(No Model.)

F. C. ROBERTSON.
CIRCUIT BREAKER.

No. 597,700. Patented Jan. 18, 1898.

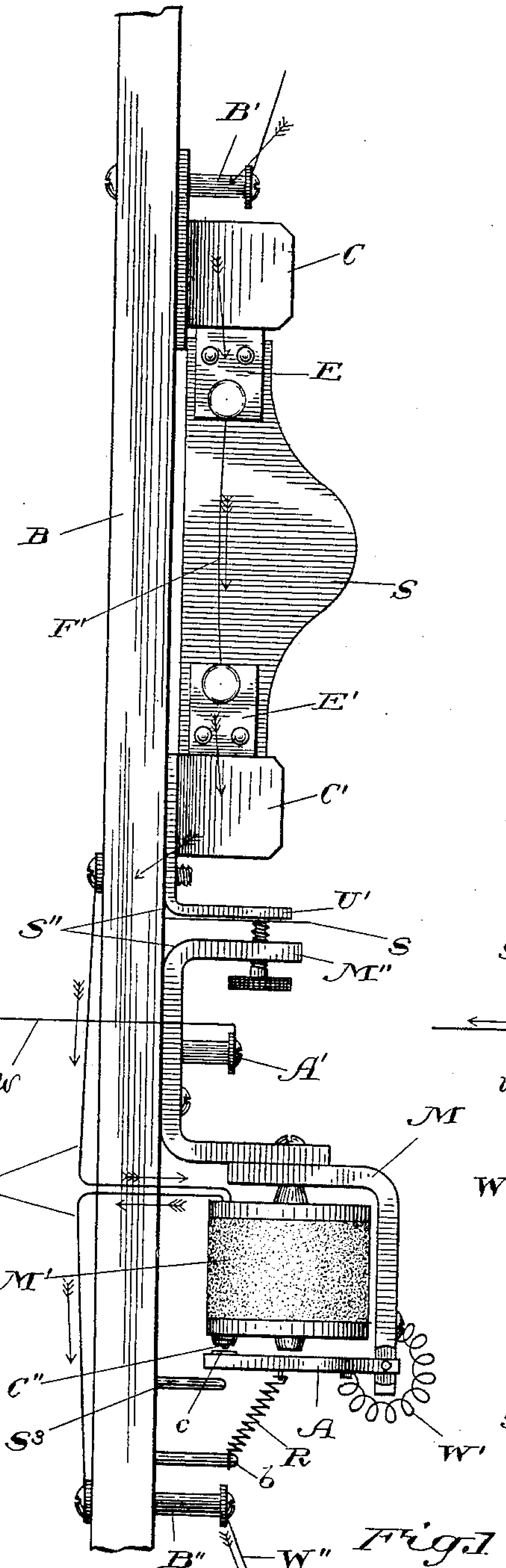

Fig.1

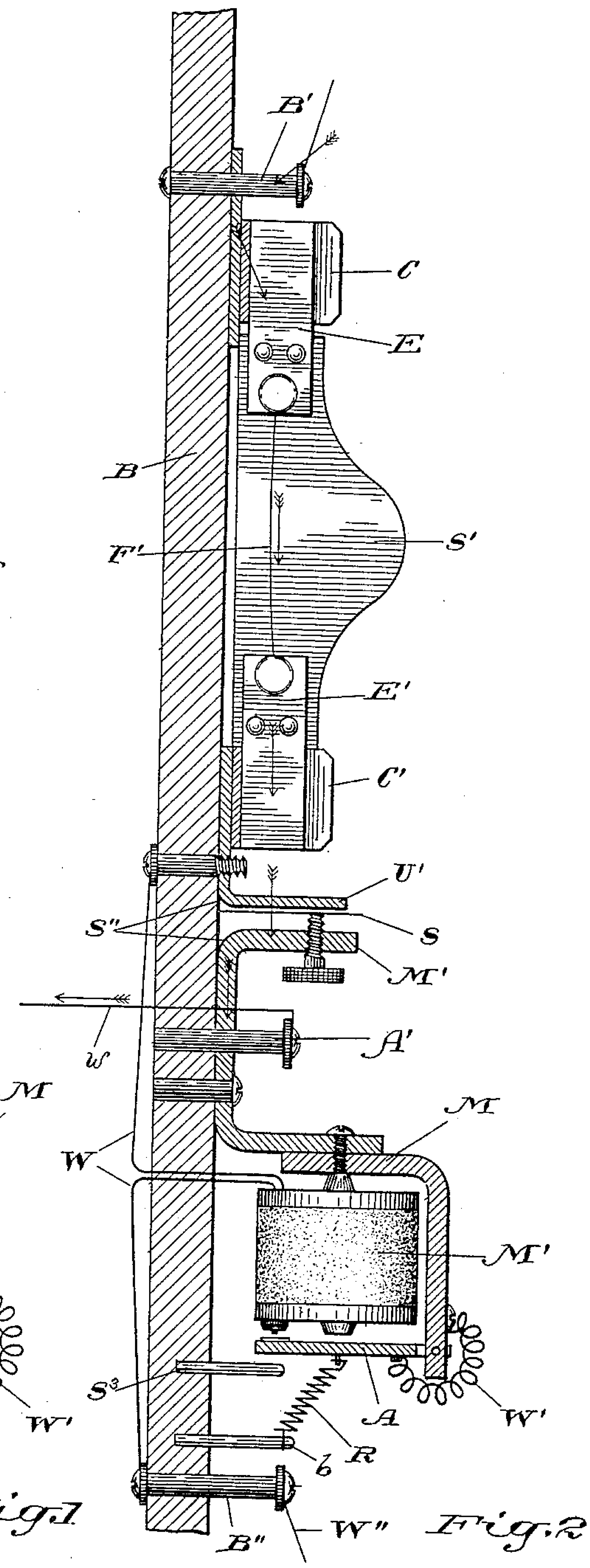

Fig.2

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UNITED STATES PATENT OFFICE.

FREDERICK C. ROBERTSON, OF TORONTO, CANADA.

CIRCUIT-BREAKER.

SPECIFICATION forming part of Letters Patent No. 597,700, dated January 18, 1898.

Application filed July 22, 1895. Serial No. 556,713. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK CHARLES ROBERTSON, of the city of Toronto, in the county of York and Province of Ontario, Canada, have invented certain new and useful Improvements in Circuit-Breakers or Line-Openers; and I hereby declare that the following is a full, clear, and exact description of the same.

This invention consists in a new improvement in circuit-breakers or line-openers adaptable to any telegraph, telephone, or other similar low-voltage electric circuit, and has for its object the prevention of damage to the magnets of the instruments in circuit due to overheating should the current become increased beyond its normal strength, brought about by the diversion of a high-voltage current thereto through accidental crossing of the said telegraph, telephone, or other similar electric circuit with a trolley, electric-light, or other high-voltage circuit.

Since the advent of the electric light and the trolley the telegraph and telephone circuits have been subjected to a new source of danger—viz., the diversion of the high-voltage current of the electric light or trolley to the telegraph or telephone circuit, brought about through the accidental crossing of the circuits. The effect produced in the low-voltage circuit is extremely detrimental to the instruments, causing the magnet-winding to become heated to such a high degree as to carbonize the dielectric covering of the wire and melt the vulcanite magnet-covers, which sometimes take fire and endanger the building in which the instruments are situated.

