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L. WOODS.

ELECTRIC RAILWAY.

(Application filed Nov. 3, 1900.)

(No Model.)

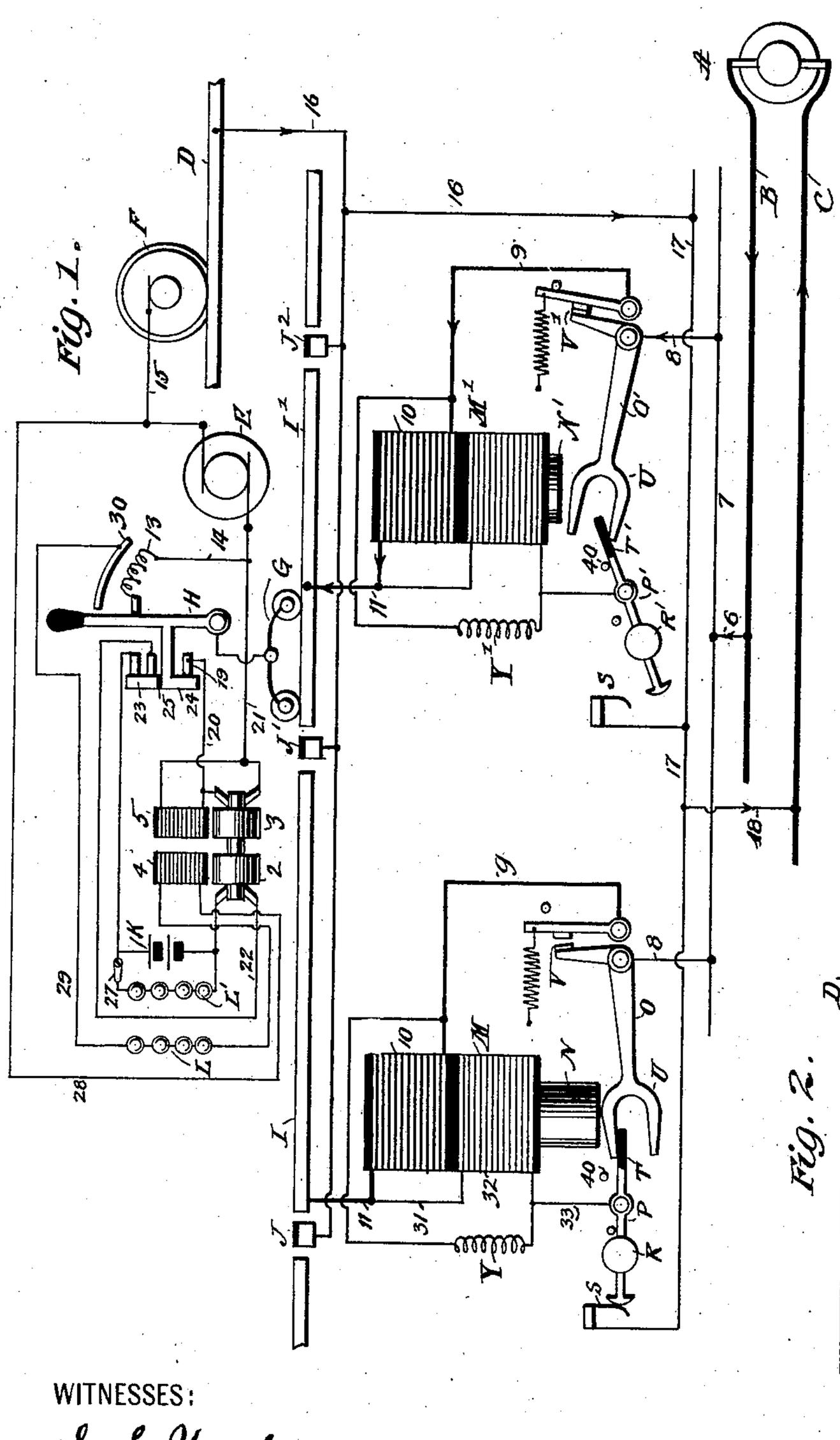

Fig. 1.

