(No Model.)

# R. M. HUNTER.

## ELECTRIC RAILWAY.

No. 414,050. Patented Oct. 29, 1889

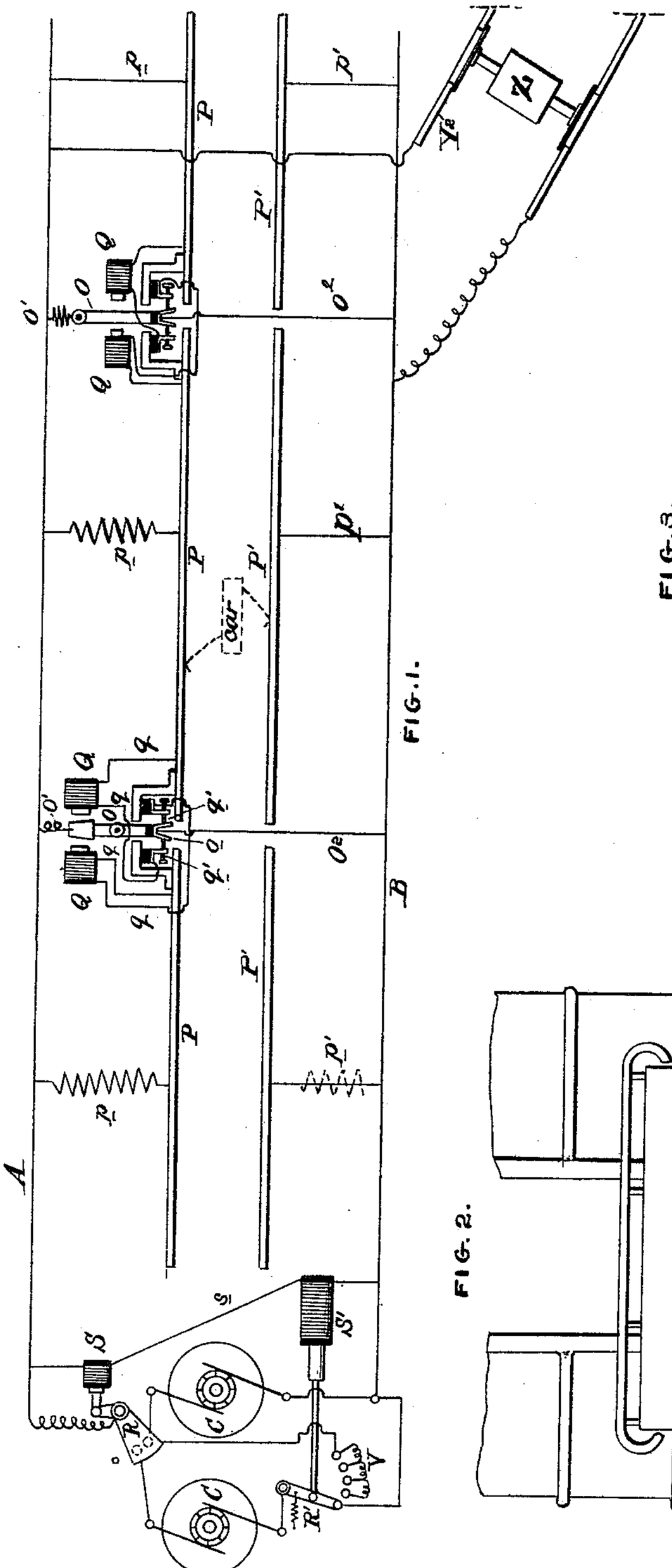


FIG. 1.

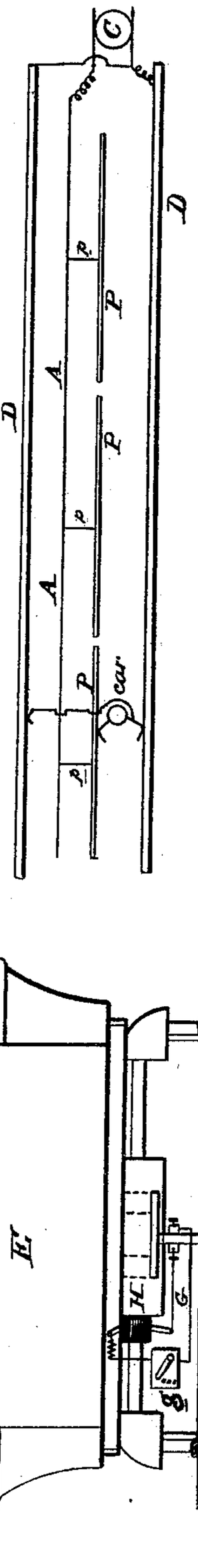


FIG. 3.

