

W. ROBINSON.
ELECTRIC RAILWAY SYSTEM.

No. 580,057.

Patented Apr. 6, 1897.

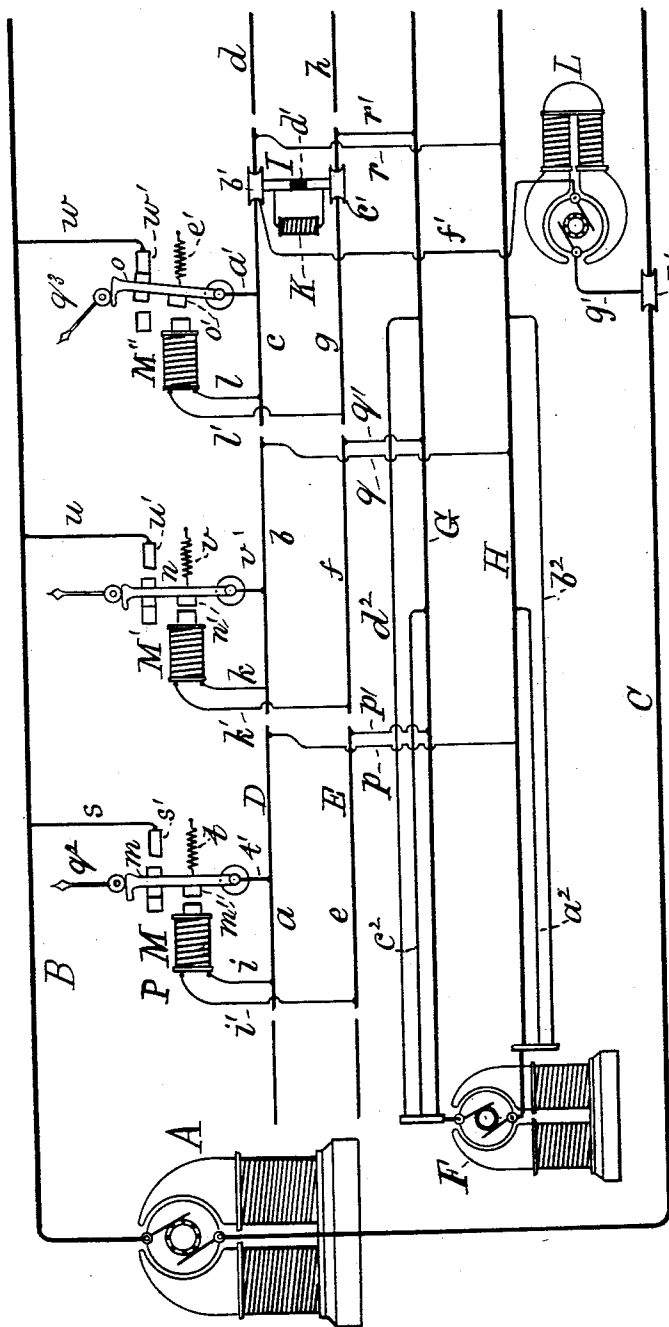


Fig. 1.

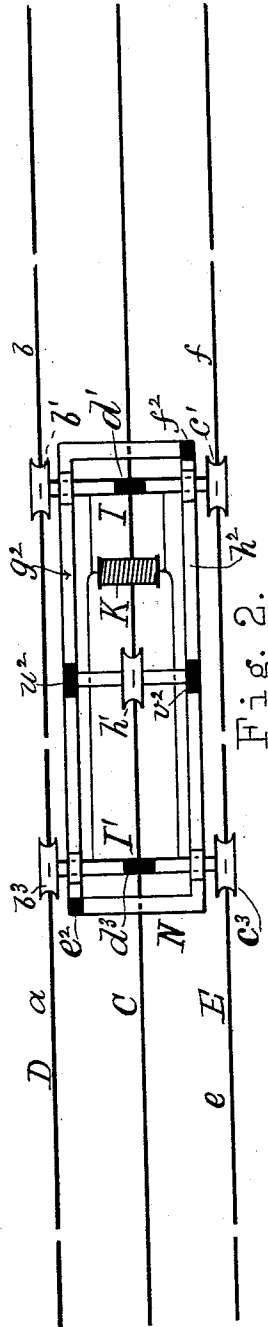


Fig. 2.

