

(No Model.)

2 Sheets—Sheet 1.

R. M. HUNTER.
ELECTRIC RAILWAY.

No. 459,815.

Patented Sept. 22, 1891.

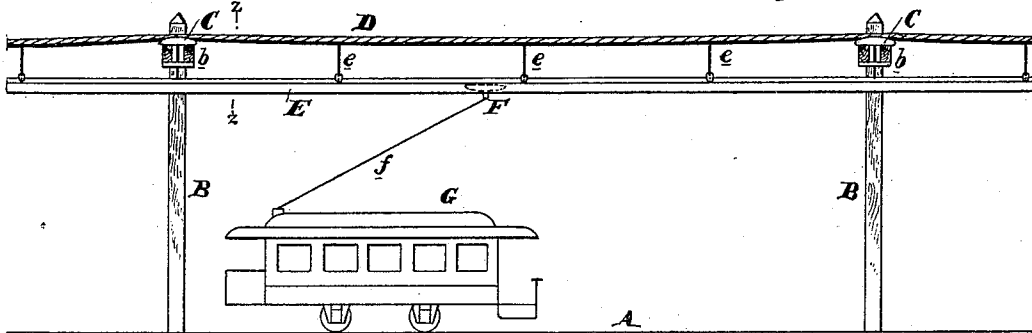


FIG. 1

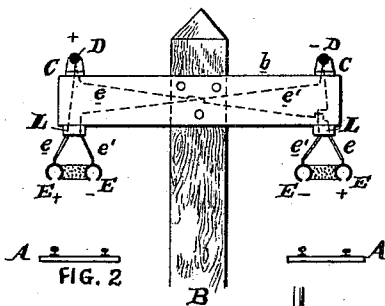


FIG. 2

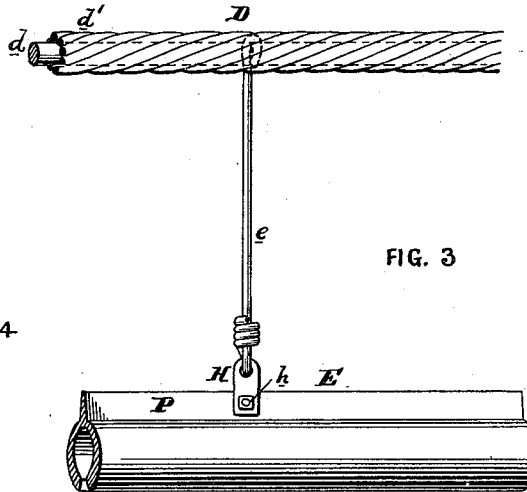


FIG. 3

FIG. 5

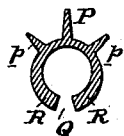


FIG. 4

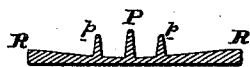
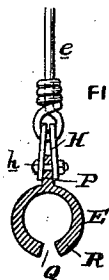


FIG. 6

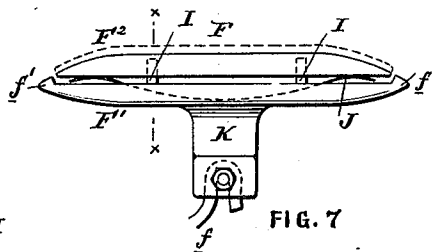


FIG. 7

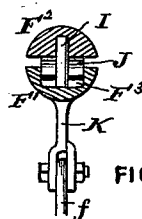


FIG. 8

Attest:
Henry Drury
C. W. Buckman

Inventor:
R. M. Hunter

(No Model.)

