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L. H. THULLEN.

SIGNAL SYSTEM FOR RAILWAYS.

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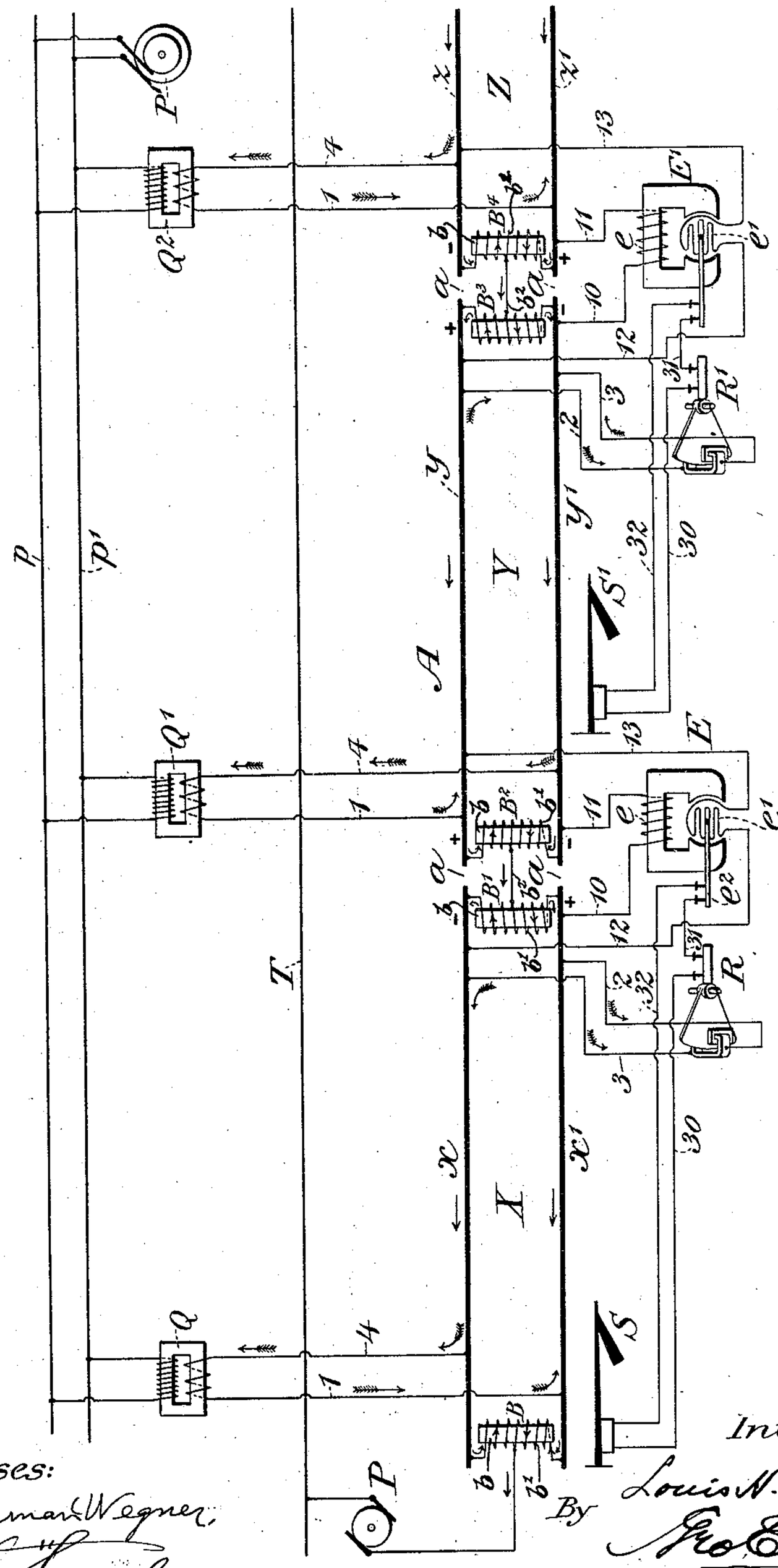

Witnesses:

C. Herman Wegner.

E. R. Loehr

Inventor:

Louis H. Thullen

By Geo. E. Crane.

his Attorney.

UNITED STATES PATENT OFFICE.

LOUIS H. THULLEN, OF EDGEWOOD, PENNSYLVANIA, ASSIGNOR TO THE UNION SWITCH & SIGNAL COMPANY, OF SWISSVALE, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

SIGNAL SYSTEM FOR RAILWAYS.