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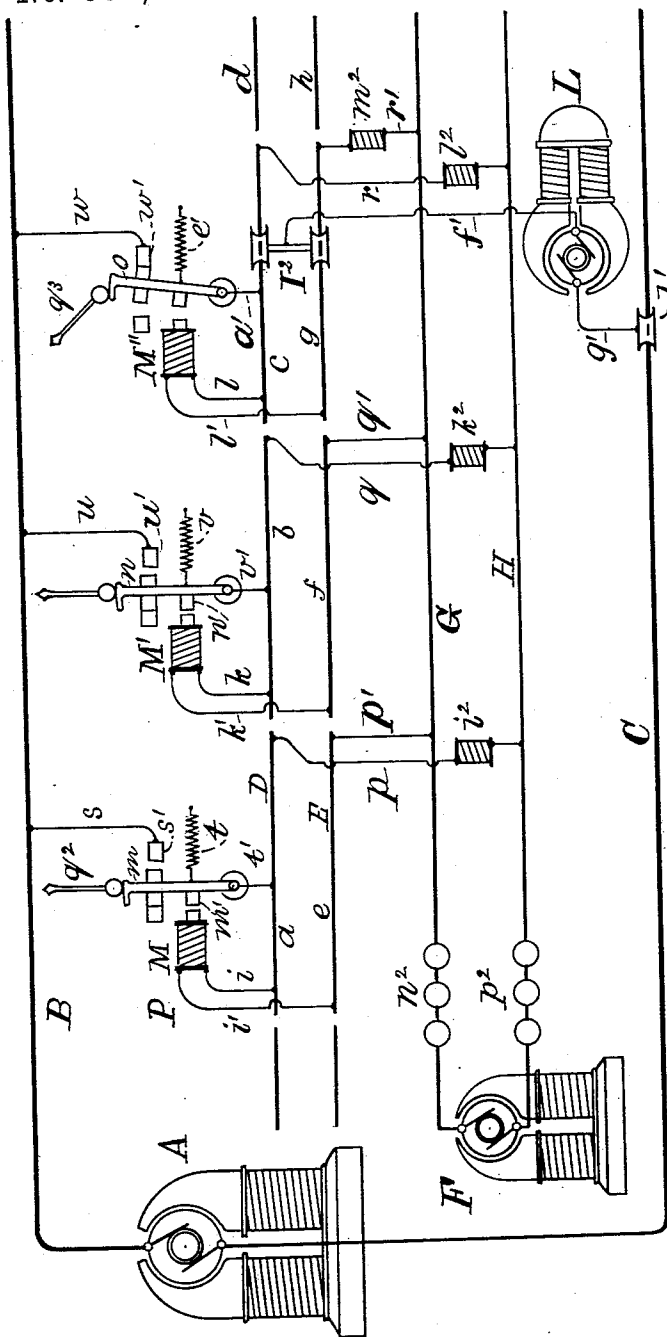


Fig. 3.

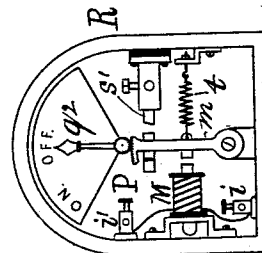


Fig. 4.

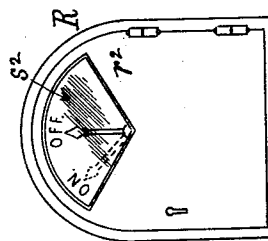


Fig. 5.

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UNITED STATES PATENT OFFICE.

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ELECTRIC-RAILWAY SYSTEM.

SPECIFICATION forming part of Letters Patent No. 580,057, dated April 6, 1897.

Application filed January 21, 1895. Serial No. 535,616. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM ROBINSON, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented a new and Improved Electric-Railway System, of which the following is a specification.

The nature of my invention will be understood from the description which follows, reference being had to the accompanying drawings, which form a part of this specification, in which—

Figure 1 is a diagrammatic illustration of my invention. Fig. 2 illustrates the trolley-carriage and its application to the conductors with which it is designed to make contact. Fig. 3 is a diagrammatic illustration of an alternate form of my invention. Fig. 4 is a disconnected illustration of the magnetic switch in a case with the door removed. Fig. 5 shows the case with the door closed.