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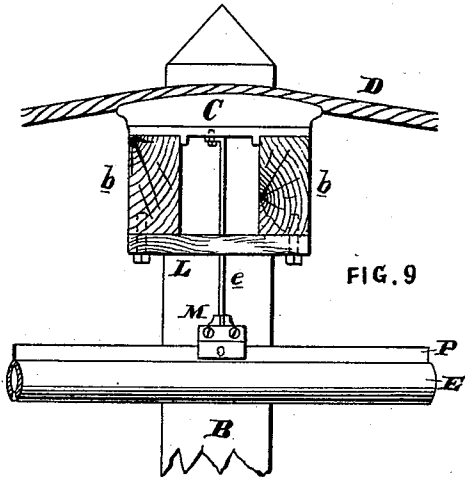


FIG. 9

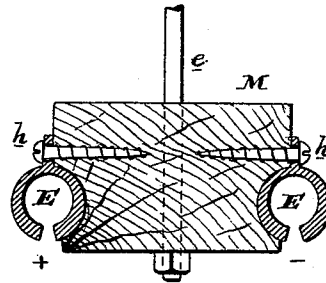


FIG. 13

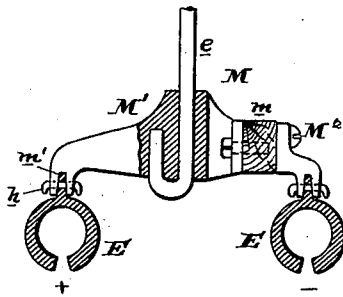


FIG. 10

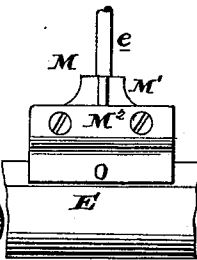


FIG. 11

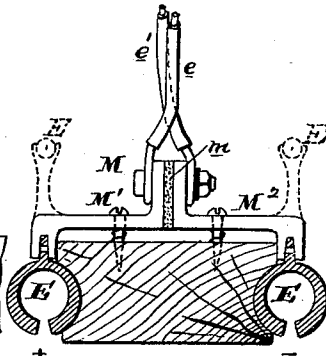


FIG. 12

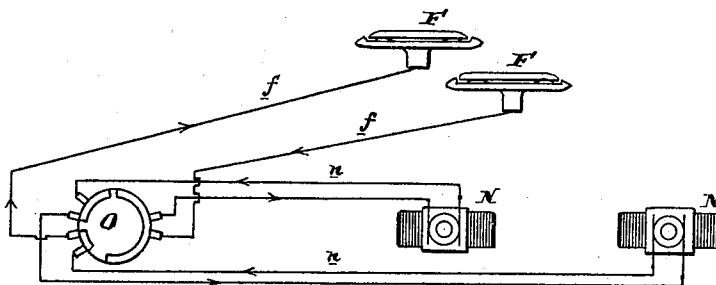


FIG. 14

Attest:
Henry Drury
E. W. Richardson

Inventor:
R. M. Hunter

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. 459,815, dated September 22, 1891.

Application filed March 16, 1888. Serial No. 267,367. (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 part thereof.

The object of my invention is to provide a suitable construction adapted to suspended or overhead conductors for electric railways, whereby strength, durability, simplicity, and low resistance result with cheapness of construction.

Another great advantage of my present invention is that the working conductors may be made of cheap metal and can be readily replaced at small cost when worn and the line-circuits which supply the currents to the working conductors are without wear.

My invention also has for its object the arrangement of suspended working conductors along parallel tracks from a line of posts arranged between the tracks, and furthermore contemplates the employment with said working conductors of supply-conductors supported along the railway and connected at intervals with the working conductors.

In carrying out my invention I suspend one or more supporting and current-supplying conductors or cables, and from it or them I suspend the positive and negative working conductors, which are hung parallel to the rails—that is, at a fixed distance from the track. When in a double-track railway I may use two sets of working conductors with two supporting-cables, I hang one pair of working conductors from each cable and electrically connect the two positive working conductors to one cable and the two negative working conductors to the other cable. In this construction the cables will be respectively connected with the two poles of the generator or source of electric power and the working conductors of the two pairs will be connected in parallel, thus reducing the resistance of the line as an entirety. The sup-

