No. 699,025. Patented Apr. 29, 1902.

E. E. SCHULTZ & C. SINTAS Y ORFILA.

AUTOMATIC DEVICE FOR THE SAFE OPERATION OF ELECTRIC CONDUCTORS WITH OR WITHOUT GUARD WIRES.

(No Model.) Application filed Aug. 21, 1900.) 2 Sheets—Sheet 1.

Fig. 1.

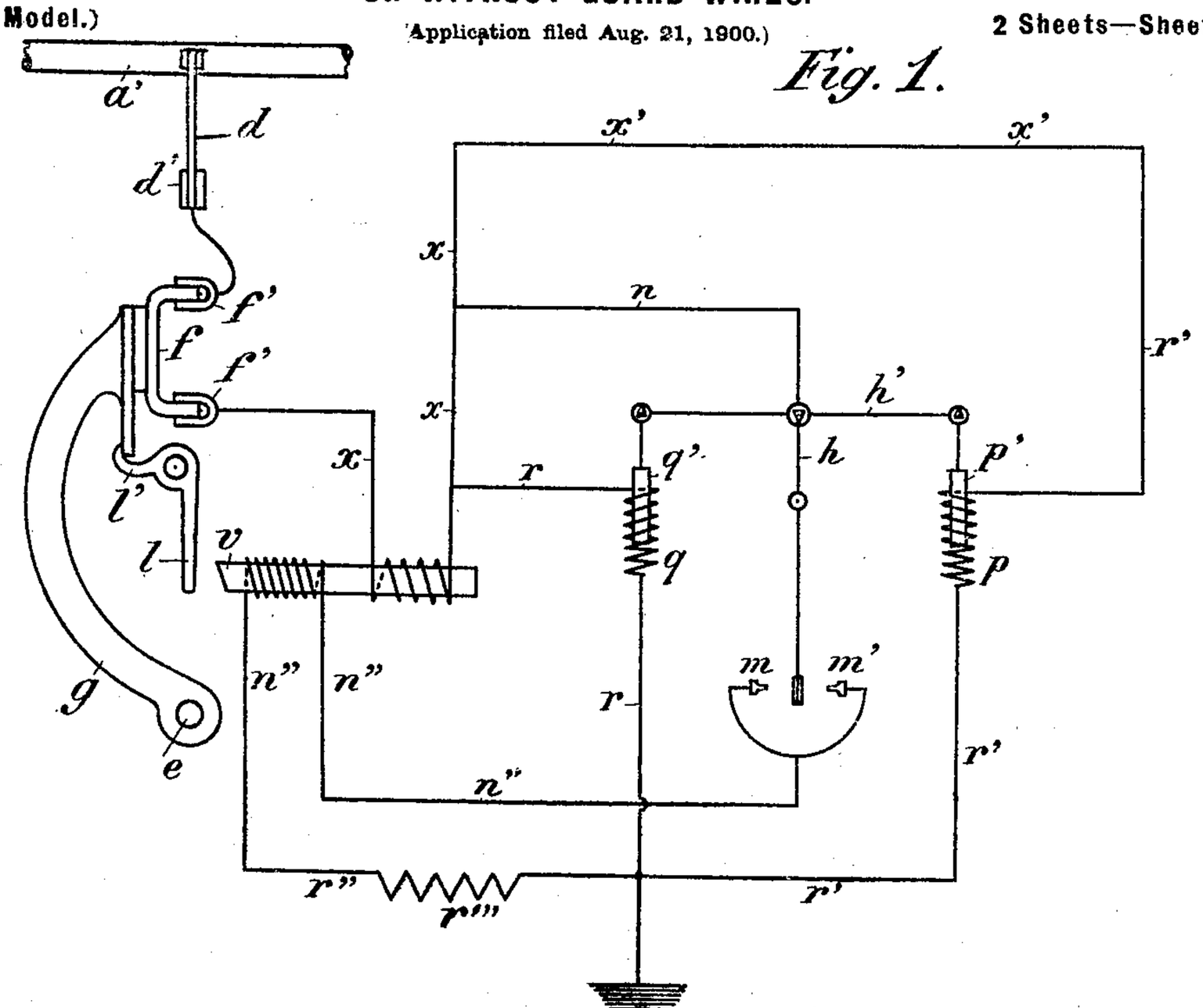

Fig. 2.

