(No Model.)

2 Sheets—Sheet 1.

J. H. GUEST.

ELECTRIC RAILWAY.

No. 604,747. Patented May 31, 1898.

Fig. 1.

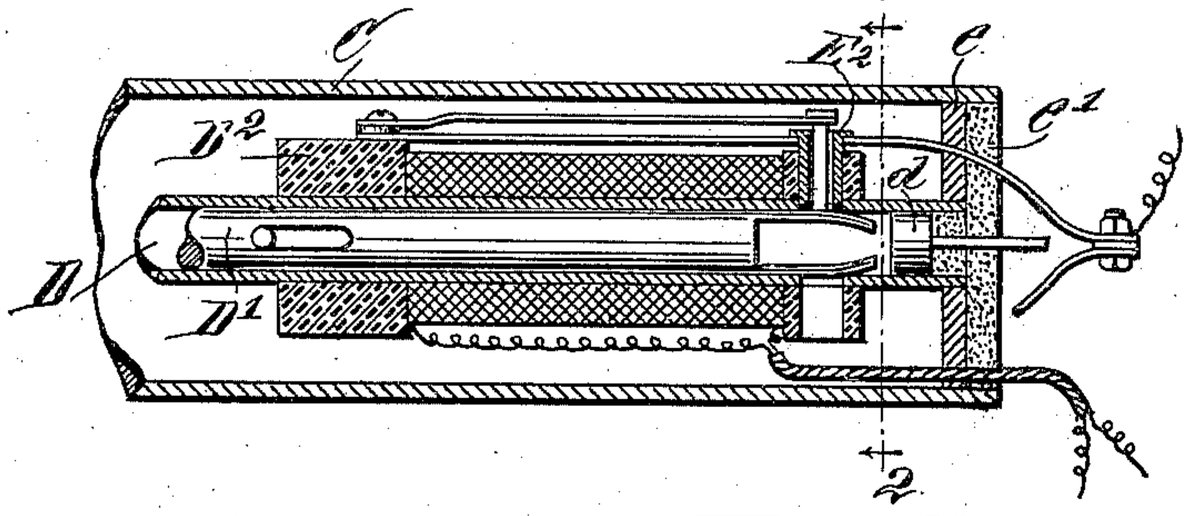


Fig. 2.

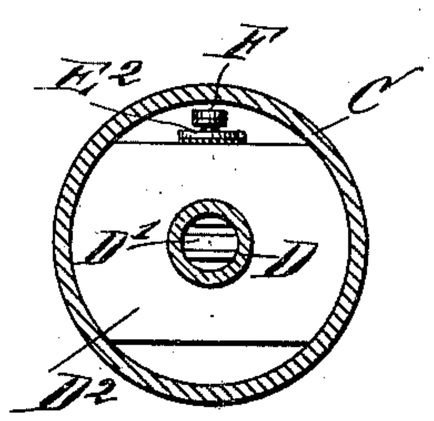


Fig. 3.

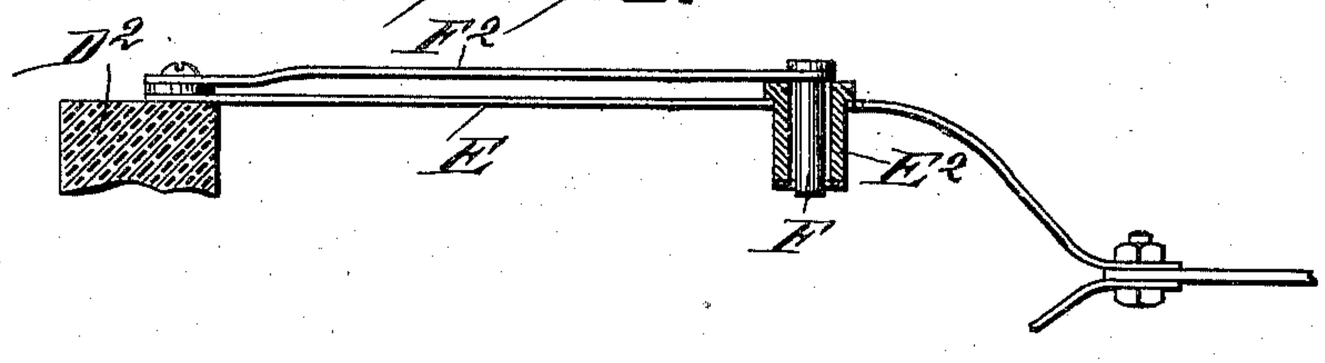


Fig. 4.

