No. 785,909. PATENTED MAR. 28, 1905.

J. C. McDONALD.

ELECTRIC RAILWAY SYSTEM.

APPLICATION FILED FEB. 9, 1904.

2 SHEETS—SHEET 1.

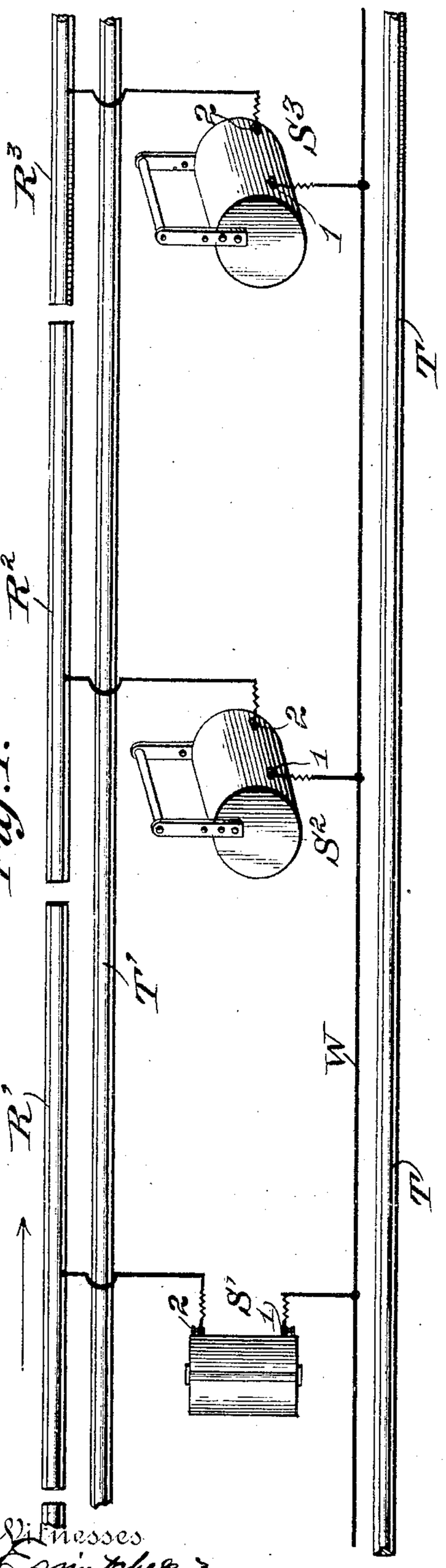

Fig. 1.

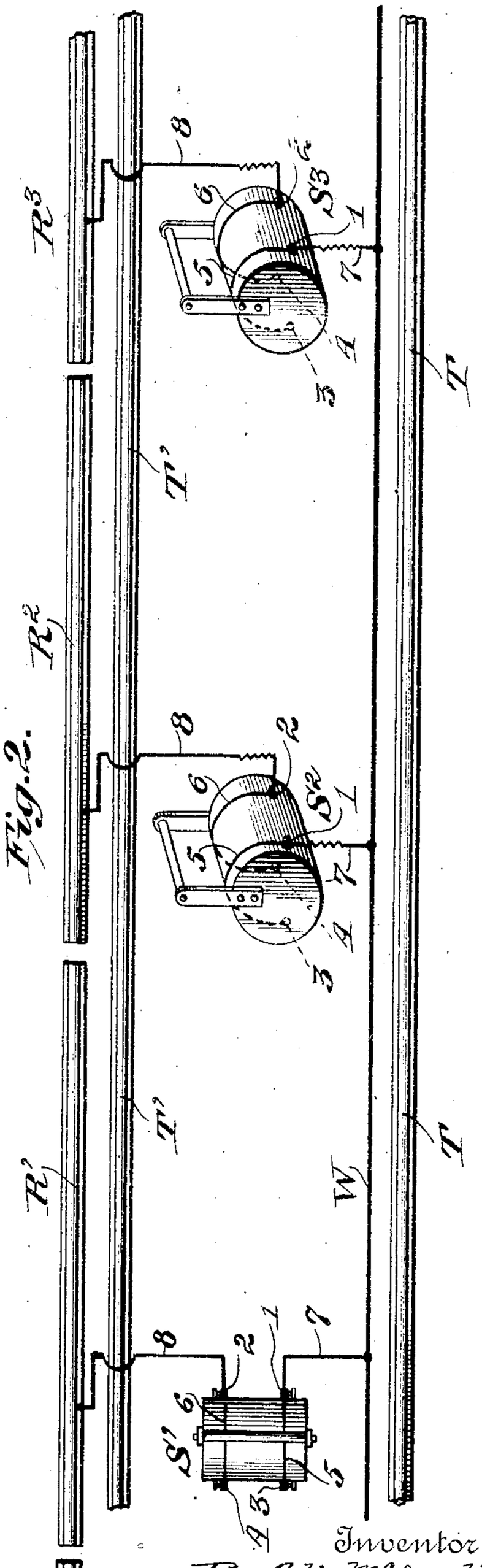

Fig. 2.

