(No Model.)

3 Sheets—Sheet 1.

R. M. HUNTER.

ELECTRIC RAILWAY.

No. 434,871. Patented Aug. 19, 1890.

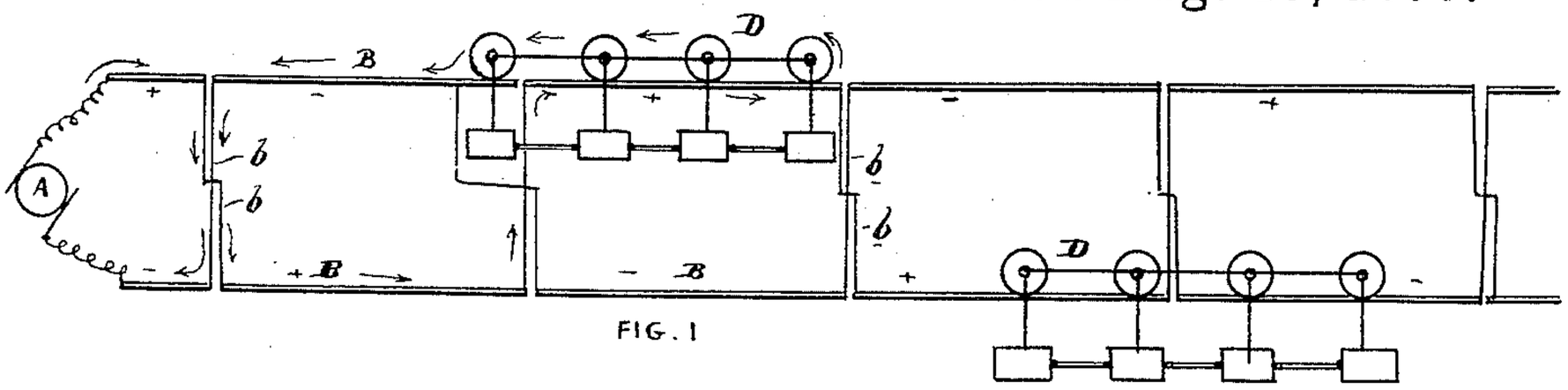


FIG. 1

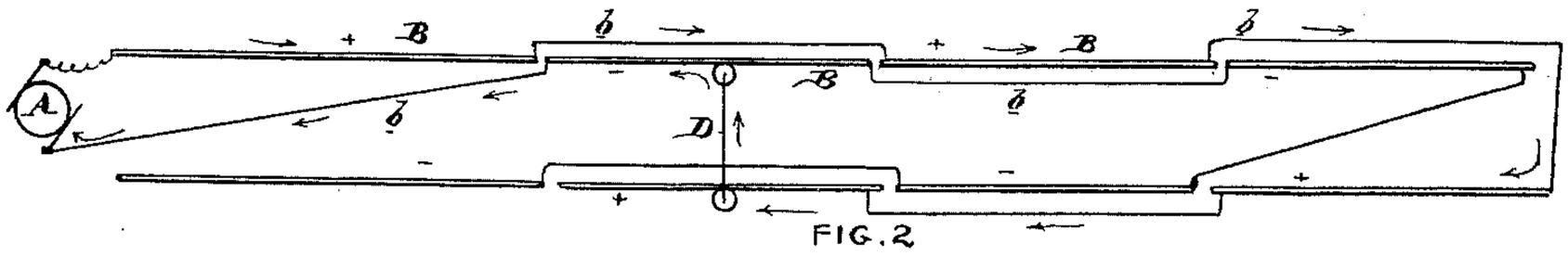


