No. 730,810. PATENTED JUNE 9, 1903.

W. A. P. WILLARD, Jr.

SWITCH ESPECIALLY ADAPTED FOR THIRD RAILS FOR ELECTRIC RAILWAYS.

APPLICATION FILED NOV. 11, 1901.

NO MODEL. 3 SHEETS—SHEET 1.

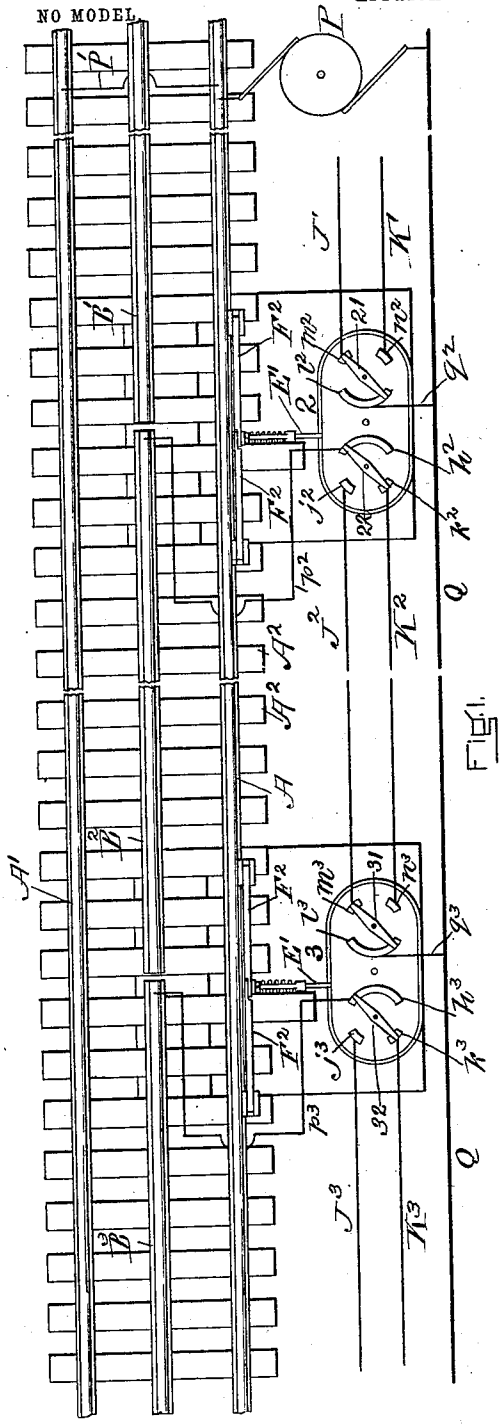


Fig. 1.