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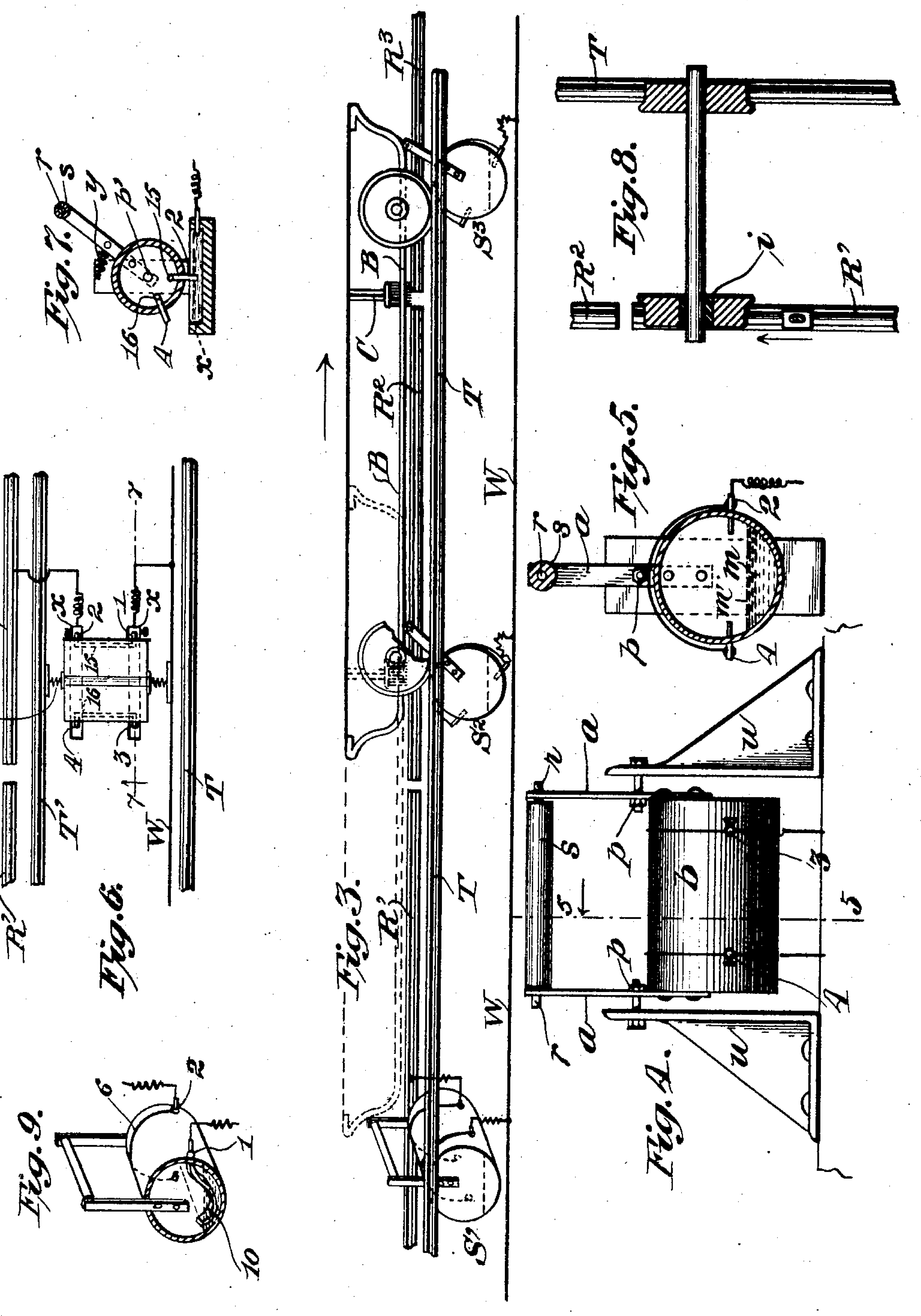

Witnesses

Inventor
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No. 785,909. Patented March 28, 1905.

UNITED STATES PATENT OFFICE.

JOHN COLIN McDONALD, OF NEW YORK, N. Y.

ELECTRIC-RAILWAY SYSTEM.

SPECIFICATION forming part of Letters Patent No. 785,909, dated March 28, 1905.

Application filed February 9, 1904. Serial No. 192,773.

To all whom it may concern:

Be it known that I, JOHN COLIN McDONALD, a citizen of the United States, residing in the borough of Bronx, city of New York, State of New York, have invented certain new and useful Improvements in Electric-Railway Systems, of which the following is a specification.