The object of this invention is to provide a circuit-breaker which will open the line-wire should the current in it be augmented to such a degree as to cause the instruments in circuit to become dangerously overheated due to the line-wire coming into an electrical contact with a conductor carrying a high-voltage current. Devices have been invented to accomplish this object, but have been known to fail to act at the proper moment. One of such devices is a simple fusible wire inserted in circuit, depending for its action on the current being raised to a certain limit, when the heat developed will melt the fusible wire and interrupt the circuit. Now it is a well-known fact that a comparatively small fusible wire will convey a sufficient current to dangerously heat and impair a finely-wound relay-magnet without melting, and it is also well-known that unless a fusible wire be used which will withstand a certain amount of mechanical infraction it is liable to be easily broken by jarring and other causes than those intended. One of the principal drawbacks to a coarser fuse acting is that when the current is weakened to such an extent by having to traverse the winding of the magnets of the instruments in circuit it becomes incapable of melting the fuse-wire. At the same time, however, the current is sufficiently strong to overheat the magnet-winding of the instruments in circuit. It is necessary, therefore, to combine with the fusible wire an arrangement whereby the instruments are cut out or short-circuited when the current is raised above the normal strength, thereby decreasing the resistance of the circuit, and consequently causing the current through the fusible wire to attain a higher intensity, which develops a considerably greater quantity of heat therein and causes it to melt and break the circuit. To attain this condition, I employ, in combination with the fusible wire, a relay so adjusted that under the normal condition of the circuit the armature of the relay will not be attracted, but on the current through it becoming increased to a dangerous extent the armature is attracted toward the magnet-core, thereby closing a subsidiary circuit to earth, which diverts the current to ground through a very small resistance compared to that of the instruments in circuit.

The invention consists, essentially, of the device hereinafter more fully set forth, and more particularly pointed out in the claim.