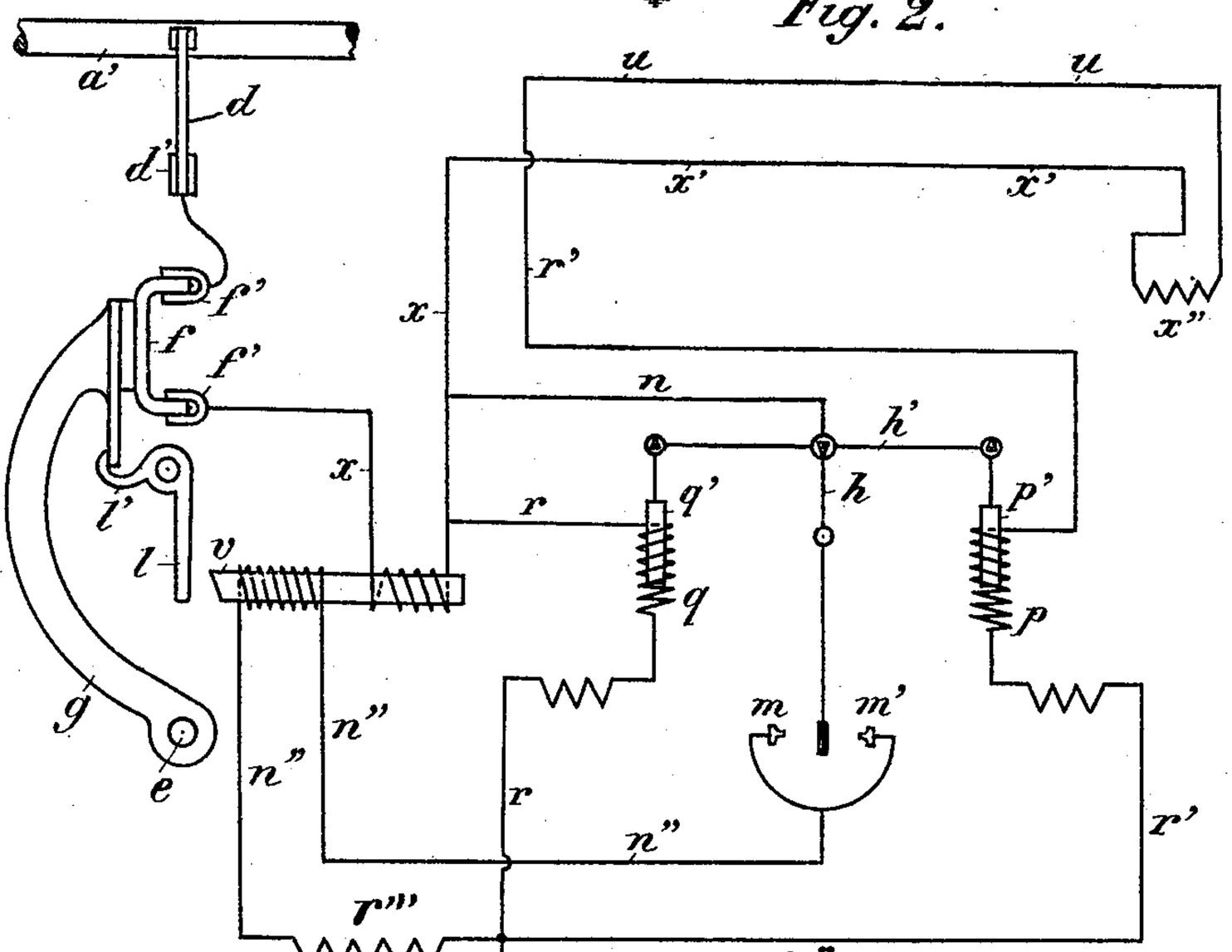

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Fig. 6.