The invention relates to improvements in electric-railway systems in which the current is fed to the car-motor from an exposed live rail; and its object is to obviate the dangers incident to having exposed such a rail alive with current all the time for its entire length by dividing the rail into numerous insulated sections and automatically feeding the current to substantially such sections only as the car happens to be traveling.

The invention consists of apparatus for carrying out the above objects and embodies the features of construction, combinations of elements, and arrangement of parts having the general mode of operation substantially as hereinafter fully described and claimed in this specification, and shown in the accompanying drawings, in which—

Figure 1 is a plan view of one form of my system allowing the car to travel in the direction of the arrow—that is, in one direction only. Fig. 2 is a plan view of another form of my system, which, however, permits the car to travel in either direction. It should be remarked that in both Figs. 1 and 2 the switches S^2 S^3 are shown simply diagrammatically and not in proper perspective for the actual position which they occupy in the working device, this latter being shown by S′. Fig. 3 is a side elevation of Fig. 2 and shows in addition a car on the tracks in various positions of travel. Note also in this figure that the switch S′ is shown diagrammatically and not in true perspective. Figs. 4 and 5 are detail views of one of the switches—for example, S′. Thus Fig. 4 is a side elevation of the switch, and Fig. 5 is a transverse cross-section along the line 5 5 of Fig. 4. Figs. 6 and 7 show a modified form of switch. Fig. 6 is a top plan view, and Fig. 7 a cross-section of Fig. 6 along the line 7 7. Fig. 8 shows a modification in which the sectional contact-rail is used also as a track for the support of the car. Fig. 9 shows a modified form of switch.

It will be observed that all the foregoing drawings are diagrammatical and that in the interest of clearness no attempt has been made to represent actual working constructions.

In the drawings, T T′ represent the tracks upon which cars run.

R′ R^2 R^3 represent three sections of the contact-rail, said sections being insulated from each other and serving for feeding current to the car-motor through the traveling contact C, depending from the car and traversing said rail.

W is an insulated supply-wire feeding current from the dynamo to the system and having branch wires 7 leading to the switches S′ S^2, &c. The contact-rails R′ R^2 R^3 run parallel to the track, and the individual sections thereof may be of any suitable length, ordinarily about the length of a car. Each contact-rail section has its corresponding switch. The purpose of the switches is to connect the current as it is wanted from the supply-wire W with their respective contact-rail sections and thereafter when no longer required to disconnect such sections.

In the switches used in my system I employ a suitable conducting fluid—for example, mercury—and the circuit is made through these switches when they are thrown by connecting contact-points, otherwise insulated from each other, with the conducting liquid, the current thereby being given an opportunity to flow from one contact-point to the other through the intervening conducting fluid, and a circuit thus established through the switch. Vice versa, the circuit is broken by manipulating the switch so that the contact-points are no longer connected by the conducting fluid.

The form of switch shown generally in Figs. 1, 2, and 3 and more in detail in Figs. 4 and 5 consists of a hollow barrel *b*, partially filled with a conducting fluid *m*—for example, mercury. To the ends of the barrel are fastened two arms *a a*. Connecting the top of these arms is a rod, which rod serves as an axis for the roller *s*. The barrel is suspended pendulum-like between two uprights *u u*, these latter being fastened to the ties. The two piv-

ots, around which the barrel swings, are shown at *p p*. The switches are so mounted that their axes of rotation will be substantially parallel with the ties, and they will preferably be placed between the rails.

In the structure shown in Fig. 1, where the car runs in one direction only, there is a single pair of contacts 1 2 led into the barrel, whereas in the system shown in Figs. 2 and 3, where the car runs in either direction, there are provided two pairs of contacts 1 2 and 3 4, projecting into the barrel from the opposite sides. In either case the contacts, consisting of bared metallic points, project into the interior of the barrel, the contacts of each pair being arranged alongside of each other on about the same horizontal plane, and are placed at such a level that when the barrel is in its normal position—that is, with the upright arms *a a* vertical—the contacts will be well above the surface of the mercury. The two contacts of each pair must be suitably insulated from each other. This can be accomplished by making the barrels themselves of insulating material, most cheaply of wood.

It will be observed that in Figs. 2 and 3, where two pairs of contacts are shown leading into the barrels, that each contact of one pair is connected to a contact of the other pair. Thus contacts 1 and 3 are electrically connected by means of a wire 5, shown as encircling the outside of the barrel. Similarly, contacts 2 and 4 are connected by the wire 6.

It will be evident upon consideration that in the form of switch shown in Fig. 1 it is not essential that the two contacts should both be above the level of the conducting fluid when the barrel is in upright position—that is, when the switch is not in circuit. On the contrary, it will be sufficient if only one of the contacts is above the level of the conducting fluid, whereas the other contact may be so placed that it will be covered by the conducting fluid for all positions of the barrel, whether upright or tilted to the right or left. The same remark applies to the form of switch shown in Fig. 2 with the two pairs of contacts, and when so modified this switch may be represented by Fig. 9. It will be observed that the two contact-points 1 and 3, with their connecting-wire 5, are replaced by the single contact-point 1, having a conducting extension dipping into the conducting fluid in the barrel and so formed as to be in contact with such liquid for all operative positions of the barrel.

