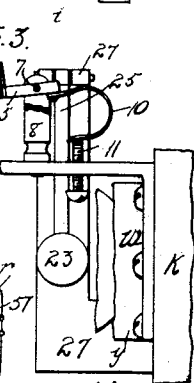
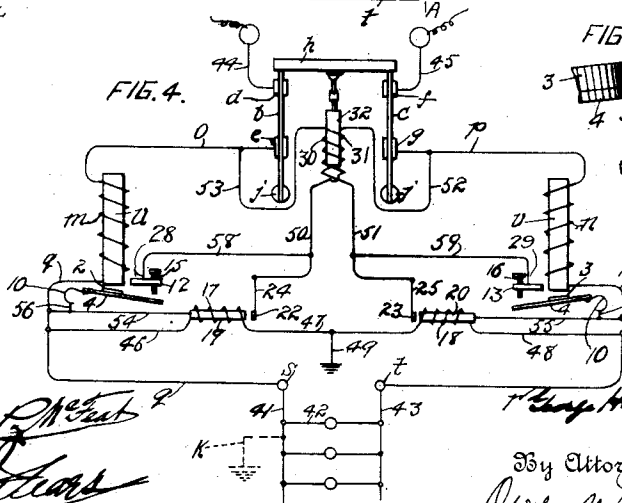
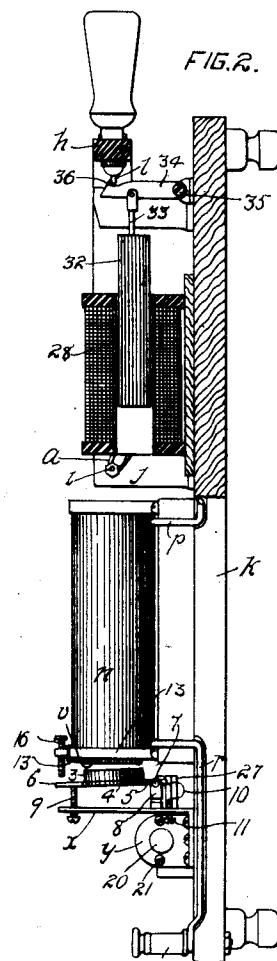
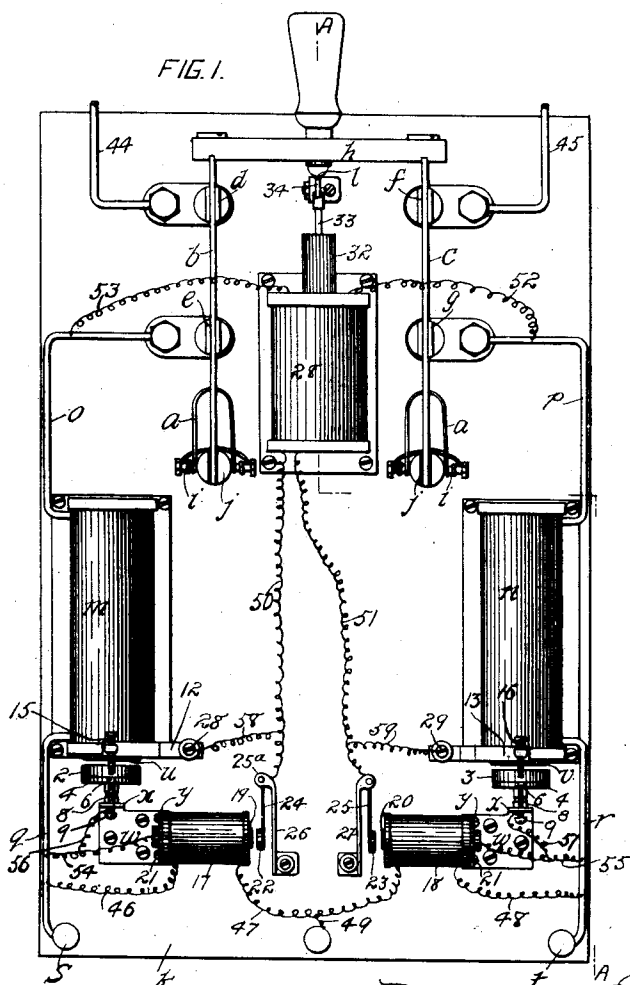


No. 831,071.