FIG. 2

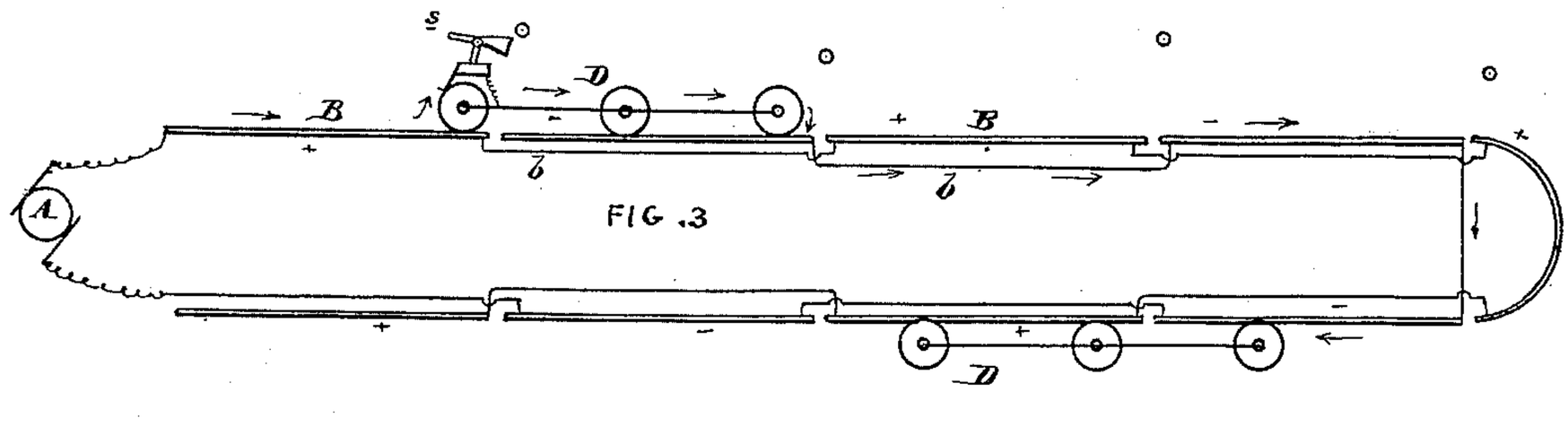
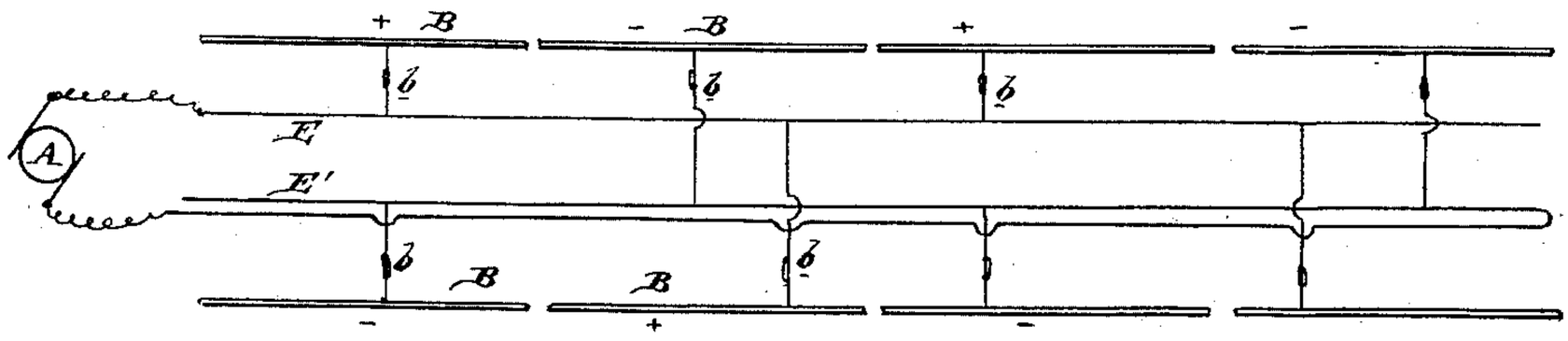


FIG. 3

FIG. 4



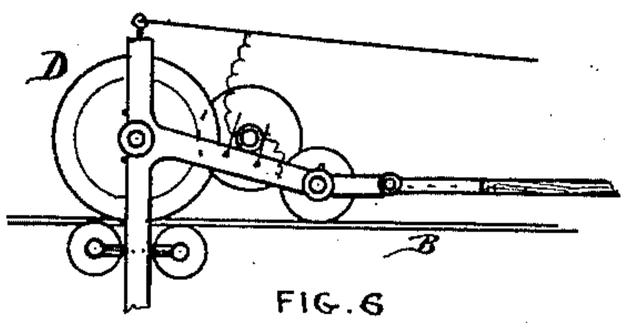
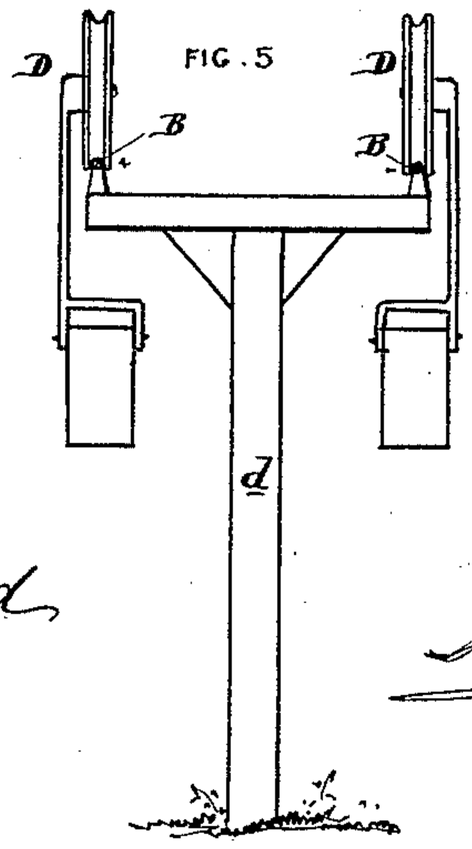