porting-cables would hang like a catenary, while the working conductors would be preferably horizontal and suspended from said cables at intervals in their length, so as to maintain their horizontal arrangement and prevent sagging or rupture. As the cables may be made strong and of good conductivity, the strength of the working conductors is of second importance. Even when hung as here explained the two working conductors may both be insulated from the sustaining-cable and convey the electric current to the motors, or one only may be electrically connected to it. These suspended working conductors may be of any construction desired; but that preferred in this case is what are known as "slotted tubes," in which the slot is below and forms a passage-way for the collector-shank connecting with the motor-circuit on the car. In my construction of this tube I make it with thickened lower parts adjacent to the slot-opening, so as to provide sufficient metal for wear and thus increase the life of the conductor, and at the same time this increase in the sectional area of the metal reduces the line resistance of the railway. In using tubes of this character great trouble is experienced by the bending or collapsing of the tube, and hence its support is an important feature, particularly so as this support is indispensable and must be within reason as to cost and presentable appearance. It is objectionable to place posts nearer together than from ninety to one hundred feet, and with this distance the tubes cannot be sustained from post to post as the only points of support without collapsing, unless the metal of the tube is made very heavy, and in that case its ductility would allow the conductor to stretch and sag down, destroying the practical operativeness of the plant. In my preferred form of conductor I provide one or more longitudinal ribs upon its top or upper part to resist the bending action, and also furnish a suitable means of suspension to the tie or suspension rods or wires. When using the supporting-cables as supply-conductors, I prefer to make the working conductors of rolled iron, owing to its cheapness and easy manufacture and facility for making repairs. The supporting-cable may be of steel covered

with strands of copper or the reverse or all copper, or may be made entirely of silicon bronze, which has a conductivity almost equal to copper with great tensile strength.

5 When employing the word "cable," I mean a rod or rope of wires or other materials or any strand suspended from one support to the next.

In the construction herein set out the cars
10 on the two parallel tracks are all coupled in multiple and receive their energizing-current from the supply-conductors through the working conductors, and while all drawing on the same source of electric supply they are in-
15 dependently controlled by varying the resistance to the passage of the current in the motor-circuits on the several cars.

In the drawings, Figure 1 is a side elevation of an electric railway embodying my inven-
20 tion. Fig. 2 is a cross-section of same on line $z z$. Fig. 3 is an enlarged detailed view of a portion of same. Fig. 4 is an end sectional view of a part of Fig. 3. Fig. 5 is a cross-section of one form of working conductor.
25 Fig. 6 shows a cross-section of the conductor-bar before being rolled into a tube. Fig. 7 is a side elevation of a collector for the working conductor. Fig. 8 is a cross-section of same on line $x x$. Fig. 9 is an enlarged side eleva-
30 tion of the upper end of the posts and the connections between the suspended conductors. Fig. 10 is a cross-section showing the method of hanging the two parallel working
conductors. Fig. 11 is a side elevation of same. Figs. 12 and 13 are cross-sections simi-
35 lar to Fig. 10, showing modified ways of connecting and insulating the suspended working conductors; and Fig. 14 is a diagram showing the arrangement of the various cir-
40 cuits on the car and connecting with the collectors.

A is the road-bed or railway, and B are vertical posts, preferably having cross-arms b at the top.

45 Supported upon the shoes C, which rest upon the cross-arms b , are the cables D, which are preferably made of sufficient strength for supporting the working conductors, and also preferably of good conductivity to reduce the
50 line resistance. These cables D may have a central rod d , about which are wrapped the small wires d' . The entire cable may be of silicon bronze, or part may be of copper or steel, or the parts d and d' may be of steel
55 and copper, one to give strength and the other conductivity.

Arranged below the suspended cables D are the two pairs of working conductors E, one of which is connected by a conductor e to
60 one of the cables D, while the other of said working conductors of one pair is connected by a conductor e' with the other cable D, and likewise the other pair of working conductors E is connected to said cables D, one of which
65 conveys positive currents and the other negative currents. By this means we will have the pairs of working conductors in multiple

connection with each other and with the ca-
bles D, and below each cable will be sus-
pended a positive and negative working con-
ductor; or pairs of conductors may be ar-
ranged for two tracks, one of which pairs
may be arranged upon each side of the line
of posts B. These connections are clearly
illustrated in Fig. 2.