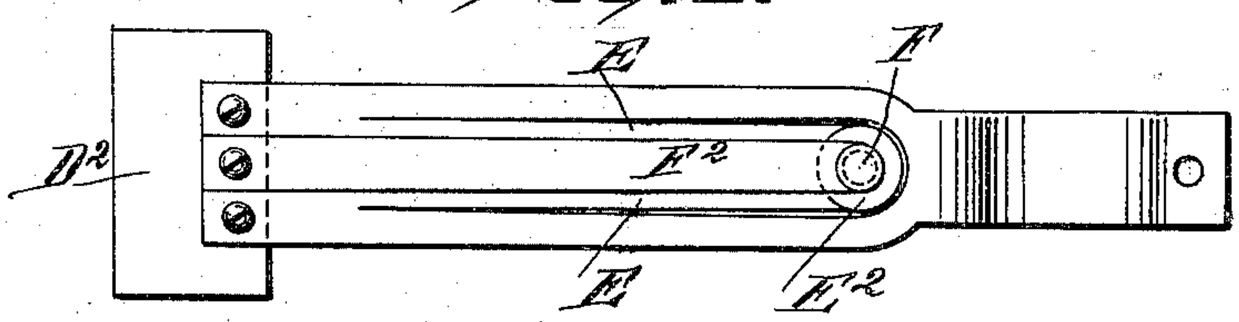
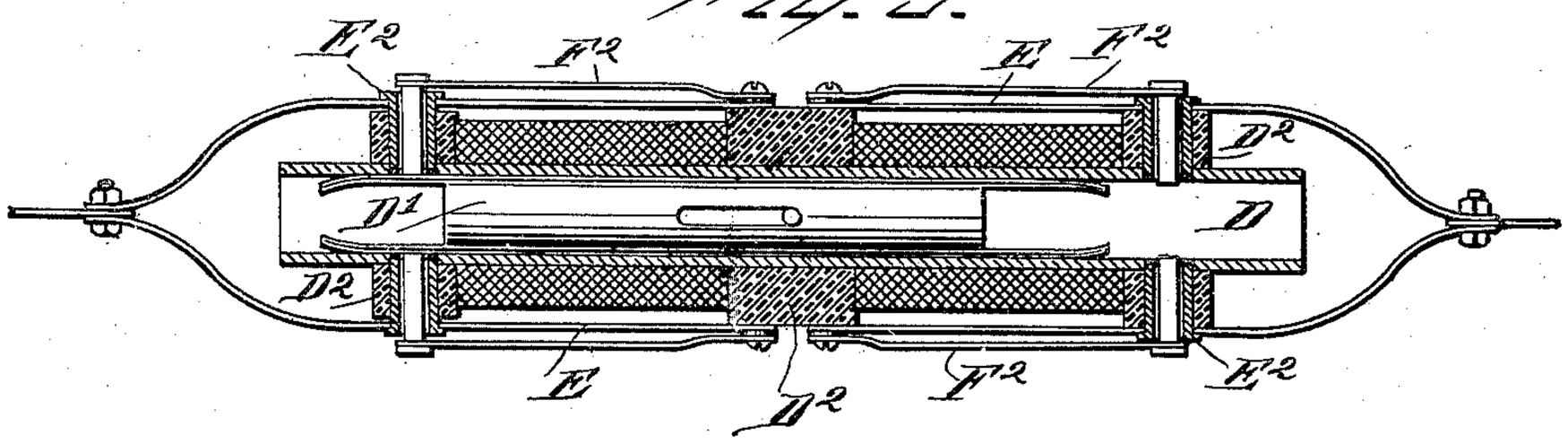


Fig. 5.



WITNESSES:
Henry T. Hirsch.
Wm. N. Capel.

INVENTOR:
John H. Guest
BY
H. C. Townsend
ATTORNEY.

(No Model.)

2 Sheets—Sheet 2.

J. H. GUEST.

ELECTRIC RAILWAY.

No. 604,747. Patented May 31, 1898.

Fig. 6.

