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A. H. BINYON.

AUTOMATIC ELECTRICAL SIGNALING APPARATUS FOR RAILWAYS.

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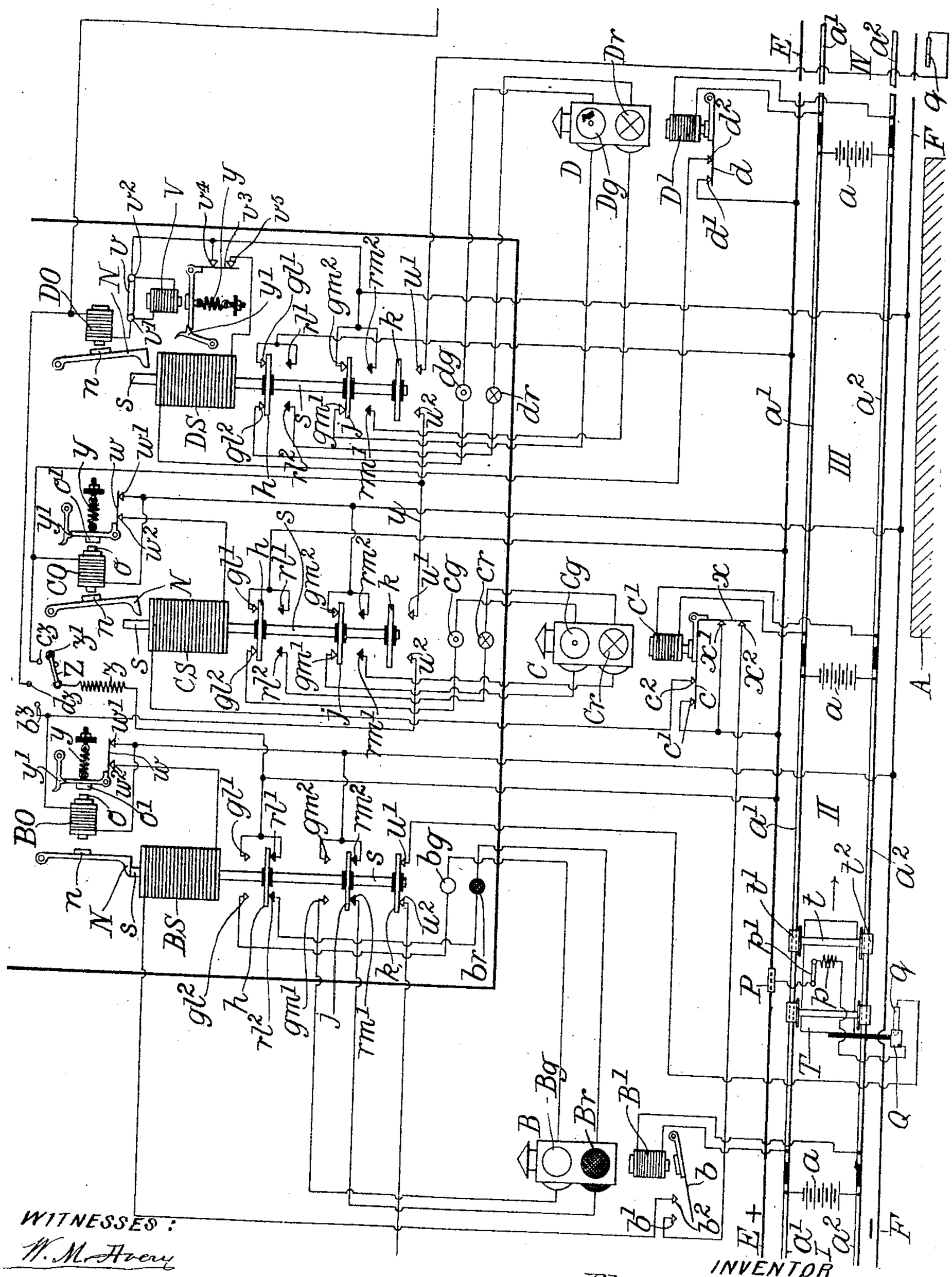

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AUTOMATIC ELECTRICAL SIGNALING APPARATUS FOR RAILWAYS.

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To all whom it may concern:

Be it known that I, ALGERNON HAMO BINYON, a subject of the King of Great Britain, residing at 100 Kenilworth Court, Putney, London, S. W., England, have invented certain new and useful Improvements in Automatic Electrical Signaling Apparatus for Railways, of which the following is a specification.