The means provided for depressing the rollers *s* of the switches, and thereby swinging them to the right or the left and so tilting the barrels, submerging one pair of contact-points or the other beneath the mercury, and so feeding the current through the switches, consists of a depressor-bar B, Fig. 3. This is a bar carried by the moving car and will be seen to be for the greater part of its length straight and parallel with the bottom of the car, but at its ends to be curved upward.

Referring now to Figs. 2, 3, 4, and 5, it will be evident that if the roller *s* of one of the switches should be pressed, for example, to the right the contacts 1 and 2 will be submerged beneath the mercury and the current will thereupon pass from the supply-wire W by the contact 1 into the mercury and out through the contact 2 and thence to the respective contact-rail section. Similarly if the roller *s* be pressed to the left the contacts 3 and 4 will in that case be submerged and the current fed from the supply-wire by means of these contacts through the mercury and thence to the contact-rail, so that in the system shown in Figs. 2 and 3 each pair of contacts does duty alternately, depending upon whichever way the car is running.

The wires 7 and 8, leading into and out of the switches, respectively, should be in flexible coils, so as to reduce liability of breakage to a minimum due to the vibration of the switches. The traveling contact C, by which the current is delivered to the motor from the contact-rail, may be of any suitable form and should be long enough to straddle the breaks between the contact-rail sections.

The operation of the system will now be sufficiently obvious. The double-travel system of Figs. 2 and 3, &c., only will be described. This will render unnecessary description of the single-travel system of Fig. 1, since one includes the other.

Referring to Fig. 3, the car when in the position shown by the dotted lines depresses only one switch S^2. Therefore at this time only one section of contact-rail R^2 is alive with current. It will be seen that the depressor-bar B will keep said switch S^2 and the rail R^2 alive throughout the time the car is traveling from the position show in dotted lines to the position shown in full lines. In this latter position it will be noticed that the traveling contact C is on the point of breaking contact with the rail R^2. It follows, therefore, that the car will stop for want of current unless the rail-section R^3 immediately ahead is made alive. This is accomplished, it will be seen, by the forward end of the depressor-bar B striking the roller *s* of the switch S^3, thereby depressing said switch S^3 and throwing current on the section R^3. The depressor-bar B will now keep this switch S^3 depressed throughout the time that the contact C is traveling over the rail-section R^3. As soon as the car moves forward slightly beyond the position shown in full lines, Fig. 3, since the contact C is no longer traveling on the rail-section R^2 and since of course under such circumstances no current is required to be on said section R^2, the switch S^2 controlling said section rises from under the curved rail end of the depressor-bar B and deadens the rail R^2. It will be observed that in Fig. 3 the

depressor-bar B is of such length, and, further, that the traveling contact C is placed in such relative position, that at a moment just prior to the breaking of electrical contact between said contact C and the section of contact-rail that has just been traveled the bar B will have depressed two switches, one of them, switch S^2, which has remained continuously depressed throughout the time that the contact C has been traveling on the rail-section R^2, and the other, switch S^3, which has just become depressed. The object of thus having both switches S^2 S^3 depressed, and consequently both of the corresponding rail-sections R^2 R^3 alive, at the same time just prior to the instant when the contact C breaks contact with the rail-section R^2 is to prevent arcing, since if the rail ahead—namely, R^3—were not made alive, so that the contact C could feed current therefrom to the motor before said contact broke contact with the section R^2 which it has just traveled, the current would be broken at this point under load, and arcing would necessarily result. The same mode of operation continues throughout all succeeding sections traveled by the car, the general result being that the car in its travel automatically cuts off the section of contact-rail that has just been traveled by the contact and renders alive the section immediately ahead and just about to be traveled by said contact. Moreover, precisely the same mode of operation takes place when the car is made to travel in a reverse direction—namely, in the direction opposite to the arrow in Fig. 3—the only difference being that the rollers of the switches in such case will be swung to the left.