A is an electric generator, B a main-line or feed wire proceeding therefrom along the railway and carrying a comparatively high-voltage current for working the car-motors, and C is the return-conductor, which may consist either of the rails of the track, in the usual way, or of a special wire, preferably mounted on insulated supports or laid in a conduit or elsewhere in any convenient manner.

D is the working conductor, made in successive sections *a b c*, &c., of any convenient or desired length.

E is an extra conductor formed in successive sections *e f g*, &c., parallel and corresponding to the sectional conductors *a b c*, &c.

The magnet M has its electrodes connected to the sections *a e*, preferably at or near one end of said sections, by the conductors *i i'*. In like manner the magnet M' has its electrodes connected to one end of the conducting-sections *b f* by the conductors *k k'*, and the magnet M'' has its electrodes connected to one end of the sections *c g* by the conductors *l l'*.

It will be understood that the magnets M, M', and M'' are provided, respectively, with armatures arranged to be operated and controlled by said magnets in any usual or suitable manner.

F is a generator producing an electric current of comparatively low potential, and from

this generator the conductors G H extend out along the line.

The conductors G H are electrically connected by the wires *p p'* to the conducting-sections *a e* at the ends of said sections opposite to those to which the magnet M is connected. In like manner said conductors G H are connected by the wires *q q'* to the sections *b f* and by the wires *r r'* to the sections *c g*. In each instance the conductors G H are connected, preferably, to the opposite ends of said sections from those to which the magnets are connected.

It will be understood that the current from the generator F, following the circuits described, keeps the magnets M M' M'' magnetized as their normal condition through the agency of a current of low potential, the circuits of said magnets being in multiple with the line conductors G H.

The line-wire B is connected by the wire *s* to the anvil *s'*, and when the magnet M is demagnetized the spring *t* brings the armature-lever *m* against the anvil *s'*, thus connecting the line-wire B to the working section *a* through the armature-lever *m* and the wire *t'*. In like manner the demagnetization of the magnet M' connects the main line B electrically to the section *b* through the wire *u*, anvil *u'*, armature-lever *n*, and wire *v'*, and the demagnetization of the magnet M'' connects said line conductor B electrically to the working section *c* through the wire *w*, anvil *w'*, armature-lever *o*, and wire *a'*. As the magnets M M' M'' are normally magnetized, and thus keep their armatures normally attracted, it is evident that the line conductor B is normally disconnected from all the working sections *a b c*, &c.

The trolley I, connected to the motor-car in any suitable manner and traveling therewith, is constructed with the two parts *b' c'* insulated from each other, as shown as *d'*, the part *b'* traveling in contact with the working-conductor line D and the part *c'* traveling in contact with the extra-conductor line E. These two parts *b' c'* are electrically connected through the resistance K, which may consist of wire, carbon, or other medium affording suitable resistance. The resistance of the coil K is approximately equal to the resistance of the coils of the magnet M. It is evident

that the trolley I, constructed in this way, when connecting the sections $c g$, as shown, makes a semi short circuit of the current passing through the magnet M'' , that is, approximately one-half of the current normally passing through the magnet M'' from the conductors $G H$ is diverted from said magnet and passes across the resistance K instead of through said magnet.

The tension of the spring e' is adjusted in such a way that when the full normal current is passing through the magnet M'' the pull of the magnet prevails against the pull of the spring e' and separates the armature-lever o from the anvil w' , thus disconnecting the line conductor B from the working section c . When, however, a considerable portion of the current is diverted from the magnet M'' through the resistance K , as described, the tension of the spring e' overcomes the pull of said magnet and brings the armature-lever o into contact with the anvil w' , thus completing the working circuit from the line-wire B through the conductor w , anvil w' , armature-lever o , conductor a' , working section c , section b' of the trolley I, conductor f' , car-motor L , conductor g' , and trolley h' to the return-conductor C .

The reason for making the trolley I in two parts $b' c'$, as shown in Fig. 2, with the resistance-coil K between them is that if any of the sections of the lines $D E$ were connected in dead short circuit this would short-circuit the generator F and probably burn it out, at the same time of course demagnetizing all the magnets connected to the lines $G H$. By using differential trolleys, however, as described, the liability to such an accident is obviated, since the differential trolley I introduces sufficient resistance into the circuit of the generator F to prevent accidents from short-circuiting.

