No. 723,592. PATENTED MAR. 24, 1903.

H. EDWARDS.

ELECTRIC RAILWAY.

APPLICATION FILED JUNE 16, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

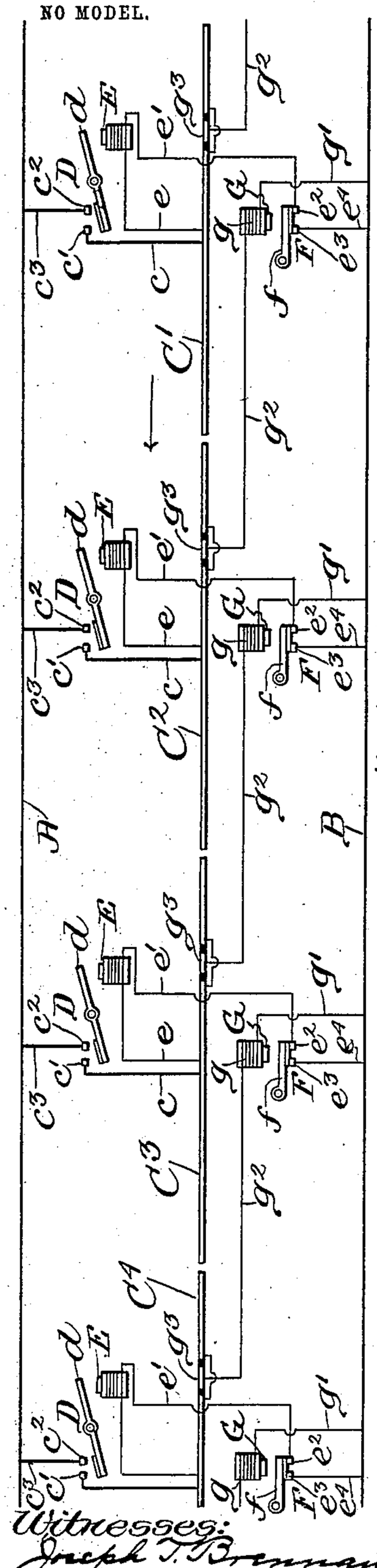

Fig. 1.

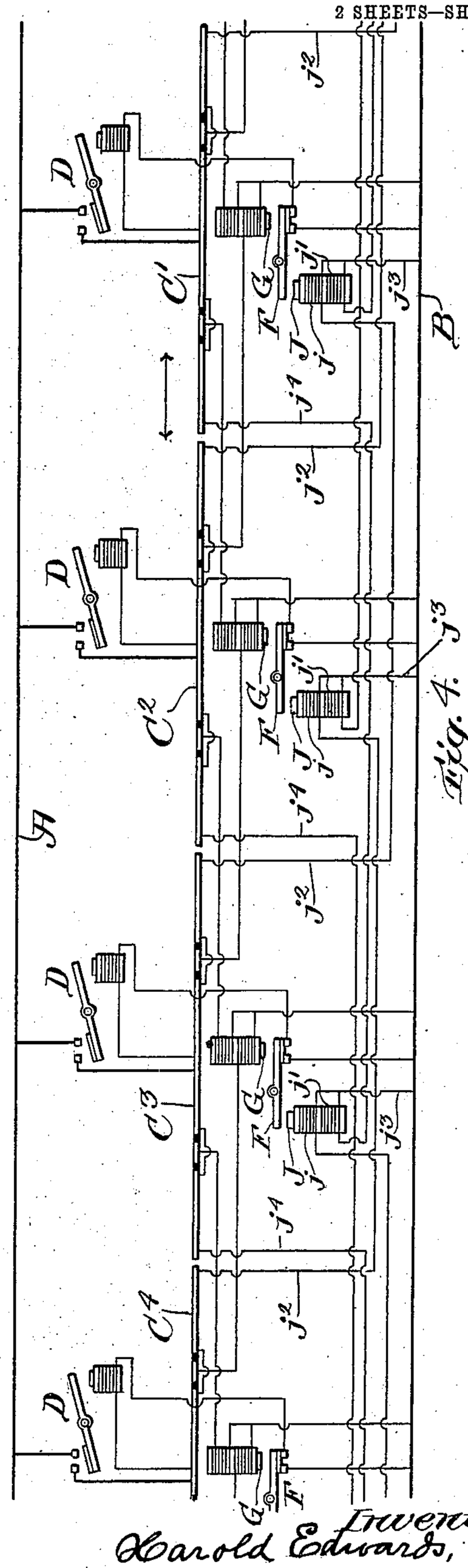

Fig. 4.