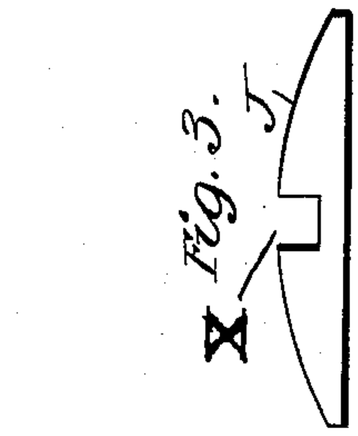

Fig. 3.

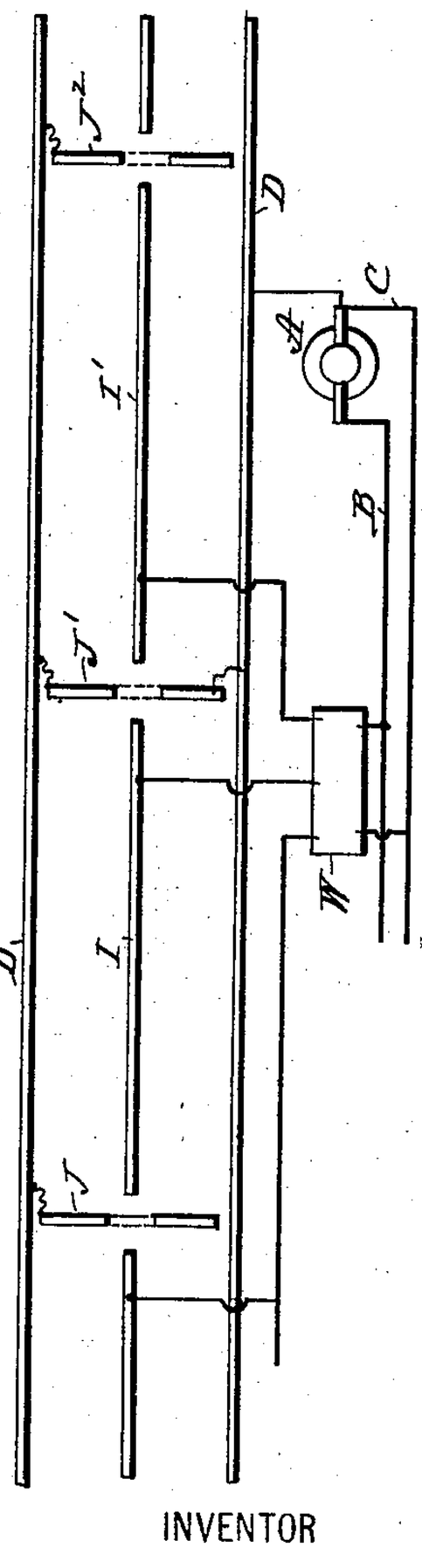

Fig. 2.

WITNESSES:

S. E. Woods.

B. Oster.

INVENTOR

Lyelle Woods.

UNITED STATES PATENT OFFICE.

LYATES WOODS, OF NEW YORK, N. Y., ASSIGNOR, BY MESNE ASSIGNMENTS, TO NATIONAL SAFETY THIRD RAIL COMPANY, A CORPORATION OF WEST VIRGINIA.

ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 686,644, dated November 12, 1901.

Application filed November 3, 1900. Serial No. 35,315. (No model.)

To all whom it may concern:

Be it known that I, LYATES WOODS, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Electric Railways, of which the following is a specification.

My invention relates to improvements in that type of electric railways in which the current main or feeder supplying the propelling-current is preferably buried or insulated throughout the length of the entire route and is provided with normally-dead sectional trolley or work conductors or rails located parallel thereto and preferably between the lines of tram-rails and nearly flush with the surface of the road-bed, each of said sectional conductors having means (preferably located in water-tight boxes outside of the road-bed) for automatically connecting it to the current-feeder main and disconnecting it therefrom as a car or vehicle passes over them, said car or vehicle being usually provided with one or more contact brushes or trolleys which serve to convey the current to and through the propelling-motor located on the car.

My invention has for its objects, first, to render the switch-actuating magnets absolutely certain of action, and, second, to provide a complete system in which absolute safety to the apparatus, to persons, and animals is assured. These two objects are secured by the apparatus hereinafter described, the features I deem novel with me being particularly specified in the claims which follow this specification.