In the drawings, Figure 1 is a view showing the apparatus and the circuit of the normal current. Fig. 2 is a transverse sectional view.

Like letters of reference refer to like parts throughout the specification and drawings.

The base B is made, preferably, of wood or vulcanite or other suitable non-conducting material, and attached to the base B by screws are the contact-clips C C′, with the magnet-frame M in close proximity to the contact-clips C C′, the insulated contact-point C″, and binding-posts B′ B″. The magnet-frame M consists of a substantially Z-shaped piece of soft iron, and carried by the magnet-frame M is the magnet-core M′, which is rigidly attached to it by a screw which passes through the magnet-frame and into the magnet-core threaded to receive it. Carried by the upper arm of the magnet-frame M is the armature A, which is so pivoted as to allow of motion to or from the magnet-core M′. Connected to the armature A is one end of a retractile spring R, while the opposite end of the retractile spring R is attached by a pin b to the base B. The object of the retractile spring R is to withdraw the armature from the magnet-core M′ to open the ground-circuit; but said retractile spring may be dispensed with when necessary to employ the device in a vertical position, the armature in such case being withdrawn from the magnet-core by force of gravity. The insulated contact-point C″ consists of a platinum-tipped piece of metal set in the vulcanite magnet-head and connected with magnet-wire at an intermediate point on the winding. Attached to the free end of the armature A is a platinum contact-point c, which impinges on the contact-point C″ and establishes an electrical connection between the grounded armature A and the contact-point C″ when the armature is drawn toward the magnet-core M′ by the electromagnet becoming energized. A pin S, driven into the base B, limits the backward movement of the armature A. Connected to the contact-clip C′ is one end of the magnet-winding W, while the other end of the magnet-winding W is connected to the binding-post B″. Tapping the magnet-winding, preferably about the second or third layer from the core, is a connection with the insulated contact-point C″. To insure a perfect electrical connection between the armature and magnet-frame, there is connected to the magnet-frame M one extremity of a short spiral copper wire W′, while the other extremity of the said wire is connected to the armature A near the pivot-point by solder or by a set-screw. The contact-clips C C′ are arranged to receive, respectively, the metallic end pieces E E′ of the fuse-plate.

The fuse-plate consists of the supporting-plate S′, of vulcanite or other insulating material. On each side of the supporting-plate S′ and overlapping it are the metallic end pieces E E′, which are fastened to the supporting-plate S′ by rivets. Near the inner edges of each of the end pieces E E′ is a hole drilled and tapped for the reception of a binding-screw. The object of the binding-screw is to attach the ends of the fusible wire F′ to the respective end pieces E E′. The center of the supporting-plate is provided with a projection on the upper side to form a handle, which can be grasped by the finger and thumb for the purpose of placing or withdrawing the fuse-plate from the clips C C′. The base B is provided with a clip S″, composed of the upward projection U′ of the contact-clip C′ and the upward projection M″ of the magnet-frame M, with which it is electrically connected. Held by the clip S″ is a sheet of mica S. The magnet-frame M is provided with a binding-screw A′, in electrical connection with it, and connected to the binding-screw A′ is a ground-wire w. Normally the current enters the circuit-breaker by means of the binding-post B′, passes through the contact-clip C, through the end piece E, through the fuse-wire F′, through the end piece E′, through the contact-clip C′, through the magnet-winding W to the binding-post B″, then through the circuit-wire W″, connected to the binding-post B″, to the switchboard or instruments in circuit. In the event of the normal circuit becoming crossed with a trolley or electric-light circuit, or other circuit of high voltage, the circuit of the current would be the same as that just described as far as the magnet, when the magnet becoming energized would draw the armature toward the magnet-core M′ and cause current to circuit through the contact-point C″, armature A, magnet-frame M, and ground-wire w, connected to the binding-screw A′, to earth, until the fusible wire F′ had burned out, when the circuit through the circuit-breaker would be opened. In the event of lightning attempting to form a circuit through the circuit-breaker the course of the current would be through the binding-post B′, contact-clip C, through the fuse-wire F′, to the contact-clip C′, where it would jump through the mica to the projection M″ and thence to the binding-screw A′, and completing its circuit through the ground-wire w. The contact-point is connected to the magnet-wire at an intermediate point in its winding, as it is considered more suitable to effect the operation of the device than if it were connected to one of the ends of the winding, for the following reasons: Suppose the contact-point to be connected at the end to which the fusible wire is attached. Then when the armature should be attracted a connection would be established between the fusible wire and earth, but the magnet would then be cut out of circuit, which would cause the armature to fall back again before the fusible wire would become melted, and the armature would therefore vibrate rapidly, producing an arc at the contact-points which would in a short time destroy them. On the other hand, were the contact-point connected to that end of the winding remote from the fusible wire the resistance of the magnet-winding would tend to prevent the current attaining the strength necessary to melt the fusible wire.