This invention relates to automatic electrical block-signaling for railways whereby upon a train entering a block-section the signals controlling that section are automatically put to "danger," and when (but not until) the entire train has passed within the section the signals controlling the preceding section are automatically put to "line clear," the object of the present invention being to provide additional safeguards against the accidental clearing of the signals.

The invention will be described with reference to the accompanying diagram, which represents it as applied in connection with the group of signals at a "through" station on a line of electric underground railway whereof the track is divided into block-sections insulated from one another.

In the example illustrated the station (platform, &c.) is represented at A, B being the "outer home" or "distant" signal lantern, while C and D are the "inner home" and the "starting" signal lanterns, respectively. The trains being supposed to travel from left to right in the figure, I represents part of the block-section of the track outside the distant signal B; II, the block-section controlled by signal B and extending therefrom to the inner home signal C; III, the station block-section controlled by signal C and extending therefrom to the starting-signal D, and IV part of the block-section controlled by and extending beyond signal D.

The rail lengths constituting the several sections are insulated from one another, as indicated, the rails a' a^2 of each section acting as members of a constantly-closed circuit distinct from the main or power circuit and serving to convey a current of low voltage, which is utilized for the purpose of energizing a relay adapted to control the circuit of a solenoid which is energized by a current of higher voltage and the position of whose core determines the condition of the signals at the commencement of the block-section in question. E and F are respectively the positive and negative members of the main or power circuit. BS, CS, and DS are the solenoids, and B′, C′, and D′ their controlling relays, respectively corresponding to the signals B, C, and D.

In each block-section the low-voltage "track-circuit" is fed with current from a source of power (such as a battery a, for example) connected to the track-rails at their forward ends, and the relay B′, C′, or D′ just mentioned is interposed in the same circuit and between the rail members thereof at their opposite ends—*i. e.*, at the commencement or entrance of the section. The relay B′, C′, or D′ is normally energized by the current in the track-circuit, so as to attract its armature, and thus operate a switch b, c, or d, whereby to bring about the closure (at b' b^2, c' c^2, or d' d^2) of the circuit of the corresponding solenoid BS, CS, or DS, whose core s, working vertically, so as to be sucked up against the action of gravity, carries a series of mutually-insulated bridge-switches h, j, and k, hereinafter described. Of these bridge-switches the one marked h when held raised by the action of the solenoid closes at gl' gl^2 the circuit of the green lamp or line-clear signal Bg, Cg, or Dg at the commencement of the corresponding section, and when, on the other hand, (in consequence of the opening of the solenoid-circuit,) the switch is allowed to fall by gravity it closes at rl' rl^2 the circuit of the red lamp or danger-signal Br, Cr, or Dr.

Where, as in the case illustrated, the green and red lamps of a signal are on separate circuits, the core of the solenoid whereby the signals for each block-section are operated preferably carries, in addition to the bridge-switch already described, a bridge-switch j, adapted to alternatively close and break (at gm' gm^2 and at rm' rm^2, respectively) the return members of the circuit of the green and red lamps of the corresponding signal. By this means it is possible to avoid the dangers (such, for example, as the simultaneous lighting of both lamps) incidental to the employment of a common return-wire from both lamps.

Normally—that is to say, when no train is in the block-section—the relay is energized, the solenoid-circuit is closed, and the bridge-switch

is held up, so as to maintain the signal at "line clear." Immediately a train (represented at T) enters the section, (say No. II,) however, its front wheels t' t^2 and their axle t short-circuit the relay, and the solenoid-circuit being being consequently broken the bridge-switch is allowed to fall by gravity, thus breaking at gl' gl^2 the circuit of the green lamp and closing at rl' rl^2 that of the red lamp, which remains lighted so long as the train continues in that section.

For the purpose of preventing the signal being returned to "line clear" until after the train has wholly passed out of the block-section in question the solenoid-core s, appertaining to the signals of each section, is when once lowered prevented by a movable stop N from being again raised, this stop being maintained in operative position by gravity or spring-pressure and being withdrawn at the proper moment by the movement of the armature n of an electromagnet BO, CO, or DO whose winding is in series, preferably, with a branch from the main or power circuit, this branch circuit being under the double control, first, of a bridge-switch k, carried by the solenoid-core appertaining to the next succeeding block-section and adapted to close the circuit of the electromagnet in question only when the said solenoid-core is lowered, and, secondly, of a switch carried by the train and adapted to close the circuit of the releasing-electromagnet only when the train has passed within the next succeeding block-section, preferably to a distance (known as the "overlap") not less than a full train length. For this purpose the train carries a shoe P (which may be the shoe conveying power to the motor) constantly in contact with the positive member E of the power-circuit and (connected to the shoe P) an insulated brush Q, mounted at the rear end of the train and adapted to make contact with a terminal contact-treadle q, situated alongside of the track not less than a train length in advance of the entrance of the section. By this arrangement the movable stop N, which comes into operative position automatically upon the fall of the solenoid-core s and the consequent lighting of the red lamp at the commencement of any block-section as soon as a train begins to enter that section is only withdrawn so as to permit the solenoid-core to rise and effect the extinction of the red and the lighting of the green lamp when the train, having passed into the next following block-section, has not only at its entrance thereinto caused the solenoid-core appertaining to this latter section to be lowered, so as to effect the lighting of the corresponding red lamp, but has moved forward so far that the brush Q, carried at the rear of the train, has been enabled to complete at the treadle-contact q the closure of the circuit of the electromagnet BO, CO, or DO, whereby the movable stop in question is withdrawn.