Referring now to the drawings, in which similar letters and figures of reference represent corresponding parts, Figure 1 is a diagrammatic view of my improved system as applied to a single line of trolley-conductors, together with the circuits and circuit-connections of the apparatus carried by a propelled car or vehicle. Fig. 2 is a diagrammatic plan view of sectional trolley-conductors, the tram-rails, &c. Fig. 3 is an enlarged side view of a leak-circuit device whose normal position is between the adjacent ends of two sectional trolley-conductors, as hereinafter set forth.

In Fig. 1, A represents the electrical generator. B is the current-feeder main leading therefrom. C is the current-return main leading to said generator. D is one of the tram-rails over which the current passes from the driving-motor over said return-conductor to said electrical generator. E is the car-driving motor, which operates between the car-wheel F and trolley G. The controller device H is preferably arranged in circuit between said motor E and the aforesaid trolley. I I′ are the sectional or trolley conductors which when cut into the circuit convey current from the feeder B to said car-driving motor. J J′ J″ are leak-circuit devices which have circuit connections to the aforesaid return-main. 2 and 3 are the armatures of the motor-generator. 4 and 5 are the field-magnets of said motor-generator. M M′ are triple-duty electromagnetic devices, each of which when energized by current flowing through its coil or coils will pick up or close the circuit between one sectional or trolley conductor and the feeder-main, then open the normally-closed circuit between the said conductor and the return-main, and will thereafter force said circuits to assume their normal condition, when the said current ceases to flow. These triple-duty devices are preferably solenoid-cores N N′, which attract and draw up the magnetic bell-crank levers O O′, respectively, and at appropriate times to close the circuit between the trolley-conductors and the feeder-main. P P′ are switches through which the aforesaid sectional conductors and the said triple-duty apparatus M M′ are normally connected to the earth or return-main.

In Fig. 2 I have shown the sectional work or trolley conductors I I′ arranged in a single line between the tram-rails D D; but the said trolley-conductors may be arranged in any other suitable way and in any appropriate place. For instance, I would not consider that I had departed from the spirit of my present invention if I elevated the trolley-conductors to any suitable height above the earth. The trolley-conductors may be of any suitable length and shape. Between the adjacent ends of each two of said trolley-conductors I have arranged transversely to the tram-rails a leak-circuit or shunt device J,

which is permanently connected to the return-circuit. The object of the leak-shunt is to prevent the current from leaking or creeping forward or backward from live trolley-conductors beneath the car to adjacent exposed trolley-conductors in front or rear thereof. These leak-shunts prevent damage from leaks in the following manner: Suppose that upon a rainy day the adjacent ends of two sectional or trolley conductors nearest the car are covered with water. It is possible under such a condition and in the absence of the leak-shunt device that a small portion of the current might leak or creep forward or backward some sections. Consequently a person or animal might receive a shock. With my leak-shunt arrangement, however, this is utterly impossible, inasmuch as the leak-shunt offers such a low resistance-path that the leaking current cannot pass it and take a path of higher resistance. The three sectional work or trolley conductors shown in Fig. 2 have their circuits grouped together and run into box W, which is preferably placed outside of the road-bed and contains the electromagnetic switch or pick-up apparatus for the said three work-conductor sections. It will be observed that the shunt device, Fig. 3, has an opening X. In practice the distance across this space is much less than the distance between the adjacent ends of any two of the trolley-conductors between which the said shunt device is located, thereby making the path from the live trolley-conductor to the shunt device of lower resistance than the path between the adjacent ends of two trolley-conductors. The space between the adjacent ends of two sectional work or trolley conductors and the aforesaid space at X in the shunt device may be filled with any suitable hard insulating material, such as stone.

