a*. Spring *h* is preferably bent as shown and is provided with a hole $h^2$ therein, in which a tooth $b^2$ of wheel *b* is engaged, as at *p*, Fig. 5, when the device is set to operative position. Spring *i* is preferably a part of spring *h* and is adapted to bear on wheel *b* between two teeth thereon when the apparatus is set. Springs *h* and *i* both tend to turn the wheel *b* in the same direction—that is, counter-clockwise in Fig. 5. The ground-strip *l* forms a stop for spring *h* when the latter is released by wheel *b* and takes the position *h'*. (Shown in dotted lines in Fig. 4.)

The circuit through the device is from conductor *t*, through spring *k*, casing *a*, winding *e*, spool $c'^c$, heat-susceptible material *d*, pin *f*, wheel *b*, and springs *h* and *i* to conductor *u*.

When an abnormally large current traverses the winding *e* of the heat-coil for a short length of time, it heats the winding, due to the resistance thereof, and the heat thus generated is conducted by the metal core *c* to the heat-susceptible material *d*. When the heat is sufficient, the heat-susceptible material *d* is softened, thereby allowing the pin *f* to turn in the core *c*. Springs *h* and *i* now cause wheel *b* and pin *f* attached thereto to turn with respect to the core *c*. When wheel *b* has turned sufficiently, spring *h* is released from the tooth $b^2$ engaged therewith and takes the position shown at *h'*, Fig. 4, spring *i* disengaging wheel *b* and taking the position shown at *i'*, Fig. 4. Springs *h* and *i* are now disconnected from wheel *b*, and consequently the circuit through winding *e* is broken. When the heat-susceptible material *d* cools and hardens, it again secures pin *f* within core *c*, thus restoring the heat-coil to operative condition. The position of wheel *b* is immaterial, as springs *h* and *i* may be engaged therewith in whatever position it is in relatively to the body of the heat-coil, provided the pin *f* is inserted into core *c*. When spring *h* operates, it grounds itself against contact *l'* of ground-strip *l*, thus grounding the line conductor *u* and switching the objectionable current therein to ground. The device may be reset by reëngaging springs *h* and *i* with wheel *b* and then may be operated again in a manner similar to that just described. The operating and resetting of the device may be repeated as many times as desired.

While I have described particular details of construction in this invention, I do not wish to limit same entirely to such details, as many modifications in the construction may be made without departing from the principles involved.

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

1. In a heat-coil, the combination of a hollow, heat-conducting element, heat-producing means, a conducting-pin inserted into the said element, fusible material securing the conducting-pin to the said element, and means whereby, when the fusible material is softened, the said pin is turned in the said element.

2. In a heat-coil, the combination of a hollow, heat-conducting element, heat-producing means inclosing the said element, a conducting-pin inserted into the said element, fusible material securing the conducting-pin to the said element, and means apart from the heat-coil whereby, when the fusible material is softened, the said pin is turned in the said element.

3. In a heat-coil, the combination of a hollow, cylindrical, heat-conducting core, a heat-producing element inclosing the said core, a conducting-pin inserted into the said core and secured thereto by fusible material, a conducting member secured to the said pin, and means apart from the heat-coil by which the said pin is turned in the said core, when the fusible material is softened.

4. In a heat-coil, the combination of a hollow, cylindrical core, a heat-producing coil wound around the said core, a conducting-pin inserted into the said core and secured thereto by a fusible material, a wheel secured to the said pin, and means apart from the heat-coil by which the said pin is turned in the said core, when the fusible material is softened.

5. In a heat-coil, the combination of a hollow, cylindrical core, a heat-producing coil wound upon the said core, a conducting-pin inserted into the said core and secured thereto by fusible material, a toothed wheel secured to the said pin, and means apart from the heat-coil by which the said pin is turned in the said core, when the fusible material is softened.

6. In a heat-coil, the combination of a hollow cylindrical core provided with annular projections thereon, one near each end, a heat-producing winding wound around the said core between the said annular projections, an annular, insluating-washer for each end of the said core and placed thereon, a metal casing supported by the said washers and inclosing the latter and the heat-producing winding, a conducting-pin inserted through the hollow core and secured thereto by fusible material, a toothed wheel secured to the said pin, and means apart from the heat-coil by which the toothed wheel and pin are rotated, relatively to the said core, when the fusible material is softened, substantially as described.

7. In a heat-coil, the combination of a hol-

low, cylindrical core, a heat-producing winding wound around the said core, annular insulating-washers placed upon the said core, a metal casing supported by the said washers and inclosing the latter and the heat-producing winding, a conducting-pin inserted through the hollow core and secured thereto by fusible material, a toothed wheel secured to the said pin, and means apart from the heat-coil by which the toothed wheel and pin are rotated, relatively to the said core, when the fusible material is softened, substantially as described.

