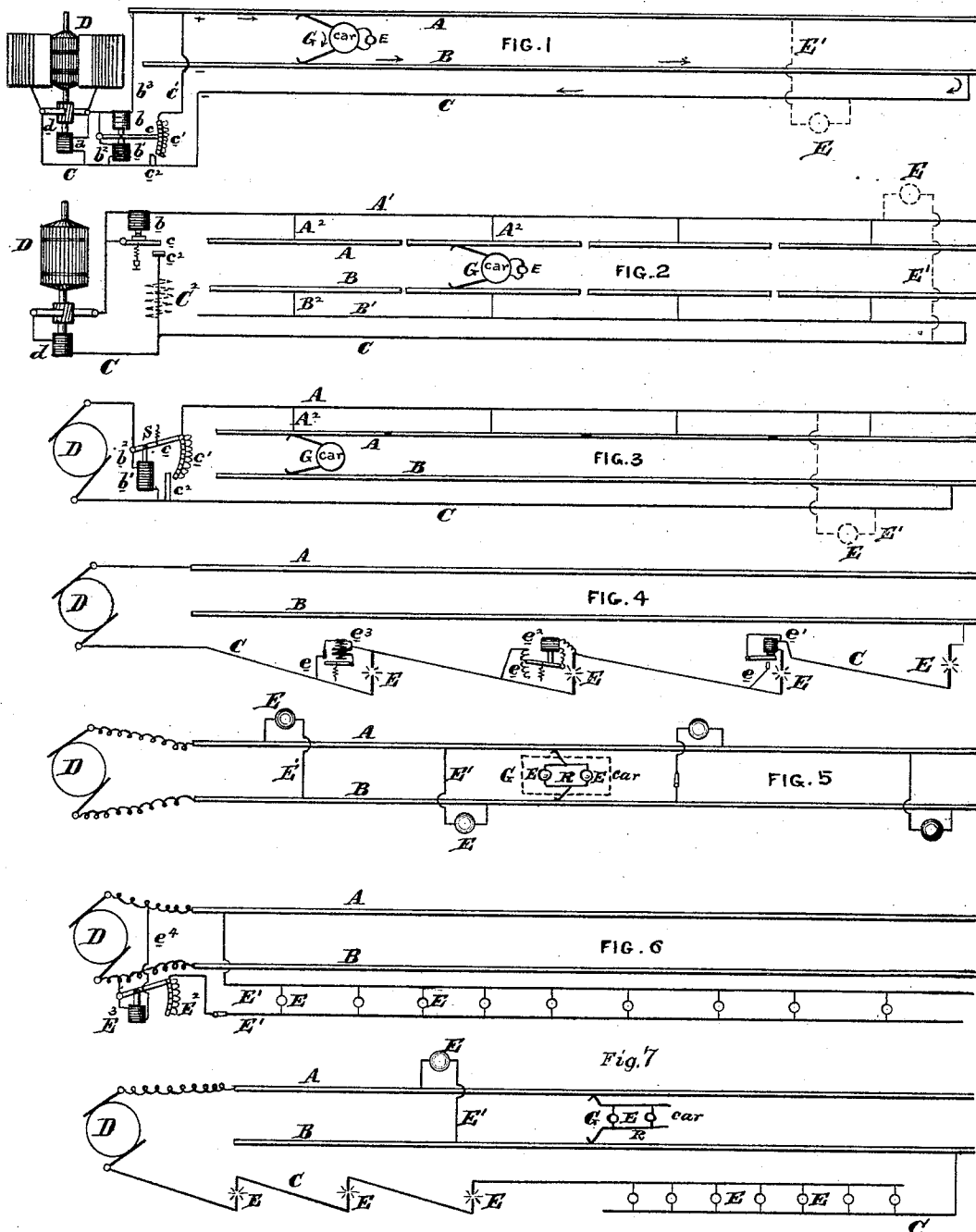


R. M. HUNTER.
ELECTRIC RAILWAY SYSTEM.

No. 523,313.

Patented July 17, 1894.



WITNESSES:

Henry Denny,
David S. Williams

INVENTOR:

R. M. Hunter

(No Model.)