The operation of the system is as follows: Suppose that a car is now standing over the triple-duty electromagnetic pick-up apparatus at M′ and is being supplied with current through the same. The path of the current is then as follows: Starting from generator A the current passes over feeder-main B, conductors 6, 7, and 8, bell-crank O′, contacts V′, conductor 9, solenoid-coil 10, conductor 11, trolley-conductor I′, trolley G, and lever H. Here the current divides. A large portion passes over rheostat 13, conductor 14, motor E, conductor 15, car-wheel F, rail D, conductors 16, 17, and 18, return-main C, to generator A. The small portion of the divided current passes from lever H over contact 19, conductor 20, to the motor-generator, where another division of the current takes place. The field part 5 and the armature part 3 being in shunt to each other each takes its appropriate portion of this current, after which these parts of the current will unite at conductor 21 and then join the larger portion on conductor 14. The current passing, as described, through parts 3 and 5 of the motor-generator causes that portion of the machine to act as a motor, and thereby drive the armature part 2, which then acts as a generator and furnishes current which charges storage battery K, the storage-battery circuits being as follows: The circuit from part 2 of the motor-generator starts from the lower brush thereof and passes over conductor 22, across the contacts at switch part 23, (which is insulated from switch part 24 by insulation 25.) Thence the current passes through battery K, and thence to the upper brush of part 2 of the motor-generator. If switch 27 is closed, as shown, some of the current will be shunted through lamps L′, thereby lighting them. The field part 4 is preferably a permanent magnet having a field-coil which is cut into the main circuit in shunt to the driving-motor E, thereby maintaining the strength of the said permanent magnet. The terminals of the coil on field part 4 connect as follows: Conductor 28 (which is one of said terminals) connects with conductor 15 near wheel F. The other terminal is conductor 29, and it terminates in contact 30. The object of the permanent magnetic field is to insure a field of non-changeable polarity, and it also acts as an aid to the instantaneous action of the apparatus when the same is needed. Now as lever H is moved toward the right to give motor E more current it makes connection with contact 30 and cuts out resistance 13. The car is supposed to be moving from right to left. Trolley G passes over the insulation between the adjacent ends of trolley-conductors I and I′ and then makes contact with conductor I before connection is broken between the trolley and conductor I′. Then current is shunted from the trolley G over trolley-conductor I, conductors 11 and 31, pick-up coil 32, conductor 33, switch P, contacts S, conductors 17 and 18, return-main C to generator A. Core N will thus become energized, and after attracting lever O will quickly move upward and simultaneously carry upward the fork U of lever O. This movement causes the vertical end of the bell-crank lever O to connect the contacts at V, thereby making an electrical connection between the feeder B and trolley G, as follows: Current leaves feeder B and passes along conductors 6, 7, and 8, bell-crank O, contacts V, conductor 9, coil 10, conductor 11, and rail I to trolley G. A small portion of the current after flowing through coil 10 shunts through conductor 31, coil 32, conductor 33, switch P, contacts S, conductors 17 and 18, and return-main C. In the meantime the fork U has continued its upward movement and immediately after the above-described circuits have been established the lower tine of the fork U strikes the insulated lever end T of switch P and moves the same until the contacts at S are separated, and thereby opening the circuit through the initially-operating coil 32. After the opening of this circuit the end T of switch P is brought against the stop 40, and thus allowing core N

to continue its upward motion if it becomes separated from the fork U, in which case the apparatus at M will have assumed the same position as the parts shown at M'. Trolley G must always be long enough to span the space between two adjacent trolley-conductors, so that it touches and travels some distance on the second trolley-conductor before it leaves the first one. Now as trolley G progresses toward the left it leaves the sectional conductor I', thereby opening the circuit through the solenoid at M', thus permitting core N' to reverse its action upon the fork U, thereby incidentally forcing it downward until the contacts at V' are opened, and then by the further downward movement of core N' and fork U switch P is forced to close the contacts at S, thereby again completing the normally-dead circuit through the initially-operating coil N'. It should be understood that during the time in which said fork U is acting to close or open the circuits there is an interval in which said switch P is not moved. During that time it is held closed by the locking friction of the contacts at S or held open by the weight R. Some such means must be provided whereby switch P is caused to remain quiescent during said intervals; otherwise the contacts at S are liable to close before the contacts at V are open, in which case the apparatus would begin a vibratory action which would be maintained by the current shunting from the feed-main and through the pick-up coils. When the entire apparatus is at rest and the machinery is about to be started, lever H is moved to the first position, where it closes the battery-circuit, preferably before the opposite side of the motor-generator has its circuit closed. Thereby the counter electromotive force in the battery-circuit is quickly raised to its highest point, and thereby preventing waste of the battery-current. After the battery-circuit is closed then the controller moves to a position where the part 3 of the motor-generator and the trolley G are connected in the circuit, and such relation may be maintained between them as long as it is necessary.