The trolley I answers a double purpose—first, to establish a semi or differential short circuit between the conducting-lines $D E$, and, secondly, to convey the working current from the sections of the line D to the motor L , as described.

It will be noted that as long as the trolley I, while running or standing still, connects the sections $c g$ so long will the magnet M'' remain partly demagnetized, as described, but as soon as said trolley leaves the sections $c g$ from either end, or if said trolley be accidentally removed, two things happen. First, the high-potential or working circuit is broken through the interruption of the contact between section b' of the trolley I and the conducting-section c , and the flow of working current therefore ceases across the contact-points at w' ; secondly, the differential short circuit being removed the low-potential current returns to the magnet M'' with full force, restoring said magnet to its normal condition of high magnetic power. This magnet now attracts its armature o' , and thus opens the contact-points at w' , that is, the feed-wire B

is switched out of electrical contact with the conducting-section c .

In Fig. 3 the trolley I^2 is substituted for the differential trolley I of Fig. 1. The trolley I^2 makes a direct metallic contact and dead short circuit between the sections $c g$. This of course completely demagnetizes the magnet M'' . It will be noted, however, that resistances $l^2 m^2$ are introduced into the conductors $r r'$ between the trolley I^2 and the generator F , thus making it impossible for said trolley to short-circuit said generator. In like manner the resistance i^2 is introduced in the wire p and the resistance k^2 in the wire q . Thus the generator F is protected from short-circuiting on whatever part of the line the trolley I^2 may be.

The generator F may be protected from short-circuiting by putting resistances $n^2 p^2$ directly in the lines $G H$, or either of them, at a point between the generator and the nearest connected sections of the lines $D E$. This resistance may be conveniently introduced in the power-house in any convenient form. When these resistances are thus used in the lines $G H$, the resistances $i^2 k^2$, &c., in the branch wires will still be used to advantage.

The magnetic switch P is shown complete as inclosed in a case R in Fig. 4, the door of said case being removed in said figure. The armature-lever m operates a pointer q^2 , which stands in an upright position, as shown, when the magnet M attracts its armature and the working current is consequently off. This condition is indicated by the word "Off" in proper position on the dial. When, however, the magnet M is demagnetized and lets go its armature, the armature-lever m flies back and makes contact with the anvil s' , and at the same time swings the pointer around to the position shown at q^3 , Figs. 1 and 3. (Shown also in dotted lines in Fig. 5.) This condition is indicated by the word "On" on the dial and indicates that the line conductor B is brought into circuit with the section of the working conductor to which the magnetic switch operating said pointer is connected. In Fig. 5 the case R is closed by the door r^2 , and said door may be provided with glass s^2 over the dial. It is intended to place these magnetic switches in boxes at convenient points above ground, and it is evident that when constructed and arranged as described an inspector watching the dial during the passing of a car can tell whether the apparatus is working properly or not. Furthermore, the apparatus P is convenient of access for any purpose. The glass face s^2 may of course be protected by a solid covering, if desired.

When the conductor C consists of the rails of the track, the conductor g' becomes a ground-wire, completing the circuit through the ordinary wheels of the car to the conductor C , that is, the wheels of the car are substituted for the trolley h' .

As all the sections of the working conductor D are out of circuit except the sections directly under the control of passing cars, the exposure to leakage of high-potential current from said line D is confined to leakage from such sections of said line as may be in circuit, as aforesaid, under the control of passing cars. However, the presence of the trolley in contact with the section *c*, for instance, affords a complete metallic circuit, as may be seen by inspection of the drawings, for the high-potential current, and therefore under the most unfavorable and exposed conditions the leakage is practically prevented.

The low-potential circuit is always metallic, and the potential of the current is so low that there cannot be sufficient leakage through the action of the elements to interfere with the proper working of the apparatus.

The feed-wires $a^2 b^2 c^2 d^2$ may be used in connection with the line-wires G H, as shown, in order to equalize the current passing to the different magnets M M' M'', or the magnetism of said magnets may be approximately equalized by putting more turns of wire on said magnets the farther they are located from the generator.

The main line-wire B, it will be understood, is reinforced by feed-wires in the usual manner. (Not necessary to illustrate.)

