(No Model.) 2 Sheets—Sheet 1.

T. HARRIS.

ELECTRIC RAILWAY SYSTEM.

No. 490,248. Patented Jan. 17, 1893.

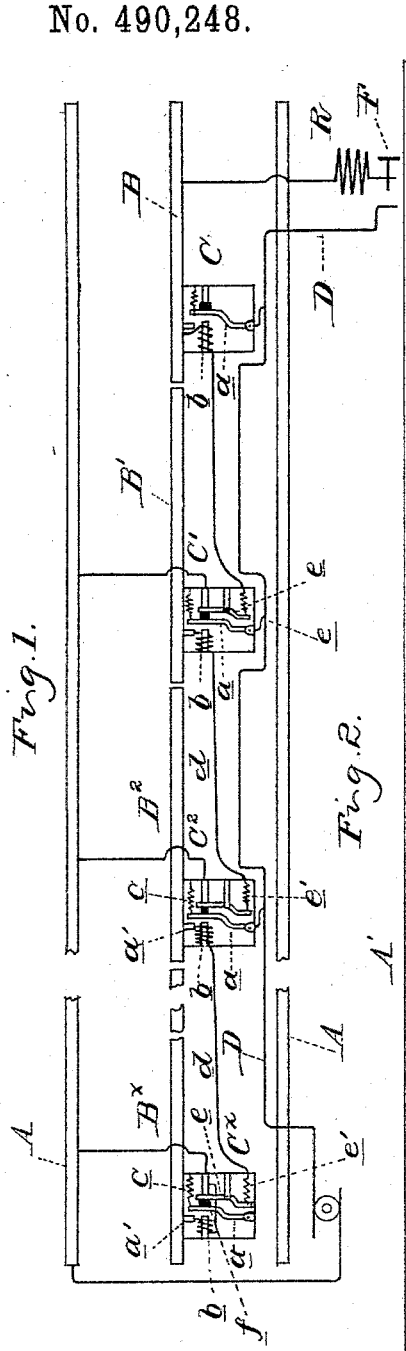

Fig. 1.

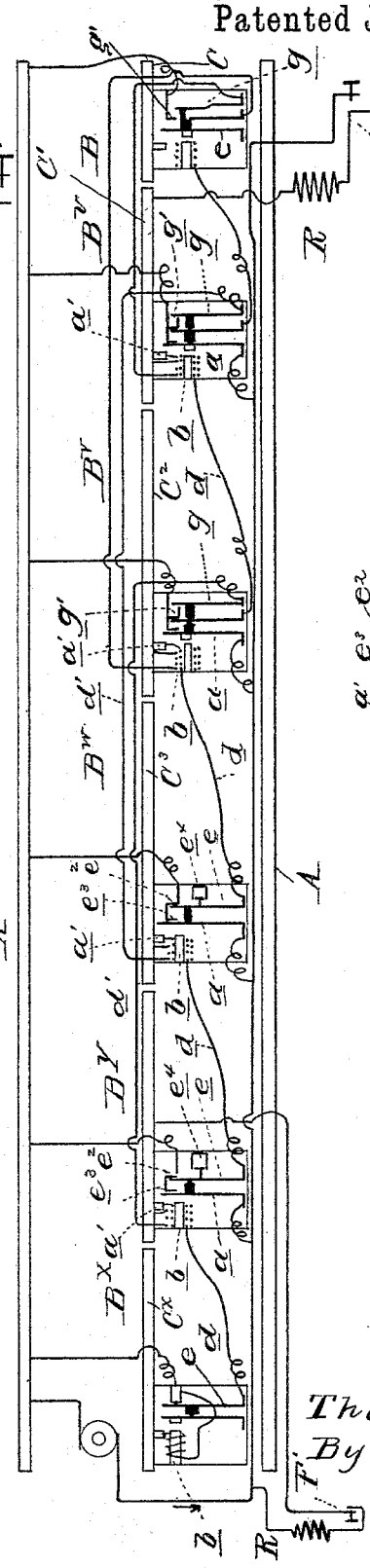

Fig. 2.