FIG. 6

FIG. 5



Attest

E. M. Breckinridge

H. A. Hart.

Inventor

Rudolph M. Hunter

(No Model.)

3 Sheets—Sheet 2.

R. M. HUNTER.

ELECTRIC RAILWAY.

No. 434,871. Patented Aug. 19, 1890.

FIG. 7

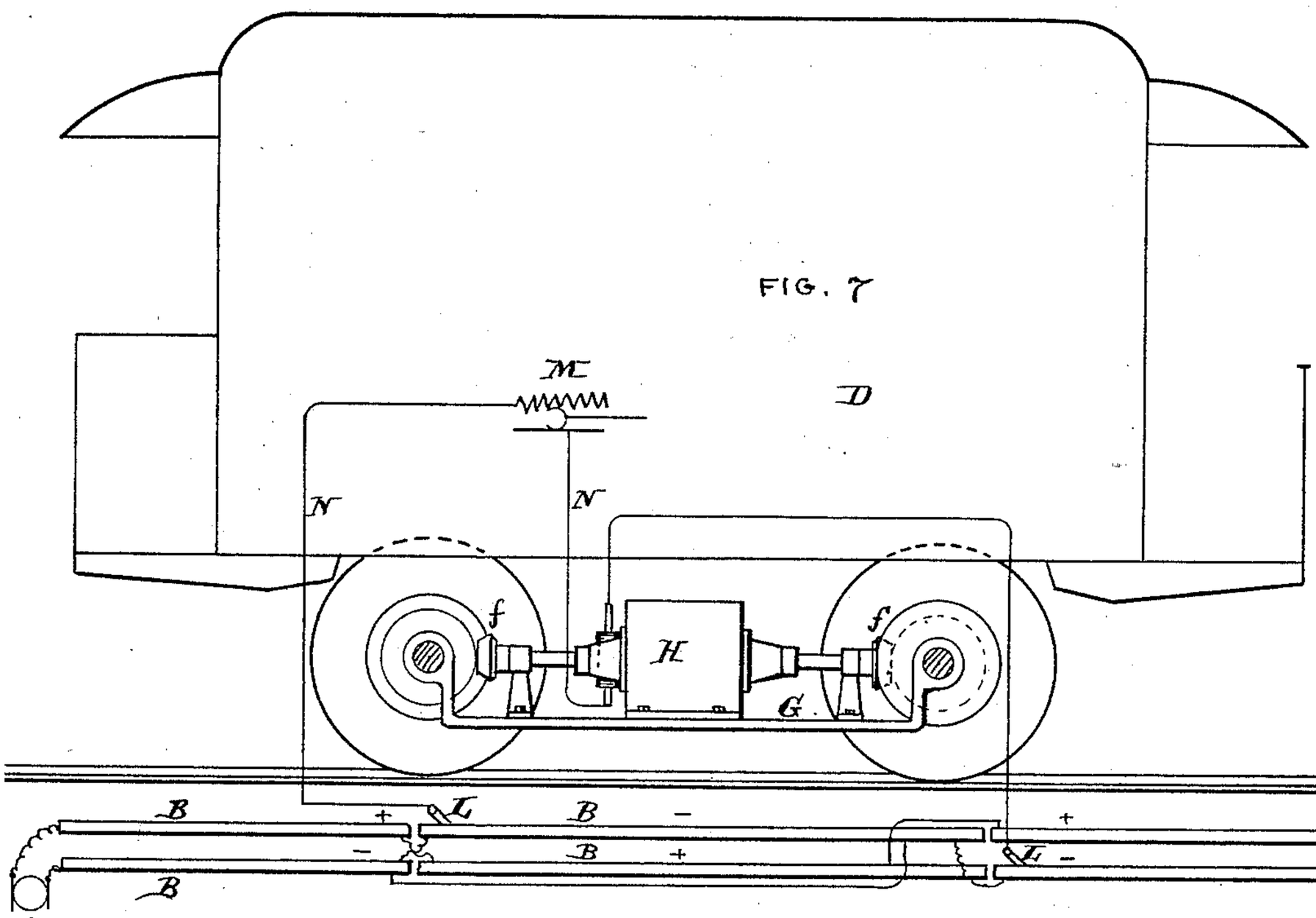
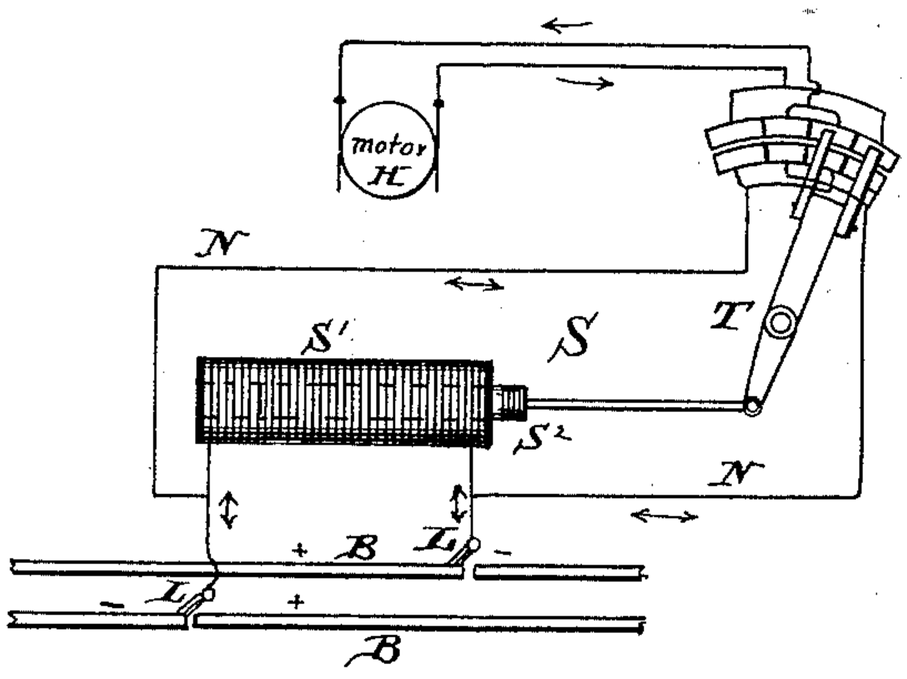