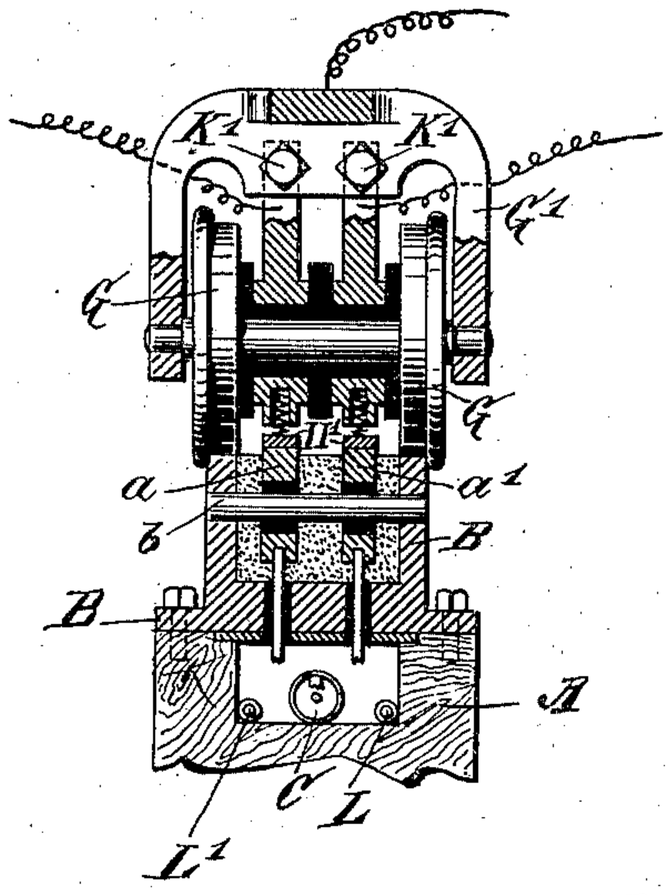


Fig. 8.

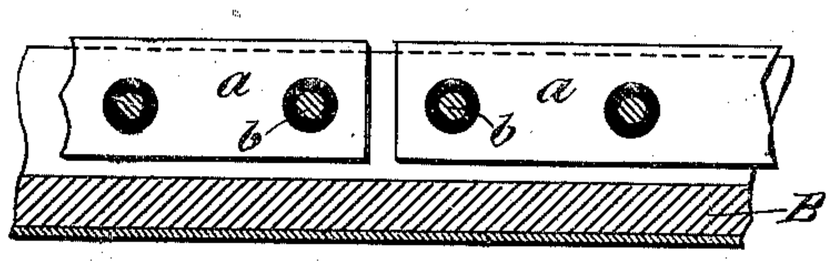


Fig. 7.

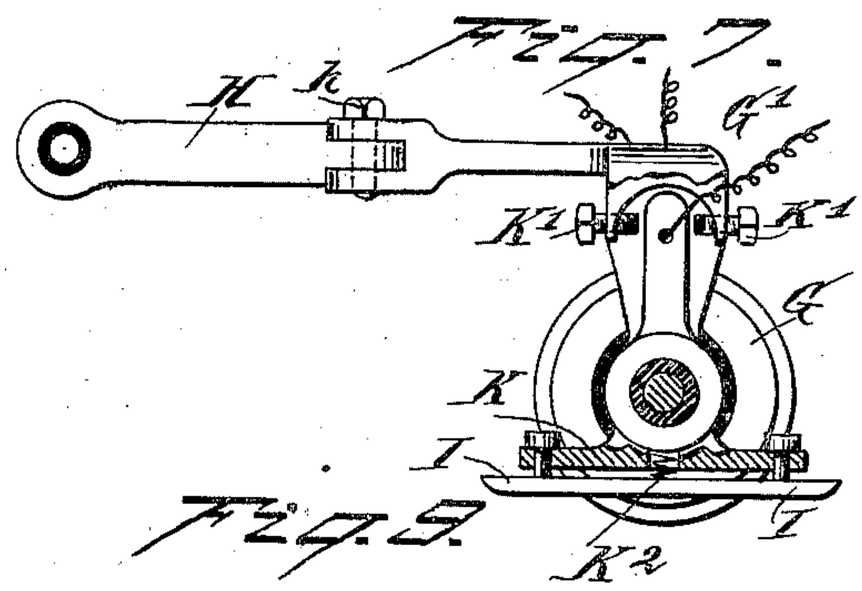
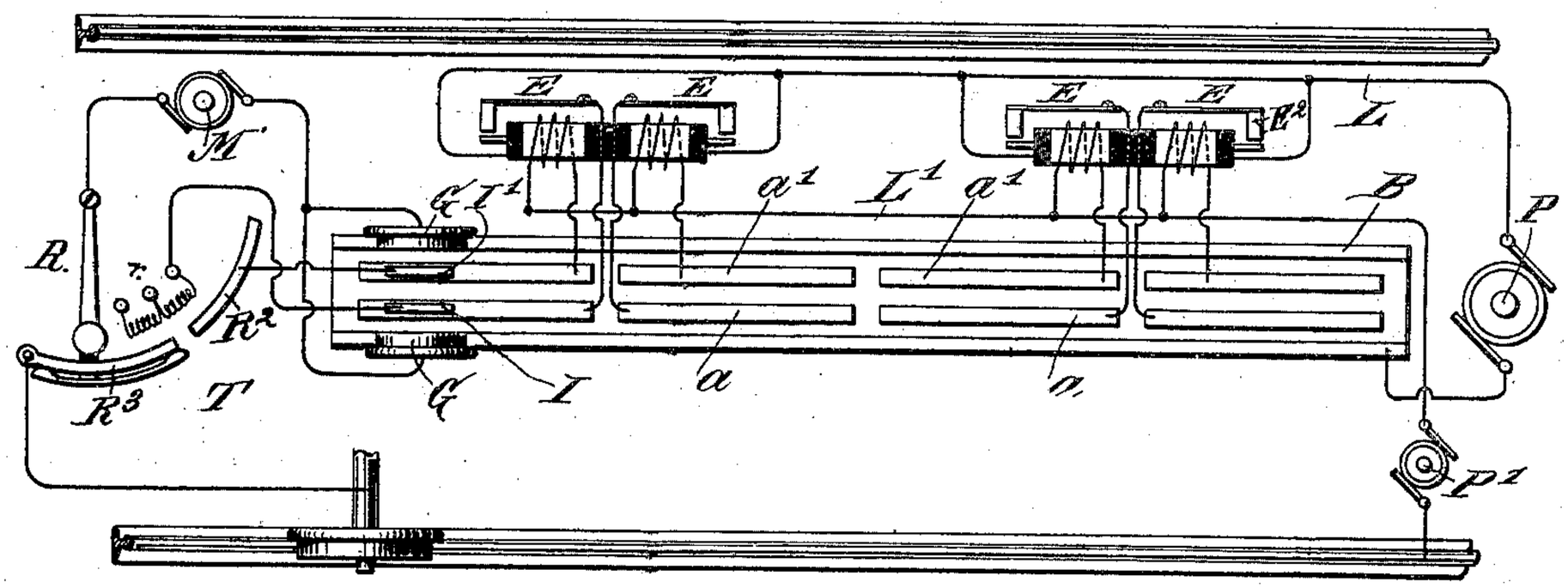