Witnesses:
Joseph T. Brennan.
Grace E. Gibbons.

Inventor:
Harold Edwards,
by Roberts & Mitchell,
Attorneys.

No. 723,592. PATENTED MAR. 24, 1903.

H. EDWARDS.

ELECTRIC RAILWAY.

APPLICATION FILED JUNE 16, 1902.

NO MODEL. 2 SHEETS—SHEET 2.

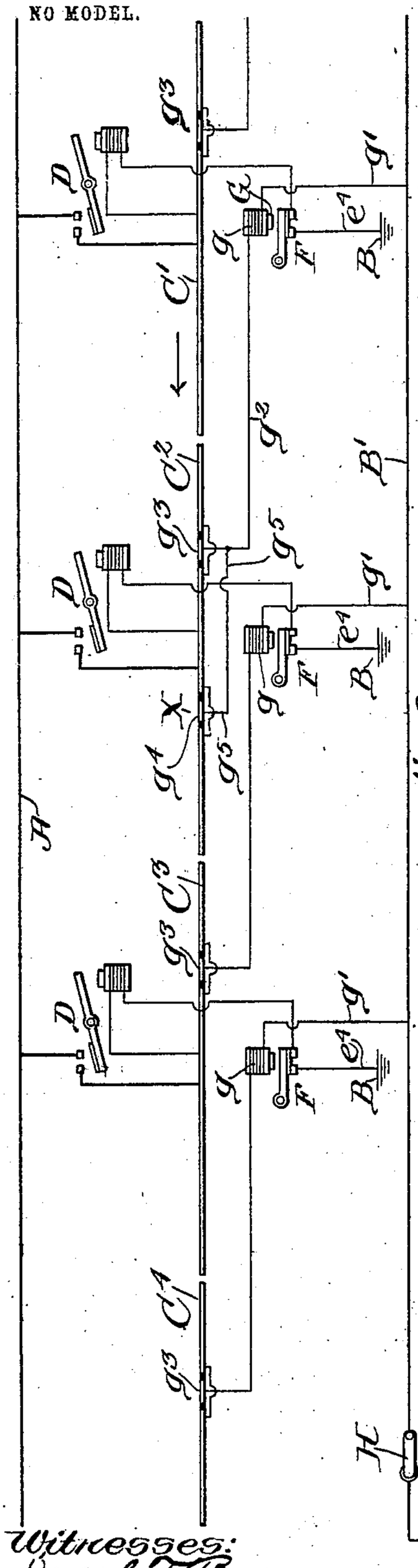

Fig. 2.

