No. 819,323. PATENTED MAY 1, 1906.

J. B. STRUBLE.

RAILWAY SIGNALING.

APPLICATION FILED MAR. 12, 1902.

FIG. 1.

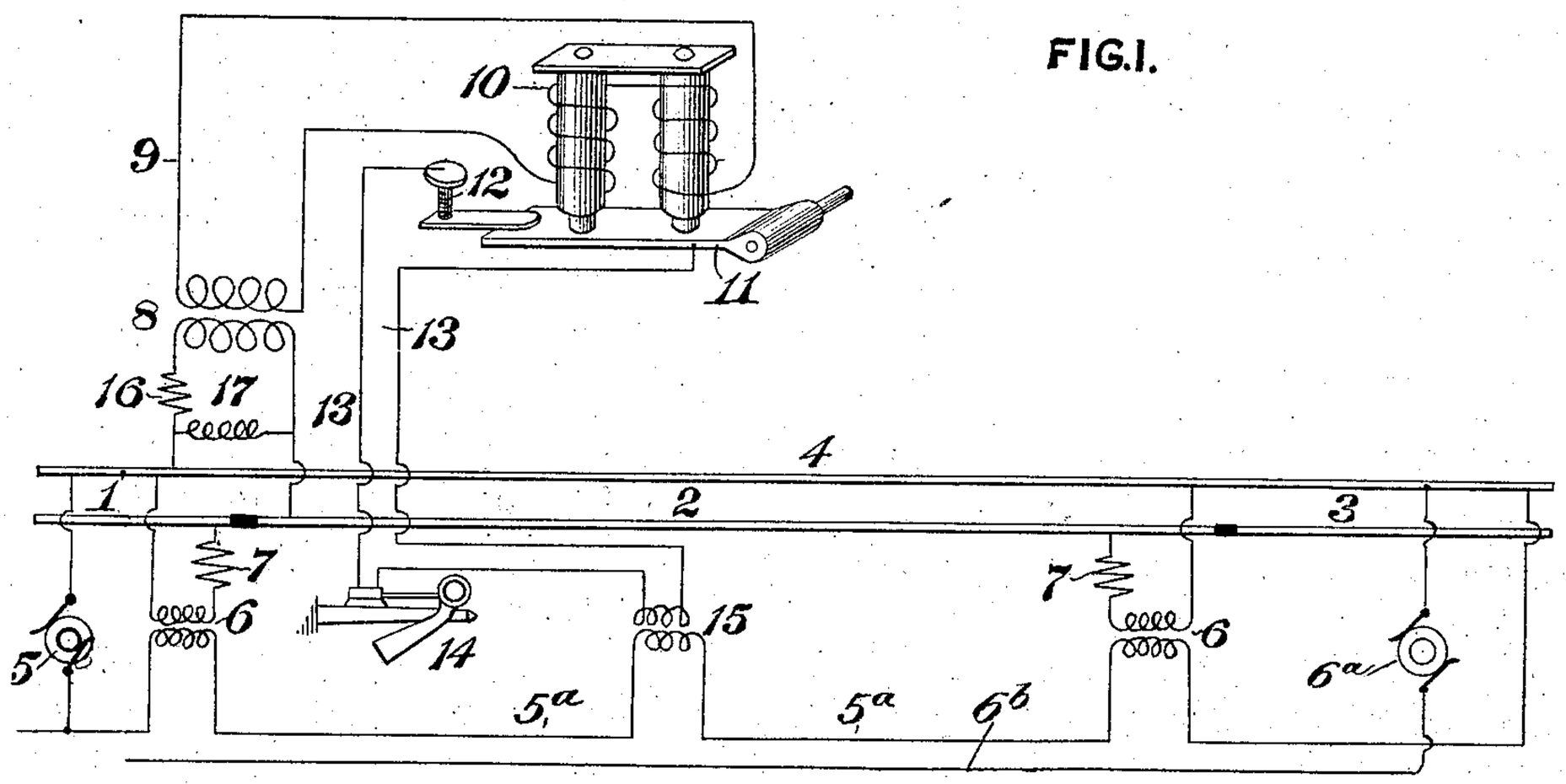

FIG. 2.