Fig. 9.



WITNESSES:

Henry T. Hirsch.

Wm. P. Capel.

INVENTOR:

John H. Guest

UNITED STATES PATENT OFFICE.

JOHN H. GUEST, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO LINUS M. CHILD, EDGAR O. ACHORN, R. SHERMAN YORK, AND WILLIAM L. WHITCOMB, OF SAME PLACE, AND CHARLES H. MOORE, OF SPRINGFIELD, VERMONT.

ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 604,747, dated May 31, 1898.

Application filed October 20, 1896. Serial No. 609,418. (No model.)

To all whom it may concern:

Be it known that I, JOHN H. GUEST, a citizen of the United States, and a resident of Boston, in the county of Suffolk and State of Massachusetts, have invented a certain new and useful Improved Electric Railway, of which the following is a specification.

My invention relates to electric railways wherein the working conductor from which the car picks up the power-current is divided into sections which are automatically connected with the power source as the car moves along by means of switches controlling the connections of said sections individually and operated by means of electromagnets which are energized when the car enters a section.

My invention relates in some of its features to the manner of supplying the actuating-current for said magnets from a supplemental stationary generator in contradistinction to the main power-generator or to a generator carried by the car itself.

My invention relates, further, to the construction and manner of sealing and protecting the magnetic switches; to the details of such switches, whereby they shall not be caused to open their connection until after the circuit is fully opened on the working conductor or rail; to the construction of the main contact-rail and the mounting of the one or more sets of supplemental contact-rails used in connection with it; to the construction and operation of the trolley or contact devices used with the main rail and supplemental rail, and to other details of construction and combination of devices more particularly hereinafter described, and then recited in the claims.

In the accompanying drawings, Figure 1 is a longitudinal section through one end of the switch-operating magnet and its containing or protective case. Fig. 2 is an end view of the same. Fig. 3 is an enlarged horizontal section through the switch-contacts and their supporting-springs. Fig. 4 is a plan of the same. Fig. 5 is a horizontal section through the double switch-operating magnet. Fig. 6 is a vertical transverse section through the trolley and contact devices, the contact-rails, and the stringer or conduit containing the switches and some of the conductors. Fig. 7 is a side elevation of the trolley and contact devices, a part being broken away. Fig. 8 shows in side elevation a part of two of the supplemental rails or conductors, the trough-shaped containing-rail being in section. Fig. 9 is a general diagram of the apparatus.