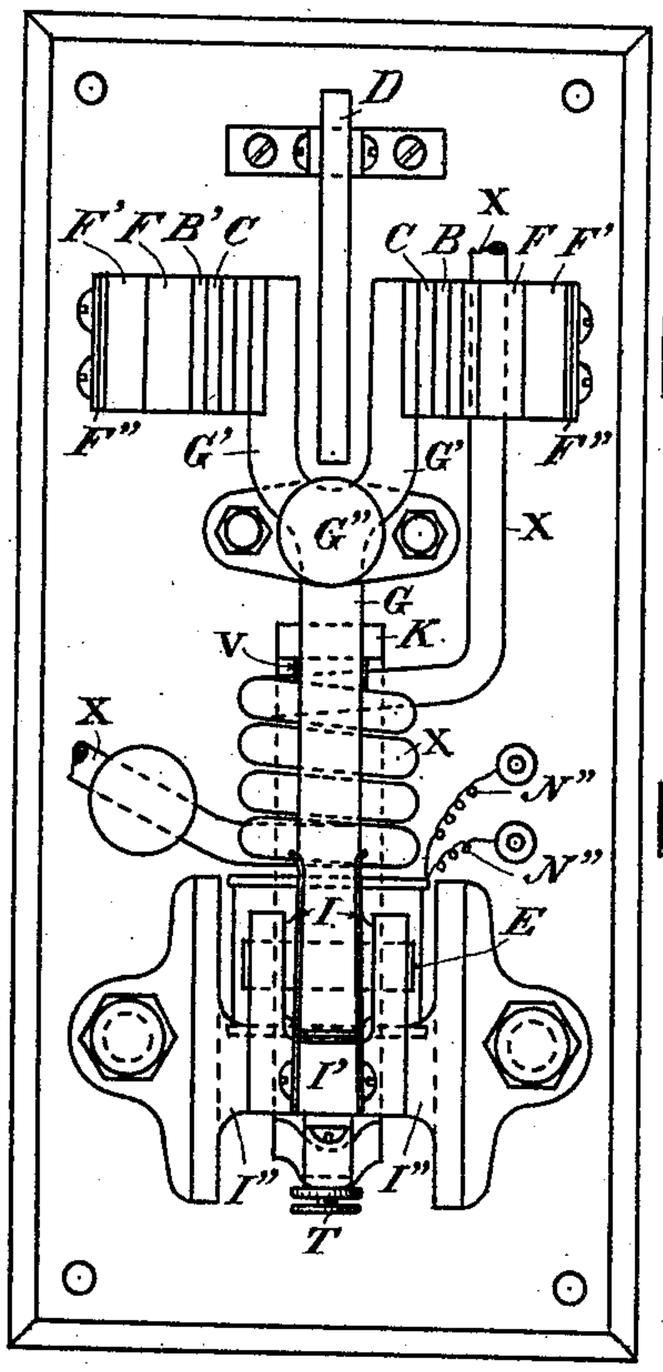


Fig. 5.