I do not limit my invention to the exact arrangement of the circuits and apparatus shown and set forth herein.

Having thus described my invention, what I claim as new is—

1. In an electric railway, the combination with the feeder, of a series of normally dead work or trolley conductor sections, an electromagnetic switch for each trolley-conductor section, a connection from each trolley-conductor section to ground or return and including an initially-energizing coil for actuating the trolley-conductor-section switch and an automatic switch for controlling said ground or return connection, the said automatic switch being mechanically actuated by the said electromagnetic switch, and a connection from each trolley-conductor section to the feeder and including a coil for holding the trolley-conductor switch closed, each of said electromagnetic switches being opened and closed by a loose solenoid-core.

2. In an electric railway, the combination with the feeder, of a series of normally dead work or trolley conductor sections, an electromagnetic switch for each trolley-conductor section, a connection from each trolley-conductor section to ground or return and including an initially-energizing coil for actuating the trolley-conductor-section switch and an automatic switch for controlling said ground or return connection, the said automatic switch being opened and closed by the mechanical action of the said electromagnetic switch, a connection from each trolley-conductor section to the feeder and including a coil for holding the trolley-conductor switches closed, and means for opening said trolley-conductor switch immediately after the trolley-conductor is out of use.

3. In an electric railway, the combination with the feeder, of a series of normally dead work or trolley conductor sections, normally open electromagnetic switches between the feeder and said sections, a coil connected to each of said sections to initially actuate one of said switches, normally closed mechanically-actuated switches in circuit with each of said coils and connecting the same to ground or to the return-main, a second coil connected to each work or trolley conductor section and which, after the initially-acting coil is cut out, controls the switch in its own circuit and the switch in the circuit of the coil connected with the ground or return-main, the said switch in the ground-circuit being controlled indirectly by said coil, through the mechanical action of the switch in circuit with said coil, and means for forcing said switches in both circuits to assume their normal conditions when said coils in both circuits are dead, each of said normally open switches being opened and closed by one electrically-controlled device.

4. In an electric railway, the combination with the feeder, of a series of normally dead work or trolley conductor sections, normally open electromagnetic switches between the feeder and said work-conductor sections, an electrical connection between two of said switches, an electrical conductor leading from said connection to ground or return-main, coils connected with the said sections for initially actuating said switches, normally closed mechanically-actuated switches in circuit with said coils, an electrical connection between two of said closed switches, an electrical conductor leading from the latter connection to the feeder-main, coils connected with the work-conductor sections for temporarily holding closed the normally open switches and temporarily holding open the normally closed switches, the action of said coils upon said closed switches being through the mechanical operation of said electromag-

netic switches, and devices coöperating with said coils whereby said switches are compelled to assume their normal positions when said coils become dead.

5. In an electric railway, the combination with the feeder, of a series of normally dead work sectional conductors, normally open electromagnetic switches between the feeder and said sections, a coil connected to each of the said sections to initially actuate one of said switches, normally closed mechanically-actuated switches through which each of said coils is connected to ground or return-main, a second coil connected to each work-conductor section, said second coil being in series with the work-conductor section and adapted to temporarily hold the switch in its own circuit closed and to temporarily hold the switch in the initially-operating circuit open, the action of said coils upon the switch connected in the ground-circuit, being through the mechanical operation of the electromagnetic switch, and a circuit around said coils to receive the discharge thereof, each of said normally open switches being opened and closed by a single solenoid-core.

6. In an electric railway, the combination with the feeder, of a series of normally dead work-conductor sections, normally open switches for connecting said sections with the feeder, coils connected between said sections and the ground or return-main and in shunt to the car-driving motor, for initially actuating said switches, coils connected between said work-conductor sections and the feeder and in series with said car-driving motor, for temporarily holding said switches closed, normally closed mechanically-actuated switches connected in the ground-circuit and controlling the same, the said closed switches being controlled by the mechanical action of the said open switches and devices, controlled by the coils in both switch-circuits, whereby said switches are compelled to assume their normal condition when the said coils become dead, each of said normally open switches being opened and closed by an electrically-controlled solenoid-core.