Referring to Fig. 6, A is a longitudinal stringer, preferably made of wood, hollowed at its top and extending along the line of track, preferably between the rails, and, if desired, buried. In the hollow top are located the switch-magnets and the insulated conductors which form such of the line conductors as it is desired to thoroughly insulate. The top of the stringer A is closed by a contact-rail B, fastened securely to the top of the stringer, so as to make a good water-tight joint, thereby sealing the trough-shaped cavity in the stringer against the entrance of moisture. The rail B is preferably itself in the shape of a trough, as shown, having flanges at its side to adapt it to be fastened to the stringer. The rail B is made of iron or other suitable conducting material, and upon it travel one or more trolley-wheels, through which the electric currents used in the system may pass. Mounted or supported within the trough-shaped conductor B are one or more sets of supplemental contact-rails or conductors *a a'*.

As the system as hereinbefore described requires two sets, I have shown in the drawings two such sets of rails, which may be formed as plain bars supported on edge with their upper edge slightly above the edge of the rail B to adapt them to be engaged by contacts or contact trolleys or shoes carried by the vehicle or by the trolley-carriage that travels on the rail B.

The supplemental rails *a a'* may be supported, as shown, by transverse pins *b*, extending from one to the other side or flange of the trough and secured therein in any suitable way, but insulated from said rails *a a'* by sleeves or washers of insulating material, as shown. The said rails may be securely anchored in the trough and insulated from one

another by a filling of concrete or insulating cement or other suitable substance, which extends flush with the edges of the trough B and as near as practicable to the upper edge of the rails *a a'*.

The upper or contact surfaces of the several rails are in ordinary cases of city traffic made flush with the road-bed, the paving or street surface being brought up close to the edge of the trough-shaped rail B. However, if circumstances permit, the said rail may be left exposed at its sides.

Within the conduit or stringer A are located the several magnetic switches, the incasing tubes of which are indicated by the letter C. This tube may be of any desired material, preferably insulation or lined with insulation, and within it and closely fitted therein are the electromagnets of the ordinary tubular construction, cut away at one side, if desired, to allow room for the electric switches. The several parts of these operating electromagnets are shown more fully in Figs. 1 to 5.

D is a metal tube, of brass or other conducting material, within which slides to a limited extent and backward and forward under the influence of the coils a core D'. With this core the contact of the switch engages, thereby closing a connection between the wire or conductor secured to the tube D and the wire or conductor connected with the moving contact.

Surrounding the tube D are the sleeves or heads D^2, preferably of insulation, between which and surrounding the tube D are wound the coils of the electromagnet, provision being made, as shown, for two coils, one connected with one of the sectional conductors of the series and the other with the next succeeding one thereof, as shown in the diagram Fig. 9.

The contacts of the switch are carried by springs or arms mounted on one of the heads D^2, as clearly shown, and contact is made with the core D' through the heads at the extreme ends of the electromagnets, which are cut away for that purpose.

Connection with the metal tube D is made by means of a plug of metal *d*, fitted or screwed tightly into the end of the tube and having a projection or extension extending outwardly for attachment of a conductor of the system, the end of the tube itself being filled in with cementing and sealing material, preferably of an insulating character, as shown, thus protecting the interior securely against the possible entrance of moisture. The heads D^2 preferably fit the interior of the tube C, as shown in the end view, and after the insertion of the magnet and the attached switch devices the end of the tube C is securely sealed with any suitable material—as, for instance, by means of a solid plug *e*, over which is applied the sealing-cement *e'*. Through this seal the connections for the switch pass.

The switch itself is constructed in the following manner: E is a spring one end of which is fastened to a head D^2, as shown, while its opposite end extends out through the sealing in the end of the tube C. The central portion of the spring is cut to form a spring-tongue, to which is secured an armature E^2, having a central portion or perforation to permit the passage of the supplemental contact. The armature E^2 is preferably faced with copper to prevent sticking. The supplemental contact F is of any suitable material—as, for instance, copper—and is secured to a spring F^2, passing over the top of the spring E, and passes through the armature E^2, extending slightly below the copper facing thereof. The spring E has a bias tending to lift the armature and with it the pin F, while the spring F^2, which is, however, the weaker one, has a bias tending to lower said pin. The consequence is that when the armature is lowered by the attraction of the core the pin F is allowed to make contact with said core, and afterward the armature itself makes contact and the two remain in contact so long as the magnet is energized. When the circuit is broken through the magnet, the armature is released, but the pin remains in contact until the armature has moved back sufficiently to engage with the under side of the spring F^2 and lift the latter, with the pin F. By means of this double action or following contact it will be seen that a rupture of circuit at the switch will not take place at the instant of the breaking of circuit through the coil on the magnet, but a slight interval will exist which will give time for the full breaking of the connection in the circuit of the coil by the trolley or contact carried by the car. The two coils are wound over the core in such way as to both tend to polarize the core in the same direction. Hence when the system is, as ordinarily, so organized that the second coil comes into action before the first goes out there will be no tendency of the switch to open momentarily, as would be the case if the coils were reversely wound, thus tending to reverse the polarity and allow the armature to spring away.

