(No Model.) 2 Sheets—Sheet 1.

T. HARRIS.

SUPPLY SYSTEM FOR ELECTRIC RAILWAYS.

No. 521,711. Patented June 19, 1894.

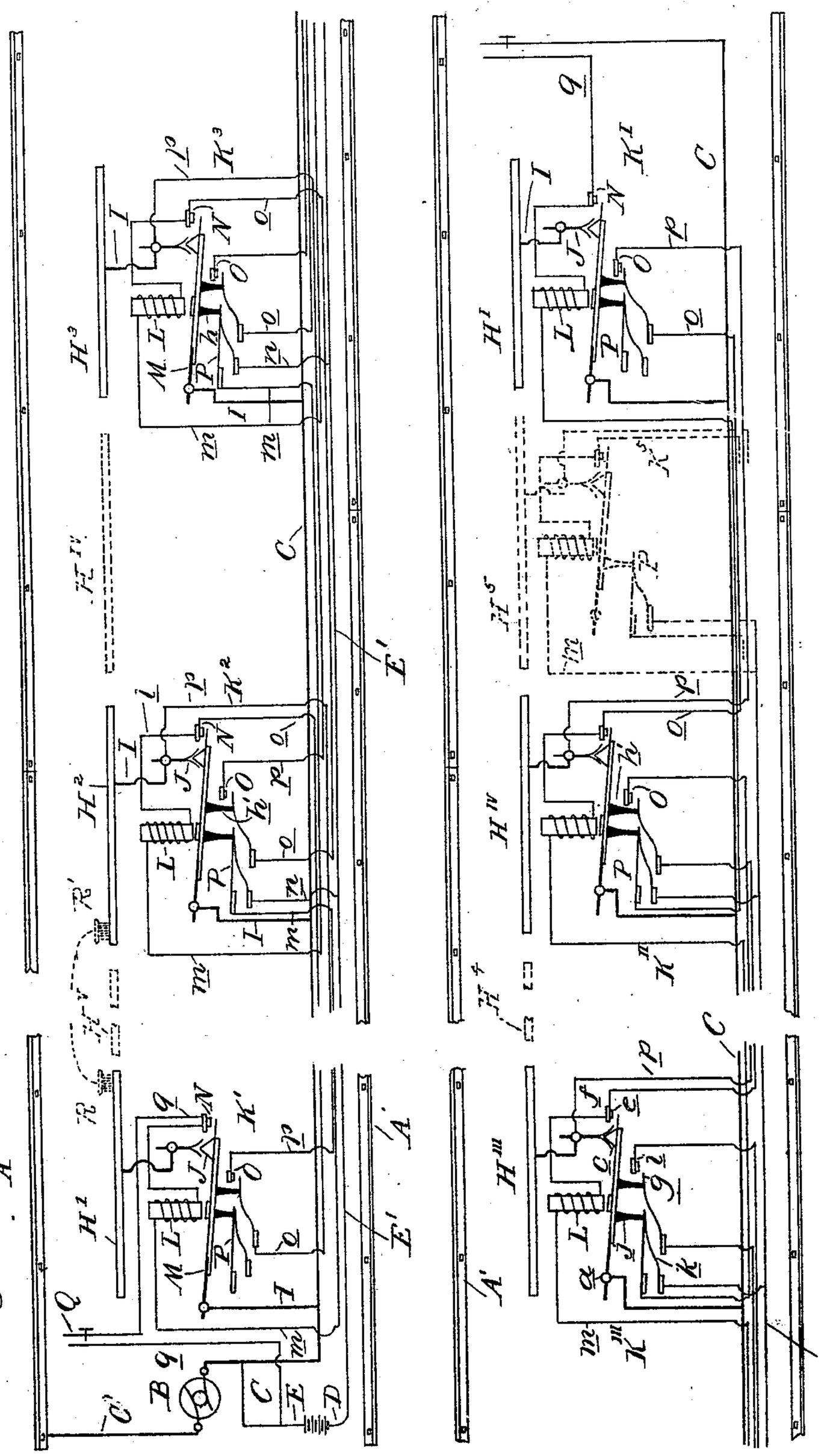

Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

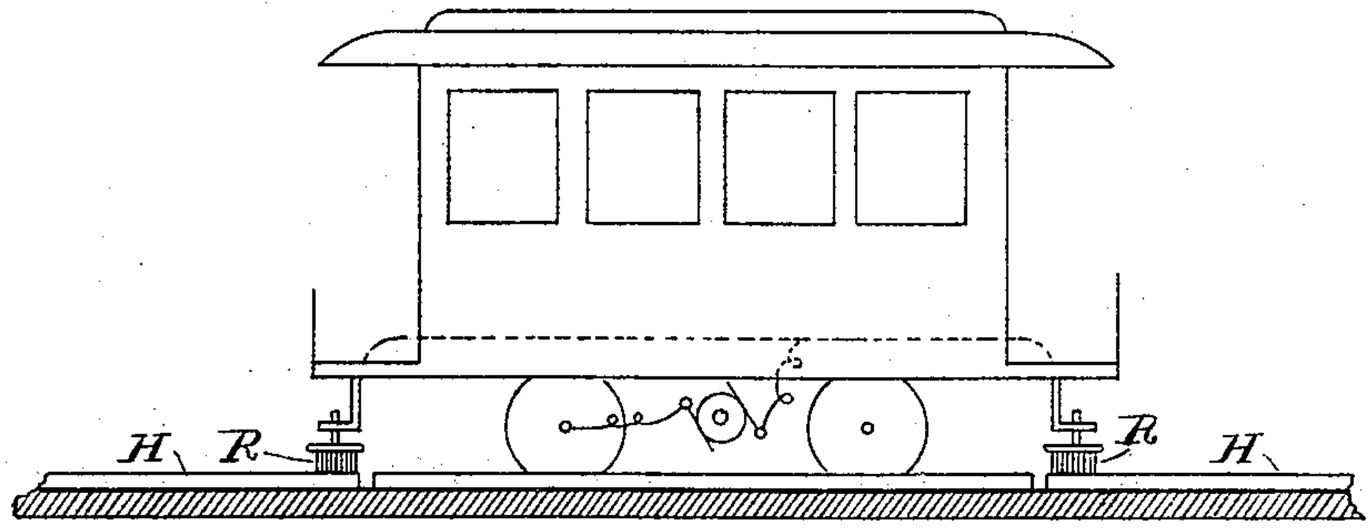
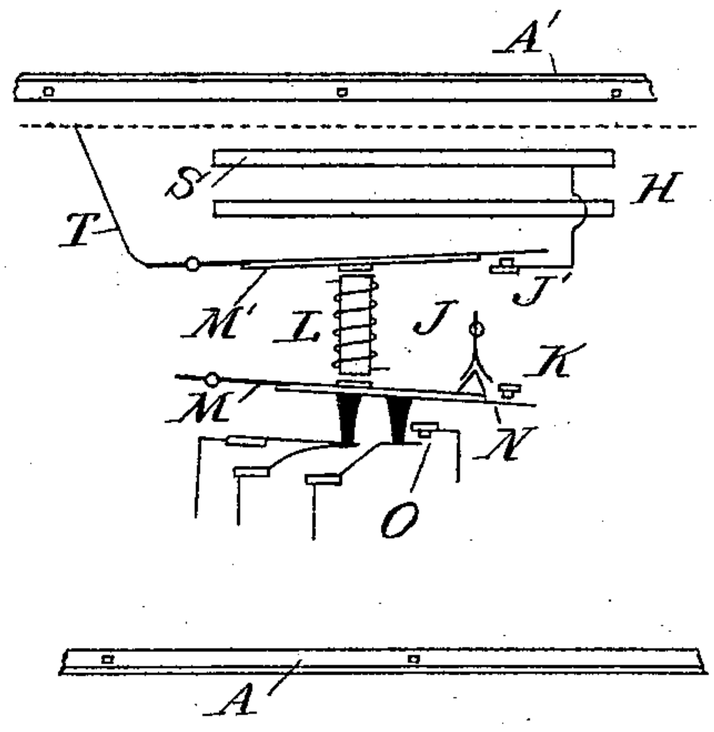


Fig. 4.

Fig. 3.



