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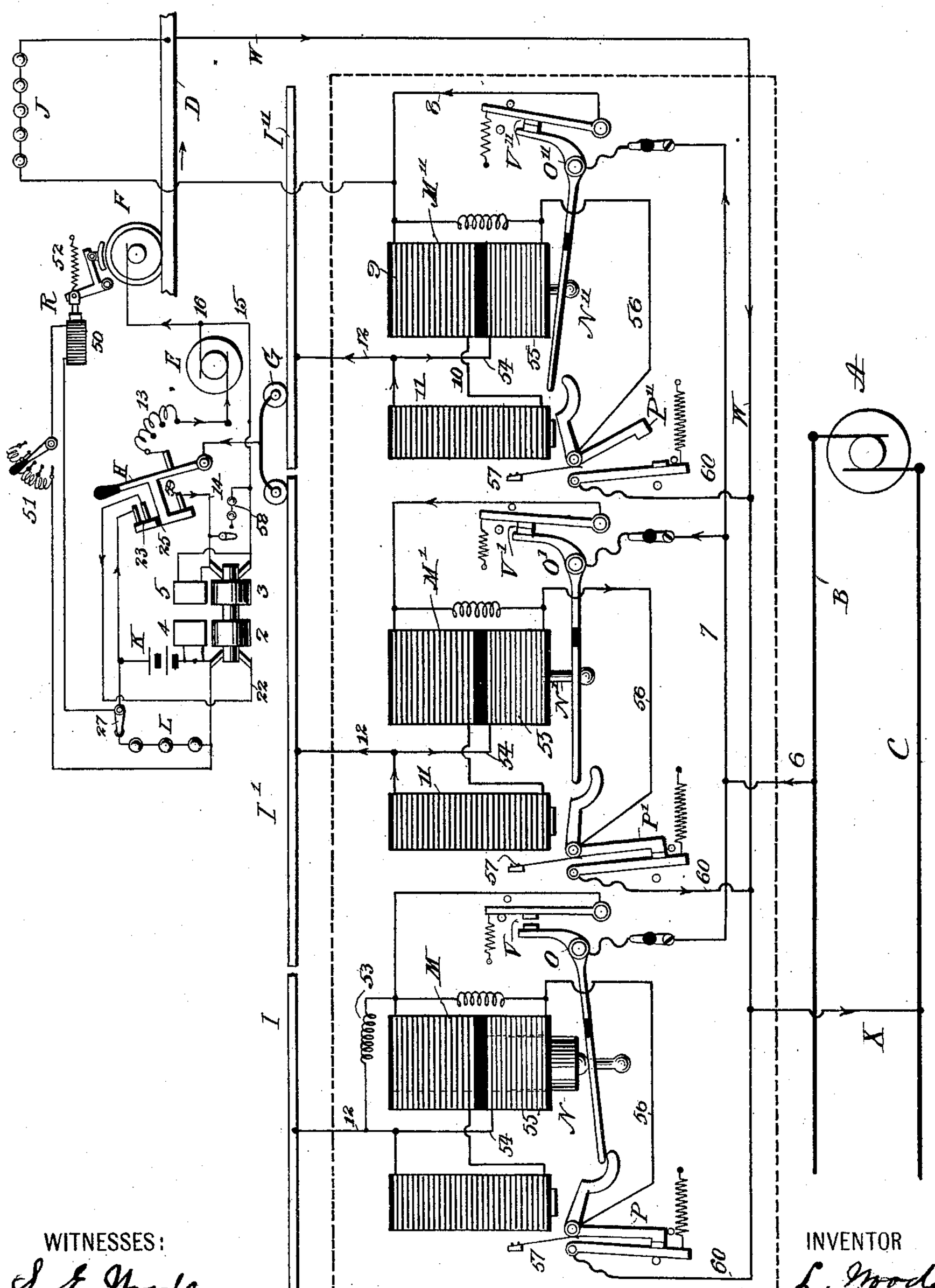
L. WOODS.

ELECTRIC RAILWAY.

(Application filed Feb. 1, 1901.)

(No Model.)



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ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 686,645, dated November 12, 1901.