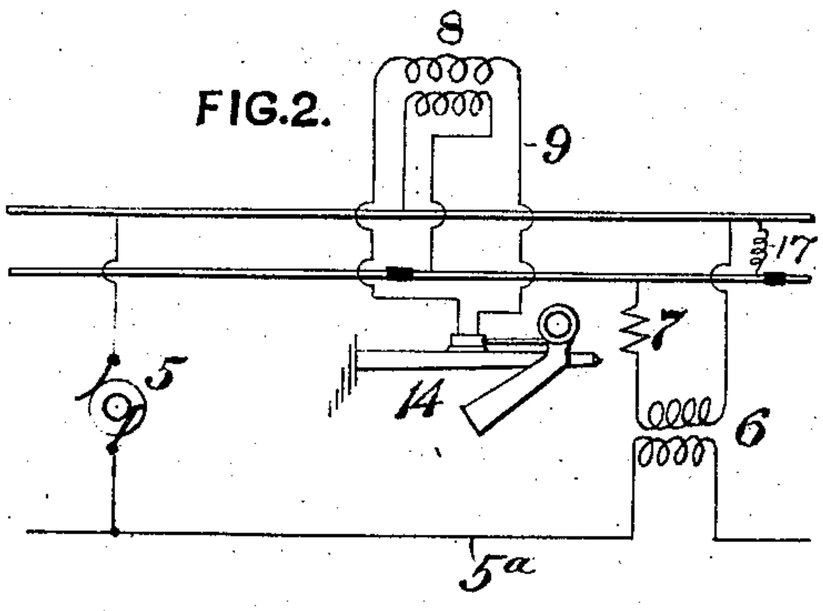

FIG. 3.

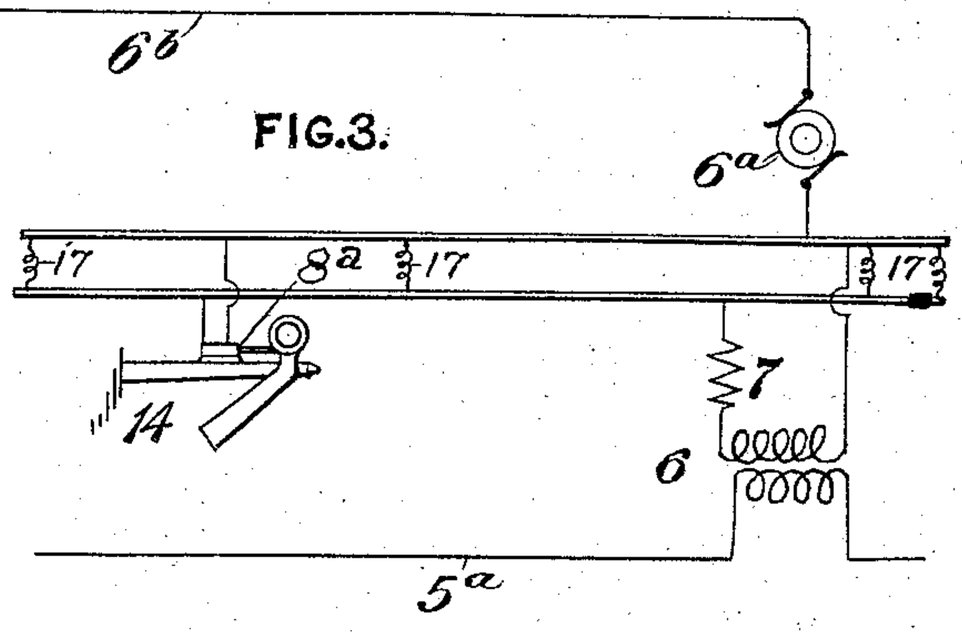

Fig. 5.

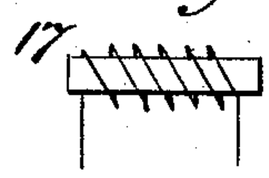

FIG. 4.

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JACOB B. STRUBLE, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO THE UNION SWITCH & SIGNAL COMPANY, OF SWISSVALE, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

RAILWAY SIGNALING.

No. 819,323. Specification of Letters Patent. Patented May 1, 1906.

Application filed March 12, 1902. Serial No. 97,861.

To all whom it may concern:

Be it known that I, JACOB B. STRUBLE, a citizen of the United States, residing at Wilkinsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Railway Signaling, of which the following is a specification.