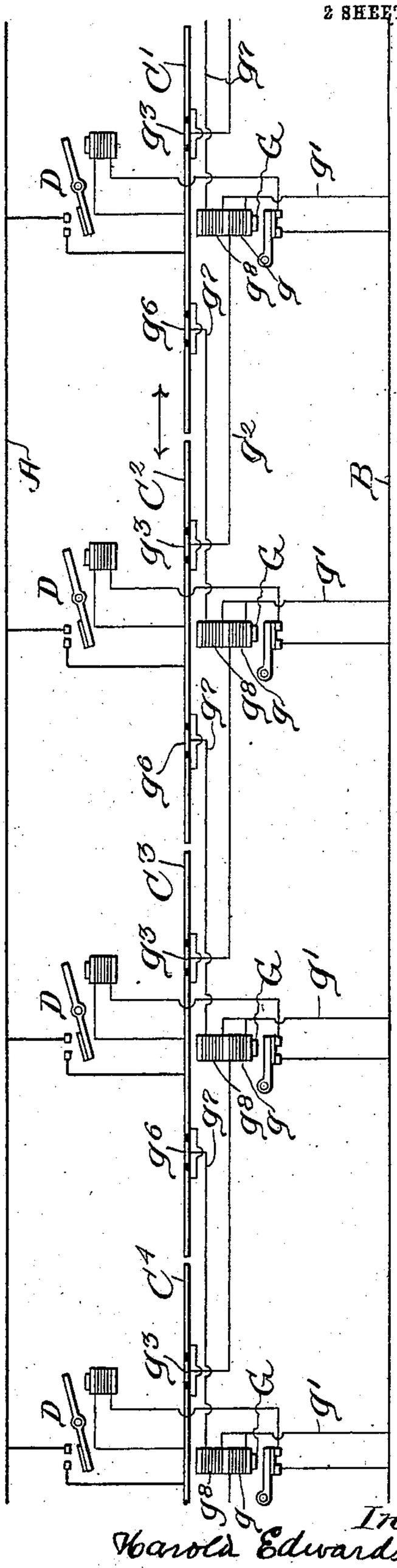

Fig. 3.

Witnesses:
Joseph T. Brennan.
Grace E. Gibbons

Inventor:
Harold Edwards,
by Roberts & Mitchell,
Attorneys.

UNITED STATES PATENT OFFICE.

HAROLD EDWARDS, OF BOSTON, MASSACHUSETTS.

ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 723,592, dated March 24, 1903.

Application filed June 16, 1902. Serial No. 111,882. (No model.)

To all whom it may concern:

Be it known that I, HAROLD EDWARDS, a subject of the King of Great Britain, and a resident of Boston, in the county of Suffolk and State of Massachusetts, have invented an Improved Electric Railway, of which the following is a specification, reference being had to the accompanying drawings, forming part hereof, in which—

Figure 1 is a diagram of part of an electric railway, showing one form of my invention which is adapted for use where trolleys pass along the trolley-rail in one direction only. Fig. 2 is a similar diagram, but includes also other features of my invention. Fig. 3 is a diagram of part of an electric railway, showing another form of my invention adapted for use where trolleys pass along the trolley-rail in both directions. Fig. 4 is a view similar to Fig. 3, but showing also another feature of my invention, which is hereinafter described.

My invention relates to that class of electric railways in which the trolley-rail or conductor is made up of sections which are insulated from each other and which comprise also means whereby a trolley or shoe passing along the trolley-rail from one section to another automatically connects the section upon which it is entering with the source of electrical power and automatically disconnects a section which it has left or is leaving from the source of electrical power, so that only that section of the trolley-rail which the trolley or shoe is on is alive.

The objects of my invention are to simplify and improve the construction of electric railways of the class above described, to provide an electric railway of this class adapted to be operated automatically by trolleys passing in both directions along the trolley-rail, and to provide an electric railway of this class in which it will be impossible for two cars with which the trolleys travel to meet in collision.

My improved electric railway in its simplest form comprises a main feeder and a return and a trolley-rail or conductor which is made up of a number of sections insulated from each other. An electrical connection is also provided between each section and the main feeder which is controlled by a normally open switch, and each normally open switch is operated by means of an electromagnet arranged in a circuit which is controlled by a normally closed switch. Means are provided to cause a trolley upon entering a section to automatically close the operating-circuit of the normally open switch of that section, and thereby close that switch and connect that section with the source of electrical energy, and to automatically open the normally closed switch of a section to the rear, and thereby break or open the circuit of the magnet of the normally open switch of that rear section, and thus open said switch, which disconnects said rear section from the source of electrical energy.

Other features of my invention are hereinafter pointed out.

In the accompanying drawings, A represents a main feed-wire, which is connected with one pole of the source of electrical energy, and B the return, which is connected with the other pole of the source of electrical energy.

$C' C^2 C^3 C^4$, &c., represent the sections which make up the trolley-rail. Each section of the trolley-rail is connected by a wire c with one electrode c' of a switch D, the other electrode c^2 of which is connected by wire c^3 with the main feed-wire A. Switches D are normally open; but when closed current flows from feed-wire A through these connections to their respective trolley-rail sections and from the sections through the trolley to the motor of the car and thence to ground through one of the rails on which the car rides.

The bridge-piece of each switch D is carried by an armature-lever d, which is operated in one direction by means of an electromagnet E and in the opposite direction by gravity or by a spring. One end of the coil of each magnet E is connected by a wire e with its respective section of the trolley-rail, and the other end of said coil is connected by wire e' with one electrode e^2 of a normally closed switch F, the other electrode e^3 of which is connected by a wire e^4 with the return or ground B.