FIG. 8



Attest
Maurice K. Holmes
S. T. Yerkes.

Inventor
R. M. Hunter

(No Model.)

3 Sheets—Sheet 3.

R. M. HUNTER.

ELECTRIC RAILWAY.

No. 434,871. Patented Aug. 19, 1890.

FIG. 9.

Attest
E. M. Breckinridge.
Wm. F. Howard Shuster

Inventor
Rudolph M. Hunter

UNITED STATES PATENT OFFICE.

RUDOLPH M. HUNTER, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO THE ELECTRIC CAR COMPANY OF AMERICA, OF SAME PLACE.

ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 434,871, dated August 19, 1890.

Application filed June 9, 1886. Serial No. 204,583. (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, all of which are fully set forth in the following specification, and shown in the accompanying drawings, which form a part thereof.

This invention relates specifically to both the construction and arrangement of the working-conductors from which the motor derives its current and to the regulating means carried by the car or motor-vehicle. The working-conductors may be arranged for telpherage, overhead system, or ordinary surface roads and adapted to operation with or without the presence of an operator. The working-conductors are divided into sections, and the normal current passing through each successive section is of different polarity. These sections may be coupled up to form two tracks, or what I term "cross-over" and "parallel" system, and each of these tracks may be utilized for telpherage, one track being the outgoing and the other the incoming track, or both may be used for the same car or train at the same time. In the case of telpherage the cars or trains may be of a length equal to or longer than the length of one of the conductor-sections, so that its ends are resting upon or in contact with a conductor of different polarity, whereby the motor or motors on the train or car are coupled up in series with said conductor-sections. In this case and where only one working-conductor is used the motor car or train may be provided with a circuit-controlling switch to cause the currents of different polarity to be commutated and passed through the motor in the same direction, just as a commutator in a dynamo-electric machine causes the alternating currents to flow out into the line in a continuous current. This controlling-switch may be made to work mechanically or electrically. In the former case it would strike against pins, rollers, or blocks, while in the latter case the reversal of the current would instantly shift the switch. It is evident that this switch might be dispensed with, if desired. The telpherage or overhead system would admit of the use of long-stretched conductors, since the train would be very long. In the case of single vehicles, like street-cars, the sectional or working conductor would have to be equal to or about the length of the car when the system is to be used in series connection of multiple-arc system. If the car is to utilize two of these conductors, then the current would pass from one section of one conductor through the motor to the corresponding section of the other conductor, similar to multiple-arc or parallel connection. In this case the sections might be of any length and the two brushes or collectors on the car would maintain contact with the respective sections. The use of a current-reversing switch is not necessarily required to make the motor rotate continuously; but if it were not used the polarity of the field-magnets would be constantly changing, an objectionable feature in many constructions of motors where the polarity of the pole-pieces should remain constant. Again, if there are any devices on the car whose operation is due to change of polarization they would not work with alternating currents, even if the periods between the reversing of the current were long. Again, if the car be supplied with secondary batteries, which must be charged by the line working-conductors—such as set out in my application, Serial No. 200,400, filed April 28, 1886—the current must pass through the battery in the proper direction; otherwise it would alternately charge and discharge the battery. The working-conductor sections may be coupled up in numerous ways, several of which are shown. Probably the most preferable way is that in which the line-resistance through the motors is the same for all locations of the motor upon the line. The particular construction of vehicle or motor-car is immaterial to my invention.