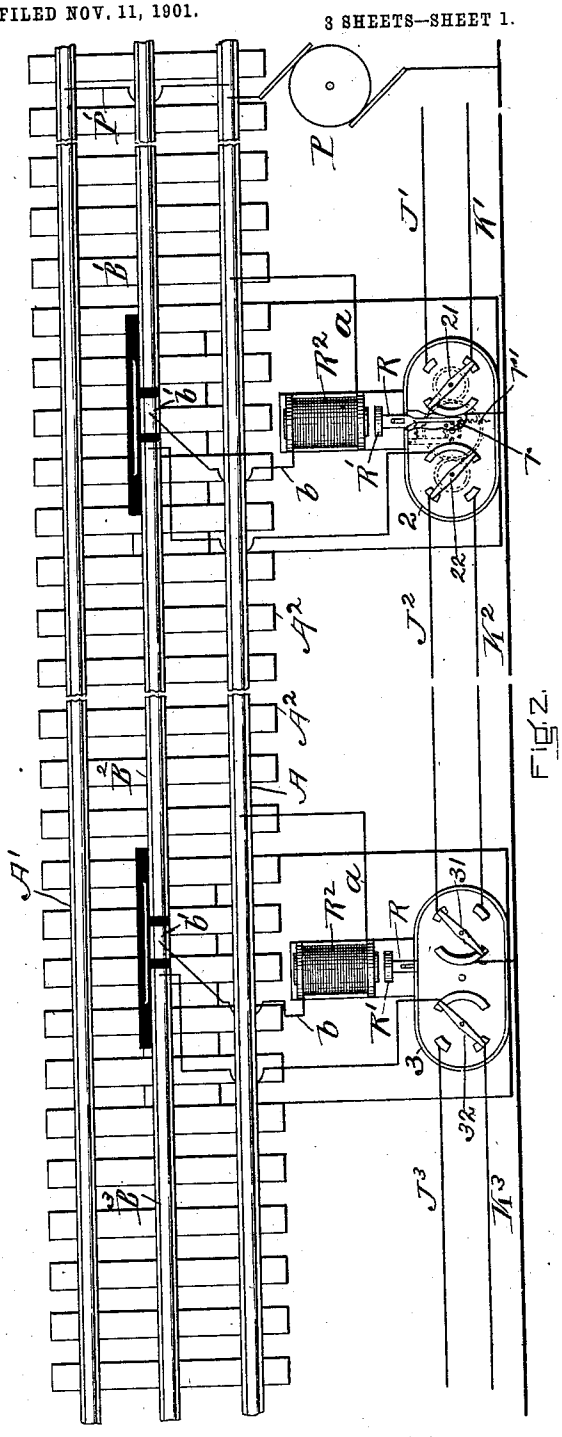


Fig. 2.

WITNESSES:
M. E. Flaherty
Saml Sappington

INVENTOR:
Wm. A. P. Willard Jr.
by Chas. O. G. Tonnele his Atty.

No. 730,810. PATENTED JUNE 9, 1903.

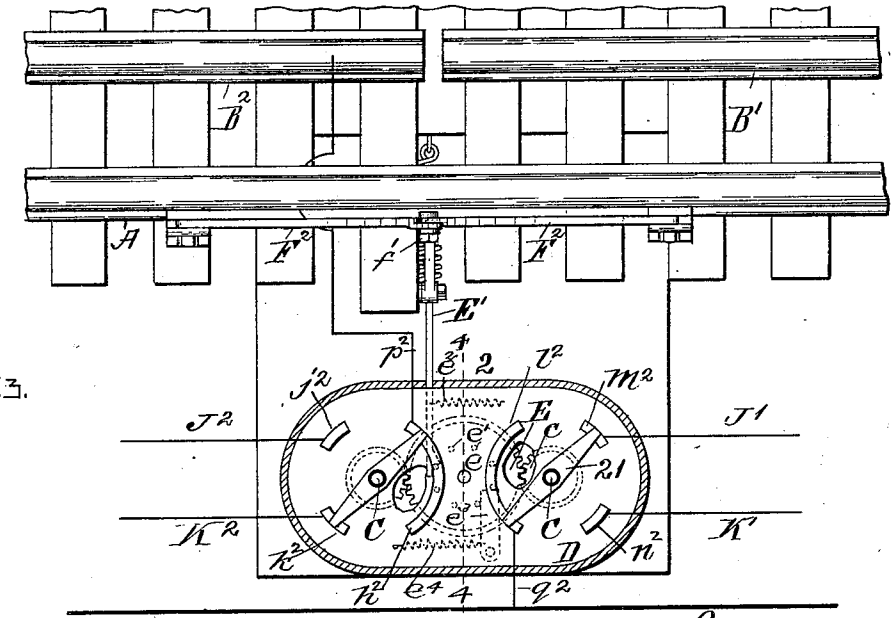
W. A. P. WILLARD, Jr.

SWITCH ESPECIALLY ADAPTED FOR THIRD RAILS FOR ELECTRIC RAILWAYS.

APPLICATION FILED NOV. 11, 1901.

NO MODEL. 3 SHEETS—SHEET 2.

Fig. 3.



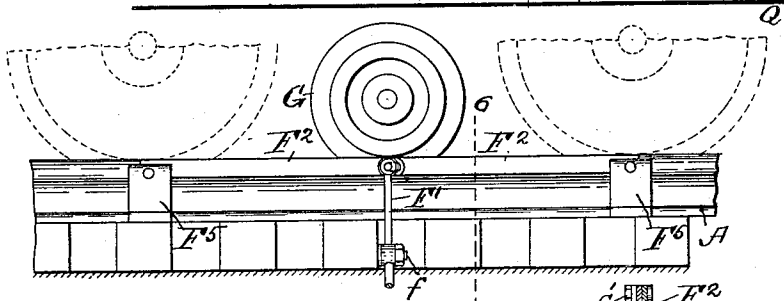


Fig. 5.

