(No Model.)

G. T. WOODS.

AUTOMATIC SAFETY CUT-OUT FOR ELECTRIC CIRCUITS.

No. 395,533. Patented Jan. 1, 1889.

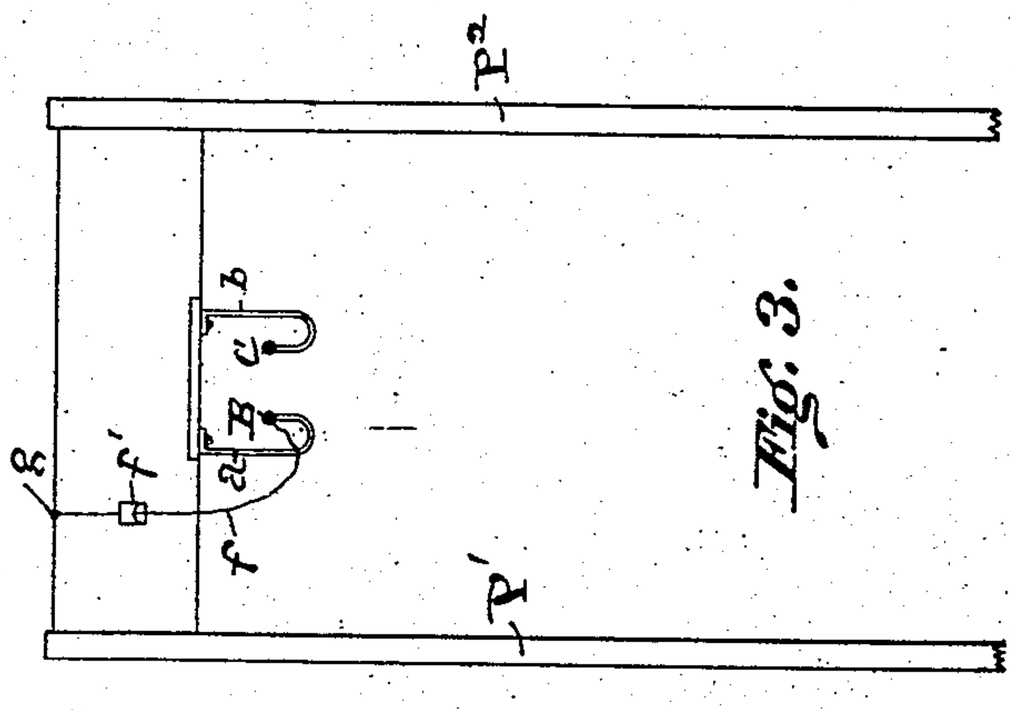

Fig. 3.

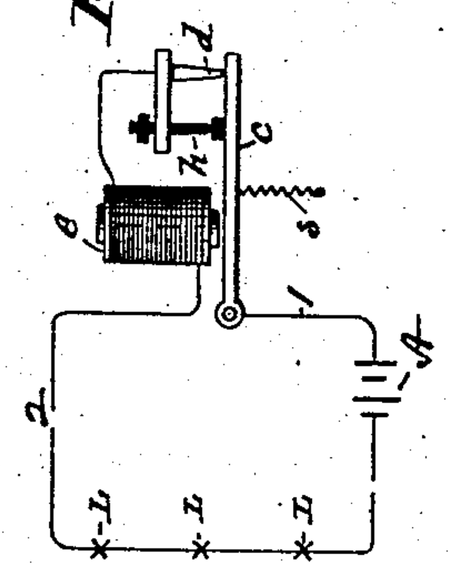

Fig. 4.

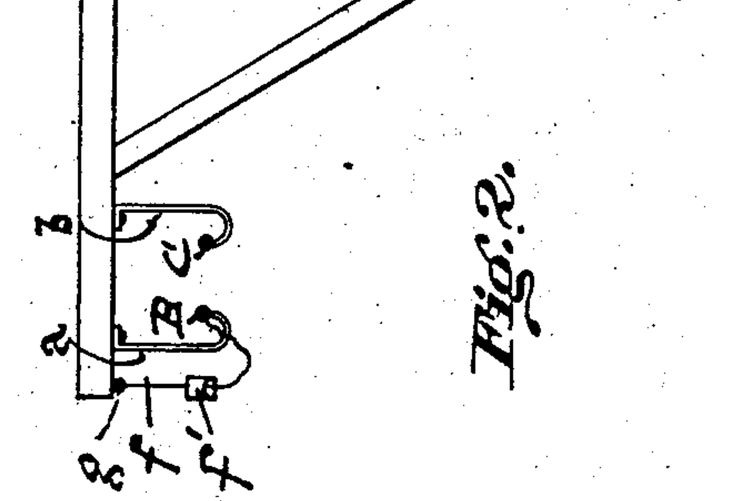

Fig. 2.