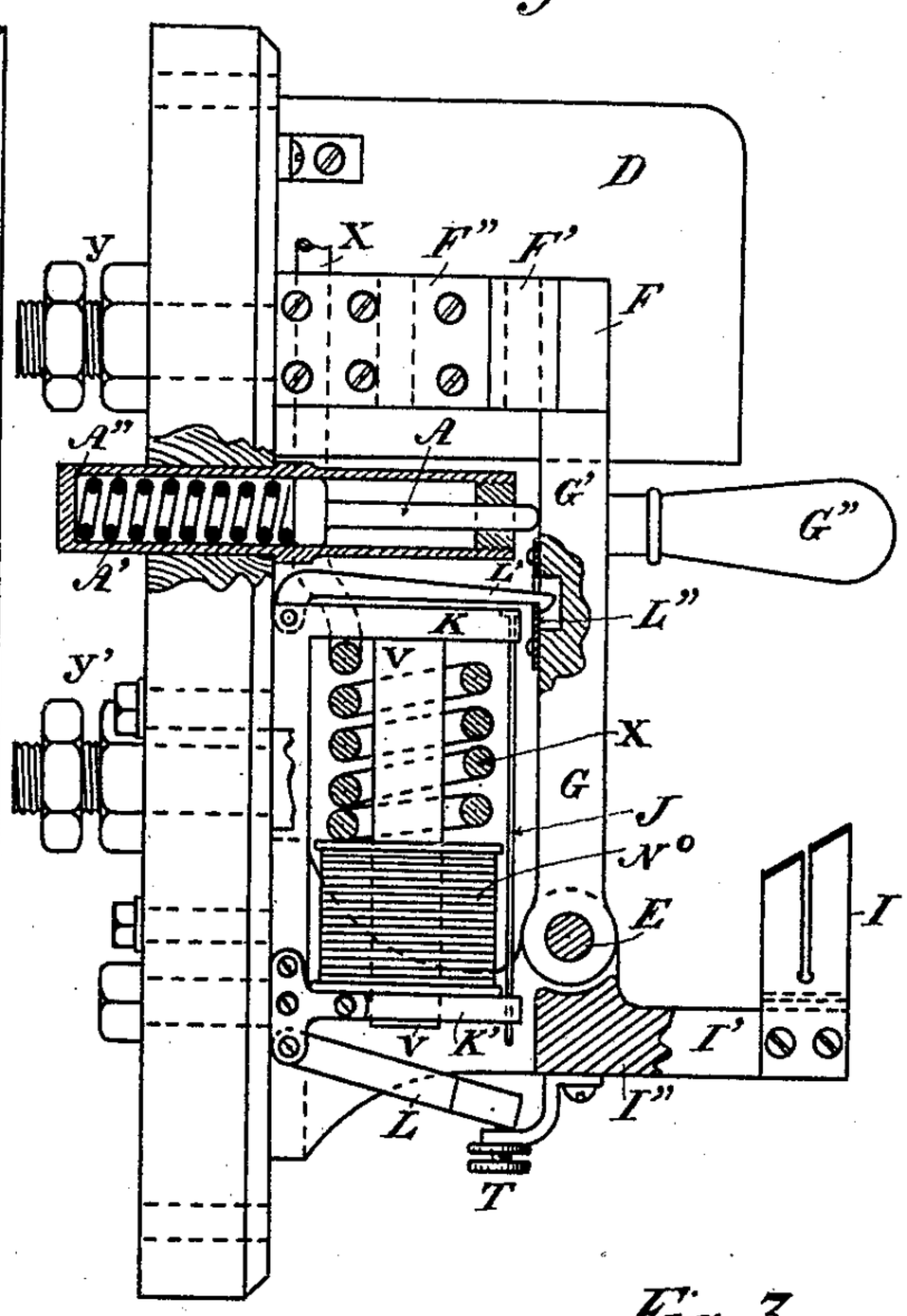


Fig. 4.

