(No Model.)

W. H. SAWYER.

ELECTRIC CIRCUIT OPENER.

No. 311,681. Patented Feb. 3, 1885.

Fig. 1.

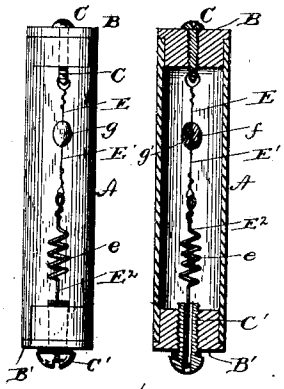


Fig. 2.

Fig. 3.

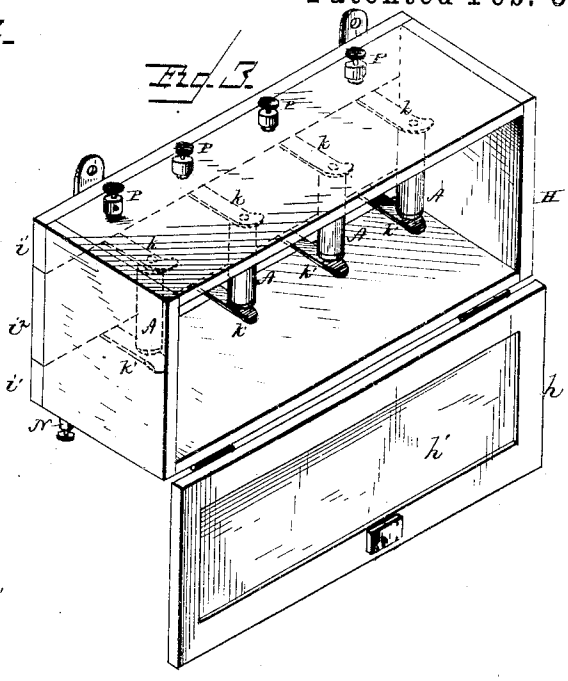


Fig. 4.

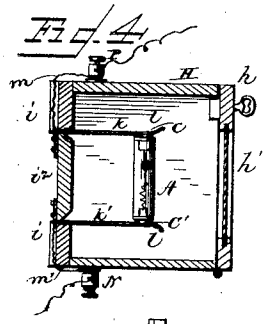


Fig. 5.

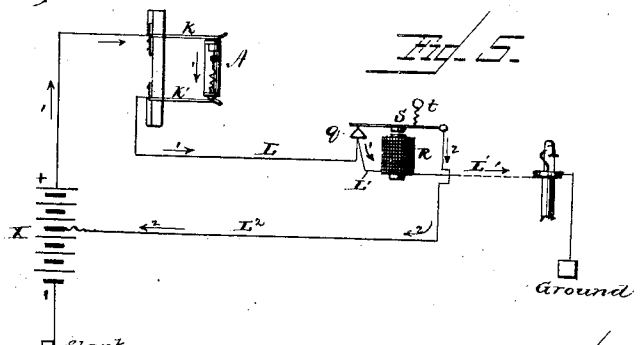
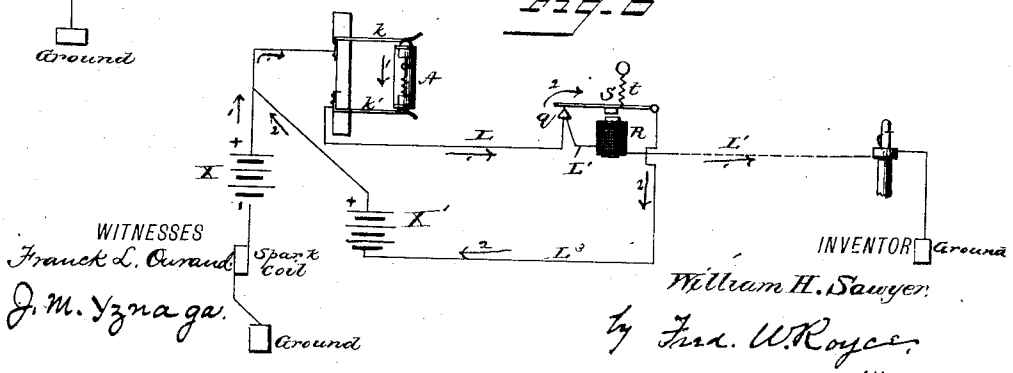


Fig. 6.