Figs. 6 and 7 show a modified form of switch, the general purpose of which and the general adaptation and relation of the same to the rest of the system is substantially identical with that indicated for the other form of switch previously described. The switch shown in these views, Figs. 6 and 7, is an improvement in the respect that it does away with the wires 7 and 8, leading to the contacts on the barrel in the other form of switch. In doing away with all wires connecting to the barrel their possible breaking off, due to the vibration of the switches, is obviated. Instead of, as in the other switch, placing the mercury or other conducting fluid inside the barrel the same is disposed in two troughs *x x*, insulated from each other and placed below the barrel and parallel to the direction of vibration thereof. One of these troughs is connected to the supply-wire W and the other to the corresponding section of contact-rail. The barrel of the switch used when the car is to travel in one direction only has a single pair of contacts 1^2 projecting out from its surface, these contact-points being connected by a wire, preferably placed within the barrel. Thus in this improved switch as compared with the other switch the contact-points project without the barrel instead of within it, and, moreover, the contact-points of each pair instead of being insulated from each other are electrically connected by wires. For travel in either direction two pairs of these contact-points are required, and this is the form shown in Figs. 6 and 7. The contact-points of each pair, it will be noted, are about on the same horizontal level and at such a height on the barrel that when the switch is in its normal position—that is, with the bars *a a* vertical—they will not be immersed in the conducting liquid. When, however, the roller *s* of the switch is pushed to the right or left, thereby rotating the barrel about its axis, one pair or the other of the contacts will be immersed in the mercury, and therefore establish an electrical connection, through the switch, from the supply-wire to the section of contact-rail.

The device illustrated in Figs. 6 and 7 is shown purely in diagrammatic form, as of course in the actual working switch a construction would be adopted that would protect the contact parts and the conducting liquid from the weather.

The means heretofore described and relied on for bringing the switches back to their normal upright and inoperative position has been simply the force of gravity; but of course a spring may also be suitably employed for this purpose—for example, (see Fig. 7,) spring *y*.

In the system as heretofore described contact-rails separate and distinct from the two tracks have been provided. However, in some cases where the conditions permit one of the tracks can be dispensed with and the contact-rail sections made to perform not only their normal function of contact-rails, but also the function of acting as one of the supporting-tracks for the car. The system will be identical in all respects with that illustrated and described heretofore, with the exception that one of the supporting-rails will be dispensed with and opposite wheels of the car will be made to travel on an ordinary continuous rail, Fig. 8, T, on one side and on the other side on the sectional contact-rail. (See Fig. 8, R′ R^2.) The only further condition required is that the wheels on the two sides of the car must be insulated from each other. This insulation can be effected in any suitable manner—for example, by insulating the wheels themselves from the axles (see Fig. 8, where the insulation is indicated by *i*) or by otherwise suitably applying insulation to effect the purpose, which is to prevent the current from short-circuiting between the rails through the wheels and axles of the car.

The conducting material used in the switches may be either mercury or some other freely-flowing conducting material. It may be desirable to provide a layer of oil (see *m′*, Fig. 5)

over the conducting material in each of the switches, so as to more effectually break any arcs that may perchance form within the switches.

The switches provided with conducting material and operating on that principle in the manner described have important advantages in connection with electric-railway systems not possessed by any other switch known to the patentee. Some of these advantages are that they can be thrown in and out of circuit with great rapidity and positiveness. No accurate adjustment of the parts or of the position of the depressor-bar B relative to the rollers *s* of the switches is required. Moreover, accuracy of adjustment being non-essential breakage of the switches due to inaccurate coöperation of the parts will not occur.

Without enumerating equivalents or attempting to describe all the modifications which may be made in my system without departing from the spirit of the invention, what I claim is as follows:

1. In an electric-railway system, a supply-wire; a stationary contact-rail formed in sections insulated from each other; a traveling contact for feeding current from the contact-rail to the car-motor, switches mechanically operated by a member attached to the car, said switches controlling the supply of current to said contact-rail, said switches consisting of a conducting-terminal; another conducting-terminal insulated from the first-named terminal; a freely-flowing conducting material; and rotary means which when operated results in the freely-flowing conducting material connecting or falling short of connecting said terminals.

2. In an electric-railway system, a supply-wire; a stationary contact-rail formed in sections insulated from each other; a traveling contact for feeding current from the contact-rail to the car-motor; switches for controlling the supply of current to said contact-rail; said switches comprising a conducting-terminal; another conducting-terminal insulated from the first-named terminal; a freely-flowing conducting material; and rotary means which when operated results in the freely-flowing conducting material connecting or falling short of connecting said terminals; and switch-controlling means consisting of a bar disposed longitudinally in relation to the car and carried thereby, and adapted by mechanical contact to throw each switch and maintain same in circuit throughout the time that current needs to be fed through that switch to the particular contact-rail section controlled by it.

3. In an electric-railway system, a supply-wire; a stationary contact-rail formed in sections insulated from each other; a traveling contact for feeding current from the contact-rail to the car-motor; switches for controlling the supply of current to the contact-rail; said switches comprising a conducting-terminal; another conducting-terminal insulated from the first-named terminal; a freely-flowing conducting material; and rotary means which when operated results in the freely-flowing conducting material connecting or falling short of connecting said terminals; and switch-operating means carried by the car consisting of a long bar disposed lengthwise of the car adapted by mechanical contact to throw in circuit and maintain in circuit each switch successively along the line of travel, throughout the time that the traveling contact needs current for the motor from the particular contact-section controlled by that switch, said switch-controlling means being adapted subsequently to release said switch.