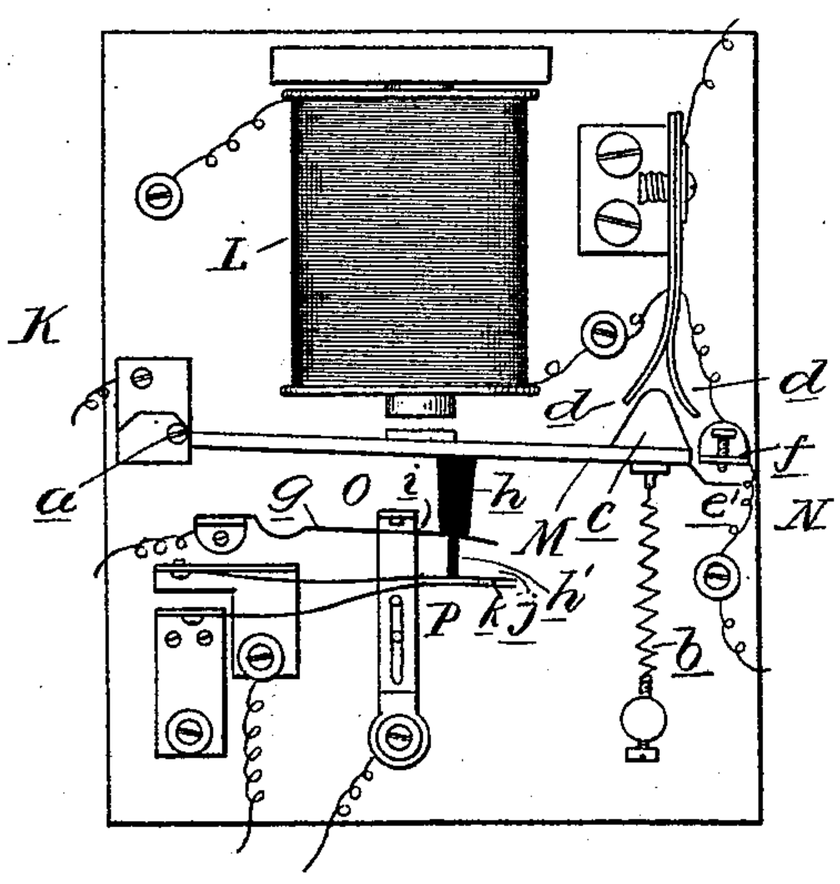
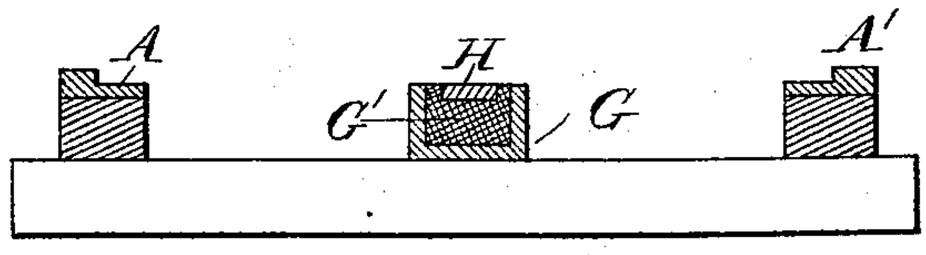


Fig. 5.



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SUPPLY SYSTEM FOR ELECTRIC RAILWAYS.

SPECIFICATION forming part of Letters Patent No. 521,711, dated June 19, 1894.

Application filed April 28, 1893. Serial No. 472,163. (No model.)

To all whom it may concern:

Be it known that I, THOMAS HARRIS, a citizen of the United States, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Electric Railways, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates more specifically to that class of electric railway, in which the motor circuit during the travel of the car is maintained in multiple connection between a sectional working conductor and a return conductor (or the ground) and wherein the sections of said working conductor are automatically connected and disconnected from the power line by the operation of electric switches operated by the travel of the car.

My invention primarily consists in the peculiar construction and arrangement of the device whereby my system is equally well adapted to single or double track roads, and further in the novel construction and arrangement of the switching devices whereby a single magnet for each section of the working conductor controls the operation of the switching devices in a simple and efficient manner.

My invention also includes an arrangement of sectional return conductor which may be used in connection with my system all as more fully hereinafter described and shown in the accompanying drawings, in which—

Figure 1 is a diagram plan of two sections of railway track equipped with my system, the two sections shown being supposed to form together a complete line of single track railway. Fig. 2 is a diagrammatic elevation of a motor car showing the traveling contact on the car for operating the switching devices. Fig. 3 is a diagram showing a modification of my system specifically referred to. Fig. 4 is an enlarged detail drawing of the switch magnet showing the different breaks controlled by said magnet in the position in which they are held normally, and Fig. 5 is a cross section of the track.

A A′ represent the rails of the track; B the generator which furnishes the power; C the positive lead or so-called power line and C′ the negative lead which in the drawings is shown connected to the rail A′ whereby the latter may serve as the return conductor.

D is a battery or other source of electricity adapted to furnish the power for actuating the switch magnets and E E′ are the positive and negative leads for such source. The battery or source of electricity D is preferably located at the station where the generator is, and the leads E E′ should extend from there the whole length of the track, but preferably to save wire the lead E may be combined with the lead C.