The working conductors E are preferably
arranged horizontal or parallel to the road-
bed, whereas the cable D hangs like a cate-
nary, as indicated in Fig. 1, and these working
conductors may be suspended at numerous
80 intervals by the suspending rods or conductors e . It is evident that, while it is preferable to supply the line-currents to the conductors or cables D, it is perfectly clear that the cables
D may be used only as sustaining-cables and
85 the current be wholly transmitted through the working conductors E. In this latter case the supporting-rod e would necessarily be in-
sulated from the conductors E, as shown in
Fig. 13, whereas in the other case it would be
90 electrically connected with the proper work-
ing conductor E, as shown in Figs. 10 to 12.

I do not limit myself to any form or con-
struction of working conductor or particular
method of suspension when considering my
95 invention broadly; but the preferred form is that which is clearly shown—to wit, a tubular conductor having a longitudinal slot Q at its
bottom. In making this tubular conductor
I prefer to form it of cheap metal, such as
100 iron, which may be easily rolled, by first roll-
ing it, as indicated in Fig. 6, with the thick-
ened edges R R and projections P p , which is afterward rolled into the shape shown in
Fig. 5.

In Fig. 4 the longitudinal projecting ribs
 p have been dispensed with. The web or rib
P acts as the means of connection for the sup-
porting-rod e . The connection may be made
in various ways, the simplest of which have
110 a single conductor E, (shown in Figs. 3 and 4,) in which the wire rod e is attached to plates H, which are bolted at h to the rib, making
a good electrical contact and at the same time
a firm connection. Where two parallel work-
115 ing conductors are to be arranged in pairs, they may be held apart an equal distance by
either of the arrangements M shown in Figs.
10, 12, or 13.

In Figs. 10, 11, and 12 we have two castings
120 M' M', which are bolted together, but insulated from each other at m , and said castings are provided with grooves m' for the recep-
tion of the ribs or webs P of the conductors E, which are fastened securely by the bolts or
125 pins h . The supporting conductor or rod e would be secured to the castings M', supply-
ing electricity of one polarity, and the other working conductor of the pair may be connect-
ed through its castings M' and conductor e'
130 with the line conductor of opposite polarity. Wooden blocks, as shown in Fig. 12, and well
paraffined, may be used to connect the two
working conductors into a rigid structure.

In the case of Fig. 13 we have the two working conductors secured fast to the insulating-block of wood through which the suspending-rod *e* passes. In place of using tubular conductors, as indicated, it is evident that the castings *M'* and *M*² may support ordinary cables or rods *E*, as indicated in dotted lines in Fig. 12, upon which the usual trolleys will travel. Where the conductors *ee'* lead up to the posts, they may pass through cross-bars *L*, so as to properly support the working conductors directly beneath the cable.

The construction of the tube herein set out gives me much wearing-surface at the lower parts and where the greatest wear from the collectors *F* comes, thus increasing the life of the working conductors very materially. The upper part of the tube is reduced in thickness, as but little wear comes upon it, and the ribs or webs greatly strengthen the tube and prevent collapsing through the action of gravity.

By the combination employed in this system I am enabled to make the working conductors *E* of cheap metal, such as iron, which can be rapidly rolled and cheaply replaced, whereas the supply-conductors *D* may be of more expensive material and which will last forever, as no wear comes upon them. The collectors *F* may be made in any suitable manner, one form being shown in Figs. 7 and 8, in which we have them formed of two parts *F'* and *F*², held in line by pins *I* and adapted to be separated by a spring *J*, arranged within the recess *F*³ of the lower part. This piston is made double-pointed or cigar-shaped, and the points are preferably formed on the lower part and so as to guard the ends of the upper part. The lower part is provided with a shank *K*, which extends through the slot *Q* and is connected with the conductor *f*, leading to the car. These pistons slide in the tubes *E* forming the working conductors, and may be pulled in either direction by the travel of the car. Their connection with the motor on the car is shown in Fig. 14, in which *NN* represent two motors having the motor-circuits *nn*, leading to the switch *O*, which also receives the flexible conductors *ff* from the collectors. By moving the switch *O* the motors *NN* may be placed in series or parallel, or one or both may be cut out of circuit, thus varying the motor resistance and without the use of auxiliary resistances.