My invention relates to railway signaling, and especially to a signaling system for electric railways wherein provision must be made to prevent the improper operation of the railway-signals due to the propulsion-current for the cars or trains of the electric railway or any other foreign current traversing the track-circuits of the signaling system.

It is customary in electric railways to employ direct current for operating the car or train motors and to employ one or both of the rails as a return-conductor for the propulsion-current.

An object of the present invention is to prevent the operative action of all currents other than an alternating signaling-current on the railway-signals.

The invention is hereinafter more fully described and claimed.

In the accompanying drawings, Figure 1 is a diagrammatic view illustrating a portion of an electric railway equipped with a signaling system embodying my invention. Fig. 2 is a view similar to Fig. 1 and illustrating a modification of my invention. Fig. 3 is a view similar to Figs. 1 and 2 and illustrating another modification of my invention. Fig. 4 is a view similar to Fig. 1 and illustrating another modification of my invention. Fig. 5 is a detail view of a reactance, impedance, or choke coil which may be employed in my invention.

Similar numerals of reference designate corresponding parts in all of the figures.

Referring now to the drawings, one of the lines of rails of the railway is shown as being divided into a series of sections 1 2 3, &c., by means of insulation at suitable points, while the other line of rails 4 is made electrically continuous and serves as a return-conductor for the propulsion-current. The sections 1, 2, and 3, &c., may be of any desired length, and in the art each section and the opposite portion of the continuous rail 4 is generally termed a "block-section."

14 designates a railway-signal, at least one being provided at the beginning or each block-section. The railway-signal 14 may be of any desired construction, and it preferably comprises a semaphore and mechanism or means for moving the semaphore from one position of indication to another.

5 designates an alternating-signaling-current generator. One pole of the alternating-current generator is connected with the line of rails 4, while the other pole of the generator is connected with a conductor 5^a, extending along the railway, and which at some point—for example, at the end of the railway—is electrically joined to the line of rails 4.

6 designates transformers, at least one transformer being provided for each block-section. As shown in the drawings, the primary windings of the transformers are in series with the conductor 5^a, and therefore with each other, and their secondary windings are electrically connected to the opposite lines of rails comprised in each block-section. It will be understood that other arrangements of the primary windings of the transformers may be provided.

The employment of an induced current for the track-circuit of each block-section permits of a high-tension current in the feed-conductors extending from the generator. To prevent an excessive amount of alternating current flowing in the track-circuit when a train is in the block-section, a resistance 7 is arranged in the track-circuit, (as shown in one of the connections of the secondary winding with a track-rail,) or each transformer 6 may be built with such resistance as is well known in the art. The track-circuit of each block-section also includes as a part thereof a "translating mechanism" 8, and this term is used in its broadest sense and includes any mechanism whereby the alternating signaling-current of the track-circuit is employed for producing by induction or otherwise a current in another circuit, as illustrated particularly in Figs. 1 and 4, or whereby the signaling-current in the track-circuit is translated into motion, as illustrated in Figs. 2, 3, and 4, the one class of mechanism being for the purposes of this invention the equivalent of the other. In the system illustrated in Fig. 1 the translating mechanism or device 8 is shown as being in

the form of a transformer, which may be of any desired form or construction known in the art—such as a converter, a transformer, a motor-generator, &c.—whereby the alternating signaling-current in the track-circuit induces a current in another or secondary circuit 9. As shown, the secondary circuit may include a relay 10, having an armature 11.

While the block-section 2 is unoccupied by a train, the alternating signaling-current in the track-circuit, which, as stated, includes a transformer 6, the opposite track-rails of the block-section or portions thereof and a translating mechanism 8, will produce a current in the secondary circuit 9, thereby energizing the relay 10; but as soon as the alternating signaling-current in the track-circuit is shunted by the wheels and axles of a car or train from the translating mechanism the relay 10 will become deënergized, and the armature 11 will drop away from the contact-point 12, thereby opening the circuit 13, controlling the signal 14. The semaphore of the railway-signal 14, when no train is in its block-section, is preferably in the "clear" position of indication; but when a train or car is in the block-section which it controls the semaphore will move or be moved to the "danger" position of indication, this being accomplished by opening the circuit 13, controlled by the relay 10, which is deënergized in the manner hereinbefore stated by the train or car in the block-section. The current for the circuit 13 may be had from any suitable source—as, for example, from the generator 5 through a converter 15, as shown in Fig. 1.