H represents the sectional working conductor; it is composed of like sections insulated from each other and preferably laid in the plane of the rails with the upper surface exposed. A simple way in which this may be accomplished would be to use flat bars for the sections of the conductors and lay them in an open conduit G filled with insulating material G′ as shown in Fig. 5. The sections of the working conductor are connected to the power line by feeders I, one feeder for each section and these feeders have normally open breaks J automatically controlled by electric switches K which are operated by the travel of the car. The construction of these switches is as follows: L (Fig. 4) is the switch magnet and M is its movable armature pivotally secured at *a* and normally withdrawn from the magnet by a spring *b*. This armature carries the movable contact *c* which is adapted to contact with the springs *d d* when the magnet is energized and these contacts constitute the break J in the feeder I. The armature carries also the movable contact *e* which is adapted to contact with the fixed contact *f* when the magnet is energized and these two contacts form a normally open break N in the circuit of the switch magnet. The armature controls two other breaks O and P, the break O is normally open and is formed by the contact spring *g* (which is moved by the insulating stud *h* on the armature) and the fixed contact *i*. The other break P is normally closed, it is formed by the two spring contacts *j k* which are brought in contact with each other when the armature is retracted by the insulating stud *h′* on the armature.

The switches are connected in a manner to form two systems, one system operates as will be afterward more fully explained in the travel of the car from left to right to connect every other section of the working conductor with the power line and the other system op-

erates in the same manner with the intermediate section when the car travels from right to left.

In the drawings H′ to H⁵ indicate the sections of the working conductor which are operated by one system of switches when the car travels toward the right and H^I to H^V indicate the alternate sections which are operated by the other system of switches when the car travels toward the left.

In the drawings in Fig. 1 the first three switches of each system are shown, they are correspondingly distinguished by the use of Italian and Roman numerals respectively.

The manner in which the switches are connected I will now explain by referring first specifically to the switch K² which is one of the switches of the system which controls the rail sections H′, H², H³, &c. The fixed contact of the break J of this switch is connected to the rail H² and the armature is connected to the power line C. This connection forms the feeder I for the rail section H² when the break J is closed. The magnet L of the switch K² has one terminal of its coil connected through the wire *l* with the fixed contact of the break N and the other terminal is connected by way of the wire *m* to one contact of the break P of the next succeeding like switch K³, and thence by wire *n* from the other contact of said break to the lead E′. The break O of the switch K² has its spring contact connected by wires *o* to the fixed contact of the break N of the next succeeding like switch K³ and the fixed contact of the break O is connected by wire *p* to the fixed contact of the break J. The other switches of the system to which the switch K² belongs are connected in like manner from the first to the last switch, with this difference that in the last switch (which is represented in the drawings by the switch K⁵ shown in dotted lines) the break O may be omitted as its connections cannot be completed; also the connection *m* of its magnet coil is made directly with the lead E′ and that part of the feeder I connecting the armature with the power line is preferably omitted. In the first switch the break P may be omitted as its contacts remain unconnected, but in addition the fixed contact of its break N is electrically connected through the wire *q* with the lead E of the switch battery and a normally open manual switch or push button Q is placed in this connection. The car in order to operate these switches in its travel from left to right is provided with two contacts or brushes R R′ which are fixed to the car in such relation that one of the two brushes will always be in contact with one of the sectional conductors which the switch system controls. These contacts are electrically connected with each other and with the motor circuit and they operate in connection with the switch system as follows: In starting the car from left to right one of its branches R R′ must be in contact with the section H′ which section like all the rest is disconnected from the power line. When the operator wants to start he touches the push button Q (which for this purpose is arranged preferably in close proximity to the break), this completes an electric circuit through the magnet L of the first switch K′ by way of the connection *q* from lead E to fixed contacts of break N, thence through coil of magnet and connection *m* to break P of switch K² (which break is normally closed) and thence through connection *n* to lead E′. The maguet L of switch K′ is now energized by the battery current and attracts its armature, this closes the break N and thereby closes the switch circuit of magnet K′, also by way of the feeder I from the power line C (which also represents the lead E) to the armature and thence through break N where it joins the other circuit. The actuating circuit of the switch K′, is thus closed through two branches and therefore the magnet L remains energized after the operator withdraws his finger from the push button. The armature of switch K′ remaining thus attracted closes the break J which connects the conductor section H′ through the feeder I with the power line and the car is thus enabled to proceed on its way. Before the rear brush of the car, however, leaves the section H′ the front brush touches the section H², this immediately closes the actuating circuit of switch K² by way of the power line C, feeder I of switch K′, section H′, brushes R R′ to section H², feeder I of switch K² to fixed contact of break J of said switch, thence through connection P back to break O of switch K′ (which is now closed) and through its connection *o* to fixed contact of break N in K², from there through magnet L and its connection *m* to break P in the switch K³ and from there to lead E′. The closing of this circuit energizes the magnet of switch K² and its armature closes the breaks J and N, the result is that thereby a new path is opened to the battery current by way of the armature of switch K² from the power line through break N, thence through magnet L and connection *m* to break P of switch K³ and thence through connection *n* to lead E′. The battery current thus continues to flow through the magnet of switch K² after the rear brush of the car leaves the section H′ and the car can proceed on its travel by taking the current from the section H² which is now connected with the power line through its feeder. Simultaneously with the closing of the breaks J and N of switch K² the break P is opened and as the battery current which energizes the magnet of switch K′ flows through said break, said magnet will be cut out and therefore the switch K will be restored to its normal condition thus disconnecting the section H from the power line. The break O in switch K² is now also closed and therefore as soon as the front brush of car touches the section H³, a switch actuating circuit will be closed through the magnet of switch K³ precisely in same manner as described for switch K², and simultaneously