Referring to the drawings, Figure 1 shows a plan view of the double conductor, which I call "cross-over" and "parallel," as adapted to telpherage or to suspended electric passenger-trains, though it is equally well adapted to surface-roads. Fig. 2 is a plan view show-

ing the same adapted to surface-roads or where both conductors are utilized for the same motor, and where the resistance for all positions of the motor on the line is equal. Fig. 3 is a similar construction better adapted for telpherage or overhead lines. Fig. 4 is a plan view of the same, in which normally no current is passing through the working-conductor sections, they being connected to continuous line-conductors, which may be buried or suspended overhead. Fig. 5 is a cross-section of my system as applied to telpherage. Fig. 6 is a side elevation of a telpherage-motor. Fig. 7 is a sectional elevation of an electric car adapted to my improved system of railways. Fig. 8 is an elevation of my improved automatic current controlling or commutating device, and Fig. 9 is a general perspective view showing my invention as applied to telpherage or overhead suspension systems.

In all of the arrangements of circuits A is the generator of electricity, and B are the working-conductors, which latter may be the rails or independent conductors, either exposed, suspended, arranged upon the surface, or inclosed within a conduit, or otherwise arranged with respect to a railway, and from which conductors current is taken by brushes or collectors of any suitable description and conveyed to the motor on the car or train. The working-conductors B are made in sections, preferably of equal length, and so coupled up by branch wires *b* that the polarity of the current passing through these adjacent sections is different.

In Fig. 1 two single lines or a double line are shown, in which the current passes alternately from one line to the other, so as to pass around every other section on each line. The cars or trains D in this figure are shown as of the telpherage system or arranged in series with two adjacent sections, and are as long as a section B, so that the current is received by the last car from one section of one polarity and transmitted through the train or motor to the front car, by which it is delivered to another section B of the opposite polarity. The car or train will therefore run a distance of one section, and then, if desired, the circuit may be coupled up so as to insure the current flowing in the same direction through the motor at the instant it passes to the next adjacent sections. This result may be accomplished either mechanically or electrically. Means for accomplishing this result are shown in Fig. 8. In this case the reversal of the current through the magnet S′ causes the switch to be operated. The mechanism shown in Fig. 8 consists of a helix in circuit with the two collectors of the vehicle which are always in contact with the respective line of conductors, (obviating the necessity of movable collectors,) so that the current which passes through the helix S′ is first in one direction and then in the other. S^2 is a polarized armature which is correspondingly reciprocated and moves a switch T, which controls a motor-circuit N, so that the current which passes through the motor always flows in the same direction, as indicated by the arrows. It is immaterial how this circuit-controller is made. If we conceive a train or car or the collectors thereof to rest upon each line-conductor of Fig. 1, in the manner indicated in Fig. 2, then we will have such a train or car coupled up in multiple or parallel with both conductors and in contact with the conductor-sections of opposite polarity, just as the telpherage-cars shown in Fig. 1 are coupled up with the sections of a single line. The two forms of trains or cars could be run upon the same road-bed or structure.