It is evident that the details of construction herein set out may be greatly modified without in the least departing from the spirit of the invention. Hence I do not limit myself to the details herein shown.

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

1. In an electric-railway system, the combination of two railways, a suspended working conductor arranged above each railway, a supply-conductor extending along the line of the two railways and common to both of them,

branch conductors connecting the supply-conductor with the working conductors of the two railways at intervals in their length, electric cars for said railways receiving current from the suspended conductors and having the motors of the several cars coupled in parallel, and means on the cars to control the current passing through the motor-circuits of the several cars independently of each other.

2. In a system of electric railways, the combination of two railways, each provided with a positive suspended working conductor and negative working conductor, a supply-conductor for delivering electricity to the positive working conductors at intervals in their length, cars for the railways having electric motors receiving current from the conductors and connected in parallel, and current-controlling devices on each car to independently control the current passing through its motor.

3. In an electric railway, the combination of supporting-posts, an electric-supply cable supported thereby, a straight or horizontal working conductor suspended from said cable by electrical connections at intervals in its length, a railway parallel with the working conductor, an electrically-propelled vehicle, and a traveling electric connection between the car and working conductor.

4. The combination of two overhead suspended tubular and slotted working conductors arranged in the same or substantially the same plane, a supporting-cable therefor, two sliding contacts adapted to travel within said conductors, a traveling vehicle, an electric motor to propel said vehicle, and two flexible electrical connections between said contacts and motor.

5. The combination of two electric cables for supplying positive and negative current, two overhead suspended tubular and slotted working conductors arranged in the same or substantially the same plane and respectively electrically connected with said cables, two sliding contacts adapted to travel within said conductors, a traveling vehicle, an electric motor to propel said vehicle, and two flexible electrical connections between said contacts and motor.

6. The combination of two electric cables for supplying positive and negative current, two overhead suspended tubular and slotted working conductors arranged in the same or substantially the same plane and respectively electrically connected with said cables and mechanically suspended from one of said cables, two sliding contacts adapted to travel within said conductors, a traveling vehicle, an electric motor to propel said vehicle, and two flexible electrical connections between said contacts and motor.

7. The combination of a series of elevated supports, a cable supported thereby, two working conductors arranged below said cable, and mechanical connections between said cable and working conductors, whereby the latter are supported by the former, a traveling ve-

hicle, current-collecting devices carried by the working conductors, and electric connections between the collecting devices and vehicle.

8. The combination of a series of elevated supports, a cable supported thereby, two working conductors arranged below said cable, mechanical connections between said cable and working conductors, whereby the latter are supported by the former, insulating separating-pieces to hold the two working conductors apart, a traveling vehicle, current-collecting devices carried by the working conductors, and electric connections between the collecting devices and vehicle.

9. The combination of a series of elevated supports, a cable supported thereby and adapted to supply electricity, two working conductors arranged below said cable, electrical connections between one of said working conductors and cable, and mechanical connections between said cable and working conductors, whereby the latter are supported by the former.

10. The combination of a series of elevated supports, a cable supported thereby and adapted to supply electricity, two working conductors arranged below said cable, electrical connections between one of said working conductors and cable, mechanical connections between said cable and working conductors, whereby the latter are supported by the former, an electric railway parallel to the working conductors, an electric car having an electric motor on it to propel it, and two electrical contacts connecting with the motor and making electric connection with the working conductors, respectively.

11. The combination of two suspended cables for supplying positive and negative electricity, two mechanically-suspended working conductors suspended from each of said cables and in which one of each of said pairs of working conductors is electrically connected with one of the cables and the other two with the other cable.

12. The combination of two suspended cables for supplying positive and negative electricity, two mechanically-suspended working conductors suspended from each of said cables and separated by insulating-pieces and in which one of each of said pairs of working conductors is electrically connected with one of the cables and the other two with the other cable.

13. The combination of two suspended cables for supplying positive and negative electricity, posts having cross-arms at their upper parts to support the two cables, one on each side of the posts, and two mechanically-suspended working conductors suspended from each of said cables and in which one of each of said pairs of working conductors is electrically connected with one of the cables and the other two with the other cable.