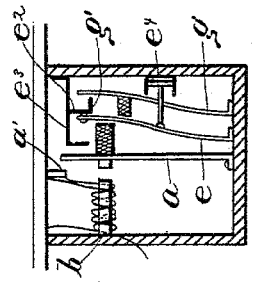

Fig. 4.

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M. B. Dougherty.

Inventor
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(No Model.) 2 Sheets—Sheet 2.

T. HARRIS.

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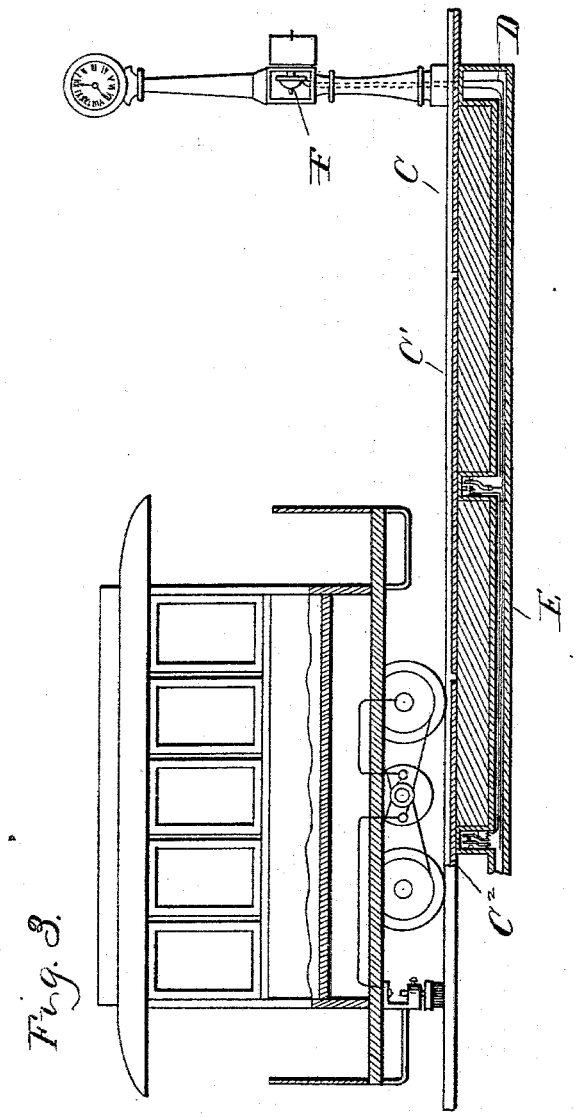

Fig. 3.

Witnesses
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UNITED STATES PATENT OFFICE.

THOMAS HARRIS, OF DETROIT, MICHIGAN, ASSIGNOR TO THE HARRIS ELECTRICAL PROPULSION COMPANY, LIMITED, OF SAME PLACE.

ELECTRIC-RAILWAY SYSTEM.

SPECIFICATION forming part of Letters Patent No. 490,248, dated January 17, 1893.

Application filed December 28, 1891. Serial No. 416,298. (No model.)

To all whom it may concern:

Be it known that I, THOMAS HARRIS, a subject of the Queen of Great Britain, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Electric-Railway Systems, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to that class of electric railway systems in which an insulated underground conductor is maintained in electrical connection with the motor on the car by a contact made between said motor and a naked sectional working conductor (or so-called third rail) on the surface of the track, the sections of said naked conductor being successively rendered, active or alive, when the car travels over it by electro-magnetic switching devices contained in boxes below or in proximity to the naked conductor sections.

The object of the present invention is to simplify the construction and arrangement of such switching devices, and at the same time, secure a positive and reliable action and cooperation of all the different parts of the system.

The invention consists in the arrangement and combination of devices, substantially as hereinafter fully described and specifically pointed out in the claims.

In the accompanying drawings which constitute a part of this specification. Figure 1 is a diagram plan of a section of railway track to which my system is applied in the manner in which I intend to apply it for a double track railway system, that is one upon which the cars are intended to travel in one direction only on each track. Fig. 2 is a like diagram plan of a section of railway track to which my invention is applied in the manner in which I intend to apply it for single track railway systems, on which the cars are adapted to travel in both directions. Fig. 3 is a vertical central, longitudinal section through the center of the track. Fig. 4 is an enlarged detail sectional elevation of one of the switch boxes.