The core D' is capable of slight longitudinal movement backward and forward under the influence of the coils, which, as already explained, act in succession, and thereby the connection between the core and tube is kept good, as well as the surface where the switch makes connection with the core. The core is shown in one of its extreme positions in Fig. 5. As will be seen, the switch at one end is drawn down into contact with the core, but the opposite end of the core is out of position where connection could be made with it by the switch, even if the armature should be drawn down by the slight attractive effects at the opposite end. The ends of the core where contact is made are slightly bent, as indicated, so that the core can pass freely under the spring-contact, if at the time the core is shifted such spring should be depressed.

As will be understood, one or more additional switch-contacts might be mounted

around the head D^2, and provision for an extra one is shown in Fig. 5. By thus providing a plurality of switches for each section of the system a number of paths for the working current is afforded, thus avoiding the tendency to burning of the contacts, which would exist if but one were employed.

The trolley or contact working upon the trough-shaped rail B preferably carries two trolley-wheels G, both of which are preferably conductors and are hung or turn upon an axis carried in a hanger or yoke G′, which is supported on the end of an arm H. This arm is preferably swiveled or hung upon, but insulated from, the car-axle or other suitable portion of the truck, so as to be capable of a vertical motion, and is jointed at an intermediate portion of its length, as at *h*, so as to be capable of turning in a horizontal plane at its free end to permit the trolley to pass freely around a curve. Connection with the double trolley-wheel is made in the usual manner by attachment to the frame or yoke.

I I are the contact-shoes, which travel upon the supplemental conductors *a a′*. A description of the manner of mounting and constructing one of said shoes will suffice for both. Each shoe is mounted and guided vertically in a hanger K, which, as shown, is supported by the main trolley, being for that purpose swiveled or hung from the axle of the trolley-wheels, but kept out of electrical connection therewith by a sleeve of insulating material, as indicated. This hanger K is so hung as to be capable of turning slightly, its turning motion being limited by stops or abutments with which an arm extending from said hanger engages, as shown, said stops consisting of screws or pins K′, mounted on the yoke G′ and faced with insulating material. Each shoe is pressed downward, preferably by a spring K^2, seated in the hanger K, and is guided vertically by means of the headed pins or studs passing through vertical openings in said hanger, as clearly shown. By this construction the shoe has a free up-and-down movement and is securely pressed into contact with the rail, but is also adapted to pass over any accidental obstructions.

The connections from the supplemental rails *a a′* are made by wires or conductors passing through the bottom of the metal trough B into the trough in the top of the stringer, where they are joined to the springs carrying the switch operated by the magnet and to one terminal of a coil of said magnet by a wire passing, as indicated in Fig. 1, through the sealing in the end of the protecting-casing C.

Referring to the diagram, the power-generator for operating the motor M on the car is indicated at P. The circuit of the motor is controlled over the ordinary controlling-arm R and artificial resistance *r* or other device of suitable character, and one pole of the motor is connected with the main trolley or contact G, as shown, moving on the trough-shaped conductor B, the latter being itself connected to one pole of the power-generator P. The other pole of said generator connects with the wire L, insulated by preference and running through the conduit, and connection is taken off at suitable intervals from said wire L to the switch-magnets, being joined for that purpose with the plugs *d* and so with the cores with which the switches make contact. A double connection, as indicated, is preferably made for each double magnet.

The supplemental stationary generator is indicated at P′, this generator being located at the station with P or any other desired point on the permanent way and supplying the current for operating the electromagnets over a circuit quite independent of the power-circuit. One pole of said generator P′ connects to an insulated wire L′, running through the conduit and itself connected at intervals to one end of the coils of the magnet through the end of the tube C or in any other preferable way, while the other end of said coils connects individually with the supplemental contacts or rails *a′*, as shown in the diagram. The shoe I′, which travels on the latter, is on the vehicle or car connected to a contact-segment R^2, which is engaged by a part on the controller device in such manner that when the controller is operated to bring the motor into action connection is closed between R^2 and a segment R^3, which in turn is joined to the main wheels of the car or car-truck which travel on the car-rail, thereby forming a connection to said rail or to ground and completing the return-circuit to the opposite pole of the supplemental generator P′, one pole of which is, as shown, connected to said rail or to ground. The circuit of said generator is, as will be seen, over line L′, to a magnet-coil, to a conductor *a′*, to shoe I′, by segment $R^2 R^3$, ground, and back to the generator P′. The magnet is thereby energized and the connection closed for the power-circuit over one of the other sets of conductors *a*, the latter being connected, as shown, individually to the springs which carry the switch-contacts by attachment of connections running down from the conductors into the conduit A and there joined to the exposed ends of the supporting-springs E. The power-circuit thus closed at any time is by its main conductor L, to the tube D, core D′, switch-contact F and E^2, spring E, conductor *a*, contact-shoe I, traveling over said set of conductors *a* to the controller-resistance, to motor M, trolley G, rail B, and back to the generator. When the shoe I′ passes from one rail *a′* to the next rail *a′*, it energizes the magnet for the next succeeding switch and releases the previously-operated one in obvious manner, thus closing and opening in succession the connections between the sections *a* and the power-circuit or conductor. At the same time the shoe I travels into and out of connection with the successive sections *a*, thereby supplying the current to the motor.