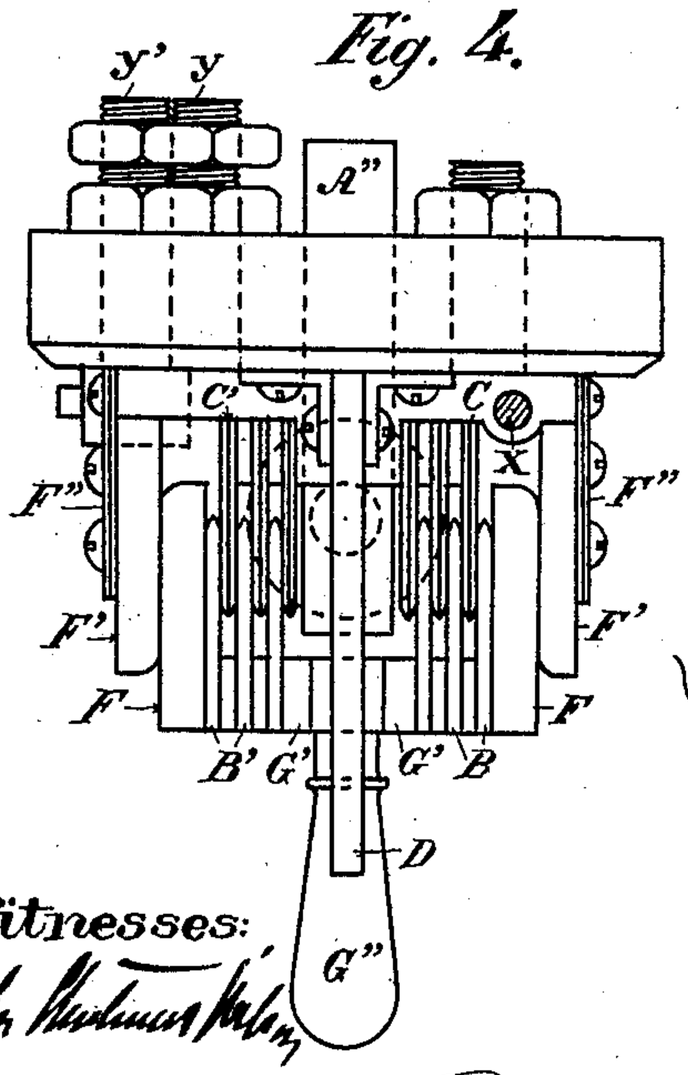
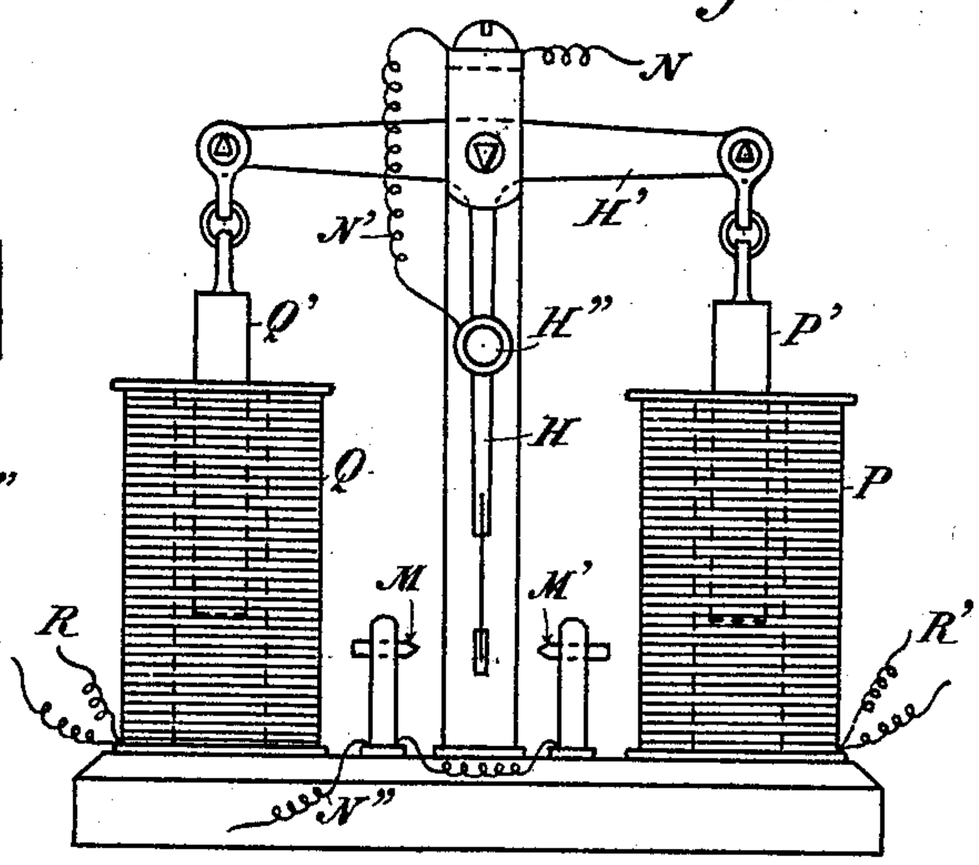


Fig. 3.



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UNITED STATES PATENT OFFICE.

ERNEST E. SCHULTZ AND CONRADO SINTAS Y ORFILA, OF BARCELONA, SPAIN.

AUTOMATIC DEVICE FOR THE SAFE OPERATION OF ELECTRIC CONDUCTORS WITH OR WITHOUT GUARD-WIRES.

SPECIFICATION forming part of Letters Patent No. 699,025, dated April 29, 1902.

Application filed August 21, 1900. Serial No. 27,620. (No model.)

To all whom it may concern:

Be it known that we, ERNEST E. SCHULTZ and CONRADO SINTAS Y ORFILA, engineers, residing at Barcelona, in the Kingdom of Spain, have invented certain new and useful Improvements in Automatic Safety Devices for Electric Circuits; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Our invention relates to improvements in circuit-controlling devices to be used in connection with suspended conductors. By the use of our said invention should such conductor or conductors break or become short-circuited with other conductors the current will cease to flow through the interrupted or short-circuited conductor.