No. 889,561. Specification of Letters Patent. Patented June 2, 1908.

Application filed March 3, 1906. Serial No. 303,945.

To all whom it may concern:

Be it known that I, LOUIS H. THULLEN, a citizen of the United States, residing at Edgewood, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Signaling Systems for Railways, of which the following is a specification.

My invention relates to signaling systems for railways and especially to railways, the track rails of which are included in and form part of the return path or conductor to the generator for the current employed for propelling motor cars along the railway.

I will describe a signaling system embodying my invention and then point out the novel features thereof in claims.

The accompanying drawing, is a diagrammatical representation of a portion of an electric railway, the track rails of which are divided by insulation to form block or track sections and are used as a part of the return path or conductor to the generator of the propulsion current, and a signaling system applied thereto and embodying my invention.

Referring now to the drawing, A designates a portion of a railway which is divided into sections, X, Y, Z, etc. These sections are generally termed "block or track sections" and I will hereinafter refer to them as "block sections." These block sections are formed by inserting insulation *a* in some form at determined points in one or both of the track rails, the one arrangement being the equivalent of the other so far as block sectioning is concerned, and both being well known in the art. In the drawing I have shown insulation *a* inserted in both of the track rails.

x, x^1 designate the track rails of block section X, y, y^1 the track rails of block section Y, and so on.

P designates a generator of current for propelling the cars, which may be either an A. C. generator or a D. C. generator.

T designates a trolley or third rail connected with one pole of the power generator and extending along the railway in a usual and well known manner.

As the track rails of the railway, one or both, are to form part of the return path or conductor for the propulsion current employed for the motor cars and still contain insulation to form block sections, I make provision for conducting the car propulsion current from the track rails of one block section to the track rails of an adjacent block section, around the points of insulation. This I accomplish by means of inductive bonds, located at the insulated points which inductive bonds comprises a core and a winding or winding surrounding the core, each inductive bond being of such construction and arrangement as to afford a path of low ohmic resistance for the propulsion current, from the track rails of one block section to the track rails of another block section. A form of bond which I preferably employ is described and illustrated in U. S. Patent No. 838,916, granted to me Dec. 18th, 1906, and which is also diagrammatically illustrated in my applications filed February 5th, 1904, Serial Nos. 192,145 and 192,146. These inductive bonds generally stated each comprise a laminated iron core which may or may not have an open magnetic circuit and a copper winding of few turns. The ends of the winding of a bond are connected with the two track rails of the block section, and a conductor extends from the middle of the winding, and which conductor is arranged to be connected to the middle point of the winding of an adjacent bond.

In the drawing I have diagrammatically illustrated the bonds and their connections.

B, B^1, B^2, B^3, etc. designate the bonds.

b designates the core and b^1 a winding surrounding a leg of the core.

b^2 designates a conductor joining the middle points of two adjacent windings. This conductor as will be seen may be common to two adjacent windings. The track rails of the railway, of course, will be connected to the generator in the usual and well known manner understood in this art. Thus it will be seen that the current taken from the feed conductor T and after passing through the car motors to the rails will flow through the rails and winding of the bonds in the direction indicated by the plain arrows. It will be seen that the propulsion current in its passage through the windings of the bonds flows in at their ends and out at its middle point or in at its middle point and out at its ends in reverse or opposite directions, the result being that the core is not appreciably magnetized, so that the bond may be used as a path of impedance for alternating signaling

currents which may be used in the track circuits. This has been all set forth in my applications hereinbefore referred to, Serial Nos. 192,145 and 192,146. It will also be seen that the propulsion current flows in the same direction in both traffic rails of a block section and in the same direction through all the block sections.

The foregoing, it will be seen, is directed more particularly to the arrangement of the track in the return path or conductor of power circuit whereby the propulsion current flows along it yet it is divided into insulated sections to form the block sections of the signaling system.

In the signaling system I employ a track circuit for each block section which, as usual, comprises a source of signaling current, a relay and the rails of the block section or portions of them. I preferably employ an alternating current in each track circuit for the signaling current, and in the event that alternating current is used for propulsion purposes the alternating current of the track circuit may be of a different frequency or phase or both from the phase and frequency of the propulsion current, or when alternating current is used for propulsion purposes I may use direct current in the track circuits. In any event, the relay or translating device is constructed to respond to control its signal to the signaling current or it may be so protected by the apparatus or devices which will prevent its being operated by the propulsion current.