therewith the opening of the break P in switch K^3 will cut out the magnet of switch K^2 and thereby restore the parts to their normal condition. In this manner the car is enabled to travel along the track from left to right by the successive operation of the system of switches just described. At the last switch which is represented in Fig. 1 by switch K^3, the armature is not connected with the power line and therefore the section H^5 is not rendered active, but it may be connected and this last feeder may then be disconnected by a mechanically or manually operated break, if desired. The other switch system operates in connection with the conductor sections H^I H^{II}, &c., and the switches of this system are constructed and arranged to operate precisely in the manner as the switches of the other system except that, being connected in the reverse order, they operate in the travel of the car from right to left. The two systems of switches operate entirely independent of each other and thus my invention is applicable to either single or double track roads without the slightest change. For a double track road, of course one track would be equipped with the conductor sections and switches adapted to operate with the car going in one direction and the other track would be equipped with the conductor section and switches operating the car in the opposite direction.

In practice the simplest way for equipping a single track road would be to place the sections of the working conductor all in line with each other between the rails of the track and connect the sections alternately to the two systems of switches.

For surface roads I propose to use short conductor sections, so that each section during the interval in which it is active, is protected by the car. In this way no danger can arise and my system is thereby made safe to be used on public streets and high-ways and the conductor sections may be entirely exposed and level with the surface of the permanent way so as to form no obstruction.

In my system the wires may all be carried under-ground and a single conduit may accommodate them all, and the switches instead of being distributed along the line may be arranged in any desired accessible position. In this and other respects my system may be modified in many ways to suit particular requirements, I deem the above description, however, sufficient to enable any skilled electrician to apply my system and add such details as may be found necessary in practical use. One modification I will, however, mention in particular and this is shown in Fig. 3, in which K represents a switch of the construction already described, and the modification consists in providing each switch with a second armature M^I which acts in connection with the opposite pole of the magnet. This armature controls a normally open break J′, the fixed contact of which is connected to a sectional return conductor S, and the armature is connected to a return conductor T to the dynamo, which return conductor would be preferably laid under ground.

It will be seen that if the track is provided with a line of sectional conductors S corresponding with the sections of the conductor H, the car may be run in multiple connection between the two sets of sectional conductors (by providing the car with suitable brushes) and thus the rail A′ is not needed to form the return conductor, which obviously would increase the factor of safety in my system.

It will be seen that the break J′ will be closed and opened simultaneously with the break J and thus when one section of the conductor H is connected to the power line, the corresponding section of the sectional return conductor S is simultaneously connected to the return conductor T to the dynamo.

I am aware that many obvious changes and alterations in the arrangement of the system can be made and substituted for those herein shown and described without in the least departing from the nature and principle of my invention.

What I claim as my invention is—

1. In an electric railway system, the combination with a continuous power line, of a working conductor composed of sections normally disconnected from said power line, a switch line and a return switch line extending along the working conductor from a stationary source of electricity, an electro-magnet for each section of the working conductor, the armature of which is adapted to connect the section with the power-line and with the switch line, two energizing circuits for each magnet one connecting the section of the working conductor with the return switch line through a normally open and a normally closed break controlled by the next adjacent magnets respectively, and the other connecting the two switch lines through the said normally closed break of the other circuit and a normally open break controlled by the magnet itself, and a contact on the car adapted to connect two adjacent sections of the working conductor, substantially as described.