I do not limit myself to the use of supplemental contacts or conductors *a a'* of any particular length or to separating those which are in the same line with one another by spaces of any particular length, as it is obvious that the length of said conductors may be shortened and the spaces widened by making the contact-shoe I or I' longer; nor do I limit myself to making the trough or conduit B in a continuous length, as it might be subdivided and the several sections shortened and connected to one another by other means. I also wish it to be understood that I do not limit myself to supporting or carrying the supplemental contact or shoe I or I' from any particular portion of the main trolley or its carriage, though by preference its hanger or support is for convenience mounted upon the axle of the trolley.

Other variations in the details of the apparatus may obviously be made without departing from the spirit and scope of my claims as hereinafter made.

It will be observed that in the system before described there are practically two circuits, each insulated from the other and both forming practically complete metallic circuits without any necessary recourse to the ground, one of said circuits being employed entirely for the purpose of operating the switch-magnets and the other for the power-circuit, the connection of the sections of which with the power-generator are controlled by said switch mechanism. By this system said circuits—to wit, one for the power and the other for the switch magnets—being entirely independent of one another and completely insulated, the dangers and the difficulties experienced with sectional electric railways in which switch-magnets are employed are largely avoided.

It is quite obvious that the switch-magnets may be operated *seriatim* over their proper circuit by a generator in any desired position or location, as well understood in the art, and while I have shown such generator as stationary—that is to say, not carried by and moving with the vehicle—I do not wish to be understood as limiting myself to the location of the same, as it may be placed in other positions, as well understood in the art.

What I claim as my invention is—

1. The combination with the trough-shaped contact-rail forming a working conductor, the supplemental contact-rails or conductors within the same, the metal cross pins or bars mounted in the sides of the trough and passing through said rails but insulated from them, and a filling of insulating cement or concrete in which the rails and pins are anchored.

2. In a conduit-railway system, a switch-operating magnet having spool-heads fitting into a protective tube hermetically sealed at its end with a plug or stopper, and permanent or fixed connections for said switch and magnet passing through and hermetically sealed in said plug or stopper.

3. A switch-operating magnet having spool-heads fitted into a containing-tube having a seal at its end through which permanent magnet connections pass and in which they are hermetically sealed.

4. The combination with the metal tube in which the contact-core slides, of the fixed metal plug filling the bore of the tube at the end, and a circuit connection to said plug extending through the end of the tube.

5. The combination with the metal tube and sliding core therein, of the fixed metal plug filling the bore of the tube and having a conducting extension, and a filling of insulating-cement over said plug.

6. In a sectional electric railway, the combination with an armature adapted to close the circuit to a section, of a supplemental contact carried or operated thereby, and having a lost motion as described, whereby said parts may follow one another in opening contact.

7. The combination with the circuit-closing armature, of a spring-actuated contact operated thereby and working through an opening in said armature.

8. The combination with the tubular armature, of the contact-pin working through said armature and normally supported thereby.

9. The combination with the circuit-closing armature and pin supported thereby, of two springs one tending to lift the armature and the other of inferior power tending to depress the pin, as and for the purpose described.

10. The combination with the trough-shaped stringer carrying the magnetic switches and connections, of a surface contact-rail forming a removable cover-plate for the same.

11. The combination with the trough-shaped stringer containing the magnetic switches, of a trough-shaped cover supported on top of said stringer and containing one or more contact-rails or conductors supported in an insulating-cement contained within said cover, and connections therefrom passing through the bottom of the trough.

12. The combination with the trough-shaped stringer containing the magnetic switches, of a trough-shaped contact-rail supported on the top thereof and forming a cover therefor, and supplemental contact-rails or conductors supported in said cover in a mass of insulating-cement, and connections therefrom passing through the bottom of said cover.

13. The combination with a reciprocating core, of contacts each adapted to touch the same, and actuating-coils wound as described to produce the same polarity in said core, and operating alternately on said core to move it in opposite directions.

14. The combination with the reciprocating core moving in a metal tube, of the magnet-coils on said tube, and a pair of armatures supported on the tube and adapted to close connection with the core at opposite ends thereof.