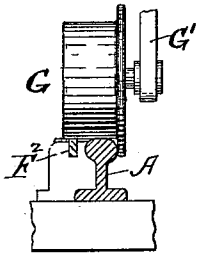


Fig. 6.

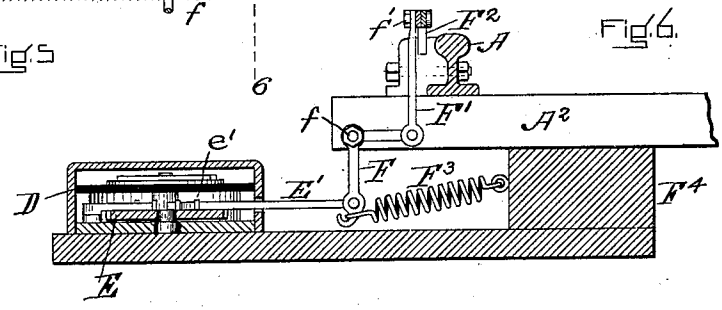


Fig. 4.

WITNESSES:
M. E. Flaherty
Saml Sepperstein

INVENTOR:
Wm. A. P. Willard Jr.
by Geo. O. G. Brown
his Atty

No. 730,810. PATENTED JUNE 9, 1903.

W. A. P. WILLARD, Jr.

SWITCH ESPECIALLY ADAPTED FOR THIRD RAILS FOR ELECTRIC RAILWAYS.

APPLICATION FILED NOV. 11, 1901.

NO MODEL. 3 SHEETS—SHEET 3.

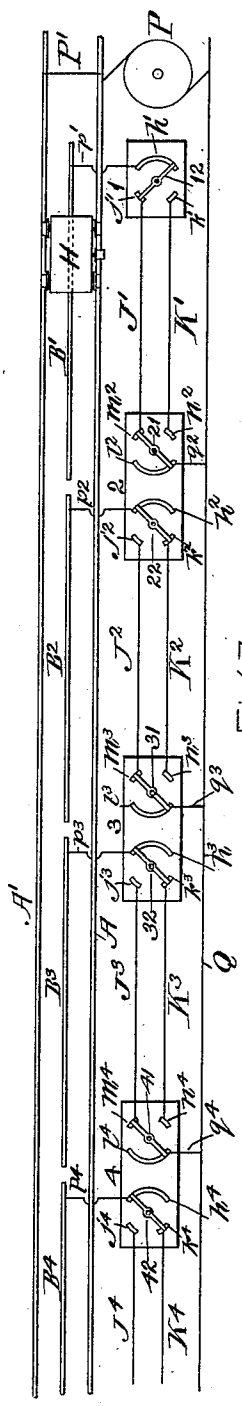


Fig. 7.

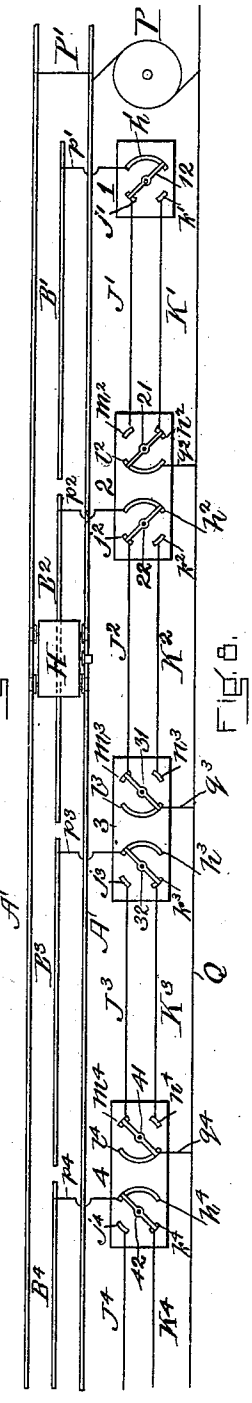


Fig. 8.