P^1 designates a generator of alternating signaling current, p, p^1, feeder mains extending from the generator along the line of railway and Q, Q^1, Q^2, etc. step-down transformers. The primary windings of these transformers are in multiple circuit with the feeders p, p^1, and their secondary windings are connected with the track rails of the block sections. One such transformer is provided for each block section and is the source of signaling current for the track circuit of the block section.

R, R^1, etc. designate relays, one being provided for the track circuit of each block section. The construction of these relays is such that they will only respond to the alternating signaling current. If necessary, suitable apparatus or devices may be employed to protect the relay against the action of the propulsion current. A form of relay which may be used is illustrated in my application filed October 13, 1903, Serial No. 176,836. The track circuit for a block section, for example block-section X, may be traced as follows: Starting from one terminal of the secondary winding of the transformer for that block section it is, wire 1, track rail x^1, wire 2 coils of the relay, wire 3, track rail x and wire 4 to the other terminal of the secondary winding. The flow of the alternating signaling current is indicated by the feathered arrows, and it will be seen that the flow is in opposite directions in the track rails of a block section. Each relay controls a local circuit of a railway signal in a manner well understood in the art. Each local circuit comprises a source of current (not shown) and an electro-magnetic part comprised in or forming part of the railway signal operating mechanism. A local circuit may be traced as follows: Starting from the railway signal it is wire 30, contact points controlled by track relay, wire 31, contact points controlled by a relay E, E^1, etc. to be hereinafter referred to, and wire, 32, to railway signal.

S, S^1, etc., designate railway signals of any desired type. I have diagrammatically illustrated them as being of the automatic semaphore type. When the alternating signaling current of a track circuit is present in the coils of the relay included in that circuit the relay responds to keep closed the local circuit and thereby causes the semaphore or other signal device of the railway signal to indicate a safety condition. When, however, the alternating signaling current is absent from the coils of the relay, as when it is short circuited by the wheels and axles of a car upon the rails of the track circuit, the relay responds to open the local circuit and causes the semaphore to indicate a danger condition. This is all well understood in the art.

The point of location of the transformer in the track circuit, the type of relay employed as well as the manner of energizing the coils of the relay from the alternating signaling current in the track circuit is immaterial so far as my invention is concerned. All that is required is that the relay shall respond to control a railway signal as to one of its operations by the alternating signaling current of the track circuit when no train is in a block section and to another operation of the railway signal when the relay is not energized by the alternating signaling current of the track circuit, for example, when the alternating signaling current is shunted from it by the wheels and axle of a car.

As both track rails of a block section are insulated at its ends from the track rails of adjacent block sections, the alternating signaling current in one block section will not react on or affect the alternating signaling current of an adjacent block section. In other words, the several track circuits of the block section are electrically independent of one another by reason of the insulations a. In the event, however, that one or both of the insulations a between two adjacent block sections should break down to such an extent as to establish an electrical connection between the two adjacent rails at that point it may be possible that the alternating signaling current of one block section would find a path through the rails where the insulation

had broken down and thus effect the relay of one or both of the block sections to have it in turn control a railway signal to give a false indication. To guard against this, in the present invention I provide means which, when an insulation *a* breaks down, controls a railway signal, for example, opens a local circuit, and thus have the railway signal positively give a danger indication. The means which I preferably employ is a relay, one being located between each two adjacent block sections. As shown, this relay is actuated to keep a local circuit closed by the difference of potential existing at the ends of the track rails of two adjacent block sections, which difference of potential is due to the alternating signaling currents flowing in the two track circuits of the adjacent block sections, and to open a local circuit wherein this difference of potential is destroyed, due to the breaking down of one or more insulations at this point. The connections of the transformers with the rails of the several block sections are such that at any given instant the polarity of the alternating signaling current of one track circuit is opposite at the same instant to the polarity of the alternating signaling current in the adjacent track circuits. For example, in block section Y, the polarity of the track rails at any one instant is indicated by the usual signs at the ends of the track rails and the direction of flow of the alternating signaling current is indicated by the feathered arrows at one instant. At the same instant, the polarity of the track rails in the adjacent block sections is also indicated by the usual signs, and the direction of flow of alternating signaling current is also indicated by the feathered arrows. It will be understood, of course, that at the next instant, by reason of the use of an alternating signaling current in the track circuits the polarity of the rails will be reversed, as will also be the direction of flow of the current in the several track circuits. For simplicity and clearness I have only illustrated the polarity of the rails of a block section at one instant. Thus it will be seen that at the ends of the track rails of two adjacent block sections there will be a difference of potential due to the alternating signaling current in the two adjacent track circuits.