Fig. 1.

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UNITED STATES PATENT OFFICE.

GRANVILLE T. WOODS, OF CINCINNATI, OHIO.

AUTOMATIC SAFETY CUT-OUT FOR ELECTRIC CIRCUITS.

SPECIFICATION forming part of Letters Patent No. 395,533, dated January 1, 1889.

Application filed August 13, 1887. Serial No. 246,844. (No model.)

To all whom it may concern:

Be it known that I, GRANVILLE T. WOODS, a citizen of the United States, residing at Cincinnati, Ohio, have invented new and useful Improvements in Automatic Safety Cut-Outs for Electric Circuits, of which the following is a specification.

My invention relates to electric conducting systems employing conductors carried above the earth upon supports, in which the breakage or "sagging" of the conductor between supports is liable to bring the wire into contact with persons or animals, thereby endangering life; and its object is to furnish a remedy for such dangerous conditions.

To this end my invention consists in adapting to and combining with an overhead conducting-main an automatic circuit-breaking apparatus, which in case of displacement or breakage of the conducting-main at any point on the line disconnects the main conductor at the generator, thereby rendering it innocuous until restored to its original condition and place. The danger referred to is especially great in the conducting systems of electric-light plants and of overhead-contact electric railways, and to these my invention is particularly applicable. The mode of application is substantially the same in each and may be carried out by interposing in the main conductor at or near the generator an automatic circuit-breaker held normally closed against the force of a retractile spring or weight by an electro-magnet included in the same or in a return branch of the circuit, to which is added suitable resistance apparatus. With these elements only the benefit of my invention will be realized in case of breakage of the conductor; but the use of high-tension currents in cities or upon traveled roadways renders it desirable to extend the benefit to a sagging of the wire as well as breakage. In such case I employ an independent return-wire constituting with the outgoing conductor an auxiliary circuit in which the magnet of the circuit-breaker is included, and attach the main conductor to said auxiliary wire in such manner that the displacement or sagging of the main conductor will cause a break of such auxiliary line and a corresponding opening of the main conducting-circuit. These and other features of my invention will more fully and at large appear in the following description, in connection with the accompanying drawings, in which I have shown the application of my invention to a common form of electric-railway circuit.

In the drawings, Figure 1 is a diagram representing the generator and conducting-line connections of an electric railway upon the overhead system to which my invention is applied. Figs. 2 and 3 are cross-sections of the line, showing my invention as applied to two prevailing modes of supporting the conductors of such conducting systems; and Fig. 4, a diagram of a closed metallic circuit, showing the cut-out included in the main circuit.

Referring now more particularly to the drawings, A represents the generator, B the outgoing conductor, and C the incoming conductor, the conductors being of heavy wire carried upon hangers *a b*, secured upon a line of gallows-posts, P, as shown in Fig. 2, or suspended from cross-wires between two lines of posts, P′ P², as shown in Fig. 3. D D represent carriages or sliding contacts carried upon the respective wires B and C, whence the current is short-circuited through the motor (not shown) by means of trailing wires. In the present illustration I have shown a system in which outgoing and return conductors are both elevated and used as a metallic circuit closed in multiple arc by the traveling contacts D D; but my invention applies equally well where the motor-driving current is carried to ground through the locomotive or to a return-rail located upon the earth.

The construction thus far described is common and well known and need not be further detailed. It is also well known that in case of the breakage or sagging of the outgoing conductor B at any point the wire is liable, in case of contact with a person or animal, to produce serious injury or even death. This I obviate by providing a third conductor, E, which may be an ordinary telegraph or telephone wire connected with the conductor B at its remote end and carried parallel with it upon the same supporting-posts back to the generator. In the vicinity of the generator A, I interpose a circuit-breaker in the main outgoing conductor, constructed and arranged as follows: The circuit-breaker is