By connecting the contact-point to the winding of the magnet at an intermediate point that portion of the winding between the fusible-wire connection and the said intermediate point remains included in the circuit to earth, the current traversing it being sufficient to maintain magnetism enough to hold the armature in position against the contact-point and prevent rapid vibration, the resistance of the said portion of the magnet-winding being not too great to prevent the current attaining the potential required to melt the fuse. For the sake of convenience the circuit-breaker can be mounted on a base of non-conducting material and fastened in the cupola or other place where the line-wire enters the office building, or the fuse can be placed in a cupola and the relay some distance away, provided the resistance of the conductor between the relay and the office-wire is not too great to effect the proper working of the apparatus. In view of the fact that the ordinary commercial fusible wire of a stated current capacity varies within certain limits as regards the strength of current necessary to cause it to melt, sometimes a fuse will carry as much as twice the amount of current it is supposed to stand. The advantages of the use of an instrument of this kind can be shown in the following manner: Assuming a case in which a telegraph-wire supplied with a working voltage of one hundred volts from a battery or generator and having a two-ampere fusible wire insulated between the instrument and line should come in contact with a trolley-wire carrying a potential of five hundred volts, should the polarity of the trolley-circuit be positive and that of the telegraph-wire also positive to line there would be a potential of four hundred volts in the telegraph-wire between the cross and the office-ground. Again, should the voltage of the telegraph-wire be negative and the trolley-wire be positive there would be a potential of six hundred volts in circuit. The resistance of the telegraph-circuit between the point of contact with the trolley-wire and the office-ground would be made up of the line resistance from the cross to the office plus the resistance of the instruments in circuit and the resistance of the battery or generator. Say resistance of line is twenty ohms, the resistance of the instruments three hundred ohms, and the resistance of the battery three hundred ohms, that would make a total resistance in circuit of six hundred and twenty ohms. With a voltage of six hundred volts and a resistance of six hundred and twenty ohms the current would be less than an ampere and incapable of melting a two-ampere fuse-wire, but would be strong enough to heat up the magnet-wire of the instruments to such an extent as to damage the insulation thereof. Now suppose a ground connection be applied at a point between the fuse-wire and the instruments. The result would be to cut the resistance of the instruments out of circuit, thus making the only resistance between the cross and ground the resistance of line-wire—viz., twenty ohms. The potential of five hundred volts through a resistance of twenty ohms gives a current of twenty-five amperes, which passing through the fuse-wire would cause it to quickly melt.

Suppose another case of a telephone-circuit being crossed with a trolley-wire at about a mile from the telephone-office, the telephone-wire having a resistance of forty ohms and the resistance of the telephone, &c., one hundred and fifty ohms, making a total resistance of one hundred and ninety ohms. Assuming that the potential at the cross is four hundred volts, then the current of telephone-circuit between the cross and office-ground would be a little over two amperes, which would be a slight margin over that supposed to melt the two-ampere fuse, and an interval of the time would necessarily elapse before the fuse would tend to melt, and as the wire in the instruments becomes hotter (due to the increased current) the resistance increases, which would further tend to weaken the current through the fuse-wire and prevent it melting. Now should the ground connection be applied at a point between the fuse-wire and the office instruments the resistance of the instruments would be cut out and the current shunted to ground and current in the fuse-wire would rise to ten amperes and quickly cause the fuse to melt.

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

A circuit-breaker or line-opener consisting of a fusible wire, a subsidiary circuit to earth and a relay-magnet interposed in the circuit between the line-wire and the protected instruments, the relay-magnet consisting of a magnet-frame, a magnet-core attached to the magnet-frame, a magnet-winding on the core, in circuit with the line-wire and protected instruments, an armature pivotally connected to the magnet-frame, an insulated contact-point connected to the magnet-core tapping the magnet-winding, the armature so adjusted that under the normal condition of the current it will be unattracted, but on an abnormal current attempting to circuit through the relay-magnet, it will be attracted and will impinge on the insulated contact-point and close the subsidiary circuit to earth, a spring for normally keeping the armature from the magnet-core, a back-stop to limit the opening movement of the armature, a lightning-arrester interposed between the fusible wire and relay-magnet, consisting of a clip and a sheet of mica supported by the clip, substantially as specified.

Toronto, July 10, 1895.

F. C. ROBERTSON.

In presence of—
C. H. RICHES,
M. A. WESTWOOD.