4. In an electric-railway system, a supply-wire; a stationary contact-rail formed in sections insulated from each other; a traveling contact for feeding current from the contact-rail to the car-motor; switches for suitably controlling the supply of current to the contact-rail; and switch-controlling means carried by the car consisting of a long bar disposed lengthwise of the car adapted by mechanical contact to throw in circuit and maintain in circuit each switch successively along the line of travel, throughout the time that said traveling contact needs current for the car-motor from the particular contact-section controlled by that switch, said switch-controlling means being adapted subsequently to release said switch.

5. In an electric-railway system, two tracks for supporting the car-wheels consisting respectively of an ordinary continuous rail and a sectional contact-rail; insulating means to prevent electrical connection between said tracks through the car-wheels and axle; a traveling contact for feeding current from said contact-rail to the motor and car-controlled switches for suitably controlling the supply of current to the said contact-rail, said switches consisting of a conducting-terminal; another conducting-terminal insulated from the first-named terminal; a freely-flowing conducting material, and rotary means which when operated results in the freely-flowing conducting material connecting or falling short of connecting said terminals.

6. In an electric-railway system, a stationary contact-rail formed in sections insulated from each other; a traveling contact for feeding current from the contact rail to the car-motor; switch-operating means carried by the car operating by mechanical contact switches for controlling the supply of current to the contact-rail, said switches comprising a hollow receptacle, supporting means for said receptacle upon which it can oscillate between a normal position and an abnormal position; means on the switch with which the switch-operating means on the car contacts to move the receptacle into said abnormal position, said

means oscillating as part of the receptacle upon the same supporting means as the receptacle; means causing said receptacle to resume its normal position as soon as said switch-operating means ceases to contact with said means on the switch; freely-flowing conducting material within the receptacle; conducting-terminals borne by the receptacle and adapted to be electrically connected by said material when the receptacle is in its abnormal position, but not to be so connected when it is in its normal position.

7. In an electric-railway system, a stationary contact-rail formed in sections insulated from each other; a traveling contact for feeding current from the contact rail to the car-motor; switch-operating means carried by the car operating by mechanical contact switches for controlling the supply of current to the contact-rail; said switches comprising a hollow receptacle, supporting means for said receptacle upon which it can oscillate between a normal position and an abnormal position; means on the switch with which the switch-operating means on the car contacts to move the receptacle into said abnormal position, said means oscillating as part of the receptacle upon the same supporting means as the receptacle; means operating to restore the receptacle to its normal position; freely-flowing conducting material within the receptacle; conducting-terminals borne by the receptacle and adapted to be electrically connected by said material when said receptacle is in its abnormal position, but not to be so connected when the receptacle is in its normal position.

8. In an electric-railway system, a stationary contact-rail formed in sections insulated from each other; a traveling contact for feeding current from the contact-rail to the car-motor; switch-operating means carried by the car operating by mechanical contact switches for controlling the supply of current to the contact-rail; said switches comprising a hollow receptacle, supporting means for said receptacle upon which it can oscillate between abnormal positions on both sides of its normal position; means on the switch with which the switch-operating means on the car contacts to move the receptacle into one abnormal position or the other, said means oscillating as part of the receptacle upon the same supporting means as the receptacle; means operating to restore the receptacle to its normal position; freely-flowing conducting material within the receptacle; conducting-terminals borne by the receptacle and adapted to be electrically connected by said freely-flowing material when the receptacle has been moved into one of its abnormal positions, but not to be so connected when the receptacle is in its normal position.

9. In an electric-railway system, a stationary contact-rail formed in sections insulated from each other; a traveling contact for feeding current from the contact-rail to the car-motor; switch-operating means carried by the car operating by mechanical contact switches for controlling the supply of current to the contact-rail; said switches comprising a hollow receptacle, supporting means for said receptacle whereby it forms part of a pendulum, and tends at all times to assume a normal position, but can be moved into abnormal positions to either side of its normal position; means on the switch with which the switch-operating means on the car contacts to move the receptacle into one abnormal position or the other, depending upon the direction in which the switch-operating means acts, said means oscillating as part of the receptacle upon the same supporting means as the receptacle; freely-flowing conducting material within the receptacle; conducting-terminals borne by the receptacle and adapted to be electrically connected by said freely-flowing material when the receptacle has been moved into an abnormal position, but not to be so connected when the receptacle is in its normal position.

10. In an electric-railway system, a stationary contact-rail formed in sections insulated from each other; a traveling contact for feeding current from the contact-rail to the car-motor; switch-operating means carried by the car operating by mechanical contact switches for controlling the supply of current to the contact-rail; said switches comprising a hollow receptacle, supporting means for said receptacle upon which it can oscillate between a normal position and an abnormal position; means on the switch with which the switch-operating means on the car contacts to move the receptacle into said abnormal position, said means oscillating as part of the receptacle upon the same supporting means as the receptacle; means operating to restore the receptacle to its normal position; freely-flowing conducting material within the receptacle; conducting-terminals borne by the receptacle and adapted each to be in electrical contact with said freely-flowing material in an abnormal position of the receptacle, but neither to be in such contact in the normal position of the receptacle.