The construction shown in Fig. 2 is especially adapted for a car simultaneously utilizing both conductors. The object sought in the arrangement shown in this figure is to make the line-resistance equal for all positions of the car or train upon the line.

The construction shown in Fig. 3 is especially adapted for telpherage, and has the same object in view as that specified when speaking of Fig. 2.

The construction shown in Fig. 4 is one which is suitable for either kind of car, and has the advantage that the sections R are connected with the generator A by line supply-conductors E E′ and branches *b*, still preserving the same rules governing the polarity of the sections. By having the generator connected with opposite ends of the supply-conductors I insure the resistance to the current from the generator through the line-motor and return, being practically constant for all positions of the car or train upon the line.

These four types or arrangements of the generic construction involved will illustrate as examples how these sections of positive and negative conductors may be coupled up and yet be within the scope of my invention.

In the case of telpherage it would be advisable to mount the conductors B on suitable posts *d*, as shown in Fig. 5. The motor or electrically-propelled train may be of any suitable construction, that shown in Letters Patent No. 428,098, dated May 20, 1890, granted to me, being excellently adapted to the purpose.

Referring to Fig. 7, D is the passenger-car, and is supported upon the usual axles and wheels. H is an electric motor carried by the vehicle and adapted to rotate the axles thereof. The vehicle is provided with collectors L, which make a contact with the working-conductor sections B B. A resistance-changer M may be employed to control the motor.

It is immaterial to my invention what the specific construction of the car, motor, or collectors may be, as they may be modified in various ways without in the least departing from the principles of my invention.

I do not limit myself to the details of construction, as 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—

1. In an electric railway, a working-conductor, from which a traveling motor receives electricity, made in sections arranged end to end, part of which sections supply electricity of one polarity and part electricity of the opposite polarity.

2. In an electric railway, a working-conductor, from which a traveling motor receives electricity, made in sections, part of which sections supply electricity of one polarity and part electricity of the opposite polarity, in combination with a traveling electric motor or vehicle receiving electricity therefrom, and a switch carried by the motor to cause the current collected to normally pass through the motor in the same direction.

3. In an electric railway, a working-conductor, from which a traveling motor receives electricity, made in sections, part of which sections supply electricity of one polarity and part electricity of the opposite polarity, in combination with a traveling electric motor or vehicle receiving electricity therefrom, and an automatic switch carried by the motor to cause the current collected to normally pass through the motor in the same direction.

4. In an electric railway, a working-conductor, from which a traveling motor receives electricity, made in sections, part of which sections supply electricity of one polarity and part electricity of the opposite polarity, in combination with a traveling electric motor or vehicle receiving electricity therefrom, and an electric switch carried by the motor and operated automatically by the change in the direction of current to cause the current collected to normally pass through the motor in the same direction.

5. In an electric railway, a working-conductor, from which a traveling motor receives electricity, made in sections, part of which sections supply electricity of one polarity and part electricity of the opposite polarity, in combination with a traveling electric motor or vehicle receiving electricity therefrom, a switch carried by the motor to cause the current collected to normally pass through the motor in the same direction, and reversing devices to reverse the motor.

6. In an electric railway, a working-conductor, from which a traveling motor receives electricity, made in sections, part of which sections supply electricity of one polarity and part electricity of the opposite polarity, in combination with a traveling electric motor or vehicle receiving electricity therefrom, and an electric switch carried by the motor operated automatically by the change in the direction of current to cause the current collected to normally pass through the motor in the same direction.

7. In an electric railway, a working-conductor, from which the traveling motor or vehicle receives electricity, made in sections, a source of electric supply, and connections between said supply and sections, whereby the sections supply alternately electricity of different polarity.

8. In an electric railway, a working-conductor, from which the traveling motor or vehicle receives electricity, made in sections, a source of electric supply, connections between said supply and sections, whereby the sections supply alternately electricity of different polarity, in combination with a traveling electric motor or vehicle receiving electricity therefrom, and a switch carried by the motor to cause the current collected to normally pass through the motor in the same direction.