To prevent the translating mechanism being affected by direct currents, which may be either the propulsion-current or stray foreign currents, I preferably provide a non-inductive resistance 16, which may be made adjustable in accordance with rules well known in the art in series with the primary winding of each transformer. While this resistance would reduce also the amount of useful alternating current passing through the translating mechanism, this loss is less objectionable than the heating produced by an excessive flow of direct current through the translating mechanism. The translating mechanism may be still further safeguarded from heating or being effectively operated by direct current in the track-circuit by means of a reactance, impedance, or choke coil 17, constructed in accordance with the rules well-known in the art and connected across the wires connecting the translating mechanism with the rails of the block-section or across the rails themselves. The reactance-coils when connected across the rails of each block-section, as shown in Figs. 1 and 3, will permit direct current to flow through the insulated rail-sections 1, 2, 3, &c., to the continuous line of rails 4, and when such coils are arranged so that the ends of the sections are connected to the continuous line of rails 4 the direct current will flow from rail 4 to one end of an insulated rail-section, along the same, and then back to rail 4 until it reaches the reactance-coil 17, connecting the continuous line of rails 4 to the next insulated rail-section, so that both rails will carry the full return-current. If the insulated rail-sections be connected by reactance-coils, as shown and described in my application for patent, Serial No. 82,523, filed November 16, 1901, both lines of rails can be used as a return for the motor-current without necessarily crossing, as in the arrangement hereinbefore described. Each reactance-coil is made with low ohmic resistance, so as to afford an easy path for the direct current from rail to rail, while the flow of alternating current is largely prevented by the reactive effect of self-induction, so that the reactance-coil has a choking effect on the alternating signaling-current, but not on direct currents.

In lieu of controlling or operating the railway-signal 14 through a relay by currents induced in a secondary circuit, the translating mechanism for controlling or operating the signal may be included directly in the secondary circuit 9, as illustrated in Fig. 2, or the translating mechanism may be made in the form of a motor 8^a, included in the track-circuit and having its shaft connected mechanically to the signal.

In the system shown in Fig. 4 the translating mechanism is in the form of a relay, the coil or coils 18 of which are included in the track-circuit. The armature 19 of the relay is pivotally mounted in operative relation to the poles of the magnet-core energized by the coil or coils 18. A tongue or lip 20 is formed at the ends of the armature, as shown, or at the ends of the poles of the magnet, (an equivalent construction,) as shown in application Serial No. 97,862, filed March 12, 1902, and these tongues 20' are surrounded by one or more turns 21 of wire or metal tape properly insulated and forming closed circuits. A circuit 13 for operating or controlling the railway-signal 14 includes a contact-arm 22 on the armature 19 and a contact-point 23. A spring 24 is so connected to the armature and the contact-arm as to tend to move the arm away from the contact-point and open circuit 13.

If while the block-section is occupied by a train the wheels and axles thereto will shunt the alternating signaling-current in the track-circuit from the translating mechanism, thereby allowing the armature thereof to be shifted by the spring and open circuit 13, a direct current should pass through the coils 18 of the relay, the entire area of the poles of the magnet and of the armature would be magnetized, and the armature drawn, so that its pole would aline with the poles of the magnet or in a direction to open the circuit 13. When

the train passes off the block, permitting the alternating signaling-current to flow through the coil 18, (the direct current still persisting,) the signaling-current in the coils 18 would produce an alternating magnetic field between the poles of the magnet through the armature, thereby inducing an alternating current in coils 21 opposite the current in the coils 18. This oppositely-induced current will produce a magnetic-field in the armature equal to twice the thickness of the tongues 20 and opposing that produced by the current through coils 18. By thus practically neutralizing a portion of the magnetic area of the ends of the armature the center of attraction or pull will be shifted, so that the armature in lieu of being held in alinement between the poles of the magnet will be shifted to an angular position, the angularity being dependent upon the proportions of the areas neutralized to the whole areas of the ends of the armature. The contact-point 23 should be so located that when the armature is in its angular position the circuit 13 will be closed to hold the signal at clear position.