PATENTED SEPT. 18, 1906.

G. H. HILL.
SAFETY DEVICE.

APPLICATION FILED JULY 7, 1902.



Witnesses
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UNITED STATES PATENT OFFICE.

GEORGE HAGAR HILL, OF MONTREAL, QUEBEC, CANADA, ASSIGNOR OF
ONE-HALF TO MICHAEL JOSEPH DOHERTY, OF MONTREAL, CANADA.

SAFETY DEVICE.

No. 831,071.

Specification of Letters Patent.

Patented Sept. 18, 1906.

Application filed July 7, 1902. Serial No. 114,640.

To all whom it may concern:

Be it known that I, GEORGE HAGAR HILL, of the city of Montreal, in the district of Montreal and Province of Quebec, Canada, have invented certain new and useful Improvements in Safety Devices; and I do hereby declare that the following is a full, clear, and exact description of the same.

My invention relates particularly to the opening of a circuit upon an undesirable change taking place in its normal condition; and the object of the invention is to provide means whereby a branch or shunt circuit will be established and the main circuit opened, either upon an increase of amperage or rise in potentials.

The invention may be said briefly to consist in including the coil of an electromagnet in the circuit to be protected and adapting said electromagnet to attract its armature upon an undesirable change taking place in the circuit and providing connections between one side of said circuit and the core of said electromagnet and the armature and the other side of said circuit, whereby a branch or shunt circuit will be established including said core and armature, said connections including an electromagnet for releasing a switch and allowing same to open the circuit.

More specifically speaking, my invention consists in including the coils of a pair of electromagnets in the main circuit, which also includes a cut-out switch, including the coils of a second pair of electromagnets in a circuit permanently in shunt with said main circuit, including a switch-releasing solenoid in an open circuit the separate terminals whereof are connected by suitable wiring to parts of said electromagnets, whereby upon either or all of said electromagnets being sufficiently energized to attract its or their armature said parts will be brought into contact, the open circuit closed, and the switch opened.

For full comprehension, however, of my invention reference must be had to the accompanying drawings, forming a part of this specification, in which like symbols indicate the same parts, and wherein—

Figure 1 is a face view of my improved safety device. Fig. 2 is a longitudinal vertical sectional view thereof, taken on line A A, Fig. 1. Fig. 3 is a detail enlarged elevation of the means for yieldingly retaining the ar-

mature of each electromagnet of the pair included in the main circuit away from the core adapted to attract it, and Fig. 4 is a diagrammatical view illustrating the application of my invention to a direct-current lighting-circuit.

For purposes of illustration I disclose my invention in conjunction with an ordinary bipolar cut-out switch, the blades and terminals whereof complete the main circuit. The blades are indicated at *b* and *c* and the terminals at *d*, *e*, *f*, and *g*, while the said blades are connected together by an insulating bridge-piece *h*, and they are pivoted, as at *i*, to standards *j*, said standards and terminal pieces being secured in the usual manner to the upper end of a base-board *k*, and the bridge-piece having an inwardly-projecting dog *l* with which a detent engages, as will be presently pointed out. A pair of coiled springs *a* tend to open the switch, as usual.

My improved safety device proper, in which this invention mainly resides, consists in a pair of overload-coils *m* and *n*, wound to act only when traversed by abnormal current between the upper terminals of which coils *m* and *n* and the switch-terminals *e* and *g* a pair of leads *o* and *p* are connected, while a pair of leads *q* and *r* connect the opposite terminals of the coils to a pair of binding-posts *s* and *t*. These coils are wound upon laminated cores *u* and *v*, thus constituting electromagnets, and a pair of brackets *w*, having arms *x* and *y*, pivotally support armatures 2 and 3 within the magnetic field of the lower poles of said magnets. The armatures are preferably laminated iron and mounted upon contact-strips 4 of sufficient length to project beyond them, as at 5 and 6, respectively, the portions 5 being reduced in width and perforated to receive a short distance from their ends pivot-pins 7, the ends whereof are seated in the prongs of forked bracket-arms 8, secured rigidly upon the bracket-arms *x*. A screw 9 is carried by each of said bracket-arms *x* in line with the portion 6 of each contact-strip and support the armatures in any desired adjacency to its magnet, while bow-springs 10, constituting spring-contacts, are secured to the ends of 5 and bear upon screws 11.