Application filed February 1, 1901. Serial No. 45,560. (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 present invention relates to certain improvements in that type of electric railways in which the current main or feeder supplying the propelling energy 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 roadbed, 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-feed main and disconnecting it therefrom as the 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 apparatus absolutely certain of action, and, second, to provide a system in which safety in operation is assured. These 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 drawing, in which similar letters and figures of reference represent corresponding parts, the figure is a diagrammatic view of my improved system as applied to a single-line railway, together with the circuits and circuit connections of the apparatus carried by the car operating upon the tram-rails.

In the drawing, A represents the electrical generator. B is the current-feeder main leading therefrom. C is the return-main leading to said generator. D is one of the tram-rails over which the current passes from the driving-motor and thence to said return-main.

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′ I″ are the sectional trolley or work conductors, which when cut into the circuit convey current from the feed-main B to said car-driving motor.

2 and 3 are the armatures of a motor-generator. 4 and 5 are the field-magnets of said motor-generator.

At R is shown a brake mechanism. 51 is the hand device or rheostat for controlling said brake mechanism.

K represents an energy-reservoir, which may be a storage battery, as herein shown at K, or any other device adapted to receive and store energy from any suitable kind of a reversible-acting engine mechanism, as shown at 2 and 4, and thereafter return some of said energy to said engine mechanism for the purpose of temporarily operating the same.

M M′ M″ are electromagnetic pick-up or circuit-controlling 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 work conductor and the feed-main, then open the normally-closed circuit between said conductor and the return-main, and will force said circuits to assume their normal condition when said current ceases to flow. The pick-up devices which translate the magnetic energy into power are preferably solenoid-cores N N′ N″, which are mechanically connected to the bell-crank levers of primary switches O O′ O″ in such a manner that the said cores will move through quite a space before they act upon said bell-cranks to move the same. In other words, there is "lost motion" in the connection between said cores and said bell-cranks. Thereby the cores in starting have no weight (other than their own) to carry. Therefore they will have gained great momentum before being called upon to lift the said bell-crank levers to close the main circuit. P P′ P″ are secondary switches through which the aforesaid sectional conductors and said apparatus at M M′ M″ are normally connected to the earth or return-main.

At J are shown several automatic signal-lamps, which will glow whenever a car arrives at that particular section of the roadway.

The mode of operation of the system is as follows: Suppose a car is over the 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 feed-main B, conductors 6 and 7, switch O'', contacts V'', conductor 8, solenoid-coil 9, conductor 10, magnet-coil 11, conductor 12, work-conductor section I'', trolley G to controller H, where the current divides. A portion thereof passes over controller H, resistance 13, motor E, car-wheel F, tram-rail D, conductors W and X to return-main C. The other portion of said divided current flows over conductor 14 and the circuits of parts 3 and 5 of said motor-generator. Thence said current passes along conductor 15, shunting the driving-motor E, and then joins the motor-circuit at 16. In the meantime the normally open primary switch O'' is held closed by the energy of solenoid at M'', and the normally-closed or secondary switch P is held open by the energy of magnet 11. The current passing, as described, through parts 3 and 5 of said motor-generator causes that portion of the machine to act as a motor, and thereby drive the part or armature 2, which then acts as a transferrer of energy or generator and furnishes current which charges the storage apparatus or battery K. The storage-battery circuits are 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 controller H by insulation 25. Thence the current passes through battery K, thence to the upper brush of part 2 of the motor-generator. If switch 27 is closed, as shown, some of the current will pass through the lamps or other devices at L, causing their operation thereby. A circuit leads from switch 27 to the solenoid 50, thence to rheostat 51, thence along the return to battery K. The action of the solenoid holds the brake-shoe "off" or away from the car-wheel, while spring 52 tends to put the brake "on." The pressure of the brake-shoe against the car-wheel may be controlled by the operation of said rheostat 51. At 53 is shown a shunt which may be made so as to shunt more or less current around the series or upper coil of the solenoid. By this arrangement the magnets may be made quite small, even when large currents are used. In any event, when large currents are employed to operate the cars I prefer to wind the series coil (the upper coil shown) with a ribbon or sheet-metal conductor. As shown in the drawing, the trolley G has extended across the gap and made contact with sectional conductor I', thereby causing some current to shunt through said conductor, thence down over conductors 12 and 54, initially operating coil 55, conductor 56, secondary switch P', thence to the return-main. Said coil 55 being thus energized causes its core to be drawn up, thus closing the switch-contacts at V'. Such action causes current to flow from the feed-main in the manner previously described, and as such current passes through magnet-coil 11 said magnet will cause switch P' to open, thus cutting off the ground connection. The pick-up apparatus at M' shows parts as they appear just after the primary switch O' has closed and the instant before secondary switch P' has opened. The springs 57 press against the joints of the switches P P' P'', thus causing sufficient friction to hold said switches at any point where the switches may be left after mechanical or magnetic action has ceased to affect them. For instance, after trolley G has passed from work-conductor I'' all current is then cut off from the pick-up apparatus of that section. Then the solenoid-core of that section will cease to hold primary switch O'' closed and magnet 11 will not influence secondary switch P'', but spring 57 will cause said switch to maintain its position until the weight of said solenoid presses upon the lever of switch O'' (and thereby opening the contacts at V'') until said lever makes contact with switch P'', and thus causing said switch to close. Then said apparatus will be in the position shown at M. At 58 I have shown lamps in circuit across the brushes of part 3. The contact 59 may be made any suitable length, so as to keep that circuit closed as long as desired. In starting from rest when all of the track-circuits are dead controller H is moved so as to close the contacts at 23 Thus the motor-generator starts up, because then parts 2 and 4 receive energy from battery K. Current is then generated in part 3. The said current would flow as follows: Starting from the upper brush of part 3, the current passes over 14, 59, H, G, I'', 12, 54, 55, 56, P'', 60, W, D, F, 15 to the lower brush of part 3. (At this time lever H has not been moved far enough to cut resistance 13 into the circuit.) This movement of the current causes the initial action of the pick-up apparatus.