It will be readily understood by those skilled in the art that portions of the poles of the magnet may be neutralized, producing the same effect as regards the maintenance of the signal in clear position, as fully described and claimed in application Serial No. 97,862, filed March 12, 1902. In the constructions set forth in said application the current in the closed circuits surrounding the tongues of the magnet is induced by the alternating signaling-current in the coil or coils 18, while in the construction having the closed circuit surrounding the tongues on the armature the currents in said circuits are induced by the alternating magnetic currents flowing back and forth through the armature.

It is characteristic of the construction shown in Fig. 4 that in case a direct current reaches the coils 18 of the relay when the alternating signaling-current is shunted such current will have no effect except to reinforce the action of the retractive spring to hold open the circuit 13, which was opened by the shunting of the alternating signaling-current in the track-circuit. It will be understood that if desired reactance-coils 17 may be employed in this form of my invention in the manner hereinbefore set forth and for the same purposes.

6^a designates a direct-current generator, and 6^b a feed-conductor extending therefrom along the line of railway and from which current is obtained for the motors of the cars traveling along the railway. The return for the power-current is through the track-rails, the insulated sections 1 2 3, &c., being bonded or joined together by the reactance-coils 17 in the manner hereinbefore stated. The reactance-coils, as hereinbefore stated, will permit the propulsion-current to pass through them, but will retard or impede the flow of the alternating signaling-current. In the invention of this application the alternating signaling-current is confined to the individual blocks by reason of the insulations located in the line of rail which is divided to form block-sections.

It is characteristic of my improvement that in all cases the translating mechanism becomes operative to set the signal to one position when and only when such translating mechanism is oprated on or affected by an alternating signaling-current. In some of the forms shown and described a direct current cannot operatively affect the translating mechanism, and in the other forms the effect of the direct current is only cumulative in the direction of a force previously or simultaneously operative to set the signal to the danger position of indication.

What I claim as my invention is—

1. A railway signaling system, having in combination a source of alternating current, a track-circuit in circuit with the source of alternating current, a reactance-coil connected across the track-rails of the track-circuit, and a translating mechanism operative to control a railway-signal by an alternating current in the track-circuit.

2. In a signaling system for railways, in which one line of rails thereof is electrically continuous and the other line of rails is divided into sections insulated or electrically separated from each other, the combination of a source of alternating-signaling-current supply connected with the electrically-continuous track-rail and an insulated section of the other track-rail, and reactance-coils connecting the continuous line of rails with the insulated rail-sections.

3. In a signaling system for railways having one of its lines of rails electrically continuous and its other line of rails divided into insulated sections, the combination of a series of track-circuits each of which comprises an insulated section of rail and a portion of the continuous line of rails, a source of alternating-signaling-current supply for each track-circuit, a translating mechanism for each track-circuit and operable by the alternating signaling-current in its track-circuit and reactance-coils connecting the insulated rail-sections with the continuous line of rails.

4. A closed track-circuit for railway signaling purposes, comprising track-rails, a source of alternating-current supply and a translating mechanism operable by the alternating current and constructed to induce a current in another circuit and thereby control a railway-signal.

5. In a signaling system for railways the combination of a series of closed track-circuits, an alternating-current generator, a series of transformers, one being provided for each track-circuit, a translating mechanism

for each track-circuit and constructed to induce a current in another circuit and thereby control a railway-signal, and a series of railway-signals, one being provided for each track-circuit.

6. In a signaling system for railways, the combination of a series of track-circuits, an alternating-current generator, a series of transformers, one being provided for each track-circuit, a translating mechanism for each track-circuit, operable by the alternating current of the track-circuit, and constructed to induce a current in another circuit and thereby control a railway-signal, a series of railway-signals, one being provided for each track-circuit, and a reactance-coil connected across the terminals of each translating device.

7. In a signaling system for railways having one of its lines of rails electrically continuous and its other line of rails divided into insulated sections, the combination of a series of track-circuits, an alternating-signaling-current generator, a series of transformers, one being provided for each track-circuit, a translating mechanism for each track-circuit operable by the alternating signaling-current of the track-circuit and constructed to induce a current in another circuit and thereby control a railway-signal, a series of railway-signals, one being provided for each track-circuit, and reactance-coils for connecting the insulated rail-sections with the continuous rail.

8. In a signaling system for railways having one of its lines of rails electrically continuous and its other line of rails divided into insulated sections, the combination of a series of track-circuits, an alternating-signaling-current generator, a series of transformers, one being provided for each track-circuit, a translating device for each track-circuit operable by the alternating signaling-current of the track-circuit, a series of railway-signals controlled by the translating mechanisms, and reactance-coils for connecting the insulated rail-sections with the continuous rail.