Contact-pieces 12 and 13 are mounted upon and insulated from the coils *m* and *n*, and they carry binding-screws 28 and 29 at

one end and at their other ends contact-screws 15 and 16, upon which the ends 6 of the armature-contacts bear when the armatures are attracted, as will be presently shown.

A pair of high-potential coils 17 and 18, wound upon laminated cores 19 and 20, respectively, are supported by the bracket-arms *y*, to which they are rigidly secured, preferably by screws 21, and a pair of armatures 22 and 23 are hung by contact-strips 24 and 25, swinging on trunnions 25^a, bearing in brackets 26 and 27.

A solenoid 28 is located adjacent to the bridge-piece of the switch, preferably between the blades *b* and *c*, and it is wound with two independent coils 30 and 31, and a laminated rod 32 within the solenoid constitutes an armature. A link 33 connects one end of this armature to a detent in the form of a bar 34, pivoted, as at 35, at one end to the base-board *k*, and its other end is made in the form of a latch 36 to engage the dog 1 and retain the switch closed against its opening-springs *a*.

The wiring of my improved safety device, as applied to a lighting-circuit, is as follows: 41 and 43 indicate house-leads which are taken from binding-posts *s* and *t*, and 42 indicates the lamp branches, while 44 and 45 indicate the leads of the external circuit. This completes the lighting-circuit proper. From lead-wire *q* a conductor 46 is taken to one of the terminals of voltage-coil 17, the other terminal whereof is connected by a conductor 47 to one of the terminals of the other voltage-coil 18, and the opposite terminal of this latter coil is connected by a conductor 48 to lead-wire *r*, while a ground-wire 49 is connected to wire 47 midway of its length. A pair of conductors 50 and 51 connect the respective wires 24 and 25 (whereby the armatures 22 and 23 are suspended) to one of the polar-terminals of each of the coils 30 and 31, the opposite terminals whereof are connected by conductors 52 and 53 to the leads *p* and *o*, the conductor 52 (leading from the coil 30 to which conductor 50 is connected) being connected to lead *p* and the conductor 53 (leading from the coil 31 to which conductor 51 is connected) being connected to lead *o*. A pair of conductors 54 and 55, respectively, connect the leads *q* and *r* to the cores 19 and 20, and a pair of branch conductors 56 and 57 connect the respective conductors 54 and 55 to the contact-screws 11, while branch conductors 58 and 59 connect the binding-screws 28 and 29 of contact-strips 12 and 13, respectively, to conductors 50 and 51. Under normal conditions the lighting-circuit entering at 44 will flow through switch-blade *b*, lead *o*, coil *m*, leads *q* and 41, lamp branches 42, leads 43 and *r*, coil *n*, lead *p*, switch-blade *c*, and out through lead 45. A portion of this current will continually traverse the shunt, including con-

ductor 46, coil 17, conductor 47, coil 18, and conductor 48; but under normal conditions this current will not be of sufficiently high potential to energize the cores 19 and 20 and attract the armatures 22 and 23.

In the event of wire *q* being grounded, as at *k*, the path of the current would be from ground through wires 49 and 47, coil 18, wires 48 and *r*, coil *n*, wire *p*, switch-arm *c*, and wire 45 to the external portion of the circuit, thus attracting armature 23 and closing the circuit comprising lead 44, switch-arm *b*, wire 53, coil 31, wire 51, hanger 25, armature 23, core 20, wire 55, wire *r*, coil *n*, wire *p*, switch-blade *c*, and lead 45, thereby completing the circuit and simultaneously opening the switch.