2. In an electric railway system, the combination with a continuous power line, of a working conductor composed of sections normally disconnected from said power-line, a contact on the car adapted to connect two adjacent sections in the travel of the car, a switch and a return switch line extending along the working conductor from a stationary source of electricity, an electro-magnet for each section of the working conductor, the armature of which is adapted to connect the section with the power line and with the switch line, and two energizing circuits for each magnet, one connecting the section of the working conductor with the return switch line and including a normally closed break controlled by the succeeding magnet and a normally open break controlled by the preceding magnet and by a push button for the initial mag-

net, and the other circuit connecting the two switch lines and including the said normally closed break of the other circuit and a normally open break controlled by each magnet itself, substantially as described.

3. In an electric railway system, the combination with an insulated power line and an insulated return power-line, of two exposed working conductors composed of corresponding sections normally disconnected from the power lines and with which the cars are adapted to travel in multiple connection, a contact on the car adapted to connect the adjacent ends of the sections of one of the working conductors, a switch line and a return switch-line extending along the working conductors from a stationary source of electricity, an electro-magnet for each two corresponding sections of the working conductors, two armatures for each magnet, one adapted to connect the section of one working conductor to the return power line, and the other armature being adapted to connect the corresponding section of the other working conductor to the power line, and to the switch line, two energizing circuits for each magnet, one connecting the sections of one working conductor (that which is adapted to be connected with the switch line) with the return switch line including a normally closed break and a normally open break respectively controlled by the adjacent magnets, and the other energizing circuit connecting the switch lines and including the normally closed break of the other circuit and a normally open break controlled by each magnet itself, substantially as described.

4. In an electric railway system, the combination with a power-line, of a working conductor composed of sections normally disconnected from said power-line, a contact on the car adapted to connect one section with the adjacent section of said working conductor in the travel of the car, a switch line and a return switch line extending along the working conductor from a stationary source of electricity, a switch magnet for each section of the working conductor, the armatures of each of which are adapted to connect said section with the power-line and with the switch line, and two energizing circuits for each magnet, one adapted to connect the magnet between the return switch line and its section of the working conductor and including a normally open and a normally closed break controlled by the magnets of the adjoining sections of the working conductor respectively—in reverse order in the two magnets of each section—and the other circuit adapted to connect the magnet with the switch lines and including the said normally closed break of the other circuit and a normally closed break controlled by the magnet itself, substantially as described.

5. In an electric railway system, the combination with a continuous power line, of a working conductor composed of sections normally disconnected from said power-line, a contact on the car adapted to connect the ends of adjoining sections of the working conductor, a switch magnet for each section of the working conductor the armature of which is adapted to connect the section with the power line, a source of electricity adapted to operate said switches and having one pole connected to the power-line and the other to a return switch line extending along the power-line, and connections whereby each magnet is comprised in two circuits, one between the return switch conductor and the section of the working conductor, which the magnet controls, and including a normally open and a normally closed break controlled respectively by the magnets of the adjacent sections and the other circuit between the power-line and the switch return line and including the said normally closed break of the other circuit and a normally open break controlled by the magnet itself, substantially as described.

6. In an electric railway system, the combination of two working conductors each composed of corresponding sections, a continuous insulated power-line and a continuous insulated return power-line, both normally disconnected from said working conductors, cars adapted to travel in multiple connection with corresponding sections of the two working conductors and provided with a contact or contacts adapted to connect the adjoining ends of the sections of one of the working conductors, a switch magnet for each two corresponding sections of the working conductor provided with two armatures one adapted to connect the sections of one of the working conductors with the power line and the other adapted to connect the corresponding section of the other conductor with the return power-line, a source of electricity adapted to operate said switches and having one pole connected to the power-line and the other to a return switch line extending along the power-line, and connections whereby each magnet is comprised in two circuits, one between the return switch conductor and the section of the working conductors which the magnet is adapted to connect with the power-line and including a normally open and a normally closed break controlled respectively by the magnets of the adjacent sections and the other circuit between the power-line and the switch return line and including the said normally closed break of the other circuit and a normally open break controlled by the magnet itself, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

THOMAS HARRIS.

Witnesses:
M. B. O'DOGHERTY,
N. L. LINDOP.