In operating this system I prefer to place all the conductors in a conduit, the trolley also, suitably attached to the car, running in the conduit in contact, as described, with the contact-conductors. In the conduit the conductors are arranged in the most convenient relative positions. For instance, as shown in Fig. 2, the return-conductor C is placed between the sectional conductors D E. The trolley-carriage N is provided with the trolleys or contact devices I I', located at or near the opposite ends thereof. As already described, the trolley I is composed of two parts $b'c'$, insulated from each other, as shown at d' . In like manner the trolley I' is composed of two parts $b^3 c^3$, insulated from each other, as shown at d^3 . The frame of the trolley-carriage N has its opposite sides $g^2 h^2$ insulated from each other, as shown at $e^2 f^2$. Thus it is evident the metallic portions of the trolley-carriage N, having electrical connection with the working conductor D, are electrically disconnected, except through the resistance K, from those portions of said trolley-carriage which are in electrical connection with the line E. The trolley h' , which completes the circuit to the return-conductor C, is located at the center of the trolley-carriage N and insulated therefrom, as shown at $u^2 v^2$.

The object of placing electrically-connected trolleys in advance of each other in the trolley-carriage N is to cause the same to overlap and operate each succeeding conducting-section before leaving the preceding section, so that there may be no possible interruption in the even flow of the operating-current when

the trolley is passing from one section to another of the working conductor.

When resistances are used in connection with the branches of the lines G H and the solid trolley I² used, all as illustrated in Fig. 3, then all parts of the trolley-carriage N are electrically connected together, except the trolley h' , which is insulated from said carriage, as already described. Moreover, the differential resistance K is in that case dispensed with.

I do not herein claim anything described and broadly claimed in my application for a patent for an electric-railway system filed December 19, 1894, Serial No. 532,380.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination, substantially as described, of a plurality of electromagnets included in a continuously-closed circuit formed in part of two parallel lines of sectional contact-conductors, said magnets being operated or controlled without opening the circuit of the same, an electric generator furnishing current to said magnets through said parallel sections of contact-conductors, and means for demagnetizing each of said magnets in succession, independently of the others, by making short-circuiting contact between said respective parallel sections of contact-conductors.

2. In an electric-railway system, the combination, substantially as described, of a feed-wire, the working conductor formed in successive sections normally disconnected from said feed-wire, a motor traveling in electrical connection with said working conductor, a source of electric supply, conductors proceeding therefrom, and a plurality of electromagnets receiving current simultaneously and directly from said conductors, each of said magnets being included in a continuously-closed circuit and operated or controlled without opening the circuit through said magnet, the actuation of each of said respective magnets operating to connect one of said sections of working conductor to said feed-wire and to disconnect the same therefrom.

3. In an electric-railway system, the combination, substantially as described, of a feed-wire, the working conductor formed in successive sections normally disconnected from said feed-wire, a motor traveling in electrical connection with said working conductor, a source of electric supply, conductors proceeding therefrom, a plurality of electromagnets receiving current simultaneously and directly from said conductors, each of said magnets being included in a continuously-closed circuit and operated or controlled without opening the circuit through said magnet, the actuation of each of said respective magnets operating to connect one of said sections of working conductor to said feed-wire and to disconnect the same there-

from, and means for demagnetizing said magnets in succession by short-circuiting.

4. In an electric-railway system, the combination, substantially as described, of a feed-wire, the working conductor formed in successive sections normally disconnected from said feed-wire, a car-propelling motor receiving current from said feed-wire through said sections of working conductor, a source of electric supply, conductors proceeding therefrom, a plurality of switch-magnets receiving current directly from said conductors, each of said magnets being included in a continuously-closed circuit and operated or controlled without opening the circuit through said magnet, said switch-magnets in succession controlling the circuit of said motor, and a traveling short-circuiting device arranged to keep said switch-magnets successively under short circuit while said device is traveling in contact with specific portions of the circuit including said respective switch-magnets.

5. The combination, substantially as described, of a feed-wire, the working conductor formed in sections normally disconnected from said feed-wire, a traveling motor arranged to receive current from said feed-wire through said sections of working conductor, a source of electric supply, conductors proceeding therefrom, a plurality of switch-magnets receiving current directly from said conductors, said magnets, respectively, being included in a continuously-closed circuit and operated or controlled without opening the circuit through said magnet, the demagnetization of either of said magnets operating to connect the feed-wire to one of the sections of working conductor, and means for demagnetizing said magnets by short-circuiting.