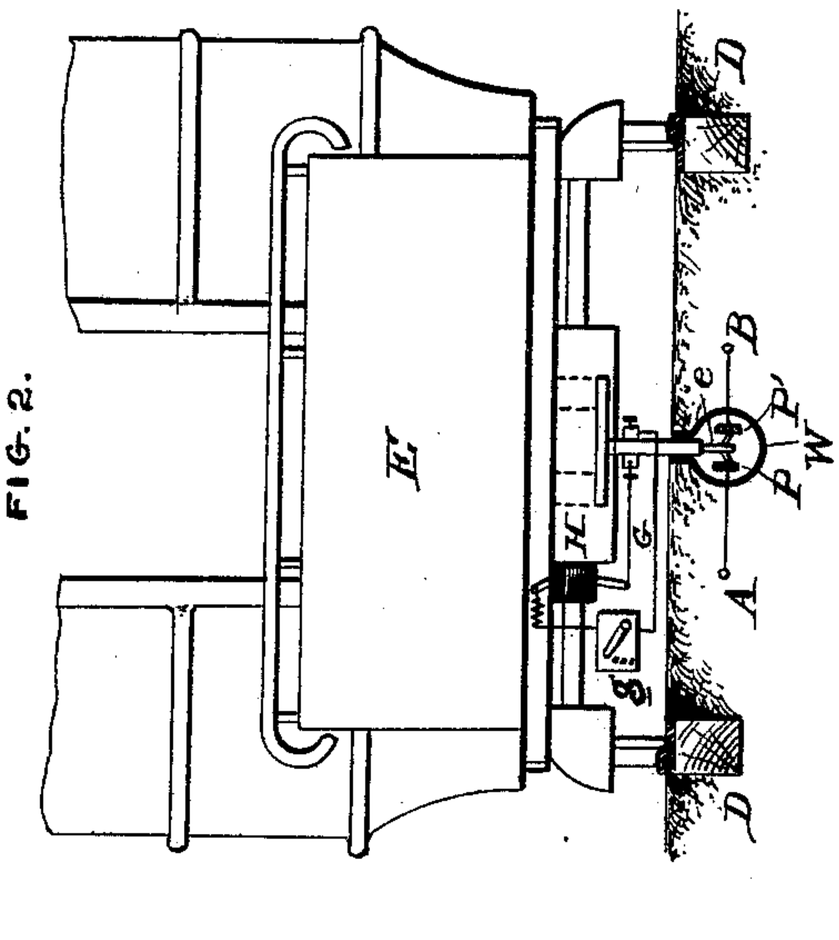


FIG. 2.

WITNESSES:
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# UNITED STATES PATENT OFFICE.

RUDOLPH M. HUNTER, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE THOMSON-HOUSTON ELECTRIC COMPANY, OF BOSTON, MASSACHUSETTS.

## ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 414,050, dated October 29, 1889.

Original application filed March 18, 1886, Serial No. 195,742. Divided and another application filed February 20, 1889, Serial No. 300,585. Again divided and this application filed April 8, 1889. Serial No. 306,398. (No model.)

*To all whom it may concern:*

Be it known that I, RUDOLPH M. HUNTER, of the city and county of Philadelphia, and State of Pennsylvania, have invented an Improvement in Electric Railways, of which the following is a specification.

My invention has reference to electric railways; and it consists of certain improvements which are fully set forth in the following specification and shown in the accompanying drawings, which form a part thereof.

This application (Case 95) is a division of my application, No. 300,585, of February 20, 1889, which is a division of my application, No. 195,742, of March 18, 1886.

My object is to provide one or more main or supply conductors receiving current from one or more generators combined with one or more sectional working-conductors and electro-magnetic connecting devices controlled by the passage of the motors or cars over said working-conductors or in contact therewith, for controlling the current in each section of the working-conductors.