11. In an electric-railway system, a stationary contact-rail formed in sections insulated from each other; a traveling contact for feeding current from the contact-rail to the car-motor; switches for controlling the supply of current to the contact-rail; said switches comprising a hollow receptacle, supporting means for said receptacle upon which it can oscillate between a normal position and an abnormal position; means on the switch with which the switch-operating means on the car contacts to move the receptacle into said abnormal position, said means oscillating as part of the receptacle upon the same supporting means as the receptacle; means operating to restore the re-

ceptacle to its normal position; freely-flowing conducting material within the receptacle; conducting-terminals borne by the receptacle and adapted to be electrically connected by said freely-flowing material when the receptacle has been moved into its abnormal position, but not to be so connected when the receptacle is in its normal position; and switch-operating means carried by the car comprising a long member which is adapted to contact at successive parts of its length with said means on the switch whereby said receptacle is moved into its abnormal position and continuously maintained in such position as long as said contact continues.

12. In an electric-railway system, a stationary contact-rail formed in sections insulated from each other; a traveling contact for feeding current from the contact-rail to the car-motor; switches for suitably controlling the supply of current to the contact-rail; said switches comprising a hollow receptacle, supporting means for said receptacle upon which it can oscillate between abnormal positions on both sides of a normal position; means on the switches with which switch-operating means on the car contacts to move the receptacle into one abnormal position or the other, depending upon the direction in which the switch-operating means acts, said means oscillating as part of the receptacle upon the same supporting means as the receptacle; means operating to restore the receptacle to its normal position; freely-flowing conducting material within the receptacle; conducting-terminals borne by the receptacle and adapted to be electrically connected by said freely-flowing material when the receptacle has been moved into one of its abnormal positions, but not to be so connected when the receptacle is in its normal position; and switch-operating means carried by the car comprising a long member which is adapted to contact at successive parts of its length with said means on the switch, whereby the receptacle is moved into an abnormal position and continuously maintained in such position as long as such contact continues.

13. The combination of a switch comprising a hollow receptacle, supporting means for said receptacle upon which it can oscillate between a normal position and an abnormal position; means on the switch with which switch-operating means can contact to move the receptacle into said abnormal position, said means oscillating as part of the receptacle upon the same supporting means as the receptacle; means causing said receptacle to resume its normal position as soon as said switch-operating means ceases to contact with said means on the switch; freely-flowing conducting material within the receptacle; conducting-terminals borne by the receptacle and adapted to be electrically connected or disconnected by said freely-flowing material, depending upon the position of the receptacle; and said switch-operating means adapted as it moves past the switch to operate it by mechanical contact.

14. The combination of a switch comprising a hollow receptacle; supporting means for said receptacle upon which it can oscillate between a normal position and an abnormal position; means on the switch with which switch-operating means can contact to move the receptacle into said abnormal position, said means oscillating as part of the receptacle upon the same supporting means as the receptacle; means operating to restore the receptacle to its normal position; freely-flowing conducting material within the receptacle; conducting-terminals borne by the receptacle and adapted each to be in electrical contact with said freely-flowing material in the abnormal position of the receptacle, but neither to be in such contact in the normal position of the receptacle; and said switch-operating means adapted as it moves past the switch to operate it by mechanical contact.

15. The combination of a switch comprising a hollow receptacle; supporting means for said receptacle upon which it can oscillate between abnormal positions on both sides of a normal position; means on the switch with which switch-operating means can contact to move said receptacle into one abnormal position or the other, said means oscillating as part of the receptacle upon the same supporting means as the receptacle; means operating to restore the receptacle to its normal position; freely-flowing conducting material within the receptacle; conducting-terminals borne by the receptacle and adapted to be electrically connected or disconnected by said freely-flowing material, depending upon the position of the receptacle; and switch-operating means comprising a long member which is adapted to contact at successive parts of its length with said means on the switch, whereby the receptacle is moved into one of its abnormal positions and continuously maintained in such position as long as such contact continues.

16. The combination of a switch comprising a hollow receptacle; supporting means for said receptacle upon which it can oscillate between a normal position and an abnormal position; means on the switch with which switch-operating means contacts to move the receptacle into said abnormal position, said means oscillating as part of the receptacle upon the same supporting means as the receptacle; means operating to restore the receptacle to its normal position; freely-flowing conducting material within the receptacle; conducting-terminals borne by the receptacle and adapted to be electrically connected or disconnected by said freely-flowing material, depending upon the position of the receptacle; and switch-operating means comprising a long member which is adapted to contact at successive parts of its length with said means on the switch,

whereby the receptacle is moved into its abnormal position and continuously maintained in such position as long as such contact continues.

