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H. B. TAYLOR.

RAILWAY SIGNAL CONTROLLING CIRCUIT.

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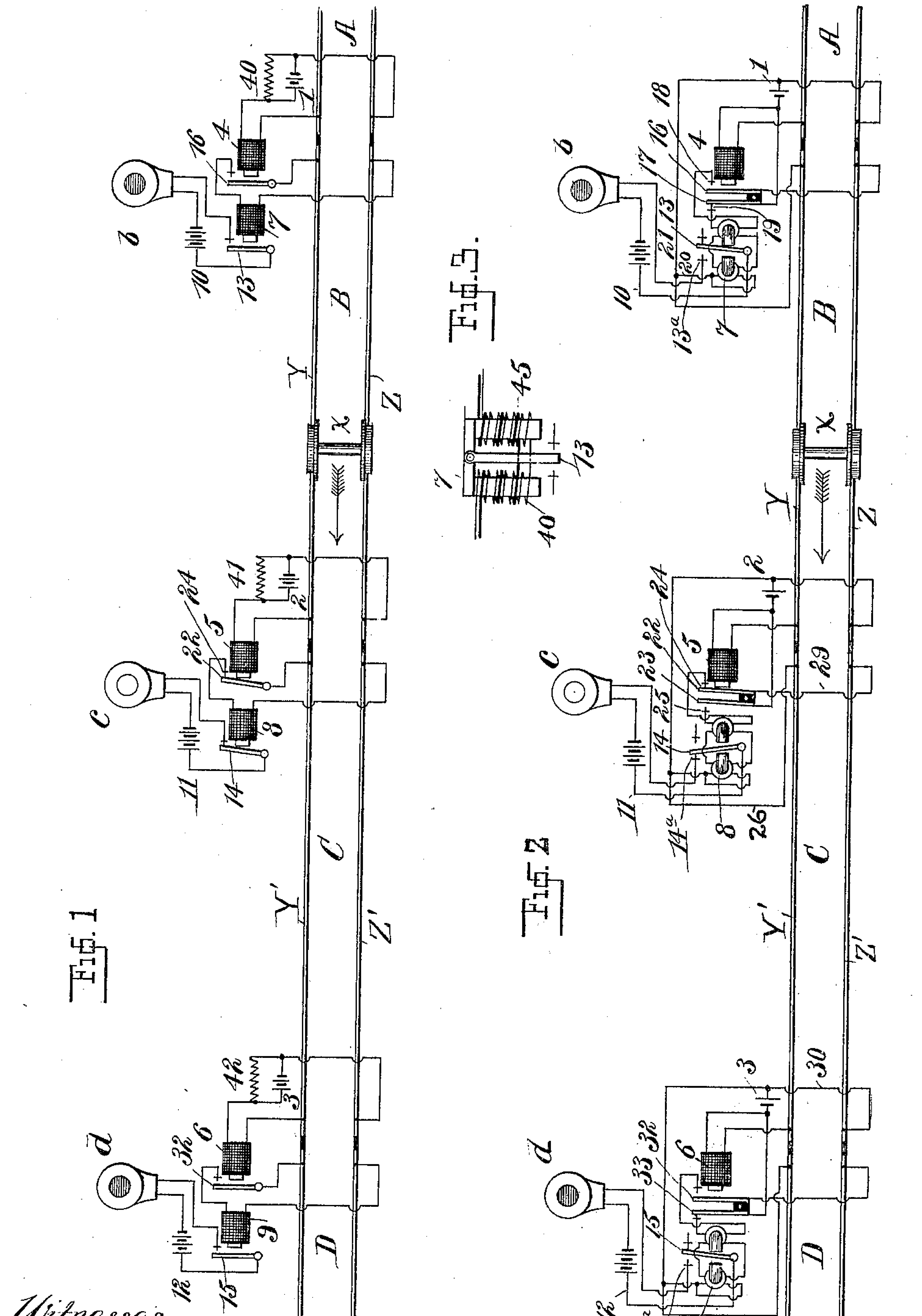

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RAILWAY-SIGNAL-CONTROLLING CIRCUIT.

No. 818,203. Specification of Letters Patent. Patented April 17, 1906.

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To all whom it may concern:

Be it known that I, HERBERT B. TAYLOR, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Railway-Signal-Controlling Circuits, of which the following is a specification.