14. The combination of two suspended cables of good conductivity for supplying positive and negative electricity, two mechani-

cally-suspended working conductors of iron suspended from each of said cables and in which one of each of said pairs of working conductors is electrically connected with one of the cables and the other two with the other cable.

15. The combination of a suspended electric-supply cable of good conductivity with two iron working conductors arranged below said cable and supported by it, and electrical connections between one of said working conductors and the cable at intervals in its length, the said cable and the iron conductor electrically connected to it being adapted to supply current of one potential and the other conductor to supply current of the opposite polarity.

16. The combination of a suspended electric-supply cable of good conductivity with two iron working conductors arranged below said cable and supported by it, electrical connection between one of said working conductors and the cable at intervals in its length, and mechanical connections between the said cable and both of said working conductors, the said cable and the iron conductor electrically connected to it being adapted to supply current of one potential and the other conductor to supply current of the opposite polarity.

17. The combination of a suspended electric-supply cable of good conductivity with two iron working conductors arranged below said cable and formed of slotted tubes, and electrical connections between one of said working conductors and the cable at intervals in its length.

18. The combination of posts B with cross-arms of suitable construction, cables D D for supplying positive and negative current, working conductors E E E E, suspended in pairs from said cables, and electrical connections between the said cables and one of the working conductors of each pair, substantially as set out.

19. A working conductor for an electric railway, consisting of a slotted tube having its slot opening downward and also having the metal on its lower parts and substantially adjacent to the slot thickened, in combination with a traveling collector or piston supported within the tube and resting upon the tube on either side of the slot.

20. A working conductor for an electric railway, consisting of a slotted tube having the metal on its lower parts and substantially adjacent to the slot thickened and provided with one or more longitudinal ribs.

21. A working conductor for an electric railway, consisting of a slotted tube having the metal on its lower parts and substantially adjacent to the slot thickened and provided with one or more longitudinal ribs upon its upper and outer part and diametrically opposite to the slot.

22. A working conductor for an electric railway, consisting of a slotted tube having the

metal on each side of the slot thickened and the slot flaring outwardly.

23. A working conductor for an electric railway, consisting of a slotted tube having an outwardly-flaring slot and one or more longitudinal ribs upon its outer surface and diametrically opposite to the slot.

24. The combination of two slotted conducting-tubes having ribs upon their upper and outer parts, rigid insulating-frames mechanically connecting said tubes at intervals apart, and suspending-rods connecting with said frames.

25. The combination of two slotted conducting-tubes having ribs upon their upper and outer parts, rigid insulating-frames mechanically connecting said tubes at intervals apart, suspending-rods connecting with said frames and electrically connected with one of the tubes, and a supply-conductor connecting with said suspending-rods.

26. The combination of a series of posts arranged along a railway, a supporting-cable sustained by the posts, two slotted conductors having their slots arranged downward, connections for uniting the slotted conductors at their upper parts and insulating them one from the other, and supports between said connections and supporting-cable.

27. The combination of two lines of railway, a line of posts between them, and two pairs of working conductors suspended from

each side of the posts and substantially over its railway, and electric connections between the conductors of the same polarity of each pair, whereby the similar conductors of the two railways will be coupled in parallel.

28. The combination of two lines of railway, a line of posts between them, two pairs of working conductors suspended from each side of the posts and substantially over its railway, and two supply-conductors for positive and negative currents suspended upon said posts and electrically connecting with the corresponding positive and negative working conductors of each pair.

29. The combination of a suspended cable, a suspended working conductor having a flat web or rib running longitudinally along its upper part, and suspending connections between the cable and the web or rib of the working conductor.

30. A suspended working conductor having a thin longitudinal web or rib upon its upper part, in combination with supports connected to the ribs for holding the conductor suspended for the purpose of exposing a continuous unobstructed under surface.

In testimony of which invention I hereunto set my hand.

RUDOLPH M. HUNTER.

Witnesses:

RICHARD S. CHILD, Jr.,
E. M. BRECKINREED.