My object is also to cause the supply of current to be transmitted over conductors which do not bear the heavy work to which the working-conductors are subjected; and, furthermore, my object is to have such supply-conductors suitably supported and, if desired, insulated, whereas the working-conductors are exposed or bare. The working-conductors are normally connected with the supply-conductors by branch conductors; but the current-supply is preferably controlled by the passage of the car, so as to give an increased current-supply as required.

My object is also to provide a railway system with two supply-conductors and sectional working-conductors when arranged with two branch conductors for each section and an electro-magnetic switch for each section affected by the current in both of said branch conductors.

My object is further to provide an electric-railway system with two or more generators of electricity combined with suitable line-conductors and switches, electrically automatic or otherwise, whereby the current in the line may be changed in intensity or quantity to compensate for leakage or change of duty.

In the drawings, Figure 1 is a diagrammatic plan view of an electric-railway system embodying my improvements. Fig. 2 is a cross-sectional elevation of a railway, showing the road-bed structure and car; and Fig. 3 is a modification of the circuits.

D are the track-rails.

W is the slotted conduit, and contains the working-conductors P P′, suitably insulated. The conductors P P′, or either of them, may be the rails or suspended conductors.

E is the car or vehicle. H is the electric motor to propel the same.

G is the motor-circuit, and has the regulator *g* therein.

*e* is the current-collector, which is carried by the car and extends through the slot of the conduit, making a sliding connection with the conductors P P′.

C and C′ are two generators to supply electricity to the line, and may be coupled up in multiple or series.

R and R′ are switches, which, when moved, change the connection of the generators from multiple to series, or vice versa.

S is a magnet to operate the switch R, and is contained in a shunt *s* connecting the positive and negative conductors A B. S is a helix, also in said shunt, and having its core connected by the switch R′.

V are a series of resistances, over which the switch-lever R′ is moved, so that in changing the connection of the generators from multiple to series the strength of the current of the second dynamo is only gradually increased to suit the demand. These switches R R′ might be moved by hand. The multiple connection will suffice unless the atmospheric condition is such that it interferes with the contacts on the various parts, motors, circuits, &c.; or, if the line-resistance becomes too great, it often necessitates that an increased electro-motive force is required to keep the road in working condition; also, in the case of one or more short branch roads Y suddenly thrown into working connection by

one or more motors Z thereon being put into action, the resistance is reduced, but the demand for current in the system is increased. The magnets S S′ would automatically couple up the generators for quantity or intensity and adjust the resistance, to fulfill the requirements. It is evident that there may be more than two generators with similar coupling devices. The switches may be operated by hand, if desired.

Referring to the circuits shown in Fig. 1, P and P′ are a series of working-conductors arranged along the railway in any suitable manner, and made in sections, and connected to the main conductors A B by connecting branches *p*, which connect the line A with sections P, and *p′*, which connect the line B with sections P′, of the working-conductors. If desired, *p* and *p′*, or either of them, may be made to increase in resistance as they approach the generator. Arranged at the adjacent terminals of two sections of working-conductors are electric switches consisting of a pivoted armature O, connected by conductor O′ (having a resistance, if desired) to the line-conductor A. This armature is normally held out of contact with either section P by springs *o* or weights, and is adapted to be operated by two electro-magnets Q, attracting it in opposite directions. These magnets are respectively in branch circuits electrically connecting the working-conductors P P′ of a section of the conductors. Normally a current is passing over the magnets Q, and one counterbalances the other; but just at soon as the motor runs on one of the sections the magnet Q of that section loses part of its power, and the other magnet shifts the switch-armature and closes the shunt-circuit O′ from line A to the section P, on which the motor is, and forms a free path for the current. The shifting of the armature also breaks the branch *q* of the section on which the motor is, so as to render its magnet inoperative until the motor leaves this section. The breaking of these branches *q* is accomplished by the springs *o* on the armature-lever O. By this it is seen that normally the armature is out of contact with either conductor-section P and the magnets are in circuit; but as soon as the power of either magnet Q is reduced the switch-armature O shifts, breaking the branch *q* of the magnet corresponding to the section on which the motor is and closing the conductor O with the said section, supplying full current to the motor. The instant the motor passes to the next section the switch-armature O oscillates in the opposite direction, first righting itself by its springs *o*, and then moving by the attraction of the opposite magnet Q. One of these electro-magnetic connections may be provided to each section or to every alternate section, as one lever O acts for two sections. The magnets Q may attract the armature, which may be made of soft iron, or a polarized armature may be used, both constructions being shown in Fig. 1. The same action results with the motors running in either direction.