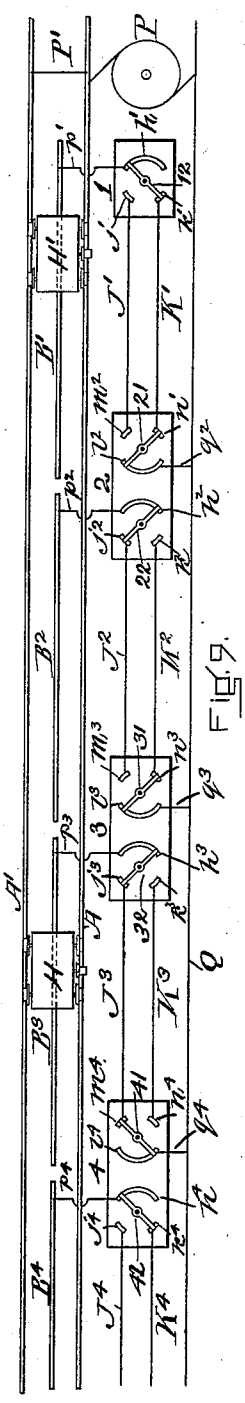


Fig. 9.

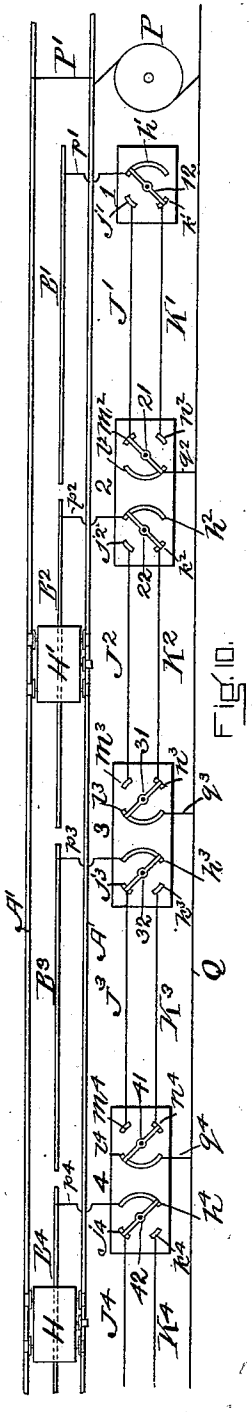


Fig. 10.

WITNESSES:

M. E. Flaherty

Saml Seppelstein

INVENTOR:

Wm. A. P. Willard Jr.

by Chas. D. G. Goepel

Attorney.

No. 730,810. Patented June 9, 1903.

UNITED STATES PATENT OFFICE.

WILLIAM A. P. WILLARD, JR., OF NEW YORK, N. Y., ASSIGNOR TO PIERRE LORRILLARD, JR., OF TUXEDO, NEW YORK.

SWITCH ESPECIALLY ADAPTED FOR THIRD RAILS FOR ELECTRIC RAILWAYS.

SPECIFICATION forming part of Letters Patent No. 730,810, dated June 9, 1903.

Application filed November 11, 1901. Serial No. 81,895. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM A. P. WILLARD, Jr., of New York city, county of New York and State of New York, have invented a new and useful Improvement in Switches Especially Adapted for Third Rails for Electric Railways, of which the following is a specification.

My invention is especially adapted for use with third-rail electric-railway systems where it is desired to make and break two adjacent circuits by the one operation, and it will be understood by reference to the drawings, in which there is shown a system especially adapted for use with such a switch.

In the drawings, Figure 1 is a plan view of a system embodying my invention, in which a mechanical movement is used to throw the switches by which the path of the current is determined, the rails and wires being broken to indicate the fact that the third-rail sections may be of any convenient or desired length. Fig. 2 is a similar view to illustrate a means for throwing the switches by electricity. Fig. 3 is an enlarged view showing a portion of the track and the switch-box, the cover of the latter being removed. Fig. 4 is a vertical section of the switch-box and switch-throwing mechanism on line 4 4 of Fig. 3. Fig. 5 is a side elevation of the track-rail and a means attached to the car for operating the track instrument, Fig. 6 being a section on line 6 6 of Fig. 5. Figs. 7, 8, 9, 10 are diagrams, which will be described in detail below.

A A′ are the track-rails, laid on the sleepers A^2.

B′, B^2, B^3, and B^4 are the third-rail sections, which are laid upon the sleepers A^2 and may be of any desired length. Each section is insulated from the ground and from every other section; but one complete section B^2 is shown in the main views, all the sections, however, being alike. Each section is connected to two switch-boxes, one at each end thereof.