Having now described one way of arranging my apparatus, while not limiting the invention to the apparatus shown and described, I claim as new—

1. In an electric railway, the combination with the feeder, of a single series of normally dead work-conductor sections, an electromagnetic primary switch for each work-conductor section, a connection from each of said sections to ground or return-main and including an initially-energizing coil for actuating said primary switch and a secondary switch for controlling said ground or return connection, and a connection from each work-conductor section to the feeder and including a coil for holding the primary switch closed and a coil which initially actuates the sec-

ondary switch, each of said switches being magnetically actuated by one magnet only.

2. In an electric railway, the combination with the feeder, of a single series of normally dead work-conductor sections, an electromagnetic primary switch for each of said sectional conductors, a connection from each of said sections to the ground or return-main and including an initially-energizing coil for actuating said primary switch and a secondary switch for controlling said ground or return connection, a connection from each work-conductor section to the feeder and including a coil for holding the primary switch closed and a coil which initially actuates the secondary switch, and a circuit which is adapted to convey a portion of the main current in shunt from the primary switch to the section work-conductor.

3. In an electric railway, the combination of a single set of normally dead work-conductor sections arranged in a single line, one of said sections being adapted to take current constantly from the feed-main and deliver a large portion of the same to the car motor or motors as the car moves along, while the remaining small portion of said current is shunted through a ground or return connection to bring into action a second section, a primary switch for each of said sections for controlling the flow of current thereto, an initially-acting or primary coil for each primary switch (normally energized by said shunted current) in a connection between the said conductor-section and the ground or return and in shunt to the said motor, a secondary coil in series connection with said motor for maintaining the action of said primary switch, an electromagnetic secondary switch included in circuit with said primary actuating-coil and controlling the ground or return connection thereof, and a secondary magnet which actuates said secondary switch only, the latter magnet being in series with said secondary coil and with said motor, each of said switches being magnetically actuated by one magnet only and each magnet being adapted to actuate one switch only.

4. In an electric railway, the combination with the feeder, of a single series of normally dead work-conductor sections, an electromagnetic primary switch for each work-conductor section, a connection from each of said sections to ground or return and including an initially-energizing coil for actuating said primary switch and an electromagnetic secondary switch for controlling said ground or return connection, a connection from each work-conductor section to the feeder and including a coil for holding the primary switch temporarily closed and a coil which initially actuates the secondary switch, and means (independent of said magnets) for holding said secondary switch temporarily open, each of said switches being magnetically actuated in one direction and mechanically actuated in the reverse direction, and each magnet actuates one switch only.