The bridge-piece of each switch F is carried by an armature-lever f, which is moved in one direction by means of an electromagnet G and in the opposite direction by gravity or by a spring. Coils g of magnet G are each connected at one end with return B by

a wire g' and at the other end by wire g^2 with a short supplemental section of trolley-rail g^3, which is herein shown as forming part of the next adjacent main section of the trolley-rail, but electrically insulated from the adjacent parts of that section. The short supplemental section of rail g^3 is preferably at a distance from the nearest end of the main section of rail of which it forms part greater than the length of the longest car or train of cars operating upon the system. It is customary in some systems to provide each car with two shoes or trolleys, one at each end of the car, which are electrically connected together and with the motor of the car. When cars so constructed are used, the short supplemental section g^3 is made shorter in length than the distance between the two shoes of a car, so that both shoes will not be on the short section g^3 at the same time, the reason for which will hereinafter appear.

It will now be clear that a pair of electrically-connected shoes or trolleys of a car in traveling from right to left, Fig. 1, and leaving section C′ will, when one shoe reaches and contacts with section C^2 and the other is still on section C′, cause a current to flow from the shoe on section C′ through the usual connection between the two shoes to the other shoe on section C^2. From the shoe on section C^2 current will then flow through section C^2 to wire e, through the coil of magnet E, through e', switch F, and wire e^4 to return B. Thus the magnet E is energized and closes switch D. Section C^2 is then connected with wire A through wires c and c^3 and switch D, which causes magnet E to continue to hold switch D closed even after both trolleys or shoes have left section C′ and passed on to section C^2, for then current is supplied to magnet E from section C^2, which is then alive. After both shoes or trolleys have passed upon section C^2 the forward shoe of the pair passes on to supplemental section g^3 of section C^2, and current is thereby caused to flow from the rear shoe, which is on main section C^2, to the forward shoe on supplemental section g^3, through wire g^2, coil g of magnet G of section C′, and wire g' to return B. This causes magnet G of section C′ to open switch F and break the circuit through magnet E of section C′, which frees armature-lever d and allows the latter to move by gravity or otherwise, so as to carry and hold the bridge-piece away from and out of contact with electrodes c' and c^2. In this manner it will now be clear a trolley or a pair of connected trolleys upon entering a section automatically closes the normally open switch of the section ahead, thereby connecting that section with the source of electrical energy, and also automatically opens the normally closed switch of the section to the rear, thereby breaking the circuit of the magnet E of said rear section, opening switch D, and disconnecting said rear section from the source of electrical energy.

In Fig. 1 of the drawings wires e^4 and g' are shown as connecting with a common return-conductor B, which may be a wire or the ground; but in Fig. 2 each wire e^4 is connected with a return-conductor B, which may be the ground, and all of the wires g' are connected with a common return wire or conductor B′, in which is arranged a switch H, which may be located in the train-despatcher's office at the end of the road or division of the road or at any desired and suitable point between the last wire g' and ground or the pole of the electrical source with which the wire B′ is connected. When switch H is closed, as shown in Fig. 2, the operation of the system is the same as above described in connection with Fig. 1; but sometimes it is desired to prevent a trolley or pair of trolleys in passing along the trolley-rail from one section to the next ahead from opening switch F of the sections, and thereby disconnecting the sections to the rear of the trolley from wire A. For this purpose I have provided switch H. When switch H is open, the contact of the forward end of a trolley or of the forward shoe of a pair of trolleys with each short section g^3 will not act to open switches F, for the reason that the circuits of which coils g form part are broken at H. Under these conditions—that is, with switch H open—the passage of a trolley or pair of trolleys over the system acts to connect each section with wire A and to leave each section so connected, so that following trolleys do not operate any of the switches, all of the latter being left closed by the first trolley; but when switch H is closed the first trolley or pair of trolleys to pass along the trolley-rail restores the system to its normal condition, as already described. It will also be clear that if the trolley or pair of trolleys of a car have entered upon section C^2 and a second car is following the first too closely as soon as the first shoe of the first car contacts with supplemental section g^3 switch F of section C′, on which the trolley of the second car is traveling, will be opened, thus opening switch D of section C′ and cutting off the power from section C′. To again throw in the section thus rendered "dead," it will only be necessary to make a momentary connection by means of a piece of wire or other metal between the conductor and the main feeder, which in systems such as the ordinary third-rail system is usually immediately under or near the conductor, or the switch D may be turned by hand where such method is not impracticable by reason of the length of the sections and the consequent possible distance of the switches.