9. A track-circuit for railway signaling purposes comprising an alternating-current supply, a translating mechanism and a reactance-coil.

10. In a signaling system, the combination with a closed track-circuit including a source of alternating-current supply, a reactance-coil and a translating mechanism, of a signal, and a circuit for said signal which is controlled by said translating mechanism.

11. In combination with a track-circuit for signaling purposes, an alternating-current supply for said track-circuit, a translating mechanism in circuit with said track-circuit and responsive in its operation to the absence or presence of alternating current in the track-circuit to control a signal, and means for preventing direct current from effectively operating the translating mechanism in its control of the signal.

12. A closed track-circuit for railway signaling systems comprising a source of alternating-current supply, a translating mechanism which is responsive to the alternating-current supply for the track-circuit, and means for shunting a direct current in the track-circuit from the translating mechanism.

13. A closed track-circuit for railway signaling system comprising portions of track-rails, a source of alternating-current supply connected with the track-rails, a reactance-coil which is connected with both track-rails and a translating mechanism also connected with the track-rails.

14. A signaling system for railways in which one of the track-rails is electrically continuous and the other of which track-rails is divided into insulated sections; the combination of a series of closed track-circuits each of which comprises a portion of the electrically-continuous track-rail and an insulated section of the other track-rail, a source of alternating-signaling-current supply, a translating mechanism, and a reactance-coil which is connected across both track-rails and included in the track-circuit; and a series of railway-signals at least one of which is controlled from each translating mechanism.

15. A closed track-circuit for railway signaling system comprising a source of alternating current located at one end of the track-circuit, a translating mechanism located at the other end of the track-circuit and a reactance-coil.

16. A system of electrical distribution and signaling for railways, comprising two sources of electrical energy delivering currents differing in character, conductors of which both rails form a part and said rails divided into blocks through which the currents from said sources of energy are transmitted, a signaling device in each block, a source of energy therefor, and means interposed between the rails of each block and each signaling device and normally adapted to actuate mechanism to close a circuit through a source of energy connected to a signaling device and to be rendered inoperative when a car enters a block.

17. In a system of electrical distribution and signaling for railways, the combination of two sources of electrical energy delivering currents differing in character, two track-rails, one continuous and the other divided into sections to form blocks, and means interposed in said track-rails whereby the current from one of said sources of energy will flow through said rails as a return-path and the current from the other source of energy be limited in its effects to the individual blocks.

18. In a system of electrical distribution and signaling for railways, the combination of two sources of electrical energy delivering

currents differing in character, two track-rails and means interposed in said track-rails whereby the current from one of said sources of energy will flow through said rails as a return-path and the current from the other source of energy be limited in its effects to the individual blocks.

19. In combination with a railway the rails of which are employed as a return for direct current employed for the motors of cars traveling along the railway, a signaling system, said system comprising a series of track-circuits, an alternating-signaling-current generator, means for supplying alternating signaling-current to said track-circuits from the alternating-signaling-current generator, and means for limiting the effect of the alternating signaling-current to the track-circuits, but permitting the direct current to pass from the track-rails of one track-circuit to the track-rails of another track-circuit.

20. In combination with a railway the rails of which are employed as a return for direct current employed for the motors of cars traveling along the railway, a direct-current generator, a feed-conductor extending along the line of railway, and a signaling system, said system comprising a series of track-circuits, an alternating-signaling-current generator, means for supplying alternating signaling-current to said track-circuits from the alternating-signaling-current generator, and means for limiting the effect of the alternating signaling-current to the track-circuits, but permitting the direct current to pass from the track-rails from one track-circuit to the track-rails of another track-circuit.

21. In combination with a railway the rails of which are employed as a return or ground for the propulsion-current for the car-motors, a signaling system, said system comprising track-circuits, a translating mechanism and a source of alternating signaling-current for each track-circuit and means for shunting the propulsion-current from the translating mechanisms.

22. In combination with a railway the rails of which are employed as a return or ground for the propulsion-current for the car-motors, a signaling system, said system comprising track-circuits, a translating mechanism and a source of alternating signaling-current for each track-circuit and means for limiting the effect of the alternating signaling-current to the track-circuits, but permitting the propulsion-current to flow from the rails of one track-circuit to the rails of another track-circuit.