5. In an electric-railway system, substantially as described, the combination with the single line of work-conductor sections, and the two switches for each section, the first of said switches being normally open and adapted to control the flow of current to one of said conductor-sections, the second switch being normally closed and adapted to control the normal connection between the said conductor-section and the ground or return, each of said switches being magnetically affected by one magnet only, the said magnets being normally energized by the power-current, of a motor-generator carried by the car, one side of said motor-generator being in constant electrical communication with the wheels of said car and with the current-collector or trolley, the other side of said motor-generator being in constant communication with a power-storage device carried by the car, and means for bringing said motor-generator into action to temporarily operate said primary switch.

6. In an electric railway, the combination with the feeder, of a single series of normally dead conductor-sections, each adapted to convey current to the car-motor, an electromagnetic primary switch for each of said conductor-sections, a connection from each of said sections to ground or return and including an initially-energizing coil for actuating said primary switch and an electromagnetic secondary switch for controlling said ground or return connection, a connection from each conductor-section to the feeder and including a coil for holding closed the primary switch only, and a coil which initially actuates and holds open the secondary switch only, the said hold-up coils being in series with each other, and means whereby when the current is cut off from said coils the secondary switch will be caused to maintain its position until it is mechanically closed by the primary switch, substantially as set forth.

7. The combination with a motor-car, of sectional working conductors arranged in a single series along the line of way, collectors carried by the car and adapted to engage with said conductors, electromagnetic devices between the work-conductors and the feed-main, each of said devices being adapted to be normally operated by the current shunted through the collectors from a preceding sectional conductor, a motor-generator (carried by the car), for actuating said magnetic devices when the current is cut off from the car-motor, one side of said motor-generator being normally in circuit with one or more of said devices and adapted to act, at times, as a generator, and, at other times, as a motor, while the other side of said motor-generator is normally in communication with an auxiliary source of power carried by the car.

8. In an electric-railway system of the char-

acter described, the combination with the feeder and the sectional work-conductors, of electromagnetic devices for connecting the work-conductor sections to the feeder in sequence, a traveling car drawing power-current from said feeder and carrying a car-driving motor, a motor-generator, a storage device, a brake device, a controller for the car-motor and a controller for said brake device, one of the active parts of said motor-generator being in communication with the said storage device and with said brake device, while the other active part of said motor-generator is electrically connected to the car-motor and to the controller therefor and communicates with said feeder, whereby energy is transferred from said feeder to said storage device and to said brake device for the purpose set forth.

9. In an electric railway, the combination with the feeder of a sectional conductor, a connection between each conductor-section and the feeder, an electromagnetic switch for each such connection, and a shunt-circuit connected through a resistance between the primary switch and the sectional conductor.

10. In an electric railway, the combination with the feeder of a sectional conductor, a connection between each conductor and the feeder, a normally open primary switch for each such connection, a connection between each conductor-section and the ground, an initially-acting coil in said ground connection for closing said primary switch, a secondary switch in said ground connection, a coil in said feeder connection for holding the primary switch closed and a second coil in said feeder connection which initially actuates and holds the secondary switch open after the primary switch is closed.

11. In an electric-railway system, the combination with the feeder of work-conductor sections, normally open primary switches for connecting said conductor-sections with the feeder, primary coils connected between the said sections and the ground or return and in shunt to the car-motor for initially actuating said primary switches, secondary coils connected between said work-conductor sections and the feeder and in series with the car-motor for holding said primary switches closed, normally closed secondary switches in the circuits of the primary coils and which are actuated as soon as the primary switches are closed, coils in series with said secondary coils and with said car-motor for initially actuating said secondary switches, and gravity devices controlled by the said primary and secondary coils and loosely connected to said primary switches whereby these switches are started by said gravity devices after said devices have attained their motion, substantially as and for the purpose set forth.

Signed at New York, in the county of New York and State of New York, this 31st day of December, A. D. 1900.

LYATES WOODS.

Witnesses:

PETER JONES,

KATE MARTIN.