If the lead 45 should happen to be grounded at any point between the switch and the generator and wire 41 were accidentally grounded, as at *k*, and the grounded connection 49 were broken down, a protective circuit traversed by a portion only of the current will then be established from the generator through 45, ground, in at *k*, through 41, *q*, *m*, *o*, *b*, and 44 back to the generator, thus energizing the magnet *m* and causing it to attract armature 2 and effect an electrical connection between conductor 56 and 58, a portion of the current then flowing through 56, 58, 50, 30, 52, *c*, 45, and out, thus opening the switch, or if the outside grounding takes place at any point between the switch and generator in lead 44 and wire 43 were grounded the protective circuit will be established from generator, through 44, ground, 43, *r*, *n*, *p*, *c*, and 45 back to the generator, over which a portion only of the current flows, thus energizing the magnet of which *n* forms a part and causing it to attract armature 3 and effect an electrical connection between conductors 57 and 59, a portion only of the current flowing through 57, 59, 51, 31, 53, *b*, 44, and out, thus opening the switch.

Upon an increase of electromotive force between the lines or between either line and the ground the magnets 17 and 18 will attract their armatures 22 and 23, thus causing the current to flow from either lead *q* or *r* through either conductors 54 or 55, core 19 or 20, armature 22 or 23, hanging conductor 24 or 25, conductor 50 or 51, coil 30 or 31, conductor 52 or 53, switch-blade *b* or *c*, and conductor 44 or 45, out, thus opening the switch.

Upon an increase of current caused by an overload the coils *m* and *n* will be energized, their armatures attracted, and the circuit closed from *q* and *r*, through 54 and 55 56 and 57, 10, 11, 4, 15 and 16, 12 and 13, 58 and 59, 50 and 51, 30 and 31, 52 and 53, *c* and *b*, and out, thus opening the switch.

From the foregoing it will be seen that upon an undesirable change taking place in the circuit to be protected either by an in-

crease of potentials, increase of amperage, or accidental grounding the switch will be released and the circuit opened.

What I claim is as follows:

5 1. The combination with a circuit to be protected, and an additional circuit permanently in shunt with and protecting said circuit to be protected, and electrical means for opening said circuit to be protected, of a protective circuit normally open while current is flowing over the lines of said circuit to be protected said protective circuit, when energized, actuating said circuit-opening means and having its terminals connected to the opposite leads of said circuit to be protected, an electromagnet the coil whereof is included in said first-mentioned protective circuit, an armature located in the magnetic field of said magnet and having one of the ends of the gap in said protective circuit in electrical connection therewith, the other end of said gap being connected to the core of said magnet, substantially as described and for the purpose set forth.

25 2. The combination with a circuit to be protected, and means for opening said circuit, of an additional circuit permanently in shunt with said main circuit, a pair of magnets included in said shunt-circuit, a pair of armatures located adjacent to said magnets, a solenoid having two windings, a pair of protective circuits comprising a pair of conductors leading from the main leads of the circuit to be protected to one terminal of each of the windings of said solenoid, a pair of conductors leading from the inner terminals of said solenoid to said armatures, and a pair of conductors leading from the cores of said last-mentioned magnets to the main leads of the circuit to be protected, each of the last-mentioned conductors being connected to the lead opposite to that to which each of the first-mentioned conductors is connected, a core within said solenoid and movable under the influence thereof and a mechanical connection between said core and said circuit-opening means whereby the circuit will be opened upon an abnormal condition obtaining therein, substantially as described and for the purpose set forth.

3. The combination with a circuit to be protected and means for opening said circuit, of a pair of magnets the coils whereof are included in said circuit one in each side thereof, an additional circuit permanently in shunt with said main circuit, a second pair of magnets included in said shunt-circuit, a pair of armatures one located adjacent to each of the magnets of said first-mentioned pair, a pair of armatures located adjacent to the magnets in said shunt-circuit, a pair of contacts one located adjacent to each of said first-mentioned armatures, a pair of contact-pieces one carried by each of said first-mentioned armatures, a solenoid having two

windings, a pair of protective circuits comprising a pair of conductors leading from the main leads of the circuit to be protected to one terminal of each of the windings of said solenoid, a pair of conductors leading from the opposite terminals of said windings to said first-mentioned contacts, a pair of conductors leading from the contact-pieces upon said armatures to the main leads of the circuit to be protected, each of the last-mentioned conductors being connected to the leads opposite to those to which the first-mentioned conductors are connected, a pair of conductors leading from the inner terminals of said solenoid to the last-mentioned armatures, and an electrical connection between the cores of said last-mentioned magnets and the main leads of the circuit to be protected, each of the last-mentioned conductors being connected to the leads opposite to those to which the first-mentioned conductors are connected, a core within said solenoid and movable under the influence thereof and a mechanical connection between said core and said circuit-opening means whereby the circuit will be opened upon an abnormal condition obtaining therein, substantially as described and for the purpose set forth.