This invention relates to improvements in what are known as "open rail-circuits," the object of the improvement being to provide a signal-controlling circuit with all the functions of any of the standard rail-circuits now in use with the addition of features peculiar to this circuit, which simplify the operation of the signals and render them more sensitive to control, while eliminating several objectionable features of the circuits now in use.

Open rail-circuits have heretofore been operated in connection with open-circuit batteries, which cannot be depended upon for any length of time, owing to their rapid deterioration. In my arrangement the open-circuit type of battery may be used; but I prefer to employ the standard gravity-battery, which, although not normally closed through a rail-circuit, is adapted to be so operated temporarily and is normally on closed circuit through a resistance separate from the rails. The advantages claimed for this method are that the batteries are operating normally through a non-variable resistance, and therefore their deterioration per signal is exactly the same, one group of cells not requiring attention any oftener than another, as is the case in systems now in use. Another point is that the breaking of a battery connection will not tend to place the signal in a false position, as is common in systems depending upon the joint action of two relays to operate the signal-circuit. Moreover, by making the high resistance across the battery one coil of a polarized relay I can obtain certain additional advantages in operation, as hereinafter set forth.

My invention comprises track-sections each of which is electrically continuous from end to end of the section and is electrically separate from adjacent sections and the circuits of the respective sections being identical in arrangement, or substantially so.

In the accompanying drawings, forming part of this specification, Figure 1 is a diagram of a railway-track circuit embodying my invention, showing the use of a resistance to put the battery on closed circuit. Fig. 2 is a similar view of a preferred form of the invention with the resistance constituting one coil of a polarized relay. Fig. 3 is a detail diagrammatic representation of the polarized relay.

Referring to Fig. 1, showing the simplest form of my invention, a plurality of track-sections are shown at A B C D with signals *b c d* corresponding to the respective sections B C D, each section being electrically continuous from end to end and being electrically separate from the adjacent sections. Batteries 1 2 3 for the respective sections A B C are connected at one end to one track-rail of the corresponding section and at the other end, through a relay 4, 5, or 6, to the other track-rail of such section. Each signal apparatus comprises in addition to the relay 4, 5, or 6 a relay 7, 8, or 9, connected across the rails of the next section in advance through a circuit including the armature 16, 22, or 32 of the relay 4, 5, or 6 for the corresponding signal. The circuits for relays 4 5 6 are normally open; but the batteries 1 2 3 are on closed circuit through high-resistance shunts 40 41 42, connected across the battery, these shunts being of sufficient resistance to prevent undue waste of current—say about fifty ohms. The relays 4, 5, and 6 are of low resistance—say one ohm—and the relays 7 8 9 are of high resistance—say about twenty ohms. The relays 7 8 9 control the local circuits 10 11 12 for the respective signals *b c d*.

In normal condition the signals are as shown at *b* and *d*, relays 4 5 6 and 7 8 9 being deënergized and the local signal-circuits open. If now a train enters rearward section B, as shown, current from battery 2 is diverted from resistance 41 and flows through relay 5, rails of section B, and axle *x*. Relay 5 now being energized attracts its armature 22 and closes a circuit at contact 24. Current from battery 3 in advance, forward, or succeeding section C now flows through low-resistance relay 6, rail Y′, armature 22, high-resistance relay 8, and back through the other track-rail Z′ to other side of battery 3. Relay 8 having the higher resistance or greater number of ampere-turns is alone energized, as not sufficient current passes through relay 6 to energize same. Relay 8 attracts its armature and operates local circuit of signal *c*. The train on reaching section C short-circuits relay 8 and signal *c* assumes the normal or danger position, while at the same time relay 6 becomes energized, owing to the decrease of resistance in the circuit, and, providing everything in section D is normal, it operates signal *d*.

I prefer to arrange the high resistance 40, 41, or 42 as one coil of a polarized relay controlling the local signal-circuits in place of the relays 7 8 9. In Fig. 2 such a system is shown, the local circuits 10 11 12 being controlled by the armatures 13 14 15 of polarized relays 7 8 9, each of which is wound with two coils, one coil, as 40, being of higher resistance than the other coil 45, relays 4 5 6 being, however, of still lower resistance than coil 45. The armatures of relays 4 5 6 are in this case provided with two contacts, being shown as double armatures 16 17, 22 23, 32 33, the two armatures or contacts of each relay—for example, contacts 16 17—being mechanically connected, but electrically separate. These two contacts 16 17 serve to control alternately the circuits of the two windings of the corresponding polarized relay 7, according to whether relay 4 is energized, and the armatures of relays 5 and 6 are similar in operation, the circuit of the low-resistance winding being closed when the corresponding relay-armature is attracted, while the circuit of the high-resistance winding is closed when such armature is retracted.