9. In an electric railway, a traveling motor or vehicle, and a working-conductor to supply electric current to the traveling motor, made in sections and arranged end to end, in combination with a source of electric supply and connecting-circuits, whereby the successive sections of working-conductors supply electricity of different polarity, and the resistance to the passage of the current through the line-motor and return is the same for all positions of the motor on the line.

10. In an electric railway, a working-conductor made in sections, in combination with a source of electric supply and connecting-circuits, the said sections being coupled in series connection, but so that conductors bridging two different adjacent sections would be in multiple-arc connection.

11. In an electric railway, a working-conductor made in sections arranged end to end, in combination with a source of electric supply and connecting-circuits, the said sections being coupled in series connection, but so that conductors bridging two different adjacent sections would be in multiple-arc connection, and in which the resistance to the current from the electric source through any of such bridging-conductors and return would be equal.

12. In an electric railway, a working conductor or conductors made in sections and arranged end to end, in combination with a source of electric supply, connecting-circuits to couple said sections alternately with opposite poles of the electric supply, and a traveling electric motor receiving electricity therefrom and coupled in multiple-arc connection with said working-conductor sections.

13. In an electric railway, working conductor or conductors made in sections, in combination with a source of electric supply, connecting-circuits whereby part of said sections are coupled in series with the positive pole of the electric supply and the other of said sections are coupled in series with the negative pole of said supply, and in which said positive and negative sections of working conductor or conductors are arranged alternately and end to end.

14. In an electric railway, two lines of work-

ing-conductors made in sections and arranged parallel with each other, a source of electric supply, and connecting-circuits whereby the currents flowing through the adjacent sections of each line of working-conductors are of different polarity, the conductor-sections at one terminal being arranged end to end, so that one line of conductors may be used for trains going in one direction and the other conductor for trains moving in the other direction, in combination with one or more electric motors or trains.

15. In an electric railway, two lines of working-conductors made in sections and arranged parallel with each other, a source of electric supply, and connecting-circuits whereby the currents flowing through the adjacent sections of each line of working-conductors are of different polarity and the currents flowing through adjacent or corresponding sections of both lines of working-conductors are of different polarity.

16. In an electric railway, the combination of two line working-conductors, each of which is divided into sections, with branch or connecting conductors uniting the sections of one conductor with the sections of the other conductor, whereby the same current will pass successively over sections in each conductor.

17. In an electric railway, two line working-conductors, each of which is divided into sections, part of which sections in each conductor supply electricity of one polarity and part of which supply electricity of the opposite polarity, in combination with branch or connecting circuits electrically uniting the sections of similar polarity of both conductors together.

18. In an electric railway, two line working-conductors, each of which is divided into sections, the alternate sections in each conductor supplying electricity of one polarity and the remaining sections in each conductor supplying electricity of the opposite polarity, in combination with cross branches or connecting-circuits electrically uniting sections of similar polarity of both conductors.

19. In an electric railway, two line working-conductors, each of which is divided into sections, the alternate sections in each conductor supplying electricity of one polarity and the remaining sections in each conductor supplying electricity of the opposite polarity, in combination with cross branches or connecting-circuits electrically uniting sections of similar polarity of both conductors and forming two circuits composed of sections from each conductor arranged alternately and coupled in series connection.

20. In an electric railway, a working-conductor, from which a traveling motor receives electricity, made in sections, part of which sections supply electricity of one polarity and part electricity of the opposite polarity, in combination with a traveling electric motor or vehicle receiving electricity therefrom.

21. In an electric railway, a working-conductor, from which a traveling motor receives electricity, made in sections, part of which sections supply electricity of one polarity and part electricity of the opposite polarity, in combination with a traveling electric motor or vehicle receiving electricity from two adjacent sections by means of collectors separated a distance substantially equal to the length of said sections.

22. In an electric railway, the combination of an electrically-propelled vehicle having a car-body supported on springs, an independent frame supported by the axles, and an electric motor carried by said vehicle and having its armature secured to the said frame and its field-magnets adapted to rotate and positively connected to the vehicle-axle.

In testimony of which invention I hereunto set my hand.

RUDOLPH M. HUNTER.

Witnesses:
RICHD. S. CHILD, Jr.,
E. M. BRECKINREED.