By making the line-conductors separate from the working-conductors they may be thoroughly protected, and, not having the severe usage of the working-conductors, there will be less liability to leakage. When a section of working-conductor needs repairing, it may be removed without disturbing the main or line conductors, or the line-conductors may be changed or tapped for auxiliary uses, as a branch road, without interfering with the working-conductors, and these additions or changes may be made while the electric railway is in operation.

The line-conductors may be bare or insulated wires, and may be hung on poles, buried in the ground, or placed in the conduit.

It is evident that one working-conductor independent of the rails alone may be used, as the rails may form the return-circuit, as shown in Fig. 3, in which similar letters of reference correspond to similar parts of Fig. 1.

I do not limit myself to mere details of construction, as they may be modified in various ways without departing from my invention.

Any matters shown but not claimed are not dedicated to the public, but form subject-matter of my application of which this is a division, and also my applications No. 171,625, of 1885, No. 192,187, of 1886, No. 205,770, of 1886, No. 214,309, of 1886, No. 215,199, of 1886, and No. 215,200, of 1886.

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

1. In an electric railway, the combination of the main or traffic rails, a slotted conduit, one or more longitudinal working-conductors arranged along the railway within the conduit and divided into sections, one or more continuous main or supply conductors normally connected with each of said sections of working-conductors, a source of electric supply connecting with the main conductor, and a motor mounted upon a car traveling upon said traffic-rails and provided with suitable current-collecting devices extending into the conduit and bearing upon said longitudinal working conductor or conductors.

2. In an electric railway, the combination of the main or traffic rails, a slotted conduit, a longitudinal working-conductor arranged parallel to but independent of the traffic-rails and located within the conduit, a supply or main conductor also extending longitudinally along the railway, electrical connections between the main and working conductors and independent of the traffic-rails, and an electric motor mounted on a car traveling upon the traffic-rails and provided with suitable current-collecting devices extending into the conduit and bearing against the longitudinal working-conductor.

3. In an electric railway, the combination of the main or traffic rails, a longitudinal sectional working-conductor arranged paral-

lel to but independent of the traffic-rails, a supply or main conductor also extending longitudinally along the railway, electrical connections between the main conductor and each section of working-conductor and independent of the traffic-rails, switches for connecting either of two adjacent sections of working-conductor with the supply-conductor, and an electric motor mounted on a car traveling upon the traffic-rails and provided with suitable current-collecting devices bearing against the longitudinal working-conductor sections.

4. In an electric railway, the combination of electric conductors extending along the line of the railway, traveling electrically-propelled vehicles receiving current from said conductors, two or more stationary electric generators for supplying electric current to the electric conductors, and switches and circuits for coupling said generators in series or multiple with respect to each other, and at all times maintain them in series with the electric conductors extending along the railway and electrically-propelled vehicles receiving current therefrom.

5. In an electric railway, the line-conductors in combination with two or more stationary electric generators, and switches for coupling said generators up in multiple or in series with each other and with line-conductors, and resistances controlled by said switches and adapted to be thrown into circuit when said generators are coupled in series.

6. In an electric railway, the line-conductors in combination with two or more stationary electric generators, and switches for coupling said generators up in multiple or in series with each other and with the line-conductors, and resistances controlled by said switches and adapted to be thrown into circuit when said generators are coupled in series, and means to vary the amount of said resistances, substantially as and for the purpose specified.

7. In an electric railway, the line-conductors in combination with two or more stationary electric generators, and electrically-actuated switches controlling the variations in the line-current for coupling said generators up in multiple or in series with each other and with the line-conductors upon the line-current becoming unsuited to the variations in resistance put upon the line, substantially as and for the purpose specified.

8. In an electric railway, the line-conductors in combination with two or more electric generators, switches for coupling said generators up in multiple or series, resistances thrown in or out of circuit by said switches, and electrical devices to actuate said switches controlled by the varying resistances on the line, substantially as and for the purpose specified.

9. In an electric-railway system, the combination of continuous main conductors and working-conductors normally connected with said main conductors, from which working-conductors the current is taken by the motors, a pair of electro-magnets respectively in electrical circuit with the working-conductors of two adjacent sections, and the return or opposite main conductor, and an armature adapted to be actuated by said magnets to close a second electric connection with the main conductor and its adjacent section to supply an increased current to the working-conductors when in circuit with a passing motor, substantially as and for the purpose specified.