6. In an electric-railway system, the combination, substantially as described, of the line or feed wire, the return-conductor, the working conductor formed in sections normally disconnected from said feed-wire, a source of electric supply, conductors proceeding therefrom, and a plurality of switch-magnets receiving current directly from said conductors, each of said magnets being included in a continuously-closed circuit and operated or controlled without opening the circuit through said magnet, the operation of said magnets, respectively, controlling and determining the positions of the respective sections of said working conductor relatively to their connection with or disconnection from said line or feed wire.

7. In an electric-railway system, the combination, substantially as described, of the line or feed wire, the return-conductor, the working conductor formed in sections normally disconnected from said feed-wire, a source of electric supply, conductors proceeding therefrom, and a plurality of switch-magnets receiving current directly from said conductors, each of said magnets being included in a continuously-closed circuit and operated

or controlled without opening the circuit through said magnet, the magnetization of said magnets, respectively, disconnecting the respective sections of working conductor from said line or feed wire.

8. The combination, substantially as described, of an electric generator, conductors proceeding therefrom, a plurality of switch-magnets, each included in a continuously-closed circuit and receiving current directly from said conductors, said magnets being operated or controlled without opening the circuit thereof, two lines of parallel contact-conductors formed in successive sections connected, respectively, to the electrodes of said magnets and to said first-named conductors, the current passing through said parallel sectional conductors to said magnets, a traveling short-circuiting device arranged to demagnetize said magnets in succession by making short-circuiting contact successively between said parallel pairs of sections of said contact-conductors, a feed-wire, a working conductor, normally disconnected from said feed-wire, and a motor deriving current therefrom, said magnets in succession operating to control the transmission of working current from said feed-wire to said motor.

9. In an electric-railway system, the combination, substantially as described, of a feed-wire, the working conductor formed in successive sections normally disconnected from said feed-wire, a motor traveling in electrical connection with said working conductor, and a plurality of electromagnets connected in multiple to a source of electric supply, the actuation of said magnets, respectively, operating to connect one of said sections of working conductor to the feed-wire and to disconnect the same therefrom.

10. In an electric-railway system, the combination, substantially as described, of a feed-wire, the working conductor formed in successive sections normally disconnected from said feed-wire, a motor traveling in electrical connection with said working conductor, a plurality of electromagnets connected in multiple to a source of electric supply and included in continuously-closed circuits, said magnets being operated or controlled without opening the circuits thereof, the actuation of said magnets, respectively, operating to connect one of said sections of working conductor to the feed-wire and to disconnect the same therefrom, and means for demagnetizing said magnets in succession by short-circuiting.

11. In an electric-railway system, the combination, substantially as described, of a feed-wire, the working conductor formed in successive sections normally disconnected from said feed-wire, a car-propelling motor receiving current from said feed-wire through said sections of working conductor, a source of electric supply, conductors proceeding therefrom, a plurality of switch-magnets connected in multiple to said conductors and included

in continuously-closed circuits, said switch-magnets controlling the circuit of said motor, and a traveling short-circuiting device arranged to keep said switch-magnets successively under short circuit while said device is traveling in contact with specific portions of the circuit including said switch-magnets respectively.

12. The combination, substantially as described, of a feed-wire, the working conductor formed in sections normally disconnected from said feed-wire, a traveling motor arranged to receive current from said feed-wire through said sections of working conductor, a plurality of switch-magnets connected in multiple to a source of electric supply, the demagnetization of either of said magnets operating to connect the feed-wire to one of the sections of working conductor, and means for demagnetizing said magnets independently of each other.

13. In an electric-railway system, the combination, substantially as described, of the line or feed wire, the return-conductor, the working conductor formed in sections normally disconnected from said feed-wire, and a plurality of switch-magnets connected in multiple to a source of electric supply and included in continuously-closed circuits, said magnets being operated or controlled without opening the circuit of the same, the operation of said magnets, respectively, controlling and determining the positions of the respective sections of said working conductor relatively to their connection with or disconnection from, said line or feed wire.