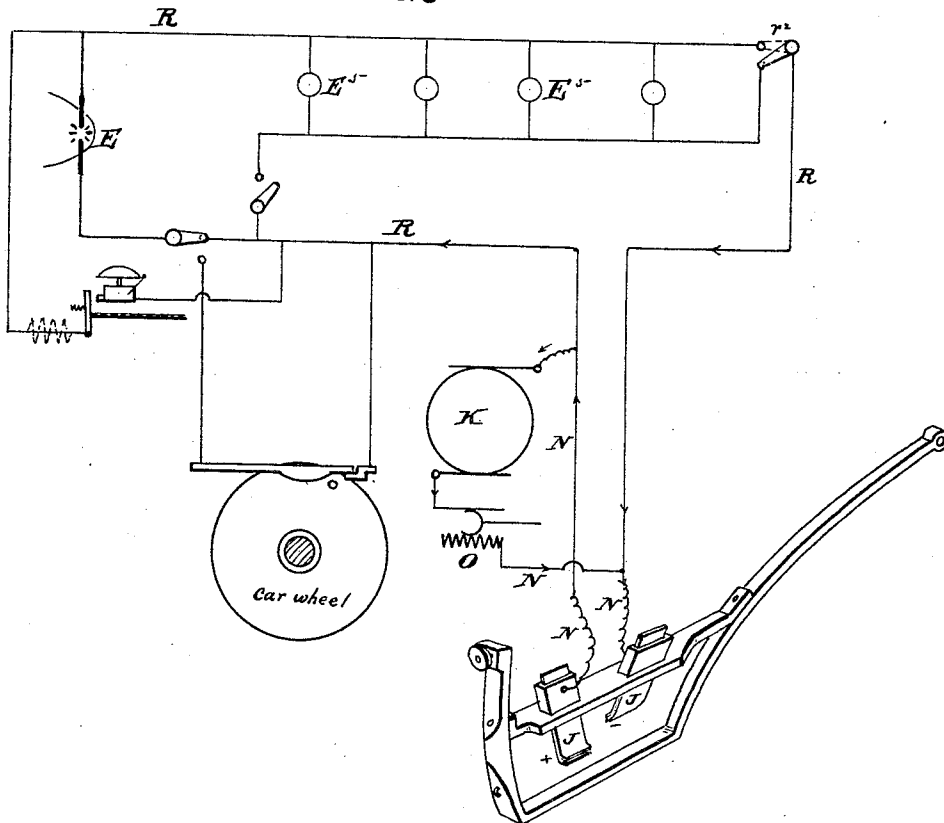
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FIG. 8



WITNESSES

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

ELECTRIC-RAILWAY SYSTEM.

SPECIFICATION forming part of Letters Patent No. 523,313, dated July 17, 1894.

Original application filed April 23, 1886, Serial No. 200,400. Divided and this application filed March 14, 1889. Serial No. 303,197. (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, (Case No. 87,) of which the following is a specification.

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

This application, Case No. 87, is a division of my application, Serial No. 200,400, filed April 23, 1886.

My invention contemplates certain improvements in combined railway and lighting circuits and in which the conductors or circuits of an electric railway are combined with electric lights, either arc or incandescent, arranged in series or multiple arc or both, in the working conductors or in the return circuit. These lights may also have a special regulator or cut out device to insure or preserve the continuity of the working current for the motors. When a large number of lights are arranged in a circuit derived from the motor circuit, a separate regulator to vary the resistance in the derived circuit may be used, whereby the number of lamps in circuit may be varied without changing the electrical condition of the main or working conductors or circuits. The lamps may receive current from the supply or main conductors, or the working conductors when such working conductors receive current from separate supply conductors, and such lamps would be in multiple arc connection or in parallel and might be on the cars when receiving their current from the working conductors. In this latter case the lights on the various cars would be arranged in parallel relatively to each other, and would while maintaining that connection shift their position on the railway.

My invention also contemplates providing an electric railway circuit with a short circuiting device controlled by the current in the working conductors whereby when all of the cars have run off the line the generator is short circuited cutting out the line by the closing of an automatic switch. This shunt or short circuit may have a resistance equal to the working conductors so as not to reduce the external resistance too much. If desired

this circuit closer may be arranged at the distant end of the working conductors or so as to make the current pass through the greatest normal working circuit. This circuit closer resets itself the moment a car is run upon the line. Also providing an electric railway such as herein set forth with a resistance changer adapted to be automatically actuated in accordance with the variations in the resistance of the line due to running cars on and off the line circuit. This resistance changer may be operated by an electro magnet in a shunt circuit across the poles of the generator or it may be operated by a magnet in a shunt around the resistance in one conductor, or it may be operated on a differential principle by both of said magnets each of which acts upon the same switch lever. Also providing an electric railway with a generator having brushes and commutator electrically movable with reference to each other such as set forth in Letters Patent No. 347,937, granted August 24, 1886, on my application serially numbered 171,625 and filed July 14, 1885, whereby the generation of current is in accordance with the requirements. The commutator is made with oblique contact pieces and is moved under the brushes or the brushes moved over the commutator by a helix or otherwise directly or indirectly, said helix being either in direct or shunt circuit.