WITNESSES

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WILLIAM H. SAWYER, OF PROVIDENCE, RHODE ISLAND.

ELECTRIC-CIRCUIT OPENER.

SPECIFICATION forming part of Letters Patent No. 311,681, dated February 3, 1885.

Application filed January 22, 1884. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM H. SAWYER, a citizen of the United States, residing at Providence, in the county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Electric-Circuit Openers, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates to improvements in automatic electric-circuit openers of that class in which a conductor of comparatively high resistance becomes heated when the circuit remains closed for an unduly long period, and causes fusion or softening of a substance which maintains the continuity of the circuit when solid and in its normal position, but when fused or softened allows the circuit-conductors to become separated. Electric circuits employed for lighting gas, annunciators, burglar-alarms, and many other uses are usually normally open, and are closed only for brief periods at intervals for operating the included instruments. The batteries used on such circuits are almost always of the kind known as "open-circuit" batteries, which waste rapidly on closed circuit, and soon run down, so as to be unfit for use. The class of circuits referred to are liable to be closed too long from various causes—as, for instance, the failure of push-button and key contacts to become separated when the pressure is removed, forgetfulness of attendants to open circuit-closing switches, and accidental grounding of wires.

The object of my invention is to provide a cheap and reliable device which may be conveniently interposed in any electric circuit, and will promptly open the same if it remains closed for a longer period than necessary or usual for accomplishing the intended purpose.

My invention will be fully understood from the following particular description, in connection with the accompanying drawings, in which—

Figure 1 is a view in elevation of a circuit-opener constructed according to my invention. Fig. 2 is a longitudinal central section of the same. Fig. 3 is a perspective view of a series of the circuit-openers mounted in a box and arranged to be included in different circuits. Fig. 4 is a transverse section of the box in a plane cutting longitudinally the metallic spring arms supporting one of the circuit-openers. Figs. 5 and 6 are diagrams illustrating preferred arrangements of the circuit-openers and accessories on long circuits.

In the drawings, the letter A indicates a glass tube, which, in practice, is preferably about one-fourth of an inch in diameter and an inch and a half long, though the dimensions of the tube are unimportant. In the ends of this tube are inserted wooden or other stoppers or plugs, B and B′, and through the stopper B is arranged a headed metal pin or screw, C, having a transverse hole through its projecting inner end, while through the other stopper or plug, B′, is arranged a headed metal pin or screw, C′, which is hollow or bored longitudinally.

To the inner end of the screw or pin C is attached one end of a short piece of fine platinum or German-silver wire, E, the opposite end of which is lapped and preferably slightly twisted, as shown at *f*, Fig. 2, with the end of another fine platinum or German-silver wire E, which has its other end looped to a heavier wire, E^2, which is coiled or bent, as shown at *e*, to form a spring. The joint, *f*, between the two wires is secured by embedding it in a mass, *g*, of readily-fusible non-metallic adhesive substance which melts at a low temperature—for example, a cementing wax such as is used by jewelers in securing small articles to lathe-mandrels. A non-metallic substance—such as wax—is preferable for embedding the lap-joint, for the reason that it permits a more prompt breakage of electrical connection between the wires than is permitted by metallic solder. The solder, being itself a conductor, maintains electrical connection between the wires temporarily, even after it melts, and a blow-pipe is required in placing it in position, whereas the wax may be freely used when simply softened. After the two fine wires are thus lightly spliced and the joint embedded in the lump of readily fusible or softened substance, the stopper B is inserted in the end of the tube, the wires being first inserted into the same with the end of wire E^2 projecting. The end of this wire E^2 is then passed through the hollow pin or screw C′, the stopper B′ is inserted in the end of the tube opposite stopper B, as shown, and the wire E^2 is drawn outward taut enough to place the spring portion *e* under a considerable tension, but not enough

to break the joint *f* as secured by the readily-fusible substance *g*. The projecting portion of the taut wire E^2 is then secured to the pin or screw C' by soldering or by winding it around and snugly under the head of said pin or screw. The circuit-opener is thus completed, and it is to be understood that the lap of the two wires E and E' is of such extent and the tension of the spring *e* such that if the securing mass of readily-fusible substance *g* were removed or softened the two wires would be separated by contraction of the spring. If the circuit-opener should be included in an electric circuit by connecting the screws or pins C and C' to opposite terminals or electrodes, and a current of sufficient strength placed on the circuit to heat the wires E and E', or either of them, the readily-fusible mass *g* would be melted or softened so as to lose its hold upon the wires, which would be then separated and the circuit broken by the action of the spring *e*, as before explained.