8. In a heat-coil, the combination of a hollow, cylindrical core, heat-producing means inclosing the said core, a pin inclosed by the said core and secured thereto by fusible material, a toothed wheel secured to the said pin, and a spring adapted to engage the toothed wheel to turn same and the pin, relatively to the said core, when the fusible material is softened, substantially as described.

9. In a heat-coil, the combination of a hollow, cylindrical core, a heat-producing element inclosing the said core, a pin inclosed by the said core and secured thereto by fusible material, a toothed wheel secured to the said pin, and a spring adapted to engage the toothed wheel to turn same and the pin, relatively to the said core, when the fusible material is softened, and thereby release itself from the toothed wheel, substantially as described.

10. In a heat-coil, the combination of a hollow, cylindrical core, a heat-producing element inclosing the said core, a pin inclosed by the said core and secured thereto by fusible material, a toothed wheel secured to the said pin, and springs adapted to engage the toothed wheel to turn same and the pin, relatively to the said core, when the fusible material softens, and thereby release themselves from the toothed wheel, substantially as described.

11. In a heat-coil, the combination of a hollow, cylindrical core, a heat-producing element inclosing the said core, insulating-washers slipped on and secured to the said core, a casing supported by the said washers and inclosing the heat-producing element and the said washers, a pin inclosed by the said core and secured thereto by a fusible material, a toothed wheel secured to the said pin, a suitable support to which the said casing is secured, springs adapted to engage the toothed wheel to turn same and the pin, the said pin turning in the hollow core, when the fusible material is softened, and thereby release themselves from the toothed wheel, substantially as described.

12. In a heat-coil, the combination of a hollow, cylindrical core, a heat-producing element inclosing the said core, insulating-washers, one for each end of, and secured to, the said core, a casing supported by the said washers and inclosing the heat-producing element and the said washers, a pin inclosed by the said core and secured thereto by fusible material, a toothed wheel secured to the said pin, a spring, one end of which is formed so as to inclose, and grasp, the said casing therein, a second spring provided with a hole therein and adapted to engage a tooth of the said wheel, and a third spring adapted to rest between two teeth of the said wheel, the said second and third springs both tending to turn the toothed wheel in the same direction, and causing the toothed wheel and pin to rotate when the fusible material is softened, thereby releasing themselves from the toothed wheel, substantially as described.

13. In a heat-coil, the combination of a hollow, cylindrical core, a winding wound around the said core, a pin inserted into the hollow core and secured thereto by fusible material, and means for rotating the pin within the hollow core, when the fusible material is softened.

14. In a heat-coil, the combination of a hollow, cylindrical, heat-conducting core, a heat-producing coil wound around the said core, insulating-washers placed upon the said core, a conducting-casing supported by the said washers and inclosing the said heat-producing coil and washers, the said core and casing being terminals for the heat-producing winding, a conducting-pin contained in the hollow core and secured thereto by fusible material, a toothed wheel of conducting material secured to the said pin, and means for causing the toothed wheel and pin to turn, relatively to the hollow core, when the fusible material is softened.

15. In a heat-coil, the combination of a hollow, heat-conducting core, a heat-producing winding wound upon the said core, insulating-washers placed upon the said core, a conducting-casing supported by the said washers and inclosing the said winding and washers, the said core and casing being terminals for the said winding, a conducting-pin contained in the hollow core and secured thereto by fusible material, a toothed wheel of conducting material secured to the said pin, a spring adapted to engage the toothed wheel, and a suitable support for the said casing, the fusible material becoming softened by the heat conducted thereto by the said core when an abnormally large current traverses the said winding, thus causing the said spring to turn the toothed wheel and pin, the pin turning within the core, and thereby become released from the toothed wheel, the fusible material again becoming hardened, after the toothed wheel has released the said spring therefrom, thereby again securing the said pin to the hollow core, substantially as described.

16. In a heat-coil, the combination of a hollow, heat-conducting core, a heat-produc-

ing winding inclosing the said core, a pin inclosed by the said core and secured thereto by fusible material, and means for rotating the pin within the hollow core when the fusible material is heated and softened, the said pin being again secured to the said core when the fusible material cools and hardens.

17. In a heat-coil, the combination of a toothed wheel, a pin secured thereto, a hollow core into which the pin is inserted, fusible material securing the pin to the core, a heat-producing element inclosing the core, and a spring adapted to engage a tooth of the toothed wheel, the said spring causing the wheel and pin to turn, and thereby becoming released from the said wheel, when the fusible material is heated and softened, the said pin being again secured to the hollow core, by the fusible material cooling and hardening, after the toothed wheel has released the spring therefrom.