15. In a conduit-railway system, a trough-shaped stringer containing one or more lines

of conductor and magnetic switches, a cover or seal for the same formed as a trough and resting on top of said stringer and a surface contact-rail or conductor supported in said trough in a mass of insulating-cement and having connections passing through said cover into the stringer.

16. A rubbing-contact shoe vertically guided on a swinging hanger, swinging in a vertical plane and provided with a pressure-spring, as and for the purpose described.

17. The combination with the main trolley, of the hanger swiveled on the axle thereof, a vertically-guided spring-actuated shoe carried by said hanger, and suitable abutments or stops between which said hanger may have a limited swing.

18. The combination, substantially as described, with the pair of contact-trolleys moving over a suitable line of rails, of a supplemental contact-shoe supported by and vertically movable independently of said trolley and adapted to engage with a line of supplemental rails between the main rails.

19. The combination, substantially as described, of a trough-shaped main conductor and trolley moving thereon, one or more supplemental contact-rails anchored in the trough, and a contact for the latter supported by the main trolley and adapted to move up and down independently thereof.

20. The combination with the main trolley-wheels, bearing respectively on two parallel lines of insulated conductor, of the hanger supported on an insulating-sleeve between said wheels, and a contact shoe or trolley carried by said hanger.

21. The combination, substantially as described, of the arm swiveled on the car-axle and jointed so as to be capable of turning horizontally, a pair of contact-trolleys mounted on the end of said arm and adapted to move over suitable conducting-rails, and two sets of intermediate contact-rails upon which bear a pair of contact-shoes insulated from one another and supported by the said trolley-wheel.

22. The combination, substantially as described, of a main conductor formed as a trough and having a pair of supplemental conductors mounted within it and arranged in sections, a pair of trolley-wheels moving on the edges of said trough, and two independent supplemental contact-shoes insulated from one another and mounted between said trolley-wheels, said supplemental shoes bearing respectively on the sectional supplemental conductors.

23. In an electric railway, a series of insulated sections and normally open magnetic switches therefor through which the car takes power-current, a supplemental series of insulated contacts normally insulated from one another and from the first-named series, and a supplemental generator for operating said switches, said generator being connected with the car over a trolley or moving contact moving upon said supplemental series.

24. In an electric railway, the combination substantially as described, of a series of sectional conductors insulated from one another, means for supplying power to the car over the same, a second series of conductors disconnected from one another, a series of switch-operating magnets, switches actuated thereby but normally open, a supplemental generator, and means for supplying current from the same over the car and a second series of sectional conductors to said magnets.

25. In an electric railway, a power-circuit for the car formed over a single series of sectional conductors insulated from ground, a traveling contact, a series of normally open switches operated in succession, and a suitable electric return, and a supplemental switch-magnet circuit supplied from a separate stationary generator and formed over a traveling contact, a second series of insulated conductors, and a third traveling contact carried by the car.

26. The combination, substantially as described, of a trough-shaped conductor forming a portion of the power-circuit, and two sets of insulated conducting rails or contacts anchored in said trough and arranged in sections, one of said sets being connected with suitable switches and forming a part of the power-circuit and the other set being connected with the coils of suitable switch-operating magnets, as and for the purpose described.

27. In an electric-railway system, the combination with the switch-magnet for each section, of a plurality of switch-contacts simultaneously operated thereby and having multiple connections for the power-current.

28. In an electric-railway system, the combination substantially as described, of a series of normally-dead power-supply surface contacts or conductors and a metallic return forming the metallic power-circuit, normally open switches for closing the connections to the sections of power-supply conductors as the car progresses, a sectional switch-operating-magnet circuit independent of the power-circuit and insulated therefrom, and a separate generator for actuating the magnet-switches individually connected to the latter sections of conductor, said switch-operating-magnet circuit being also a metallic circuit and formed over two sets of conductors positive and negative respectively, one set being divided into sections and insulated from the contacts or conductors over which the power-current is supplied to the car, as and for the purpose described.

29. In an electric-railway system, a main supply-conductor, a series of branch circuits connected therewith, said branch circuits being normally open, an auxiliary circuit, a series of branch circuits connected therewith, said auxiliary branch circuits being also nor-

mally open, but adapted to be closed by the passage of the car, means arranged solely in said auxiliary branch circuits and actuated by the opening and closing of said auxiliary circuit for opening and closing said main circuits, and means for completing the main branch circuits through the translating devices on the car.

Signed at New York, in the county of New York and Stateof New York, this 14th day of October, A. D. 1896.

JOHN H. GUEST.

Witnesses:
DELBERT H. DECKER,
WM. H. CAPEL.