E, E¹, etc. designate the means hereinbefore referred to, which I have stated are preferably in the form of a relay. In fact it is a type of motor the armature of which carries an arm e^2 controlling one or more contacts comprised in a local circuit of a railway signal, and which motor comprises a field coil *e* and an armature coil e^1 in both of which current has to flow simultaneously in the same direction to have it move its armature in one direction. A reversal of the flow of current in one or the other of the windings or no flow of current in one or the other of its two windings causes or permits of a reverse movement of the armature, which reverse movement of the armature is availed of to open the local circuit. As shown, one terminal of the field winding *e* is connected with an end of a track rail in one block section (for example X, by a wire 10, and the other terminal with an end of a track rail in an adjacent block section (for example Y), by a wire 11. One terminal of the armature winding e^1 is connected with an end of the other track rail in block section X by a wire 12, and the other terminal with an end of the other track rail in block section Y by a wire 13. Thus a circuit through both coils of the relay E will be established, each of which circuits may be traced as follows: Starting from wire 1 of a transformer Q, Q¹, etc. in a block section (for example Q¹), it is, track rail *y*, wire 13, armature coil e^1, wire 12, track rail *x*, wire 4, transformer Q, wire 1, track rail *x*, wire 10, coil *e*, wire 11, track rail y^1 and wire 4 to transformer. It will be noted that this circuit has the voltage of two transformers Q, Q¹. It will also be noted that a track relay is supplied with signaling current from the transformers of two clock sections, but the track relays are of such design that when one transformer is short circuited from it, the relay will not release its armature to open the signal circuit as it will yet have current from one transformer which will be sufficient to hold closed the contact e^2. The same may be true of the relays E, E¹, etc.

In the event that the relays E, E¹, etc. be designed to open a local circuit when one of their operating transformers is short circuited, the signaling system illustrated is what is termed an "overlap system". For example, a train in block section X short circuits current from the transformer Q from the track relay R and relay E, causing these relays to have their armatures move to open the local circuit of railway signal S so that the signal device thereof will move to a position indicating danger. When the car or train moves out of block section X, and into block section Y, transformer Q¹ of block section Y is short circuited from the track relay R¹ and the relay E¹, thus opening the local circuit on railway signal S¹ so that its signal device will move to a position indicating danger. The short circuiting by the train in block section Y of the transformer Q¹ also affects the relay E, which being deprived of the current and voltage from one of the transformers required for its operation, does not move its armature to close the local circuit of railway signal S. Thus the signal device of a railway signal will be held in a position indicating danger so long as a car or train is in the block section guarded by that railway signal or in the block section next in advance.

Suppose now that the insulation between the track rails *x* and *y* of block sections X and Y should break down to such an extent as to

establish an electrical path between these two rails. In this case the armature coil e^1 would be short circuited, and as no current would flow in the armature, it would move to open the local circuit of railway signal S. This circuit for the current from the transformers Q, Q^1, through the relay E under the above conditions would be, wire 1 of transformer Q^1, rail y, rail x, wire 4, transformer Q, wire 1, rail x^1, wire 10, coil e, wire 11, rail y^1 and wire 4 to transformer Q^1. In the event that the insulation between rails x^1 and y^1 broke down to an extent to form an electrical path between these two rails, then the field coil e^1 would be short circuited, and as no current would flow in it, the armature would again move to open the local circuit of railway signal S. In the event that both insulations a should break down sufficiently to establish electrical paths between the track rails of the two block sections the track relays as well as the relays E, E^1, etc. operated from the transformers Q, Q^1, of these block sections would operate to open the local circuits of the railway signals in which they are included.

I do not limit myself to this particular type of relay as it is apparent that any relay or several relays, could be used, that would be operated in one direction (to close a circuit on a railway signal) by the difference of potential of the signaling current in the rails at the ends of two adjacent block sections, and operated in the reverse direction to open the circuit when that difference of potential is in any way destroyed. Nor do I limit myself to any particular form of connection of relay to the tracks, or the transformer to the track as the latter could be connected so that the same polarity at any one instant would be the same on both sides of the insulated joint in which case the leads of the relay and armature would be cross-connected such as from the field of relay the lead wire 10 would be connected to rail x^1 and the lead wire 11 would be connected to rail g and the lead wires from armature winding could be connected as follows: Lead wire 12, would be connected to rail x and lead wire 13 to rail y^1.