This invention is especially applicable to electric-railway systems using the overhead trolley. When used in this connection, all danger of broken line-wires is eliminated. As soon as a wire breaks or becomes short-circuited all current to that section of the system is immediately cut off through the automatic operation of a device to be hereinafter described.

In order to more fully describe our said invention, reference will be had to the accompanying drawings, in which—

Figure 1 is a diagrammatic view of a railway system in the circuit of which is connected the circuit-breaking device. Fig. 2 is a similar view to Fig. 1, the only difference being that in this view a guard-wire is employed with the system. Fig. 3 is an elevation of a switch for controlling the automatic circuit-breaker. Fig. 4 is a plan view of the circuit-breaking device. Fig. 5 is a side elevation of the same, and Fig. 6 is a front view in elevation of the circuit-breaking device.

The same letters refer to similar parts throughout the several views.

In order to avoid confusion in Figs. 1 and 2, where the parts are simply conventionally shown in diagram, small letters are used to designate the parts, the corresponding large letters being used in the remaining views to designate the corresponding parts in the construction.

Referring first to Figs. 1 and 2, Fig. 1 is a diagrammatic view of a railway system as commonly employed in which my improvements have been incorporated, Fig. 2 being a view similar to Fig. 1, the circuits being slightly altered to conform to a system having an overhead conductor and a guard-wire running parallel thereto.

Taking the diagram shown in Fig. 1 first, x represents the feeder, and x' the line-wire, the latter corresponding to the ordinary overhead trolley or main conductor. Connected up to this line-wire x' at each end are the conductors r and r'. Each of these conductors is provided with the solenoids q and p, respectively, into which coils the cores or plungers q' and p', respectively, are adapted to move. h is a needle or arm to which is attached the horizontal balancing-arm h', which supports said plungers q' and p'. This arm or needle is connected in the main line by the conductor n, shown as tapping the line along the feeder x. Adjacent to the end of this needle h are two oppositely-disposed contact-points $m\,m'$, these contacts forming a connection with the conductor n''. This conductor n'' is passed around the magnet v, as shown, and finally connects with the conductor r'', thus completing this circuit through the ground, when the arm or needle swings in either direction and forms a connection with either of the contacts $m\,m'$. The main feeder x is also wrapped around the magnet, but with a fewer number of turns and with a coarser-diameter wire than is the case with the conductor n'', said conductor x being connected with the switch-contact f'. Opposing this contact f' is another contact f', which contacts are adapted to be connected by the switch-blade f, carried by the switch-arm g, pivoted to swing from the point e. l' is a pawl or dog the point of which is adapted to engage behind a lug of the switch-arm g and adapted to normally hold said switch in a closed position. This dog has an extension l, which forms an armature to the magnet v. a' represents the main feed-wire directly from the dynamo or other

source of supply. d' is the terminal for the switch-contact f', adapted to be connected in circuit with the main feed-wire a', such as by means of the connector d.

The operation of the system shown in Fig. 1 is as follows: Current is supplied to the system by the conductor a', passing through the parts $d\,d'$ and the switch-poles $f'\,f'$ and switch-blade f, thence to the conductor x. This conductor x passes around the magnet v and then out to the main conductor x', or, if it be a railway system, the trolley-wire will be represented by the wire x'. Before reaching the wire x', however, the current has branched off from the conductor x, part of said current passing in shunt over the wire r, through the coil q, and then connecting with the conductor r'. Following the other part of the same circuit, the current after passing over the conductor x' passes over the wire r', through the coil p, and then connects with the conductor r'. It will thus be seen that when the circuit is in its normal working condition the magnet v is constantly magnetized by the main current passing over the conductor x; but it is not magnetized strong enough to attract the armature l. It will also be seen that the circuit is divided through the coil q and attracting its core q' with a certain intensity, and at the same time a part of said current passes through the coil p, thereby causing the same to attract its core p'. Thus it will be seen that these coils q and p are constantly attracting their respectives cores with an equal amount of force; but should the wire x' become broken or disconnected the current will cease to flow through the coil p, the entire current flowing through the coil q. Consequently the arm h' will become unbalanced, and the contact carried by the arm or needle h will contact against the contact m'. As this arm h is in connection with the main circuit through the conductor n, when connection is made with the contact m' the current is caused to traverse the wire n'', around the magnet v, and through the conductor r'' and resistance r''' to the ground, which completes the circuit. When the circuit is thus completed, the magnet v attracts the armature l, which causes the dog l' to release the switch f, which will cause the circuit to be broken between the contacts $f'\,f'$, after which the needle h will swing back to its normal position, ready for the next emergency. In order to restore the circuit to its normal condition, it will simply be necessary to again close the switch f.