4. The combination with a circuit to be protected, and a circuit-opening device, of a magnet having a double winding thereon, one of said windings being connected at one of its terminals to one side of the circuit, means whereby the other terminal of such winding is temporarily connected to the other side of the circuit, one of the terminals of the other winding being connected to one side of said circuit but oppositely to the first-mentioned winding, means whereby the other terminal of the last-mentioned winding is temporarily connected to the side of the circuit opposite to that to which the first-mentioned terminal of this last-mentioned winding is connected, and means actuated by said magnet for opening the circuit.

5. The combination with a circuit to be protected, and means for opening said circuit, of an additional circuit permanently in shunt with said main circuit, a pair of magnets included in said shunt-circuit, a pair of armatures located adjacent to said magnets, an electromagnet having two windings, a pair of protective circuits comprising a pair of conductors leading from the main leads of the circuit to be protected to one terminal of each of the windings of said duplex-wound electromagnet, a pair of conductors leading from the other terminals of said duplex-wound electromagnet to said armatures, and a pair of conductors leading from the cores of said pair of magnets to the main leads of the circuit to be protected, each of the last-mentioned conductors being connected to the leads opposite to that to which each of the

first-mentioned conductors is connected, an armature within the magnetic field of said duplex-wound magnet and an operative connection between said armature and said circuit-opening means whereby the circuit will be opened upon an abnormal condition obtaining therein, substantially as described and for the purpose set forth.

6. The combination with a circuit to be protected, and means for opening said circuit of an additional circuit permanently in shunt with said main circuit, a pair of magnets included in said shunt-circuit, a pair of armatures located adjacent to said magnets, a solenoid having two windings, a pair of protective circuits comprising a pair of conductors leading from the main leads of the circuit to be protected to one terminal of each of the windings of said solenoid, a pair of conductors leading from the inner terminals of said solenoid to said armatures, and a pair of conductors leading from the cores of said last-mentioned magnets to the main leads of the circuit to be protected, each of the last-mentioned conductors being connected to the leads opposite to that to which each of the first-mentioned conductors is connected, a core within said solenoid and movable under the influence thereof and a mechanical connection between said core and said circuit-opening means whereby the circuit will be opened upon an abnormal condition obtaining therein, substantially as described and for the purpose set forth.

7. The combination with a circuit to be protected, and means for opening said circuit, of a pair of magnets the coils whereof are included in said circuit one in each side thereof, an additional circuit permanently in shunt with said main circuit, a second pair of magnets included in said shunt-circuit, a pair of armatures one located adjacent to each of the

magnets of said first-mentioned pair, a pair of armatures located adjacent to the magnets in said shunt-circuit, a pair of contacts one located adjacent to each of said first-mentioned armatures, a pair of contact-pieces one carried by each of said first-mentioned armatures, a solenoid having two windings, a pair of protective circuits comprising a pair of conductors leading from the main leads of the circuits to be protected to one terminal of each of the windings of said solenoid, a pair of conductors leading from the opposite terminals of said windings to said first-mentioned contacts, a pair of conductors leading from the contact-pieces upon said armatures to the main leads of the circuit to be protected, each of the last-mentioned conductors being connected to the leads opposite to those to which the first-mentioned conductors are connected, a pair of conductors leading from the inner terminals of said solenoid to the last-mentioned armatures, and an electrical connection between the cores of said last-mentioned magnets and the main leads of the circuits to be protected, each of the last-mentioned conductors being connected to the leads opposite to those to which the first-mentioned conductors are connected, a core within said solenoid and movable under the influence thereof and a mechanical connection between said core and said circuit-opening means whereby the circuit will be opened upon an abnormal condition obtaining therein, substantially as described and for the purpose set forth.

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

GEORGE HAGAR HILL.

Witnesses:

WILLIAM P. McFEAT,
FRED. J. SEARS.