Under normal conditions the signals indicate "danger," although the system may be operated on the normal safety or normal caution plan by slight changes in the arrangement of devices. Battery 1 is on closed circuit through high-resistance coil of polarized relay 7. Armature 13 of relay 7 breaks the operating-circuit of signal *b* at 13^a. Battery 2 is similarly energizing high-resistance coil of polarized relay 8. Relay 4, which is of low resistance—say one ohm—controls armatures or contacts 16 17, armature or contact 16 being adapted to engage with contact 18 and armature or contact 17, as shown, with contact 19. Current from battery 1 flows to armature 17, contact 19 to high-resistance coil of relay 7 and back to battery by wires 20 and 21. It will be noticed that this circuit does not include any part of the rails in the section. The arrangement of devices at signals *c* and *d* is exactly as at signal *b*.

Referring now to signal *c*, battery 2 energizes polar relay 8 through the high-resistance winding by a circuit similar to that of signal *b*. A wire from battery 2 leads to relay 5, which is of low resistance, and from relay 5 to one rail of preceding section B, relay 5 being in parallel to relay 8. Said relay 5 is not, however, energized, as there is no return to the battery 2 under normal conditions. As above stated, polarized relays 7 8 9 are wound with a low-resistance winding 45 in addition to the high-resistance winding 40, said relays being adapted to be energized through the low-resistance windings by current acting magnetically in a reverse direction to the current in the high-resistance windings. Assume now that all signals are in the normal position, as shown at *b* and *d*. Referring to section B, battery 2 will energize relay 8 through the high-resistance winding, and no current is flowing through the rails of section B. Now if a train enters section B from A a low-resistance circuit is established in shunt relation to the circuit through relay 8, the latter circuit being broken. This circuit is from battery 2 through relay 5 of low resistance, rail Y, wheels and axle *x*, and rail Z back to battery 2. Relay 5 now being energized pulls its armatures 22 and 23 forward, breaking the circuit through polarized relay 8 by moving armature 23 away from contact 25. At the same time armature 22 engages contact 24 and closes the circuit through low-resistance winding of relay 8. If now the section C is in a normal condition—*i. e.*, no broken or misplaced rails and unoccupied—current will flow from battery 3 through relay 6, rail Y′, wire 26, through low-resistance winding of relay 8 to contact 24, armature 22 of relay 5, wire 29 to rail Z′, thence through wire 30 back to battery 3. The low-resistance winding of polarized relay 8 is higher in resistance than the resistance of relay 6—say five ohms—and relays 6 and 8 now being in series only sufficient current will flow through the circuit to operate polarized relay 8, in consequence of which signal-circuit 11 of signal *c* will be closed at contact 31 and signal *c* will indicate that section C is clear. Assume now that the train enters section C. As the first pair of wheels bridge the rails Y′ and Z′ polarized relay 8 becomes deënergized, owing to the much lower resistance of the rails of section C and the axle of the train. Signal *c* will, however, not change its position until there is a reversal of current through relay 8. Relay 6 will now become energized, owing to its receiving more current from battery 3, and will draw the armatures 32 and 33 forward in a similar manner to that just described at section C. When the train passes out of section B entirely into section C, relay 5 will become deënergized and release armatures 22 and 23 and allow armature 23 to engage contact 25, thus establishing the circuit through the high-resistance winding of polarized relay 8 from battery 2 and opening the signal-circuit at contact 27, permitting signal *c* to assume the normal position. The high-resistance winding of the polarized relays may be about twenty ohms. It will be seen that as soon as a section is vacated current ceases to flow through the rails of that section, thus forming a normally open rail-circuit, but a normally closed battery-circuit. Suitable overlap may be provided and operated on the same principle; but as it is practically a repetition of what has been explained it is not necessary to show same in detail.

In the form of the invention shown in Fig. 1 the battery is placed on permanently-closed circuit by the high resistance connected across same.

Having thus described my invention, the following is what I claim as new therein and desire to secure by Letters Patent:

1. In a signal system, the combination of a series of electrically-separate track-sections, a signal for each section, a relay located at the entrance end of each section and connected to the rails thereof, a single relay connected to the rails of the advance end of the adjacent section and controlling the first-named relay, a signal-operating circuit controlled by the first-named relay, a single source of energy and a normally open track-circuit operating each of said relays to clear the signal.