18. In a heat-coil of the character described, the combination of a hollow, cylindrical, heat-conducting core provided with annular projections therearound, one near each end, a heat-producing winding wound around the said core between the said annular projections, insulating-washers for the said core, one for each end, and placed thereon, a casing of conducting material supported by the said washers and inclosing the said core and washers, the ends of the said winding being secured to the core and casing, respectively, a pin of conducting material inserted into the hollow core, a fusible material securing the said pin to the said core, a toothed wheel secured to one end of the said pin, the said wheel being of conducting material, a spring, one end of which is split and formed into a hollow cylinder for holding and grasping the said casing, a second spring adapted to engage the toothed wheel at two places, at one place a tooth of the wheel engaging a hole in the said spring and at the other place a portion of the spring resting between two teeth of the wheel, both engagements of the said second spring with the toothed wheel tending to turn the latter in the same direction, a third spring, and a suitable support upon which the said springs are mounted, the fusible material being heated and softened by the heat conducted thereto by the heat-conducting core when an abnormally large current traverses the heat-producing winding, thus allowing the second-mentioned spring to cause the toothed wheel and pin to turn, the pin turning within the hollow core, and thereby release itself from the toothed wheel and come in contact with the third-mentioned spring, the action of this second-mentioned spring breaking the circuit of the said winding, at the toothed wheel, the said pin being again secured within the hollow core, by the fusible material becoming cooled and hardened, substantially as described.

19. In a heat-coil, the combination of a hollow, heat-conducting element, heat-producing means, a pin inserted into the said element, fusible material securing the pin to the said element, and means whereby, when the fusible material is softened, a relative turning is produced between the pin and the said element.

20. The combination with a heat-coil comprising a toothed wheel and a casing adapted to inclose the inner portions of the heat-coil, of a support formed into a thimble for holding and grasping the said casing, and a conducting member adapted to engage the toothed wheel, the said support preventing the heat-coil from being turned by the said conducting member, but allowing the heat-coil to be turned, or removed, by a greater force.

21. The combination with a heat-coil comprising a toothed wheel and a casing adapted to inclose the inner portions of the heat-coil, of a spring-support formed into a thimble for holding and grasping the said casing, and a spring adapted to engage the toothed wheel, the said spring-support preventing the heat-coil from being turned by the said spring, but allowing it to be turned within, or removed from, the said spring-support by a greater force, the said spring becoming released from the toothed wheel when the heat-coil operates, substantially as described.

22. In a cut-out for electric circuits, the combination of heat-concentrating means, a rotary portion secured within the heat-concentrating means by heat-susceptible material, and means for turning the rotary portion when the heat-susceptible material softens.

23. In a cut-out for electric circuits, the combination of heat-producing means and a conductive portion, for inclusion in the circuit, one being secured within the other by heat-susceptible material, and means for turning one with respect to the other when the heat-susceptible material is softened.

24. In apparatus of the class specified, the combination of a heat-concentrating device, a rotary detent secured within the said device by heat-susceptible material, and circuit-controlling means adapted to engage the said detent and tending to rotate same, the heat-susceptible material becoming softened under abnormal current conditions and permitting the said means to turn the detent and open the circuit.

25. In apparatus of the class specified, the combination of heat-concentrating means, a rotary detent provided with a plurality of engaging devices and secured within the heat-concentrating means by heat-susceptible material, and circuit-controlling means arranged to engage one of the engaging devices and adapted to turn the detent and bring the said engaging devices into engaging position, one

after another, when the detent is released by the softening of the heat-susceptible material.

26. In apparatus of the class specified, the combination of heat-producing means, a rotary detent normally held against rotation by heat-susceptible material, and circuit-controlling means adapted to produce a relative turning between the heat-producting means and the rotary detent, one within the other, when the heat-susceptible material is softened.

27. In a device of the class specified, a coil of wire for producing heat, a rotary detent normally held against rotation by heat-susceptible material, and means adapted to produce a relative turning between the said coil and the rotary detent one within the other when the heat-susceptible material is softened.

28. In a device of the character described, a conductive portion, a coil of wire wound upon the conductive portion, a rotary detent secured to the conductive portion by heat-susceptible material and circuit-controlling means adapted to produce a relative turning between the detent and the said coil one within the other, under abnormal current conditions.

29. In a device of the character described, a metal spool, a resistance-wire wound upon the said spool, a toothed wheel secured to the said spool by heat-susceptible material, and circuit-controlling means adapted to engage the toothed wheel and to produce a relative turning between the latter and the resistance-wire one within the other, upon an abnormally large current in the device, the operation of the latter bringing the teeth of the wheel successively into engaging position for their engaging means.

30. In an excess-current-operable device, a conducting-spool, a resistance-wire wound upon the spool, a rotary detent secured to the said spool by heat-susceptible material, and means for engaging the detent to produce a relative turning between the latter and the said spool one turning within the other, to open the circuit through the device, upon an excess current in the latter.

In witness whereof I hereunto subscribe my name this 12th day of November, A. D. 1903.

FRANK B. COOK.

Witnesses:
JNO. F. TOMPKINS,
FRED R. PARKER.