The foregoing are the general features of my invention and may be better understood by a detailed description with reference to the accompanying drawings, in which—

Figures 1, 2, and 3 are diagrams showing the combination of the regulating devices for the electric railway conductors. Figs. 4, 5, 6 and 7 are similar views showing the arrangement of the electric light circuits combined with the railway circuits. Fig. 8 is a diagram showing the circuits on the car.

A and B are the two working conductors and may be made continuous or in sections. If continuous they may have the same ends connected to the poles of the generator as in Fig. 5, or opposite ends as shown in Fig. 1, this latter construction being the most preferable, as then the line resistance to the motors is the same for all positions on the line, and is equally divided between all motors on the line irrespective of their number. This is shown in my Patent No. 381,555 of 1888.

In place of connecting the working conductors directly with the generator they may be made in sections and connected by branch wires $A^2 B^2$ with conductors $A' B'$, and these conductors may be connected at opposite ends with the generator to insure equality of resistance in the working circuit as shown in Fig. 2. Or these two arrangements may be combined as shown in Fig. 3 in which one working conductor is continuous and the other sectional. When connected at opposite ends a return conductor C is used which may be buried or suspended on poles and preferably insulated.

The quantity of current generated to suit great differences in the number of motors on the line, is regulated directly at the generator D by an electro magnet d either in shunt a or direct line circuit which shifts the relative positions of the brushes and commutator of the generator substantially as shown in Figs. 1, and 2 and set out in Letters Patent No. 343,937, granted to me August 24, 1886. To regulate the line current to suit small variations in the number of motors or other electrical variations which it is not desirable to depend upon the motors to control, I provide a variable resistance c' in circuit C' which may be part of the line, and by means of a contact lever c more or less resistance may be inserted or removed to vary the current in the line. This lever c may be operated by a helix b' in a shunt circuit b^2 around the generator as shown in Fig. 3, or by such a helix combined with another b opposing it and arranged in a shunt or derived circuit b^3 in the line as shown in Fig. 1. In the construction shown in Fig. 1 the helix b is of low resistance compared with b' , as at times much of the entire line current passes through it and resistance c' . The magnet b' must be of high resistance to prevent the line current being shunted or short circuited. It will be noticed here that when helix b is used there are two paths open for the outgoing current and either one may be considered the line. In this case the helices $b b'$ work on a differential principle, the helix b taking the place of the spring S shown in Fig. 3.

When all of the cars run off the circuit the line is then open and the helix b being untraversed by a current, the armature or lever c either falls or is drawn down by helix b' (if used) and short circuits the generator by contact c^2 , and if desired through a resistance C^2 equal say at least to one motor or to the resistance of the working conductors and their connection. By this means the generator may be constantly run without danger to itself or to the helices $d b'$ and is always ready to throw the proper current on the line automatically upon a motor being put upon circuit. Fig. 2 shows the extra resistance C^2 clearly, and the resistance c and magnet b' has been left off to more clearly illustrate the principle of the cut out.

Figs. 2 and 3 when combined make the

regulator shown in Fig. 1 with the omission of the resistance C^2 . Each of these parts therefore work to produce their own distinct function and at the same time, one is dependent upon the other in keeping the electric railway as an entirety under perfect regulation, and its working is in a great measure dependent upon the working of the others.

E are electric lamps, either arc or incandescent lights and receive their current from the electric railway line circuit and may be coupled with said circuit either in series as shown in Fig. 4 or in multiple arcs as in Fig. 5. When in series the lamps E may be arranged in the return circuit C , and arc and incandescent lights may be combined as shown in Fig. 7. If the arc lights are arranged in the railway circuit as in Fig. 4 then it would be necessary to provide a shunt circuit e around the lamp and a regulator to control the shunt, that too great a resistance shall not be interposed in the line circuit. To do this a simple cut out magnet e' may be arranged in the line circuit and adapted to allow its armature to fall if the arc should offer too great a resistance. In place of this, an electro magnet e^2 may be used in the shunt to vary the resistance around the arc to compensate for variations in same; or a simple Brush cut out regulator e^3 may be used in which a high resistance helix is always in the shunt, and a low resistance helix is put into circuit to cut off the lamp if the arc is too great as set out in his patent of November 16, 1880. These different constructions are shown in Fig. 4. When the lamps are arranged in multiple arc they are placed in shunts E' connecting the positive and negative railway conductors, either the working or supply conductors. In Fig. 6 the incandescent lamps are shown in one of these shunts E' , and a variable resistance E^2 is also placed in the shunt to vary the resistance proportionally to the abnormal increase in the line current to protect said lamps. This resistance is put in or out by a lever and electro magnet E^3 arranged in a shunt e^4 across from the terminals of the working conductors or their supply conductors as shown in Fig. 6.