23. In combination with a railway the rails of which are employed as a return for direct current employed for the motors of the cars traveling along the railway, a direct-current generator, a feed-conductor extending along the line of railway, and a signaling system, said system comprising a series of track-circuits, an alternating-signaling-current generator, means for supplying alternating signaling-current to said track-circuits from the alternating-current generator, and reactance-coils for limiting the effect of the alternating signaling-current to the track-circuits, but permitting direct current to flow from the rails of one track-circuit to the rails of another track-circuit.

24. In combination with a railway the rails of which are employed as a return for direct current employed for the motors of the cars traveling along the railway and one of said rails being electrically continuous and the other of said rails being divided into insulated sections, a feed-conductor extending along the line of railway, and a signaling system, said system comprising a series of track-circuits, an alternating-signaling-current generator, means for supplying alternating current to said track-circuits from the alternating-signaling-current generator, and reactance-coils connecting the insulated rail-sections with the continuous rail.

25. In a system of electrical distribution and signaling for railways, the combination of two sources of electrical energy delivering currents differing in character, outgoing feeder-conductors, two track-rails, one continuous and the other divided into sections to form blocks, and a reactance device connected across the rails of each block.

26. A signaling system comprising a source of direct current, a source of alternating signaling-current, a feeder for the direct current and a common return for both currents, motor-vehicles actuated by the direct current, signaling devices actuated by the alternating signaling-current, and means controlled by the movement of the motor-vehicle for controlling the movement of the signaling device.

27. A signaling system comprising a source of direct current, a source of alternating signaling-current, a feeder for the direct current, a common return for both currents, motor-vehicles actuated from the source of direct-current energy, signaling devices actuated from the source of alternating-signaling-current energy, and means carried by the moving vehicles and adapted to shunt the alternating signaling-current around the signaling devices.

28. A signaling system comprising two sources of electric energy delivering currents differing in character, a system of conductors involving a common return for both currents from said sources of energy, motor-vehicles actuated by the current from one of said sources of energy, signaling devices actuated by the current from the other source of energy, means in said system of conductors for maintaining electric separation of the two currents transmitted, and means carried by the moving vehicles for shunting the current

used to operate the signals around any one of the signals.

29. A signaling system comprising two sources of current differing in character, a system of distributing-conductors over which both currents are transmitted and formed in part by both rails of a railway, a motor-vehicle on such rails, a series of signaling-circuits over which only one of such currents is transmitted, signaling devices in said signaling-circuits, means for maintaining the electric separation of the two currents and confining their individual action to certain apparatus; one current to the operation of the motor-vehicle and the other to the operation of the signals; together with means carried by the vehicle for cutting a signaling device out of circuit.

30. A signaling system comprising two sources of electric energy differing in character, a distributing-circuit for the currents from said sources of energy formed in part by both rails of the railway, motor-vehicles actuated by the current from one source of energy, signaling devices in said distributing-circuit, electrically independent of each other and adapted to be operated by the current from the other source of energy, means for effecting and maintaining the separation of the two currents generated and delivering said currents to the respective apparatus designed to be operated thereby, a moving vehicle carrying means for electrically isolating a signal when a vehicle moves into the portion of the distributing-circuit in which said signal is located.

31. In combination, two sources of electric energy, a distribution-circuit for each source of energy, motor-vehicles operated from one of said sources of energy, a number of circuits electrically independent of each other for controlling signaling devices and supplied with current from the other source of energy, and signaling devices.

32. In a signaling system for railways the trackway of which is divided to form block-sections, a signaling-circuit for each block, a source of alternating signaling-current for each of said signaling-circuits, a translating mechanism for each signaling-circuit, and reactance-coils connected across the rails of the block-sections.

33. In an electric railway system, a source of power-current of one character, vehicles operated thereby, a circuit for said power-current comprising two conductors with which the car makes moving contact, one of which is formed by the track, independent signal-circuits in each of which the rails of the track form both sides, a source of current for said signal-circuit furnishing current of a different character and connected to both rails, a signal device completing each signal-circuit, and reactance-coils connected across the track-rails of the signal-circuits.

In testimony whereof I have hereunto set my hand.

JACOB B. STRUBLE.

Witnesses:
DARWIN S. WOLCOTT,
F. E. GAITHER.