What I claim as my invention is:

1. In a signaling system, the combination with two block sections the track rails of one section being insulated at its ends from the track rails of the adjacent block section, of a signaling current flowing in the rails of each block section, in such directions as to maintain a difference of potential between the track rails of the two block sections at the points of insulation, a relay for each block section and a relay at each point of insulation the armature of which is operated in one direction by the maintained difference of potential and is operated in a reverse direction when the difference of potential is destroyed.

2. In a signaling system, the combination with a plurality of block sections, both track rails of a block section being insulated at its ends from the track rails of the adjacent block sections, a signaling current for each block section, the signaling current in one block section flowing in a direction opposite to the flow of the signaling current in an adjacent block section whereby a difference of potential is maintained at the ends of two block sections between the track rails of the two block sections, a relay between two block sections operated by such difference of potential to close a signaling circuit and operated to open the signaling circuit when such difference of potential is destroyed.

3. In an electric railway system, a source of current of one character, vehicles operated thereby, a circuit for said current formed in part by the track rails and conducting the said current in one direction, the track rails being each divided by insulation to form block sections, reactance bonds the coils of which are connected across the track rails of the block sections, conductors connecting the middle points of adjacent coils, a signaling current for each block section, flowing in opposite directions in the track rails, and said signaling currents maintaining a difference of potential at the points of insulation between the track rails of adjacent sections, a railway signal controlled from each signaling current, and means located at insulation points and operated as to one movement by the difference of potential between adjacent block sections and operated as to another movement when such difference of potential is destroyed for also controlling the railway signals.

4. In a signaling system, the combination of two block sections, both track rails of one block section being insulated at its ends from the track rails of the other section, an alternating signaling current for each block section the flow of the signaling current in block section at any one instant being opposite to the flow of the signaling current in the other block section at the same instant, whereby a difference of signaling current potential is maintained between the rails at the adjacent ends of the block sections, and a relay device operated as to one of its movements by the said difference of potential and operated as to another of its movements when said difference of potential is destroyed.

5. In a signaling system, the combination of two block sections, both track rails of one block section being insulated at its ends from the track rails of the other section, an alternating signaling current for each block section the flow of the signaling current in one block section at any one instant being opposite to the flow of the signaling current in the other block section at the same instant,

whereby a difference of signaling current potential is maintained between the rails at the adjacent ends of the block sections, and a relay device comprising field and armature coils one terminal of the field coil being connected to one rail of a block section and one terminal of the armature coil being connected with the other rail of the same block section and the other terminals being connected with the track rails of the other block section, and said relay being operated as to one of its movements by said difference of potential and operated as to another of its movements when said difference of potential is in any way destroyed.

6. In an electric railway system, a source of current of one character, vehicles operated thereby, a circuit for said current formed in part by the track rails and conducting the said current in one direction, the track rails being divided by insulation to form block sections, reactance bonds for conducting said current around insulation points, a signaling current for each block section flowing in opposite directions in the track rails thereof, and said signaling currents maintaining a difference of potential at the ends of the adjacent block section and between the lines of rails of the two adjacent block sections, and means located between adjacent block sections and operated as to one movement by the difference of potential between the lines of rails of adjacent block sections and operated as to another movement when such difference of potential is destroyed, and said means controlling railway signals.

7. In a signaling system, the combination with a plurality of block sections, the rails of one section being insulated at its ends from the track rails of the adjacent block section, a signaling current flowing in the rails of each block section, a relay connected to both block sections, and a means whereby the breaking down of an insulated joint will operate a signal that controls the traffic in said block.

8. In a signaling system, the combination with a plurality of block sections, the rails of one section being insulated at its ends from the track rails of the adjacent block section, of a signaling current for each block section, a relay connected to both block sections that governs the traffic through said sections.

9. In a signaling system, the combination with a plurality of block sections, the rails of one section being insulated at its ends from the track rails of the adjacent block section, of a signaling current for each block section, a relay connected to both block sections, and a means for operating the signal of an adjacent block when a train is in the block.

In testimony whereof I have signed my name to this specification in the presence of two subscribed witnesses.

LOUIS H. THULLEN.

Witnesses:
A. HERMAN WEGNER,
HENRY R. BAUER.