In the operation of the system herein described, the car motors will be as usual in multiple arc between the positive supply main or so-called power line which is the underground conductor, and the return conductor, for which I prefer to use one of the rails on which the cars travel.

Referring to Fig. 1, A A′ designate the two rails on which the cars travel, and which in this case form one track of a double track system.

B, B′, B^2, B^x, represent sections of the naked working conductor preferably placed between the track rails, each section being about the length of a car, more or less, as deemed most desirable in this class of systems; the section B represents the first section at the starting point, and B^x, the last section at the end of the track, all sections being electrically insulated from each other.

C, C′, C^2, C^x, represent the switches belonging to these sections, and which are preferably sunk in the street and inclosed in water tight casings.

D represents the positive underground or supply main, which is also preferably sunk in the street in a water tight conduit E. This conductor is well insulated, and for the sake of connecting it readily with the switch boxes, the conduit and switch boxes are preferably contiguous or intersecting each other; any kind of underground system, however, may be adopted for this power line conductor, as deemed most desirable.

F is a push arranged at the starting point of the track in proximity of the track; this push may be inclosed in a little box after the manner of erecting alarm boxes in the street, or be combined with an ornamental post, street lamps or other device, or it may be arranged in any other manner, whereby it is easily accessible to the driver or conductor of the car to be used in starting the car on its way as will appear more fully hereinafter.

The switch boxes are substantially arranged as follows: Each contains an armature lever *a*, which is arranged to make and break electrical connection with its section of the naked conductor (or with a suitable contact *a′* secured thereto) by the action of an electromagnet *b*, which attracts said lever against the tension of a spring *c*, when said magnet is energized. Each armature lever *a* (except the one in the last box) is electrically con-

nected with the supply conductor D, and the coils of the electro-magnets are connected in multiple arc circuits *d*, between the sections of the naked conductor and the return rail. These circuits *d* in which the coils of the electro-magnets are included are controlled by contact levers *e*, which are also inclosed in the switch boxes, but the contact lever which controls the magnet inclosed in one box, is inclosed in the next succeeding box, and is oppositely actuated by the movement of the armature lever *a* contained therein, to make and break its circuit. To this end the contact lever *e* is preferably placed close to the armature lever *a*, and is provided with a spring *e'* whereby the latter when not attracted by its electro-magnet, bears against the former and keeps its circuit closed, and when the lever *a* is attracted by its magnets, the spring *e'* acts and breaks the circuit *d*. A suitable insulating block *f* is secured to one of the two contact levers to prevent electrical connection between them. The circuit of the magnet in the last switch box, is arranged to be controlled by the same contact lever *e*, which controls the last preceding coil, and no switch *e* is required in the first box.

The car is provided with a suitable brush adapted to make electrical contact with the naked conductor, and to lap the breaks between the ends of the sections thereof, in the passage from one section to the other. The push button has one contact electrically connected to the supply main, and the other to the first section B of the naked conductor with a suitable adjustable resistance R in circuit therewith.

In practice the car being on the starting end of the track, by pressing on the push button F, a circuit is closed from the main supply conductor to the section B, thence by way of the coil of the electro-magnet *b*, and contact lever *e* in the second switch box, (the levers *e* being normally closed) to the return rail A'. The closing of this circuit energizes the magnet *b* in the first switch box, attracts the lever *a* and thereby connects the section B directly with the main supply conductor through the armature lever *a*, the magnet *b* remaining energized after the push button is released. The motor on the car is thus enabled to take its current from said conductor in the usual manner. It will be seen that if the conductor section B is once rendered active by pressing on the push button, it will remain active, no matter if the motor is supplied with current or not, and therefore the car may be started on its journey whenever desired. While the car passes from section B to section B', the brush will momentarily connect the section B with section B' of the conductor, and thus establish a circuit through the magnet in the second switch box, thereby attracting the lever *a*, and thus connects the section B' with the main supply conductor. At the same time while the lever *a* contacts with the section B' the lever *e* breaks the circuit of the electro-magnet in the first box and thus renders the first section B non-active again after the brush has left it. It will be seen that if the section B' is once rendered active, it will remain active whether the motor is supplied with the current or not, and the section B' only becomes non-active after the brush has passed on to the section B^2. The travel of the car thus renders one section after another active, while it passes over it and renders it non-active, as soon as the brush passes onto the next section, the same operation of the parts being repeated from section to section. When the car arrives upon the last section B^x, the magnet in the last box becomes energized in the same way as in the preceding sections, but as its contact lever *a* is not connected to the main supply conductor the last section remains active only momentarily while the brush is lapping with the preceding section, and the further progress of the car is thus arrested. The last preceding section is rendered non-active by the action of the contact lever *e* in the last box in the same manner as before.