a pivoted armature, *c*, forming contact at *d* with the line B, but normally held open by a retractile spring, *s*. From the pivot a wire, B′, connects it back to one pole of the generator. The armature *c* is controlled and the contact at *d* maintained by an electro-magnet, *e*, included in the auxiliary return E. It will be obvious that any break in the main conductor B will at once open the contact at *d* and the current will cease to flow. In this auxiliary return-wire is also included a variable resistance, F, and also, if desirable, a fusible "cut-out," G. The variable-resistance device consists of an electro-magnet having its coils and armature in the conducting-line, the armature resting outwardly against two or more termini of a branched conductor, each branch having a somewhat high resistance, but together offering a conducting medium equal to the capacity of the conducting-main. As the magnet is energized, it withdraws its armature from the contact-points successively, never, however, leaving the last in series. Thus the varying energizing strength of the current cuts out or in, as the case may be, a greater or less number of the branch contacts, thus increasing the resistance of the conductor as the strength of current increases, and, vice versa, increasing the conductivity of the line as the strength of current diminishes. These being common devices their functions need not be described in detail, excepting to say that as employed in this connection an excess of current in the auxiliary return E will cause a break by fusion at G, and thus protect the coils of the variable-resistance instrument F, while the latter instrument insures the safety of the coil of magnet *e;* but in order to extend the benefit of the circuit-breaker to a case where a mere displacement of the main conductor B occurs, as in sagging, I provide in the return-conductor E, at convenient points—say at the supporting-posts—short couplings or suspending-links *f*, attached to the main conductor in such a manner as not to interfere with the proper use of the latter, but in case of displacement or sagging of the latter to bring a breaking-strain upon the conductor E at the point of connection through and by means of the suspending-link. The connection of the link *f* is mechanical entirely, and to insure insulation an insulating-block, *f′*, of any suitable material, is inserted therein. To further insure the breakage of the line E, the connection of the link *f* is made to a short section, *g*, of weaker material—as lead, for example—interposed in the line E, which, while not impairing its conductivity, breaks easily under a strain. A breakage of the line E at any of the sections *g* destroys the circuit and releases the armature *c*.

In order that the break of the electric circuit at the point *d* may not cause a spark or fuse the metal contact-points, I provide a carbon follower-contact, *h*, acting upon a carbon button attached to the armature *c* in rear of the contact *d*. The carbon pencil *h* is passed through a supporting-piece, *i*, in electrical communication with the line B, and arranged to rest at its lower point upon the contact-button of the armature and follow downward with the movement of the armature until stopped by the enlargement or head *h′* of the carbon pencil, which engages upon the supporting-piece *i*. The effect is to carry a partial current through the carbon contacts after the metal contacts have separated, thereby preventing a spark at the latter. In the continued falling of the armature the contact is finally broken at the carbon contacts.

In Fig. 4 I have shown the arrangement of the circuit-breaker in the single circuit. Starting from the generator A, the circuit is traced by wire I to the armature *c* through contact *d* to and through the magnet *e*, thence over the main circuit-wire 2 to the lamps L or other apparatus in which the current is utilized, and thence back to battery. The construction and arrangement of the cut-out apparatus being such as already fully described, it will be obvious that a breakage of the line 2 at any point will cause the armature *c* to drop and disconnect the generator.

I claim as my invention and desire to secure by Letters Patent of the United States—

1. In combination with an electric generator, its conducting-line circuit, and devices—such as lamps or motors—for utilizing the current passing over such circuit, a break-circuit armature in circuit in or near the generator held to conducting control by a magnet normally charged by the electric charge upon the conducting-circuit against an independent normally-active withdrawing force acting automatically to hold the circuit closed while the conducting-line is otherwise intact and charged, and to open the circuit when the conducting-line is broken or impaired at any other point, substantially as set forth.

2. In combination with a generator and outgoing conductor of an electric circuit, (as an electric light or power circuit,) a circuit-breaking armature in the outgoing conductor, an auxiliary wire constituting a return branch of the circuit, and an electro-magnet in said return branch controlling the circuit-breaking armature, substantially as and for the purpose set forth.

3. In combination with a generator and outgoing conductor of an electric circuit, (as an electric light or power circuit,) a circuit-breaking armature in the outgoing conductor, an auxiliary wire constituting a return branch of the circuit and arranged parallel therewith, an electro-magnet in said return branch controlling the circuit-breaking armature, and insulated links connecting the main conductor to the auxiliary wire in such manner that a displacement of the main conductor will sever the auxiliary wire, substantially as and for the purpose set forth.

4. In an electric light or power circuit, the

combination of a circuit-breaker in the outgoing conductor and a fusible cut-out, a variable-resistance device, and a magnet controlling the circuit-breaker in the return-conductor, arranged and operating substantially as set forth.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

GRANVILLE T. WOODS.

Witnesses:
L. M. HOSEA,
CHESTER W. MERRILL.