These switch-boxes are numbered 1, 2, 3, and 4. Each switch-box (except box 1) contains two switches. The switches are numbered, respectively, 12, 21 22, 31 32, and 41 42 and are alike in all respects.

As the means for operating each switch is identical with every other, I shall only describe in detail the construction of one of them—for example, the contents of switch-box 2, referring especially to Figs. 3 and 4. Each switch 21 22 is mounted upon an insulated stud C, suitably supported in the floor of the box and in the insulating-plate D. Each switch turns with its stud. Each stud C carries a gear *c*, located below the switch 21 22 and separated therefrom by the insulating-plate D. Each gear is in mesh with a central gear E, mounted to rotate on a stud *e*, and having projecting from its upper surface a series of pins *e′*.

E′ is a pushing-pawl which is mounted to slide horizontally, its pushing-surface resting against one of the pins *e′*, being held in engagement with it by a spring e^3, one end of which is attached to the pawl E′, its other end being attached to the floor of the switch-box. e^3 is a holding-pawl which engages the rear of one of the pins *e′* to prevent any retrograde movement on the part of the gear E and is normally held in that position by the spring e^4. I prefer to move the pawl E′ to rotate the gear E in the following manner: Its rear end is attached to the vertical arm of a bell-crank F, pivoted to one of the sleepers A^2 at *f*, the horizontal arm of this bell-crank being connected by the connecting-rod F′ with connecting-pin *f′* of a pair of toggles F^2, located near the track-rail A.

A spring F^3, connected to a suitable block F^4, located between the sleepers A^2, holds the pawl E′ normally in a rearward position, and the connections are so arranged that when the pawl E′ is in that position the toggles F^2 are lifted above the level of the track-rail A. A depression, however, of these toggles will give to the pawl E′ the necessary movement to turn the central gear E through a proper portion of a circle.

The outer ends of the toggles F^2 are pivoted to blocks F^5, bolted or otherwise attached to the rail structure. The adjacent ends of the toggles are slotted where they receive the connecting-pin *f′*, so that there may be a slight sliding motion between the adjacent ends of the toggles when they are depressed.

It will be seen that if the toggles F^2 are placed so near the rail A that each car-wheel

will strike them as it passes they will be depressed and the switches thrown many times during the passage of a train unless some special mechanism is provided to prevent it. While such mechanism may be readily planned, it would only serve to complicate the structure, and consequently, as shown in the drawings, the toggles F^2 are set sufficiently far from the rail A to clear the ordinary running-gear of the train, provision being made for depressing the toggles by means of a wheel G, of wide tread, which is supported in a suitable journal-box G', carried by the forward truck upon the proper side of the train, so as to run on the track-rail. As its construction is not peculiar and as its use does not require a reconstruction of the ordinary form of truck adopted by railroads, except in so far as a hanger carrying the journal-box must be suspended from the truck, it has not been deemed necessary to show the hanging of this wheel in detail, as it is believed that any one skilled in the art could without further instructions add such a journal-box to a car-truck.

The mechanism above described then operates in the following manner: As a train approaches the switch-box mechanisms the wheel G depresses each pair of toggles F^2 in turn. The depressing of the toggles acting through its bell-crank F throws the pawl E', connected therewith, which, as it is normally in engagement with one of the pins e', pushes the gear E through a portion of a turn, thus turning the gears c c through a quarter of a revolution and throwing the switches 21 22, &c., from the positions shown, for example, in Fig. 3, to positions at right angles thereto, the holding-pawl being pushed aside to allow the pin e' in rear of it to pass it and then resuming its normal position behind that pin and holding it and the gear E from any backward position. After the wheel G has passed over the toggle the spring F^3 withdraws the pawl F', which is reset by means of the spring e^2, ready to operate the switches 21 22 again when the toggles F^2 are depressed by the wheel G upon the next train. Each insulating-plate D carries upon its upper surface two sets of terminals. These terminals are located to engage the ends of the switch-arms 12 21 22, &c. The switch-box 1 is constructed in precisely the same manner as the other switch-boxes above described, the only difference between this switch-box and the other switch-boxes in the system being that it lacks one of the studs C and one of the gears c, with its support and operated switch.

The circuit connections are shown fully in the diagrams Figs. 7, 8, 9, and 10, where there is also shown the effect of the travel over the line of two cars H H', the latter car being shown only in Figs. 9 and 10.