In applying my system to a single track, I arrange the parts as shown in Fig. 2, in which the same letters of reference are used as in Fig. 1, to represent the same or equivalent parts as in Fig. 1. The portion of the track shown in this figure represents a track composed of five sections B^x, B^y, B^w, B^v, B^u, B, of the naked conductors, B representing the first and B^x the last section as in Fig. 1. The switch boxes are arranged the same as before, and contain switching devices operating precisely on the same principle as before. As far as the parts are concerned the operation of which is required to enable the car to pass over the track in the direction from section B to section B^x their construction, arrangement and operation are substantially the same as in Fig. 1, and it will not be necessary to go over this ground again. I may, however, state that in this Fig. 2, for the sake of greater simplicity of illustration, I have represented the levers *a e* as springs which are the precise equivalent thereof.

In addition to the parts described in Fig. 1, the switch boxes are now equipped as follows: The last box on the section B^x remains unchanged as before; in the other boxes the spring or lever *e* is provided with two contacts e^2 e^3 and preferably with a dash pot, vane or similar contrivance e^4 for retarding its motion. The electro-magnets in the intermediate switch boxes are each provided with an additional coil which like the first coil is connected in a multiple arc circuit *d'* between the section of conductor to which the switch box belongs and the return rail, and these second coils are controlled in like manner as the first coils by contact levers or contact springs *g*, adapted to make and break connection with fixed contacts *g'*. The only difference between the arrangement of these second coils and the first coils is that they are

wound in opposite direction and that while the circuits of the latter are controlled by contact levers or springs inclosed in the switch box succeeding the one in which the coil is contained, the contact lever or spring controlling the circuit of any one of these second coils is inclosed in a switch box preceding the one in which the second coil is contained (or more correctly speaking in the second preceding box). The reason for this arrangement is obvious, considering that they have to perform the same function, but with the cars traveling in the opposite direction.

Push buttons F, F′ are arranged at both ends of the route, but instead of applying them to the first and last section I apply them preferably to the second and to the one-preceding-the last-but-one section, thus rendering the end sections permanently non-active.