In Figs. 3 and 4 I have illustrated simple and very convenient means which I have invented for including the circuit-opener in a circuit.

The letter H designates a wooden box, having a door, *h*, provided with a glass or other transparent pane, *h'*, through which the interior of the box may be observed when it is closed. The back of the box in the present instance is formed of three pieces, *i*, *i'*, and i^2, and to the back of the center piece, i^2, are secured elastic metallic strips *k* and *k'*, which are bent across its opposite edges so as to project into the box and form the supporting-arms, between which is held the circuit-opener, as shown, said arms having cavities or recesses, as at *l l*, formed in their facing-surfaces to receive heads of the screws or pins C and C'. The arms also have their free tips inclined from each other, so that the circuit-opener may be placed in position by simply pressing it in between these tips and the arms until its pin or screw heads reach the cavities prepared for them. The arms *k* and *k'* are respectively connected by wires *m* and *m'* with binding-posts P and N, by which they may be connected in a circuit, in the usual manner. The box may contain as many circuit-openers as desired, and when there are several circuits in the same building or leading from the same battery or locality, I prefer, for convenience, to inclose the circuit-openers for all in the same box. If at any time, on closing a circuit, it is found that the instruments in the same do not operate, it will usually be found on inspection that the fine wires of the circuit-opener in such circuit are separated, the separation having taken place after a previous closing, which continued for a length of time sufficient to heat said wires and melt or soften the wax or alloy, as before explained. In order to place the circuit again in operative condition, the now unserviceable circuit-opener may be withdrawn from its supporting-arms and replaced by a new one. Before doing so, however, the attendant should temporarily connect the arms *k* and *k'* by a short rod or a wire to test whether or not the circuit is otherwise intact. It will be understood that the size of the fine wires E and E' is so proportioned to the strength of the current used on the circuit that a brief closing of the circuit will not cause such heating of said wires as will melt the wax or alloy; but if the current remains on the circuit longer than the usual time required for operating its instruments, said wires will become heated with the result already stated.

When the circuit-opener as now described is used in connection with a very long circuit, it may be found desirable to provide for placing a portion of the main battery or an extra battery on a short circuit through the fine wires E and E', in order to insure the heating of said wires.

In Fig. 5 I have illustrated an arrangement of devices by means of which a portion of the main battery of a gas-lighting circuit is placed on a short circuit through the circuit-opener when the main line is closed. L is a portion of the main circuit leading from one pole of the battery X through the circuit-opener, as shown, to a metal contact-point, *q*, from which another portion, L', leads through the coils of electro-magnet R and onto ground through the instruments to be operated. An armature, S, is arranged to be attracted by the magnet R to make contact with the point *q*. From an intermediate portion of the battery a wire, L^2, leads to the armature S from a plate of opposite character to that from which the main circuit-conductors lead. It will now be obvious that when the main circuit is closed the current will first flow as indicated by the arrows No. 1, the magnet R will attract its armature into contact with point *q*, and thus close a short circuit, over which a portion of the battery-current will flow back to part of the battery, as indicated by arrows No. 2.

In Fig. 6 the main circuit, circuit opener, magnet, armature, and contact-point are arranged and lettered as shown in Fig. 5; but, instead of placing a part of the main battery on a short circuit, I connect one pole of the main battery and a similar pole of an extra battery, X', with one end of the circuit-opener, and the opposite pole of this extra battery I connect to the armature S of the magnet by a wire, L^3. In this case, when the main circuit is closed and the magnet attracts its armature to point *q*, the main current will flow through the circuit-opener, as shown by arrows No. 1, and the current of battery X' will also flow through the circuit-opener on short circuit, as shown by arrows No. 2. In this arrangement the main and auxiliary batteries must be of equal electro-motive force and the external resistances properly arranged to prevent either battery from disadvantageously counteracting the other. The main difference between the plans of Figs. 5 and 6 is that in Fig. 5 the retractile spring *t* of the armature must be adjusted to such tension that when the main cir-

cuit is broken by the circuit-opener the part of the battery on short circuit will not be strong enough to cause the magnet to hold down its armature, as that would keep the main portion of the battery on the line through wire L^2 and the armature.