7. In an electric railway, the combination with the feeder, of a series of normally dead work or trolley conductor sections, normally open electromagnetic switches between the feeder and said sections, coils connected to the work-conductor sections to initially actuate said switches, and connecting the same to ground or return-main, normally closed mechanically-actuated switches in circuit with said coils, coils connected to said work-conductor sections for temporarily holding open the normally closed switches and temporarily holding closed the normally open switches, and means connected to the ground or return circuit whereby the electric current is prevented from leaking or straying from a work-conductor section and accidentally operating the pick-up apparatus.

8. In an electric railway, the combination with the feeder, of a series of normally dead work or trolley conductor sections, normally open electromagnetic switches between the feeder and said sections, coils connected to said sections to initially actuate said switches, normally closed mechanically-actuated switches in circuit with said coils and connecting the same to earth or return-main, said closed switches being mechanically controlled by said electromechanical switches, coils connected to said sections for temporarily holding open said normally closed switches and temporarily holding closed said normally open switches, and leak-collecting devices arranged between the adjacent ends of said sections and connected to the earth or return main.

9. In an electric railway, the combination with the feeder, of a series of normally dead work-conductor sections, normally open switches for connecting the said sections with the feeder, coils connected between said sections and the ground or return-main and in shunt to the car-driving motor, for initially actuating said switches, coils connected between said work-conductor sections and the feeder and in series with the car-driving motor, for temporarily holding said switches closed, normally closed switches, which are mechanically actuated by said open switches, in the circuits of said shunt-coils, which are temporarily opened during the time the switches in the series circuits are closed, devices, controlled by the coils in both the series and shunt circuits, whereby the switches in both of said circuits are forced to assume their normal conditions when said coils are inactive and normally dead, means for initially actuating the normally open switches when the circuit is open between the car apparatus and the feeder-main, each of said normally open switches being directly opened and closed by one solenoid-core.

10. In an electric railway, the combination with the feeder, of a series of normally dead work-conductor sections, normally open electromagnetic switches for connecting said sections to said feeder, normally closed switches which are mechanically actuated by said electromagnetic switches and in a shunt-circuit, between the said conductor-sections and the return-circuit, whereby the initially-actuating current is controlled, a current-collector carried by the car, a motor-generator, a storage battery connected to said motor-generator, a car-driving motor, and a controller apparatus having contacts and connections whereby in the first position of the controller, the battery-circuit is completed through one part of said motor-generator and by a further or progressive movement of the said controller, the current-collector and the second or remaining part of the motor-generator are connected to each other and to the car-driving motor-circuit.

11. In an electric railway, the combination with the feeder, of a series of normally dead

work-conductor sections, normally open electromagnetic switches between the feeder and said sections, coils connected to said sections to initially actuate said switches, normally closed switches which are mechanically actuated by said open switches and in circuit with said coils and connecting the same to the ground or return-main, coils connected to said sections for temporarily holding open said normally closed switches and temporarily holding closed said normally open switches, and devices mechanically independent of said switches and coöperating with said coils to open and close said switches.

12. In an electric railway, the combination with the feeder, of a series or normally dead work-conductor sections, normally open electromagnetic switches between said feeder and said sections, coils connected to said sections to initially actuate said switches, normally closed switches which are mechanically actuated by said open switches and in circuit with said coils and connecting the same to the ground or return-main, coils connected to said sections for temporarily holding open said normally closed switches and temporarily holding closed said normally open switches, and devices mechanically independent of said switches and coöperating with said coils to control said switches; the said devices having a longer travel than said switches and being adapted to jolt said switches and thereby prevent their contacts from sticking together, each of said normally open switches being opened and closed by one of said devices.

Signed at New York city, in the county of New York and State of New York, this 24th day of October, A. D. 1900.

LYATES WOODS.

Witnesses:
G. T. WOODS,
THOS. MARTIN.