10. In an electric-railway system, the combination of continuous main conductors and working-conductors normally connected with said main conductors, from which working-conductors the current is taken by the motors, a pair of electro-magnets respectively in electrical circuit with the working-conductors of two adjacent sections, and the return or opposite main conductor, and an armature adapted to be actuated by said magnets to break the circuit of one magnet and also close a second electric connection with the main conductor and its adjacent section to supply an increased current to the working-conductors when in circuit with a passing motor, substantially as and for the purpose specified.

11. The combination of the line-conductors A B, working-conductors P P′, electro-magnets Q Q, armature O for closing an auxiliary circuit from conductor A to working-conductor P, branch circuits $q$, containing said electro-magnets Q Q, wire O′, and circuit-breakers $q'$ $o$, to control the circuits $q$ O′, substantially as and for the purpose specified.

12. In an electric railway, the line or main conductors in combination with a sectional conductor, a branch connecting one main conductor with one section of the working-conductor, a second branch connecting the section with the other main conductor and containing an electro-magnet, and an auxiliary circuit-closer actuated by said electro-magnet to supply a stronger current to the section when the motor is upon it, substantially as and for the purpose specified.

13. In an electric railway, the combination of an electrically-propelled vehicle, a sectional working-conductor, a continuous line-conductor, interposed resistances between the line and working conductor sections, and automatic devices controlled by a vehicle making contact with a section of working-conductor to reduce the resistance between the line and working conductor section.

14. In an electric railway, the combination of an electrically-propelled vehicle, a sectional working-conductor, a continuous line-conductor, interposed resistances between the line and working conductor sections, said resistances increasing as they are nearer to the generator to make the current passing over them equal, and automatic devices controlled by a vehicle making contact with a section of working-conductor to reduce the

resistance between the line and working conductor section.

15. In an electric railway, a main conductor and a sectional working-conductor, in combination with permanent electrical connections between main-conductor and working-conductor sections, additional circuits between the main-conductor and working-conductor sections, and switches in said additional circuits.

16. In an electrical railway, a main conductor connecting with a source of electric supply, and a sectional working-conductor, in combination with permanent electrical connections between the main-conductor and working-conductor sections, having increasing resistances as they approach the source of electric supply, additional circuits between the main-conductor and working-conductor sections, and switches in said additional circuits.

17. In an electric railway, a main conductor and a sectional working-conductor, in combination with permanent electrical connections between the main-conductor and working-conductor sections, additional circuits between the main-conductor and working-conductor sections, and electro-magnetic switches in said additional circuits.

18. The combination of two main conductors with two lines of sectional working-conductors, electrical connections between said main-line conductors, respectively, with one of said lines of sectional working-conductors, a circuit-controlling switch in said connecting-circuits with one of said line of working-conductors, an electro-magnet to operate said switch, and a circuit connecting said main conductors and including the electro-magnet.

19. The combination of a main or supply conductor, a sectional working-conductor therefor, a return-circuit, a source of electric supply connecting with the main conductor and return-circuit, an electrically-propelled vehicle receiving current from the working-conductor and return-circuit, connecting-circuits between the main conductor and sections of working-conductor, and electro-magnetic switches in parallel connection with the motors on the electrically-propelled vehicles for controlling the current to the sectional working-conductor.

20. The combination of positive and negative conductor arranged along a railway, electrically-actuated cars therefor receiving current from said conductors, a supply-conductor, and electro-magnetic devices in parallel with the motor on the car and controlled by the passage of the car to connect the positive conductor with the supply-conductor to increase the current passing to the car.

21. In an electric railway, the combination of electric conductors extending along the line of the railway, traveling electrically-propelled vehicles receiving current from said conductors, two or more stationary electric generators for supplying electric current to the electric conductors, switches and circuits for coupling said generators in series or multiple with respect to each other and at all times maintain them in series with the electric conductors extending along the railway, and the electrically-propelled vehicles receiving current therefrom, and resistances located close to the generators and adapted to be thrown into and out of circuit to compensate for variation in the current passing to the conductors of the railway.

In testimony of which invention I hereunto set my hand.

RUDOLPH M. HUNTER.

Witnesses:
ERNEST HOWARD HUNTER,
E. M. BRECKINREED.