Referring first to the double switch-boxes, one terminal l^2 h^2, l^3 h^3, and l^4 h^4 of each set is a segment comprising an arc of about ninety degrees. Segments l^2, l^3, and l^4 are connected by wires q^2, q^3, and q^4, respectively, with the trunk-line Q, running to the generator P, this being a preferred means of connecting each switch with the generator, while h^2, h^3, and h^4, as well as the segment h' of box 1, is each permanently connected with one of the third-rail sections B^2, B^3, B^4, and B' by means of wires p^2, p^3, p^4, and p', respectively. It is evident, however, that this segment may be dispensed with and connection made directly with the switch-stud C. The other two terminals of each set, m^2 n^2, j^2 k^2, m^3 n^3, j^3 k^3, m^4 n^4, j^4 k^4, are merely contact-points arranged, respectively, at about ninety degrees from the ends of the segment-terminals. The terminals j' k' of box 1 and m^2 n^2 of box 2 are connected, respectively, by bus-wires J' K', the bus-wires J^2 K^2 and J^3 K^3 connecting corresponding terminals of box 2 and 3 and 3 and 4, respectively, the bus-wires J^4 K^4 running to the next box in the system. (Not shown.) The generator P is also connected by a wire P' with the track-rails A A'. As has been stated above, the purpose of this mechanism is to throw in circuit only that section of the third rail upon which the car is about to enter and over which it is to pass. It is to be understood that the car is provided with a motor and mechanism adapted to take its current from the third rail and complete the circuit through the track-rails A A'. Such mechanism is not illustrated, as it is now well understood in the art. Prior to starting the car the switch 12, as shown in Fig. 7, is in position at right angles to that shown—namely, so that it connects the segment h' with the terminal k', so that no current can possibly pass through the bus-wire J'. As the car H is about to start, however, this switch 12 is thrown by hand or by any convenient means for the purpose into the position shown in Fig. 7, thus completing the circuit from the generator P through the trunk-line Q, wire q^2, segment l^2, switch 21, terminal m^2, bus-wire J', terminal j', switch 12, segment h', wire p' to the third-rail section B', thence through the car to the track-rails A A', and back by wire P' to the generator P. When the car has reached the end of the section B', its switching-wheel G strikes the toggles F^2, depressing them and operating the switch-box 2 in the manner above described, so that each switch 21 and 22 is turned through an angle of ninety degrees, being then set in the position shown in Fig. 8. It will be seen that the switch 21 being thrown from the terminal m^2 to the terminal n^2 has broken the circuit through the wire J', while the switch 22 has moved to the terminal k^2, thus completing a circuit from the trunk-line Q through the wire q^3, segment l^3, switch 31, terminal m^3, bus-wire J^2, terminal j^2, switch 22, segment h^2, wire p^2 to the second section B^2 of the third rail, thence through the car and track-rails, as before, to the generator through the wire P'. In like manner as this car proceeds to switch-box 3 it throws the

switches 31 and 32 into the position shown in Fig. 9, thus breaking the circuit through the bus-wire J^2 and completing a circuit of the same character as before through the bus-line J^3. In the meantime the car H′ is to be started, and for this purpose the switch 12 is again thrown by hand as before, this time into the position shown in Fig. 9, and the circuit is now completed not through the bus-line J′, but through the bus-line K′, the current passing from the generator through the trunk-line Q, wire q^2, segment l^2, switch 21, terminal n^2, bus-wire K′, terminal k', switch 12, segment h', wire p' to the section B′, thence through the car H′ to the track-rails, and thence by the wire P′ to the generator. Upon passing off from this section the switch-throwing mechanism of switch-box 2 is operated automatically, as before, to throw the switches 21 and 22 into the position shown in Fig. 10, thus breaking the circuit through the bus-wire K′ and making a circuit through the third rail B^2, as follows: from the generator P through the trunk-line Q, wire q^3, segment l^3, switch 31, terminal n^3, bus-wire K^2, terminal k^2, switch 22, segment h^2, wire p^2, to the third-rail section B^2, and thence through the car and back by the track-rails, as before. It seems unnecessary to describe these circuits any further. By the use of two bus-wires, a set of terminals at each end of these wires, and two sets of switches it will be seen that the two bus-wires are used alternately and that the switch in one switch-box is turned to make the circuit, the circuit being broken at the proper time by the turning of the switch in the next switch-box, and each car as it passes from one section to the next throws two switches, one of which breaks the circuit through the bus-wire which has supplied current, the other making contact with the other bus-wire, so that that wire is in condition to be utilized by the following car when the switch at the entering end of the section has been thrown, and at the same time throwing the switch belonging to the section to make connection through one of its bus-wires.