14. In an electric-railway system, the combination, substantially as described, of the line or feed wire, the return-conductor, the working conductor formed in sections normally disconnected from said feed-wire, and a plurality of switch-magnets connected in multiple to a source of electric supply and included in continuously-closed circuits, said magnets being operated or controlled without opening the circuit of the same, the magnetization of said magnets, respectively, disconnecting the respective sections of working conductor from said line or feed wire.

15. The combination, substantially as described, of a continuously-energized circuit including a plurality of electromagnets connected in multiple, two parallel lines of contact-conductors formed in successive sections, the electrodes of said respective magnets being connected to one end of the respective parallel pairs of said sections of contact-conductors, the current to said magnets respectively passing from the main conductors through said respective pairs of parallel sectional conductors, a traveling short-circuiting device arranged to demagnetize said magnets in succession by making short-circuiting contact successively between said pairs of sections of said contact-conductors, a feed-wire, a working conductor, normally disconnected from said feed-wire, and a motor

deriving current therefrom, said magnets in succession operating to control the transmission of working current to said motor.

16. The combination, substantially as described, of a plurality of continuously-closed multiple circuits, a switch-magnet included in each of said circuits, an electric generator furnishing current to said magnets, said magnets being connected in multiple to the conductors from said generator and operating independently of each other, a traveling motor, a feed-wire, a sectional working conductor normally disconnected from said feed-wire and conveying current to said motor, the circuit of said motor being controlled at successive stages by said switch-magnets in succession, and means for actuating or controlling said magnets by short-circuiting.

17. The combination, substantially as described, of a series of constant circuits, a magnet included in each of said circuits, an electric generator furnishing current to said magnets, said magnets being connected in multiple to the conductors from said generator and operating independently of each other, a traveling motor, the circuit of said motor being controlled at successive stages by said magnets in succession, means for actuating or controlling said magnets by short-circuiting, and resistances arranged to prevent the short-circuiting of said generator.

18. The combination, substantially as described, of a series of continuously-closed circuits, a switch-magnet included in each of said circuits, an electric generator furnishing current to said magnets, said magnets being connected in multiple to the conductors from said generator and operating independently of each other, a feed-wire, a sectional working conductor normally disconnected from said feed-wire, a car-propelling motor traveling in electrical connection with said working conductor, the circuit of said motor being controlled at successive stages by said magnets in succession, and means for actuating or controlling said magnets through the differentiation of the current passing through the same and without actually opening the circuits of said magnets.

19. In an electric-railway system, the combination, substantially as described, of the line or feed wire, the return-conductor, the working conductor formed in disconnected sections, magnets included in continuously-closed circuits formed in part of said sections of the working conductor, an electric generator furnishing current to said magnets, said magnets being connected in multiple to the conductors from said generator and operating independently of each other, the magnetization of said magnets, respectively, disconnecting the respective sections of working conductor from said line or feed wire.

20. In an electric-railway system, the combination, substantially as described, of the line or feed wire, the return-conductor, the working conductor formed in successive sec-

tions disconnected or insulated from each other, and normally disconnected from said line or feed wire, magnets included in continuously-closed circuits formed in part of
5 the respective sections of the working conductor and in part of independent sectional conductors, said magnets operating independently of each other and being actuated or controlled without opening the circuits of the
10 same, an electric generator furnishing current to said magnets, said magnets being connected in multiple, through said sectional conductors, to the conductors from said generator, the operation of said magnets, respectively, controlling and determining the status
15 of the respective sections of said working conductor relatively to their connection with or disconnection from, said line or feed wire.

21. In an electric-railway system, a traveling trolley or contact-maker provided with a
20 differentiating device constructed and ar-

ranged to actuate or control the magnet or magnets of the primary or controlling circuits by differentiating the currents passing through the coils of said magnet without actually opening the circuits or making a dead
25 short circuit of the same.

22. In an electric-railway system, the combination, substantially as described, of a feed-wire, a working conductor normally disconnected from said feed-wire, an electromagnet
30 controlling the connection between said working conductor and feed-wire, and a pointer or indicator connected to and operated by the armature or armature-lever of said magnet, said indicator showing or indicating the relative
35 positions of the circuits and apparatus controlled by said magnet.

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Witnesses:

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