In Fig. 2, X is intended to represent the location of a station or stopping place for cars or trains traveling over the road, and a feature of my invention consists in providing means to prevent a car or train which is approaching a station—such, for example, as station X—from passing an intervening section of the trolley-rail while another car or train is at the station. To secure this result,

a short supplemental and insulated section g^4 is herein shown as inserted in the main section C^2 of the trolley-rail, so situated with relation to the station X that when a car or train is stopped at the station one shoe of a pair of trolleys on the car will rest on section g^4 and the other on section C^2. Section g^4 is connected by a wire g^5 with wire g^2 of section C', so that while a car is at station X current flows from section C^2 through the trolleys of the car to section g^4, through wire g^2 and to and through the coils g of magnet G, and through wire g' to conductor B' or to ground. So long as supplemental section g^4 is connected with ground through magnet G of section C' and current flows through said connection a following train entering section C' will lose its supply of power and be stopped, since that section cannot be connected with feed-wire A so long as the energized magnet G holds open switch F in the circuit of magnet E.

By the arrangement shown in Figs. 1 and 2 only trolleys traveling in one direction—that is, from right to left—will automatically disconnect the section to their rear from feed-wire A as they travel along the trolley-rail; but in Fig. 3 I have shown an arrangement whereby a trolley entering a section from either end from right to left or left to right in said figure will automatically disconnect a section to its rear from the wire A as it travels along the trolley-rail.

As shown in Fig. 3, each trolley-rail section C' C^2 C^3, &c., is in addition provided with a short insulated supplemental section g^6, located near the end of such section of trolley-rail opposite to that in which the short supplemental section g^3 is located, and while each supplemental section g^3 is connected with the coil of magnet G of the section of trolley-rail which is at one end of that section of trolley-rail in which supplemental section g^3 is located each section g^6 is connected by a wire g^7 with a second coil g^8 on the magnet G of that section which is at the other end of the section of trolley-rail in which supplemental section g^3 and g^6 are located. For example, the short section g^3 of section C^2 is near one end of section C' and is connected by wire g^2 with one end of coil g of magnet G of section C', and the short section g^6 is near the other end of section C^2 and is connected by wire g^7 with a second coil g^8, wound upon magnet G of section C^3.

A trolley or pair of trolleys entering section C^2 from the right will, as described in connection with Fig. 1, disconnect section C' from wire A, and a trolley or pair of trolleys entering section C^2 from the left besides acting to close the switch D of section C^2 will also by contact with g^6 cause current to flow from C^2 through the trolley to g^6, through wire g^7 to and through coil g^8 of magnet G of section C^3, to wire g', which connects with return B. This energizes magnet G of section C^3 and opens switch F, which causes switch D to be opened and section C^3 to be disconnected from wire A.

A trolley or pair of shoes passing over a main section of the trolley-rail from right to left first contacts with short supplemental section g^3, which acts to disconnect the next section to the rear of the trolley from wire A, and when near the other end of the main section of trolley-rail it contacts with short supplemental section g^6, which acts to momentarily break the operating-circuit of switch D of the next section ahead. If there be another trolley or pair of shoes on that section ahead which are approaching from the opposite direction, that section will be disconnected from wire A and the car of the trolley on that section cut off from its power and stopped. The same description of operation applies to a trolley passing over a main section of the trolley-rail from left to right, except that such trolley first contacts with short section g^6 and next with short section g^3, as will be clear without further description.