Referring now to the system shown in Fig. 2, in this view a guard-wire is provided, the arrangement of circuits being changed accordingly. In this case current is taken from the conductor a' and flowing through the parts $d\,d'$ and the switch f and contacts $f'\,f'$, through the conductor x to the main conductor x', through the resistance x'', and then over the guard-wire u, over the wire r', through the coil p, resistance-wire r' and r'', then to the ground. At the same time a divided current passes from the conductor x by the wire r, through the coil q, resistance, and wire r to the ground. In this case, too, it will be seen that the current is divided, one portion of said current passing through the coil q and another through the coil p in such proportions as to keep the balancing or controlling device in equilibrium. The relative amount of current passing through each of these coils p and q may be adjusted by resistances which are inserted in both of the circuits. Now in this case should the conductor x' and guard-wire u become short-circuited an excess of current will flow through the coil p, or should either the guard-wire or main conductor become disconnected or broken an excess of current will flow through the coil q. In either case the balancing device will become unbalanced, connection will be made with the wire n'', and the magnet v will become energized, attracting the armature l, and thereby disengaging the dog l', which releases the switch f, which having a normal tendency to fly back will break the circuit between the contacts $f'\,f'$, as in the foregoing instance.

In Fig. 3 we have shown one form of controlling or balancing device such as may be employed in connection with our invention. This device, it will be seen, operates on the same principle of two solenoids acting in opposition, the forces exerted upon each other normally equalizing themselves. In this view, P and Q represent the solenoid-coils, and P' Q' are the corresponding cores adapted to move into and out of said coils. These cores are both suspended from the ends of the balancing-arm H' at equal distances from the pivot thereof and are adjusted so as to be balanced when no current is passing through the coils. Attached to or integral with the arm H' is the arm or needle H. This arm H is provided at its bottom end with any suitable non-fusible contact suspended from a spring. At about the center of said arm H is provided the screw H'', to which is connected the wire N', by means of which current is supplied directly to the arm H, thus avoiding the necessity of passing the current from the base of the device and through the pivots. M and M' are suitable oppositely-disposed contacts carried by the base of the device, so placed as to be adapted to contact with the contact carried by the arm H. These contacts M and M' are both electrically connected together, and it makes no difference which way the arm H swings the circuit completed thereby will be the same. This device is connected up in the circuit in the following manner, reference being had to Figs. 1 and 2: The wire N, leading from the top of the device, is connected to the wire n, wires R' from the coil P are connected in series with the conductor r', the wires R, leading from the coil Q, are connected in series with the conductor r, and the wire N'' is connected to the conductor n'', and the device is ready to operate as described.