2. In a signal system, the combination of series of electrically-separate rail blocks or sections, a signal and signal-operating circuit for each section, said signals located to indicate the condition of an advance section, a source of electrical energy and a normally deënergized relay connected in series to the rails at the advance end of each section, a single relay connected to the rails at the entrance end of each section and controlling the signal-operating circuit, the circuits formed by said sources of energy, rails and relays being normally open, the relay at the advance end of a section arranged to control the rail-circuit of the next section in advance, and said rail-circuits forming the only conductors of electrical energy between the signals.

3. In a signal system, the combination of a track divided into blocks or sections, with signals for each section, a normally open track-circuit for each section, a polarized relay for each section, normally energized by a connection independent of the track-circuit and controlling the corresponding signal, said relay comprising a coil connected to the normally open track-circuit for reversing the polarization of the polarized relay to operate the signal, a normally deënergized electromagnetic track device located at the distant end of same block and connected to the normally open track-circuit so as to be energized by the entrance of a train on the block and circuit-controlling means operated by said normally deënergized track device, on energization thereof, to break the normally energized circuit and close the normally open track-circuit of the polarized relay of the advance section.

4. In a railway signal system, the combination of a series of normally open-circuited track blocks or sections, a source of energy for each block, signals for the respective blocks and signal-circuits for the respective signals, two relays located at the adjoining ends of two blocks, one of said relays normally deënergized and controlling the other relay, the second-named relay controlling the signal-circuit, the source of energy of the rearward section connected to the rails thereof by a connection including the first-named relay and also connected to the second-named relay by a connection controlled by said first-named relay, said second-named relay included in the track-circuit of the advance section.

5. In a railway signal-controlling system, the combination of normally open-circuited rail-sections and signals for the respective sections, controlling-circuits for said signals, closed-circuit batteries connected to said open-circuited rail-sections, a relay for holding open the signal-circuit, normally energized by the circuit of the rearward-section battery, the said relay adapted to close the said signal-circuit when energized by the current of the forward-section battery, and means for energizing said relay as last stated consisting of the forward-section rails and battery and a relay connected to the rearward-section battery and circuit-controlling devices operated thereby to open the connection from the first-named relay to the rearward-section battery and close the connection from same to the forward-section battery.

6. In a railway signal system, the combination of normally open-circuited rail-sections and signals for the respective sections, batteries for the respective sections connected to the rails at one end of said sections, polarized relays connected to the rails at the opposite end of said sections by normally open-circuited connections for controlling the respective signals, said relays having high and low resistance windings of opposite magnetizing effect and connected respectively with the battery of the preceding section and with the rail-circuit of the advance section, and said windings adapted to alternately control the signal upon being alternately energized by closing or opening the rail-circuit of the corresponding section.

7. In a railway signal system, the combination of track-sections, each section forming a rail-circuit, a relay having two windings of opposite magnetizing effect connected respectively to the corresponding rail-section and to the battery of the preceding section, one of said windings being energized by a track-battery of the preceding section, the other winding being normally open-circuited but adapted to be energized by a track-battery connected to the same section as said relay, and a low-resistance relay connected to

each rail-section and located adjacent to the said double-wound relay, the said low-resistance relay adapted to control the energization of either winding of the first-named relay.

8. In a signal system, the combination of a track divided into blocks or sections, a signal located near the entrance end of each block for protecting said block, a circuit including a circuit-closer for the signal, a relay controlling the said circuit-closer located at the entrance end of the block, said relay being normally energized by a track-battery of the preceding section, said relay also being adapted to operate the signal of its corresponding section upon being energized by a track-battery of the said section and a relay operative from the section preceding the signal and connections controlled by said relay for cutting off from the signal-operating relay the current from the battery in the section preceding said signal and supplying said relay with current from the battery in the advance section thereby operating the signal-circuit.

9. A railway signaling system, consisting of the combination of a consecutive number of open-circuited track-sections, signals properly located for indicating the condition of an advance section, a source of energy in circuit with each signal for actuating the same, two coöperatively-acting electrically-controlled devices connected with the rails of adjoining track-sections for controlling each signal-circuit, and a source of electrical energy so connected to each track-section that the entrance of a train on a section preceding the signal will cause the electrical device of that section to become operative and with the electrically-controlled device of the advance section to operate the signal of the advance section.

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