While a certain degree of protection is afforded by the construction and arrangement as described above, yet it is possible with the arrangement shown in Fig. 3 for the trolleys of two trains or cars approaching a given section, as C^2, to pass the short section g^6 of section C' and g^3 of section C^3 at the same time, so that neither car or train will be stopped, and both will be free to pass upon section C^2, where they would be liable to meet in collision. Also it will be seen that it is possible with the arrangement shown in Figs. 1 and 2 for a train which for any reason was stopped in the middle of section C^2, for example, to be overtaken by a following train with a rear-end collision as the result. To prevent such events and to afford perfect protection against collision, each armature-lever F may be provided with two arms, as shown in Fig. 4, one of which is controlled by electromagnet G and the other of which is controlled by an electromagnet J, on which are two coils j and j'. Each of the main sections of the trolley-rail C' C^2 C^3 is connected by a wire j^2 with one end of the coil j of the magnet J of a distant section. For example, section C^2 is connected by wire j^2 with the coil j of the section to the right of section C', (not shown,) section C^3 is connected by wire j^2 with the coil j of section C', and section C^4 is connected by wire j^2 with the coil j of section c^2. When a trolley is in section C^4, that section is alive and current flows therefrom through wire j^2 to and through the coil j of magnet J of section C^2 and through wire j^3 to return B. It will therefore be clear that so long as section C^4 is alive magnet J of section C^2 is energized and switch F of section C^2 held open, so that a following car or train of cars cannot close switch D of section C^2 to connect that section with wire A. Where trolleys travel over the trolley-rail in one direction only, of course these wires j^2 connect each section with the coil j of the second sec-

tion to the rear; but in cases where the trolleys pass in both directions over the trolley-rail, as in Fig. 3, each section is connected also by a wire j^4 with the coil j' of the second section in the opposite direction. For example, section C′ is connected by wire j^4 with one end of coil j' of section C^3 and the other end of coil j' is connected with wire j^3.

My improved electric railway is not only useful in railway systems where the trolleys travel over the trolley-rail in one direction only, but also in systems where the trolleys travel in both directions over the trolley-rail.

What I claim is—

1. In an electric railway, in combination, a main feed-wire; a return-conductor; a trolley-rail having a number of insulated sections; a normally broken connection between each section and the main feed-wire; a normally open switch for controlling each of said connections; a circuit for operating each of the normally open switches; a normally closed switch in each of said operating-circuits; and means to cause a trolley upon entering a section to automatically close the operating-circuit of the open switch of said section and thereby close said switch, and means to automatically open the normally closed switch of a section to the rear and thereby open the normally open switch of said rear section.

2. In a single-track electric railway, in combination, a main feed-wire; a return-conductor; a trolley-rail having a number of insulated sections; a normally broken connection between each section and the main feed-wire; a normally open switch for controlling each of said connections; a circuit for operating each of the normally open switches; a normally closed switch in each of said operating-circuits; and means to cause a trolley upon entering a section from either of its ends to automatically close the operating-circuit of the open switch of said section, and thereby close said switch; and means to cause said trolley to also automatically open the normally closed switch of a section to the rear and thereby open the normally open switch of said rear section.

3. In an electric railway, in combination, a main feed-wire; a return-conductor; a trolley-rail having a number of insulated sections; a normally broken connection between each section and the main feed-wire; a normally open switch for controlling each of said connections; a circuit for operating each of the normally open switches; a normally closed switch in each of said operating-circuits; means to cause a trolley upon entering a section to automatically close the operating-circuit of the open switch of that section and thereby close said switch; and means to cause said trolley to also automatically open the normally closed switch of a section to the rear and thereby open the normally open switch of said rear section; and automatic means to prevent a second approaching trolley from closing the normally open switch of an intervening section between the two trolleys while the section which the first trolley is on is connected with the main feed-wire.

4. In an electric railway, in combination, a main feed-wire; a return-conductor; a trolley-rail having a number of insulated sections each provided with an insulated supplemental section; a normally broken connection between each main section and the main feed-wire; a normally open switch for controlling each of said connections; an electromagnet for operating each of said switches; a connection between each section and its respective magnet and between each magnet and the return; a normally closed switch in each of said connections; an electromagnet for operating each of said normally closed switches; and a connection between the supplemental section of each main section and the operating-magnet of the normally closed switch of another main section, and between each of said last-mentioned magnets and said return.

5. In an electric railway, in combination, a main feed-wire; a return-conductor; a trolley-rail having a number of insulated sections, each provided with an insulated supplemental section; a normally broken connection between each main section and the main feed-wire; a normally open switch for controlling each of said connections; an electromagnet for operating each of said switches; a connection between each section and its respective magnet and between each magnet and the return; a normally closed switch in each of the latter connections; an electromagnet for operating each of said normally closed switches; a return-wire; connections between the supplemental section of each main section and the operating-magnet of the normally closed switch of another main section, and between each of said magnets and the return-wire; and a switch in said return-wire.

HAROLD EDWARDS.

Witnesses:
R. B. HUTCHESON,
RUBY M. BANFIELD.