I have shown in Fig. 2 a similar construction of switch-box except that in this case the pawl, although it slides horizontally, is operated by a pull caused at the proper time by the exciting of an electromagnet. The pawl is marked R and instead of pushing one of the pins e' its end is hook-shaped, as shown at r, so that it engages one of the pins and pulls it to turn the gear E the proper distance, a holding-pawl being provided similar in character to the pawl e^3, but differently located in the switch-box, as will be readily understood. The outer end of the sliding pawl R is provided with an armature R′ within the control of an electromagnet R^2, which is excited through a wire a, which connects with the track-rails, and also through a wire b, which connects with a button or short section b' of the third rail. Each button b' is located between adjacent ends of two third-rail sections, and as the trolley-shoe passes across from one excited section it bridges the insulation or opening between that section and the button b', thus connecting this button with the said excited section. A divided circuit is thus made for the instant through the electromagnet R^2, exciting it and causing it to attract the armature and give the necessary movement to the switches in the switch-box, thus bringing the next section of the third rail into circuit and breaking the circuit in the section over which the shoe has just passed. A spring r' serves to withdraw the pawl R when it is released by the electromagnet. It is of course understood that this circuit is only formed for the instant while the shoe is passing over the button b'.

As stated above, while I have thus shown what seems to me the best and simplest mode of accomplishing the desired result—namely, throwing the third rail into circuit by means attached to the car coöperating with a switch-throwing means which will not only close the new circuit but break that which the train is leaving—I do not mean to limit myself to the exact mechanism above described nor to the use of two switches operating in the same section to throw alternately one or the other of two bus-lines into circuit, for it is well known that in all block-signal systems a signal is set at "danger" as a train enters upon a section and as the train leaves the section the same signal is again set at "safety" and a fresh signal set at "danger." By similar means it will be easily possible by substituting a switch suitably connected for the signal to close the circuit through a section and when a train is leaving a section to open the switch again. The description which I have given, however, in detail and the mechanism which I have shown in the drawings enables the track to be used at all times and in either direction with but little complication of circuits or mechanism, and hence I prefer the form of invention which I have fully described above.

It will be seen that there is, in fact, a pair of switches for each third-rail section, one located at each end of the section, one permanently connected to the trunk-line, and one to the third-rail section, the two being in different switch-boxes and being operated by different mechanisms, each switch-box containing a switch mechanism, one element of which belongs to one third-rail section and the other to the next third-rail section.

In the above description I have used the track-rails for what may be termed a "return-circuit," such being the simplest mode of making connection between the generator and the motor on the car. I do not mean, however, to limit myself to this form of return-circuit. It is evident that in the use of the system above referred to it is important that a second train shall not enter upon a third-rail section until the previous train has

left it, as by so doing it would throw the switches and break the circuit already made through the section already occupied. It is therefore desirable that proper signals shall be placed far enough from the end of each section to enable a train to be stopped before reaching the next section.

While I am aware that the system above described is not broadly new, the practical value of such a system must depend largely upon the simplicity of its switch connections, and my present aim has been that the terminals at the switch shall be so simply planned and so placed that each switch when making contact with the given bus-wire shall always make contact with the same terminal thereof.

What I claim as my invention is—

1. A switch-box provided with two rotatable switches located in proximity, each switch being pivotally mounted upon a separate stud, in combination with a track-rail and means adapted to be operated therefrom to operate both switches simultaneously, as described.

2. The switch-box above described, consisting of a central gear and two side gears, each in mesh therewith, and each carrying a switch, said central gear being provided with pins and a pawl adapted to engage said pins to rotate said central gear, in combination with a track-rail, and means adapted to be operated therefrom, whereby said pawl may be operated to rotate said central gear, as described.

WM. A. P. WILLARD, JR.

Witnesses:
J. D. GILLETT, Jr.,
THOS. F. SHIELDS.