In Fig. 6 the circuit-opener will break both battery-circuits simultaneously, and a high adjustment of the armature-spring is of course not necessary.

It is not essential to use wooden or other non-conducting stoppers for the tube A, it being itself a non-conductor, and the metal pins to which the fine wires are attached might be large enough to fit snugly in the ends of the tube. I prefer, however, to use wood or cork, on account of their cheapness and the elasticity which holds stoppers of such materials in place. The tube might be replaced by simple non-conducting bars or an open frame to keep the fine wires properly taut, so far as actual use is concerned; but the tube protects the inclosed parts in handling and packing, and is as cheap and efficient support for the other parts as could well be contrived, and I therefore prefer to use it.

I wish it to be understood that I do not confine myself to the particular details of construction which I have shown for carrying out any part of my invention, but may vary the same in any manner which circumstances may suggest without departing from its essential principles.

I am aware that a strip of readily-fusible metal has been included in a circuit for breaking the same by its fusion when the circuit remains closed too long or too strong a current flows thereon; and I am also aware that a stick of wax has been arranged to support two spring-terminals of a circuit in contact with each other and to be melted by the heating of a surrounding coil of fine wire, and so removed to allow the springs to separate when the circuit remains closed longer than necessary. I do not claim either of such circuit-openers.

Instead of attaching the fine wire E′ to a separate wire, which is coiled to form a spring, I may make the fine wire long enough to pass through the plug, and have a portion of its length coiled to form the spring; or I may attach the said fine wire to a strip of elastic rubber attached to the plug, and connect the end of said wire also to the metal pin or screw by a slack wire, which will permit the rubber strip to contract when released from tension by the parting of the two fine wires.

I am aware that in an electrical cut-out or circuit-opener two wires under tension have had their ends lapped and held together by a readily-fusible metallic solder, and I do not claim such a construction, broadly.

I am aware that in a circuit-opener a mass of readily-fusible non-conducting material has been arranged to hold apart two metallic plates pressed toward each other by a spring, said plates being electrically connected by fine pliable wires extending from one plate to the other through the interposed non-conducting and readily-fusible mass, the operation being that when the circuit-opener is interposed between two electrodes with its plates in contact with said electrodes, respectively, a current of excessive strength will heat the fine wires connecting the plates, the mass embedding said wires will be melted and allow the spring to force the plates toward each other, bending the intermediate fine wires and breaking connection with one or the other of the said electrodes, thus opening the circuit. The electrodes between which the circuit-opener is placed have been simply two rigid and rigidly-supported metal plates, one of which must be removed in order to replace an old circuit-opener by a new one. I lay no claim to such a circuit-opener or the means referred to for supporting it.

What I claim is—

1. In an electric-circuit opener to be operated by heat generated by an electric current traversing the circuit, the combination, with the lapping fine wires and a spring tending to draw them apart, of the mass of non-metallic adhesive substance readily fusible by heat and embedding the lap-joint of the wires, substantially as described.

2. In a circuit-opener, the combination, with the lapping fine wires of high resistance, one having a spring connected therewith, and the mass of substance easily softened or melted by heat inclosing and securing the lap-joint of said wires, of the transparent non-conducting tube inclosing said wires, and metallic connecting attachments for said wires arranged in the opposite ends of said tube, substantially as described.

3. The combination of the fine-wire E, the lapping fine wire E′ and attached wire E^2, having a portion thereof bent or coiled to form a spring, *e*, the glass tube inclosing said wires, and the metallic supports for said wires arranged in the ends of said tube, substantially as described.

4. The combination, with the circuit-opener composed of the fine wires under tension and held in lapping contact by a mass of substance embedding their lap-joints and readily fusible or softened by heat, of the metallic spring-arms arranged to receive and support said circuit-opener between them and come in electrical connection with said fine wires, substantially as described.

5. The combination, with one or more circuit-openers of the kind described, of an inclosing-box provided with metallic spring-arms arranged to clasp said circuit opener or openers, and adapted to be connected in an electric circuit, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

Witnesses: WILLIAM H. SAWYER.

GILMAN E. JOPP,

FRANK S. MEAD.