Referring now to Figs. 4, 5, and 6, these

views illustrate an improved form of automatic switch adapted to be used in conjunction with our invention and is controlled in its action by the controlling or balancing device. In these views I'' represents a bracket secured to the base in any suitable manner. This bracket I'' is provided with an extension I', to which the springs I are secured. Pivoted to this bracket I' by means of the pin E is the switch-arm G, provided at its upper end with a bifurcated portion G' and the handle G''. B B' are switch-blades carried by the bifurcated portions G', and secured beside these blades B B' are plates of carbon or other non-fusible substance. Mounted upon the base of the device and secured thereto by means of the plates F'' are the carbon contacts F', which are adapted to contact with the carbons F upon the switch-arm G. Oppositely disposed to the switch-blades B B' are the switch-blades C C'. When the switch-arm G is thrown into its closed position, these switch-blades B B' and C C' mesh with one another, thus forming a laminated connection. The carbon contacts F F' at the ends are so proportioned in respect to the switch-blades B, B', C, and C' that the final break is made between the carbons F and F'. As the blades B B' C C' are generally made of copper or other good conductive metal, fusing of the same is prevented, as the arc formed by the break occurs between the carbons. D is a shield composed of a sheet of insulating material secured in an upright position upon the base and passing between the bifurcated portion G', the purpose of which is to prevent the arc forming between the blades C C'. These blades C are carried by one pole of the switch, which is secured to the base by means of the screw—for instance, as shown. The other pole of the switch carries the blades C' and is secured to the base of the switch by means of the binding-screw *y*, passing through the base of the switch and providing means for making a connection upon the rear of the switch. V is the core of a magnet mounted upon the base of the switch, around which is wound the conductor X, having one of its terminals connected to one of the switch-poles and its other end connected to the binding-screw *y'*. N' is a coil composed of wire of much smaller diameter and a greater number of turns, also surrounding the core V. L is an armature hinged to the base of the magnet and adapted to swing toward and from said magnet-core V. This armature L normally rests in a lowered position, as shown in Fig. 5, the distance being adjusted by means of the screw T. In the path of said armature L is a pin J, mounted in the frame of the electromagnet. At the upper end of this pin J is pivoted a latch L'. This latch L' is provided upon its free end with a notch which is adapted to engage an opening in the escutcheon-plate L'' in the switch-blade G when said latch is in its lowered position. Mounted above said latch is a cylindrical body A'', having a cylindrical opening therein. Mounted within said opening is a plunger A, one end of which is adapted to bear against the inner face of said switch-arm G. A' is a coiled compression-spring, also mounted within said body A'' behind said plunger A, the tendency of which is to force said plunger outward. The plunger A in turn bearing against the switch-arm G also tends to throw said switch-arm back and break the circuit; but this is prevented by the latch L' until the magnet V is sufficiently energized to attract the armature L, when the latter will swing up against the pin J, which in turn will strike against the latch L, causing the notch thereon to disengage from the escutcheon L'' upon said switch-arm G, when the action of the plunger A will cause the same to drop back and rest between the springs I, thus automatically breaking the circuit. This automatic switch is connected in circuit as follows: Binding-screw *y* is placed in connection with the source of current-supply, and the binding-screw *y'* is the leading-out terminal of the switch and is connected with the conductor *x* or main feeder. N' N'' are terminals of the coil of fine wire N° and are connected in series with the conductor *n''*, which places it in connection with the balancing or controlling device. Normally the entire strength of the current is flowing over the conductor X and around the magnet V; but owing to the few number of turns of the same around the core V the armature L is not attracted; but when through an emergency the controlling device throws the current through the coil N'' of fine wire the armature is attracted, striking against the pin J, which in turn releases the latch L', with the result hereinbefore pointed out.

It is obvious that this device is not confined to use with a railway or electric-light circuit, but may be used in any circuit where such a device is desirable. It will also be seen that many changes might be made in the details of the apparatus without departing from the principle or spirit of our said invention.

Having thus described our invention, what we claim, and desire to secure by Letters Patent of the United States, is—

1. In an automatically-operated device for electric circuits, the combination with the main feeder, and main circuit-conductor, and an automatic switch adapted to open and close the circuit through said feeder; of a controlling device consisting of a pair of stationary coils, connected in circuit with said feeder and conductor, respectively, a balancing-arm pivoted above said coils, and plungers or cores swinging from the ends of said arm adapted to reciprocate within said coils, a swinging arm carried by said balancing-arm, a contact carried by said arm, in circuit with said main feeder, and contacts adapted to close the circuit with said swinging-arm contact, whereby

when said circuit is closed said automatic switch is thrown open, substantially as described.

2. In a controlling device for electric circuits, the combination with a pair of stationary coils, adapted to be independently connected in the circuit, and a pair of stationary contact-points electrically connected together; of a balancing-arm pivoted above said coils, plungers upon each end of said arm, adapted to reciprocate within said coils, a swinging arm carried by said balancing-arm, and a contact carried by said arm also connected in the circuit, and adapted to close the circuit with said stationary contacts, substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

ERNEST E. SCHULTZ.
CONRADO SINTAS Y ORFILA.

Witnesses:
JAIME CASTELLS,
MADDIN SUMMERS.