17. The combination of a hollow receptacle; supporting means whereby the receptacle can freely oscillate into abnormal positions to either side of a normal position; means on the switch with which switch-operating means can contact to move the receptacle into either of said abnormal positions, said means oscillating as part of the receptacle upon the same supporting means as the receptacle; means operating to restore the receptacle to its normal position; freely-flowing conducting material within the receptacle; conducting-terminals borne by the receptacle and adapted to be electrically connected or disconnected by said freely-flowing material, depending upon the position of the receptacle; and said switch-operating means adapted as it moves past the switch to operate it by mechanical contact.

18. In an electric switch, the combination of a hollow receptacle; supporting means for said receptacle upon which it can oscillate free and unimpeded like a pendulum between a normal position and an abnormal position; means automatically operating to restore the receptacle to its normal position when the switch is not being operated; freely-flowing conducting material within the receptacle; conducting-terminals borne by the receptacle and adapted each to be in electrical contact with said freely-flowing material in one position of the receptacle, but neither to be in such contact in the other position of the receptacle.

19. In an electric switch, the combination of a hollow receptacle; supporting means for said receptacle upon which it can oscillate free and unimpeded like a pendulum between abnormal positions on both sides of a normal position; means automatically operating to restore the receptacle to its normal position when the switch is not being operated; freely-flowing conducting material within the receptacle; and conducting-terminals borne by the receptacle and adapted to be electrically connected or disconnected by said freely-flowing material, depending on position of the receptacle.

20. In an electric switch, the combination of a hollow receptacle; supporting means for said receptacle whereby it forms part of a pendulum and automatically assumes a normal position when the switch is not being operated, but can be moved into abnormal positions to either side of its normal position; freely-flowing conducting material within the receptacle; and conducting-terminals borne by the receptacle and adapted to be electrically connected or disconnected by said freely-flowing material, depending upon the position of the receptacle.

21. In an electric switch, the combination of a hollow receptacle; supporting means for said receptacle upon which it can oscillate free and unimpeded like a pendulum between abnormal positions on both sides of a normal position; means automatically operating to restore the receptacle to its normal position when the switch is being operated; freely-flowing conducting material within the receptacle; conducting-terminals borne by the receptacle and adapted to be both in electrical contact, or to be both out of electrical contact with said freely-flowing material, depending upon the position of the receptacle.

22. In an electric switch, the combination of a hollow receptacle; pivotal supporting means for said receptacle whereby, like a pendulum, it automatically, when not being operated, assumes a normal position, but can freely oscillate into abnormal positions to one side or the other of said normal position; freely-flowing conducting material inside the receptacle; conducting-terminals borne by said receptacle and adapted to be electrically connected or disconnected by said freely-flowing material, depending upon the position of the receptacle.

23. In an electric switch, the combination of a hollow receptacle; supporting means whereby said receptacle, like a pendulum, tends to assume a normal position, but can be moved to one side or the other of said normal position; freely-flowing conducting material within said receptacle; a layer of oil upon said freely-flowing conducting material; and conducting-terminals borne by said receptacle and adapted to be electrically connected or disconnected by said freely-flowing material, depending upon the position of the receptacle.

24. In an electric-railway system, two tracks for supporting the car-wheels, consisting respectively of an ordinary continuous rail and a contact-rail consisting of sections insulated from each other; insulating means to prevent electrical connection between said tracks through the car wheels and axles; means for conveying the current from the contact-rail to the motor; switches for controlling the supply of current to said contact-rail; said switches comprising a hollow receptacle; supporting means for said receptacle upon which it can oscillate between a normal position and an abnormal position; means on the switch with which switch-operating means on the car contacts to move the receptacle into said abnormal position; means operating to restore the receptacle to its normal position; freely-flowing conducting material within the receptacle; conducting-terminals borne by the receptacle and adapted to be connected or disconnected by said freely-flowing material, depending upon the position of the receptacle; and switch-operating means carried by the car and operating the switches by mechanical contact.

25. In an electric-railway system, two tracks for supporting the car-wheels, consisting respectively of an ordinary continuous rail and

a contact-rail formed in sections insulated from each other; insulating means to prevent electrical connection between said tracks through the car wheels and axles; means for feeding the current from said contact-rail to the motor; switch-operating means carried by the car for operating switches which control the supply of current to said contact-rail; said switches consisting of a hollow receptacle; supporting means for said receptacle upon which it can oscillate between a normal and an abnormal position; means operating to restore the receptacle to its normal position; freely-flowing conducting material within the receptacle; and conducting-terminals borne by the receptacle and adapted to be connected or disconnected, depending upon the position of the receptacle.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

JOHN COLIN McDONALD.

Witnesses:
LAURA A. NORTHROP,
WILLIAM J. CHISHOLM.