According to the present invention a resistance is interposed in the circuit of the electromagnet just mentioned at a point in the positive wire of the circuit as near to the brush P as practicable, so as to enable the working voltage in this circuit to be kept reasonably low, and thus diminish the risk of the insulation breaking down on the wire which connects the contact q with the winding of the electromagnet to which current is supplied from said contact.

Preferably the resistance is carried by the train, and consequently interposed in the connection between the brushes P and Q, as indicated at p. A fuse is also interposed, as at p', in the same connection next to the shoe P. In cases, however, where the resistance is placed outside of the train in the course of the wire connecting the contact q with the releasing-electromagnet said resistance should be inclosed in a box which is constructed of metal or fireproofed material and filled in solid with some suitable insulating substance.

Each contact q is not connected directly to the winding of the releasing-electromagnet, to which current is supplied from said contact, the circuit being interrupted between a pair or pairs of contacts u' u^2, which are adapted to be bridged by a bridge-switch or bridge-switches k, carried by the core or cores s of the solenoid or solenoids succeeding that one to which the releasing-electromagnet in question appertains, the circuit being, however, closed only when the last-mentioned solenoid-core is lowered. By this means it is insured that a signal shall not be allowed to be put to "line clear" until all the signals intervening between that signal and the train which has last passed it have been put to "danger."

Means are provided whereby in the event of the releasing-magnet receiving an excess of current the circuit of the solenoid will be automatically broken and the signal left at "danger." The means employed for the purpose may be of various kinds. Thus, for example, (as shown in connection with the magnet DO,) an inclosed fuse v may be introduced in the circuit of the releasing-magnet, the fuse-terminals v' v^2 being connected by a shunt passing through the winding of an electromagnet V, whose armature on being attracted opens a cut-out switch v^3, interposed in the solenoid-circuit, so that on an excess of current in the releasing-magnet circuit destroying the fuse the solenoid-circuit will be automatically broken at the terminals v^4 v^5, normally bridged by the cut-out switch v^3, or, preferably, (as shown in connection with the magnets BO and CO,) the releasing-magnet itself may be adapted to actuate a cut-out switch w, interposed in the solenoid-circuit, the magnet for this purpose being provided with an additional or rearwardly-extending pole piece or pieces o and a corresponding additional armature o', whereby to actuate the cut-

out switch *w*, so that on an excess of current passing through the magnet-coils a magnetic field will be created such that the additional armature *o'* will be attracted and the solenoid-circuit thereupon automatically broken between the terminals *w' w²*, normally bridged by the switch *w*.

The armature of the magnet V, as also the additional armature *o'* of the releasing-magnet, may be held in normal position by means of an adjustable spring, as at *y*, whereby to regulate the amount of excess current required to actuate the circuit-breaking switch *v³* or *w*, as the case may be, and there may also be provided in each case an automatically-acting catch *y'*, adapted to prevent the solenoid-circuit being again closed and the signal put to "line clear" except by the intervention of an authorized person.

For the purpose of enabling the stop N, appertaining to any solenoid, to be momentarily withdrawn from operative position if the corresponding track-section be vacant, so as to enable the corresponding signal to be altered by a responsible official from "danger" to "line clear," if so desired, there is provided a manually-controlled switch Z, which is in constant electrical connection through a resistance *z* with a suitable source of power, such as the main conductor E. The switch Z, which normally rests (and preferably is locked) in the inoperative position, may be moved therefrom and brought into position to enable the circuit of any one of the releasing-electromagnets BO CO DO to be closed, for which purpose the switch-lever may be pivoted to turn through an arc so as to pass over, without touching, terminal contacts *bz cz dz* on branches from the positive members of the corresponding releasing-electromagnet circuits, a push-button *z'* or equivalent device carried by the switch-lever enabling that circuit to be momentarily closed over which the switch-lever Z has been arrested.