I do not limit myself to any particular arrangement of lamps or their circuits provided they are combined with an electric railway adapted to light the roadway and stations and receive their current from the railway by series, derived, or shunt circuits.

G represents a car which receives current from the working conductors. This car is propelled by an electric motor K receiving current from the conductors $A B$, and its speed is controlled by a resistance hand regulator O in the motor circuit N . $E' E^5$ are electric lamps carried thereby and in shunt relation with the motor and contained in the lamp circuit R . These lamps are in a circuit R and receive current from the supply or line conductors through the working conductors, or the working conductors alone when

supply conductors are not used, and are in multiple or parallel connection with the motors and other lamps in stationary position along the railway.

5 The several cars are independently controlled and lighted.

The resistance changer or regulator O may be operated by hand, and by increasing the resistance the motor may be slowed down.

10 It is evident that so far as my invention is concerned the conductors for supplying current to the electrically propelled cars may be the rails, separate conductors on the surface, in a conduit, or suspended, or may be partly
15 the rails and partly separate conductors as for instance when using an overhead conductor as the outgoing and the rails as the return circuit.

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

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

25 1. In an electric railway the combination of a generator and working conductors, with one or more electric lamps arranged in one or more branch circuits in shunt connection with the line circuits, and one or more electric lamps arranged in series with the line
30 circuits or working conductors.

2. In an electric railway the combination of a generator, and working conductors, with one or more electric lamps arranged in one
35 or more branch circuits in shunt connection with the line circuits, one or more electric lamps arranged in series, and a number of lamps arranged in multiple are with the line circuits or working conductors.

40 3. In an electric railway the combination of the generator and working conductors connecting therewith for supplying the electromotors, with a branch circuit, electric lamps arranged in said branch circuit, and a resistance changer to vary the resistance in said
45 branch circuit.

4. In an electric railway the combination of the generator and working conductors connecting therewith for supplying the electromotors, with a branch circuit, electric lamps
50 arranged in said branch circuit, and an automatic resistance changer to vary the resistance in said branch circuit.

55 5. In an electric railway the combination of the generator and working conductors connecting therewith for supplying the electromotors, with a branch circuit, electric lamps arranged in said branch circuit, and an electrically controlled resistance changer controlled
60 by the change in resistance of the motor line circuit to vary the resistance in said branch circuit and keep the current constant with the varying number of motors in circuit with the line or working conductors and other electrical disturbances therein.

65 6. The combination of generator D, motor line circuits or working conductors A B, a

branch circuit E', electric lamps E and a resistance changer E² therein, a shunt circuit e⁴ around the generator, and a helix E³ included
70 therein and adapted to actuate the resistance changer.

7. In an electric railway, the combination of a generator, working conductors and connecting circuits constituting the railway circuits,
75 with electric lamps interposed in said railway circuits and receiving electricity from the same source as the motors, and electrically actuated cut out devices to cut out one or more of said lamps without interrupting the railway
80 circuit if they should offer an abnormal resistance to insure the continuity of the electric railway circuit.

8. In an electric railway the combination of a generator, working conductors and necessary connecting circuits constituting the railway circuits, with electric lamps interposed in
85 said railway circuits and adapted to receive electricity from the same source as the motors, and electrically actuated devices forming shunts around said lamps and adapted to
90 decrease the resistance in the shunts proportionally as the resistance in the lamps increases, to insure a uniform resistance in the motor circuit of the electric railway.

9. In an electric railway the combination of a generator, working conductors and necessary connecting circuits constituting the railway circuits, with electric lamps interposed in
100 said railway circuits and adapted to receive electricity from the same source as the motors, and electrically actuated devices forming shunts around said lamps and adapted to
105 decrease the resistance in the shunt proportionally as the resistance in the lamps increases to insure a uniform resistance in the line circuit of the electric railway, and automatic cut out devices to cut out one or more
110 of the said lamps if they should go out or offer an abnormally great resistance, to preserve the continuity of the motor circuit of the electric railway.

10. The combination of a railway, working conductors extending along the same, a source of electric energy, a supply conductor extending
115 from the source of energy and connected at intervals with one of the working conductors, traveling electrically propelled cars receiving current from said working conductors, and a regulator to vary the current flowing
120 to the conductors through the supply conductors in accordance with the demand.