In operation it will be seen that the passage of the car from B to B^x is effected by the operation of the devices shown separately in Fig. 1, and which are also present in Fig. 2, and operate in like manner as previously described, except that on account of the different arrangement of the push button F, the car will not be enabled to start until it is first advanced from section B to section B^u (which may be done by connecting section B temporarily with section B^u). When the car has advanced to the end of the route, it is started on its return trip by first advancing it from the section B^x to the section B^y, this may be done by manual work or by the use of a suitable switch (not shown) which temporarily renders the section B^x active. The section B^y is first rendered active by pressing the push button F′, whereby the electro-magnet in the switch box of section B^y is energized by having its inner coil included in a closed circuit, (which is connected to the spring e in the last box) and the magnet attracting the spring a in the switchbox of section B^y connects said section with the supply conductor through the spring a. Thus the motor is enabled to supply its current from the section B^y and start the car on its journey. The spring e in the switch box of section B^y is now on the contact e^3, and thus as soon as the brush of the car laps the sections B^y and B^w, the inner coil of the electro-magnet on section B^w will be energized and attract its spring a thus connecting said section with the supply conductor; at the same time the spring e in said box is now free to contact at e^3, and thus the inner coil of the electro-magnet in the switch box of section B^v, is included in a closed circuit, and its magnet is energized, as soon as the brush laps on the section B^v, thus connecting the section B^v, with the supply conductor by the agency of the same devices as described for the sections B^w and B^y. In the same manner and by the agency of the same devices the car is enabled to travel over the section B^u and over other switches supposed to be intervening between it and the section B, at which it completes its round trip. While the car is on section B^v, the spring g which is arranged in the switch box of said section (and normally out of contact by the pressure of the spring a) makes contact with the fixed contact g', when the spring a is attracted by its electro-magnet. Both coils of the electro-magnet on section B^y are thus connected in closed circuits with the current passing through them in opposite directions. This neutralizes the magnet and allows the spring a to break contact and restore the section B^y again to its non-active condition. In like manner when the car is on section B^u the magnet in the switch box of section B^w, is neutralized by the closing of the circuit through both coils and the section is rendered again inactive in the passage of the car from B^v to B as soon as the car has passed to the second adjoining section. The section B is provided with two springs g as shown, these are normally kept out of contact with the fixed contact g', and with each other by two shoulders formed on the insulating block secured to the spring a, but when the latter spring is attracted by its magnet, the two springs will come in contact with each other and with the contact g' and thus neutralize the magnets in the last two sections remaining active when the car enters upon section B. It will be remembered that the springs e in breaking contact with e^2 in the passage of the car from B to B^x renders the section just passed over inactive, at the instant the brush laps onto the next section; now if there is a second contact e^3, as in the single track system, the spring e in the breaking contact at e^2, must be delayed a small fraction of time to prevent it from making contact too quickly at e^3, otherwise the section just passed over would not be rendered inactive. This object of delaying the movement of the spring e may readily be obtained by making it relatively wide, so that it will be slightly resisted by the air in its movement.

It is obvious that many minor modifications of my system may be made within the spirit of my invention, or equivalent devices may be substituted for those described and shown, and I do therefore not intend to limit myself to the precise arrangement, construction and operation of the devices, shown and described.

It will be seen that my improved system does away with the use of a battery or any other electrical contrivance on the car, beyond the motor and contact brush, and further there are no parts exposed beyond the sectional conductor on the ground; the switches are simple and may be securely housed and protected against any climatic or atmospheric influences.

What I claim as my invention is

1. The combination of a power line, a working conductor in sections normally disconnected from the power line and normally con-

nected to a return conductor, an electro-magnet for each section the armature of which connects the section to the power line and cuts out the preceding section, and means for actuating said magnets by a derived current from the power line, the same consisting in a manual switch for connecting the initial sections of the working conductor to the power line, a traveling contact on the car for connecting the ends of two adjoining sections, and a circuit connecting each section of the working conductor with the return conductor and in which the electro-magnets and cut outs are located, substantially as described.

2. The combination of a power line, a working conductor in sections normally disconnected from the power line and normally connected to a return conductor, an electro magnet for each section the armature of which connects the section to the power line and cuts out the preceding section, and means for actuating said magnets by a derived current from the power line, the same consisting of a push for connecting the initial section of the working conductor with the power line, a traveling contact for connecting the ends of adjoining sections of the working conductor and circuits connecting the sections of the working conductor with the return conductor, said circuits containing the electro-magnets with the cut-outs, substantially as described.

3. The combination of a power line, a working conductor in sections normally disconnected from the power line and normally connected to a return conductor, an electro-magnet for each section, the armature of which connects the section to the power line, and controls one or two cut-outs of adjacent sections according the requirements, and means for actuating said magnets by a derived current from the power line the same consisting in a manual switch or switches for connecting the initial section or sections of the working conductor to the prime conductor, and a traveling contact on the car adapted to span the ends of the two adjoining sections of the working conductor, and one or two circuits connecting each section with a return conductor according to the requirements for running the cars in one or both directions, said circuits containing the electro-magnets and cut-outs, substantially as described.

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

THOMAS HARRIS.

Witnesses:

JAMES WHITTEMORE,

M. B. O'DOGHERTY.