In cases or situations where it is desirable to maintain a block-section of the track vacant between trains following one another means may be provided whereby on the entry of a train into any block-section the consequent putting of the signal at the commencement of that section to "danger" is not followed by the clearing of the signal at the commencement of the next preceding section until said train has passed clear out of the section into which it has thus entered.

In the example illustrated it is assumed to be desired to prevent a train passing forward beyond the distant signal B so long as another train remains in the station-section III, and means are shown for preventing the distant or outer home signal B being cleared until the inner home signal C is also cleared after the setting of the starting-signal D to danger by the passage out of the station of the train which, *e. g.*, was standing therein. For this purpose the circuit of the distant-signal solenoid BS is controlled not only by its own relay B', but also by the relay C' appertaining to the corresponding inner home signal, the inner-home-signal relay C' being adapted to operate concurrently with the switch *c*, which controls the solenoid CS, a second switch *x*, which when the relay C' is energized closes at *x' x²* the circuit of the solenoid BS. Hence, although the distant-signal B will have been put to "danger" (as shown by the diagram) when passed by a train T, and its relay B' will operate to so far close the circuit of the distant-signal solenoid BS when this train passes the immediately-succeeding inner home signal C, the distant-signal B will not then be cleared, since the circuit of its solenoid BS will not be completely closed until the train on subsequently leaving the station-section III has passed beyond the starting-signal D and has consequently ceased to short-circuit the relay C'. In this case a treadle-contact *q* is not required within the station-section III, and the contact *u'*, which appertains to the inner home-signal solenoid CS and which would otherwise be connected to the (absent) contact *q*, is connected directly to the contact *u²*, appertaining to the starting-signal solenoid DS, while the positive wire leading to the releasing-magnet CO of the inner-home-signal solenoid CS is branched from the wire *u*, which connects the said contacts *u' u²*, as indicated.

It is to be understood that whereas the relays B' C' D', appertaining to the group of signals B C D, are situated in proximity to the track, the solenoids BS CS DS and the releasing-electromagnets BO CO DO, together with the mechanism appertaining thereto, may all be assembled as usual in one signal-cabin wherein are also placed the "repeat-lamps" *bg cg dg* and *br cr dr*, respectively, corresponding to and in circuit with the main signal-lamps B*g* C*g* D*g* and B*r* C*r* D*r* and the switch Z.

It is obvious that although the signals are described above as given by lamps they might equally well be given each by the movements of a semaphore, the alternation of the circuits produced by the raising and lowering of the solenoid-core being employed to produce corresponding alternations in the action of electromagnetically-operated mechanism whereby the position of the semaphore-arm is controlled.

It will be obvious that although the invention is particularly applicable in the case of an electric railway arranged to work in the manner described its utility is not confined to the circumstances specified, as the invention may be adapted for use in connection with any system of automatic control wherein solenoids or electromagnets are employed to work signals, points, locks, or other apparatus—such, for example, as other road-block

solenoids which may in turn serve for controlling further instrumentalities.

I claim—

1. In automatic electric signaling apparatus for railways worked on the sectional block system, the combination with solenoids severally serving, when energized, to hold switches in the position wherein they close the respective electrical circuits for conveying current whereby the signals appertaining to the corresponding block-sections of the railway are maintained at "line clear" and with means whereby, upon a train entering any block-section the circuit of the solenoid controlling the signal at the entrance of said section will be automatically broken so as to cause said signal to be put to "danger;" of mechanical stops appropriated to the several solenoids and each adapted to normally tend to prevent the solenoid-core from moving to the position wherein the corresponding signal is cleared; releasing-electromagnets severally adapted when energized to withdraw the respective stops from operative position; switches normally open, interposed in the circuits of the respective releasing-electromagnets and placed each in proximity to the railway-track at a point in advance of the entrance to the block-section following that section whose signal is controlled by the corresponding solenoid; and a device carried by the train at its rear end adapted to close the circuits of the several releasing electromagnets on passing the said respective switches, substantially as specified.

2. In automatic electric block-signaling apparatus for railways as specified, a releasing-electromagnet, and means substantially as herein described for causing the circuit of a signal-controlling solenoid to be automatically broken in the event of an excess current passing in the circuit of the releasing-electromagnet corresponding to said solenoid.

3. In automatic electric block-signaling apparatus for railways as specified, the combination of releasing-electromagnets, and a manually-operated contact-switch adapted to enable the circuits of the several releasing-electromagnets to be momentarily closed at will so as to permit the signals to be cleared only when the track-sections, to which appertain the signals controlled by the corresponding solenoids, are vacant, substantially as specified.

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