11. The combination of a railway, working conductors extending along said railway, an electric generator, traveling electrically propelled cars receiving current from said conductors and an electric regulator in parallel
125 with the armature of the generator to vary the current flowing to the conductors in accordance with the demand.

12. The combination of a railway, a working conductor extending along the railway and supplying current to electrically propelled cars thereon, a line conductor extend-
130

ing along the line of the railway and containing electric lamps to light the railway, and a common source of electric supply for the railway conductor and lighting or line conductor.

5 13. The combination of a railway, a working conductor extending along the railway and supplying current to electrically propelled cars thereon, a line conductor extending along the line of the railway and containing
10 electric lamps to light the railway, a common source of electric supply for the railway conductor and lighting or line conductor, and a regulator to regulate the current flowing to each conductor.

15 14. The combination of a railway, a working conductor extending along the railway and supplying current to electrically propelled cars thereon, a line conductor extending along the line of the railway and containing
20 electric lamps to light the railway, a common source of electric supply for the railway conductor and lighting or line conductor, and an automatic electric regulator to regulate the current flowing to each conductor.

25 15. The combination in an electric railway, of two working conductors and two supply conductors extending along the railway and connected at intervals, two or more fixed electric lamps coupled in parallel and receiving
30 current from the supply conductors, and two or more electric lamps coupled in parallel with the working conductors and movable along the railway without changing their electrical parallel connection with the fixed electric lamps.

35 16. In an electric railway, the combination of a positive and negative working conductor for supplying current to the motors on the car, a generator, a cut out circuit across the
40 poles of the generator, a circuit controller in said cut out circuit, and an electro magnetic device to operate said circuit controller energized by the current flowing over the working conductors.

45 17. In an electric railway, the combination of a positive and negative working conductor for supplying current to the motors on the car, a generator, a cut out circuit across the
50 poles of the generator, a resistance in said circuit, a circuit controller in said cut out circuit, and an electro magnetic device to operate said circuit controller energized by the current flowing over the working conductors.

55 18. In an electric railway the combination of a positive and negative working conductor for supplying current to the motors on the cars, a generator having one of its poles connected to one conductor, and its other pole
60 connected with the other conductor through a variable resistance.

19. In an electric railway the combination of positive and negative working conductors for supplying current to the motors on the cars, a generator having one of its poles connected to one conductor, its other pole connected with the other conductor through a variable resistance, and electro magnetic de-

vices actuated by the current of the generator to automatically vary the resistance in the working conductor of the railway to suit
70 the demand.

20. In an electric railway, a working conductor extending along the railway for supplying electric current to a traveling car, a fixed source of electric energy, a supply conductor leading from the source of electric
75 energy and connecting with the working conductor at different points in its length, a traveling car, an electric motor upon the car adapted to propel it, an electric circuit on the
80 car independent of the electric motor and including an electric lamp but also receiving current from the working conductor, and a traveling contact carried with the car and making a moving contact with the working
85 conductor for simultaneously supplying current to the electric lamp circuit and electric motor.

21. In an electric railway a positive and negative conductor extending along the line
90 of the railway, a generator for supplying electricity thereto, electric lamps arranged along the railway to light it receiving their current from the same source as the railway conductors, one or more electric lamps movable
95 along the railway, a traveling circuit including said movable lamp and making a moving contact with said railway conductor, an electric motor to move the lamp and circuit, a resistance regulator to control the current in
100 the motor independently of the lamps, and a regulator to regulate the current in the conductors extending along the railway.

22. The combination of a railway, working conductors extending along the same, a source
105 of electric energy, traveling electrically propelled cars receiving current from said conductors and each independently movable, a regulator on each of the cars to control its movement, electric lamps on the several cars
110 in multiple and receiving current from the working conductors, and an automatic regulator to vary the current flowing to the conductors in accordance with the demand.

23. In an electric railway, the combination
115 of outgoing and return conductors, a stationary source of electric supply, supply conductors leading from the source of electric supply and connecting at intervals with said outgoing conductors, a series of electrically propelled
120 vehicles receiving current from said conductors, an independent resistance hand regulator for each of the vehicles for varying the current flowing through the motors, and electric lamps in multiple with the motors of the
125 vehicles and receiving current from the same source as the motors.

In testimony of which invention I hereunto set my hand.

RUDOLPH M. HUNTER.

Witnesses:

ERNEST HOWARD HUNTER,
E. M. BRECKENREID.