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PATENTED APR. 2, 1907.

J. B. STRUBLE.

SIGNALING SYSTEM FOR ELECTRIC RAILWAYS.

APPLICATION FILED JAN. 3, 1907.

3 SHEETS—SHEET 1.

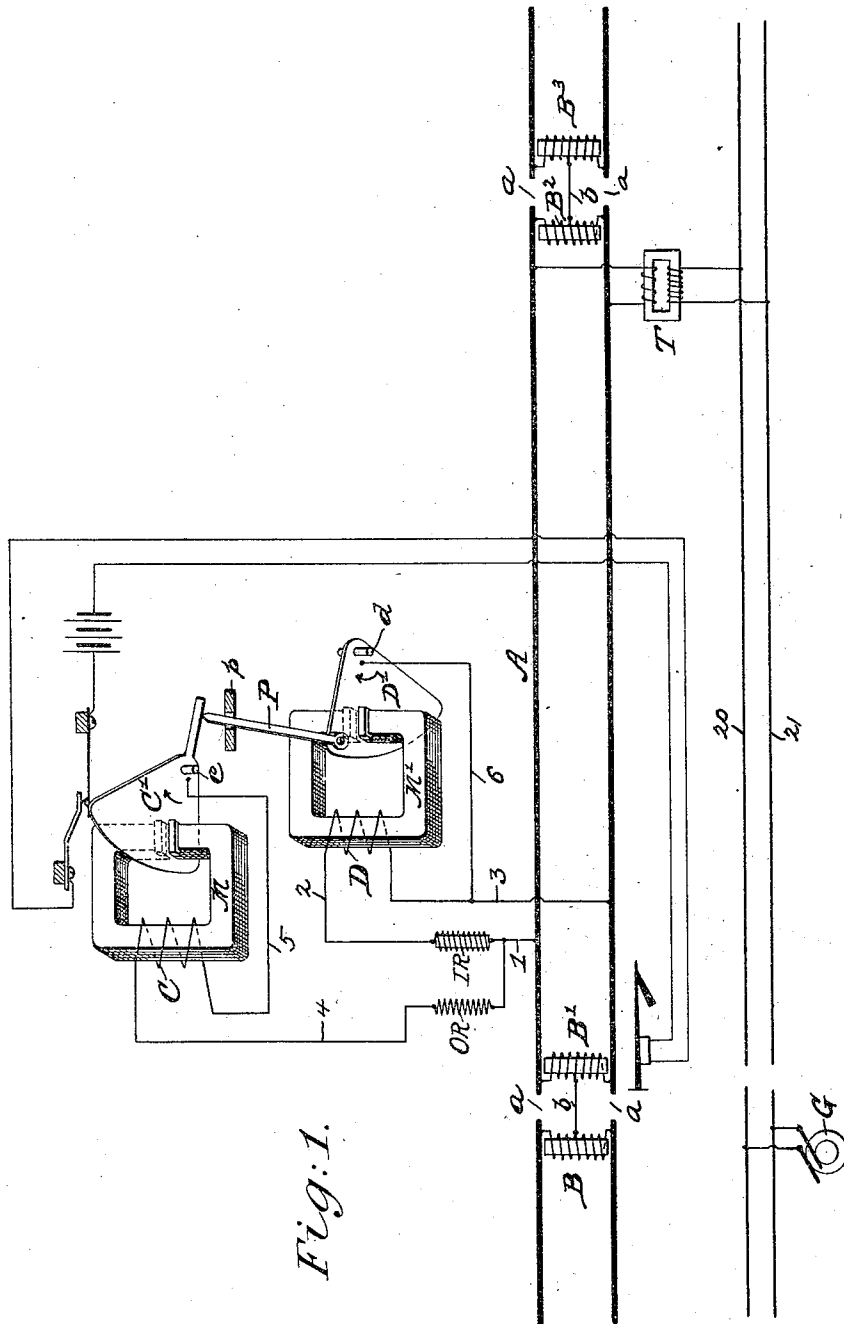


Fig. 1.

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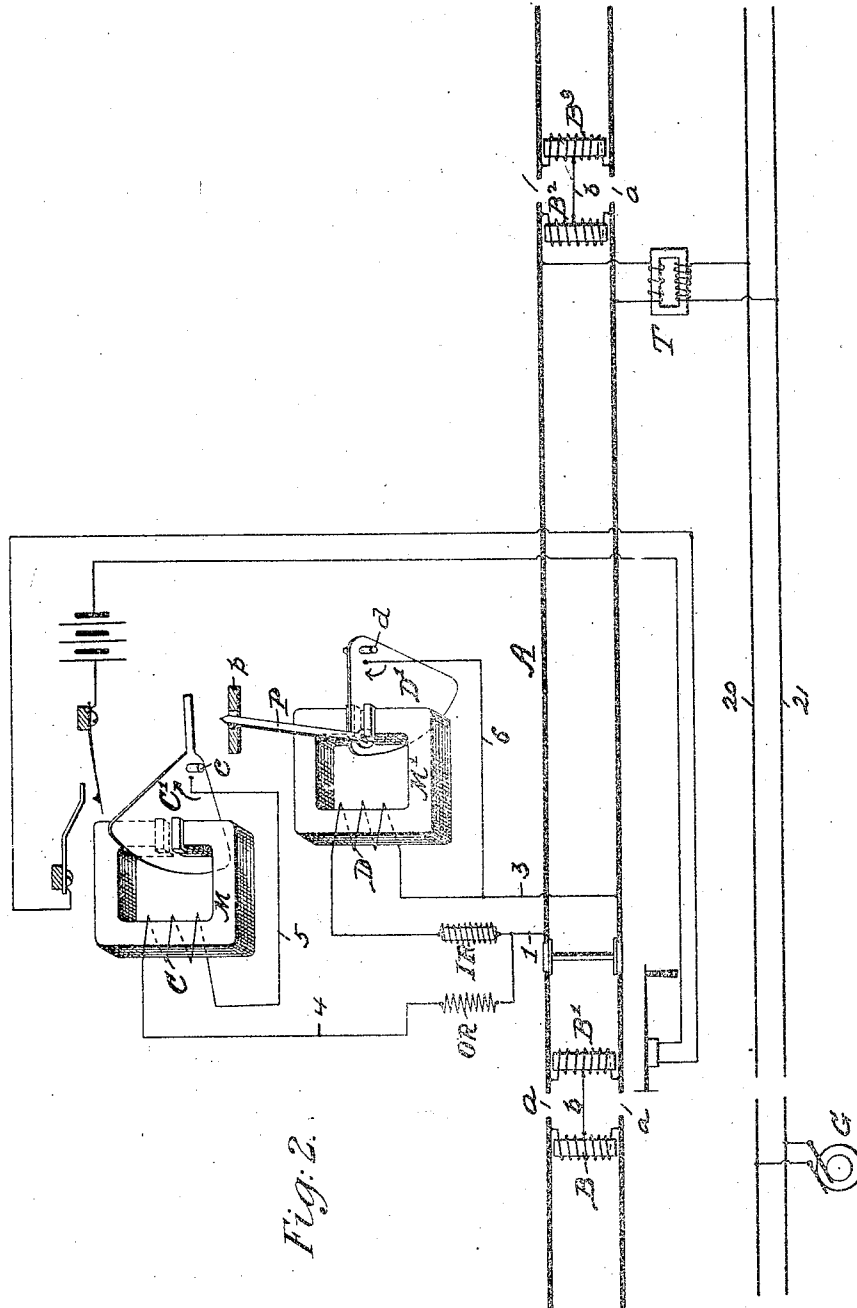


Fig. 2.

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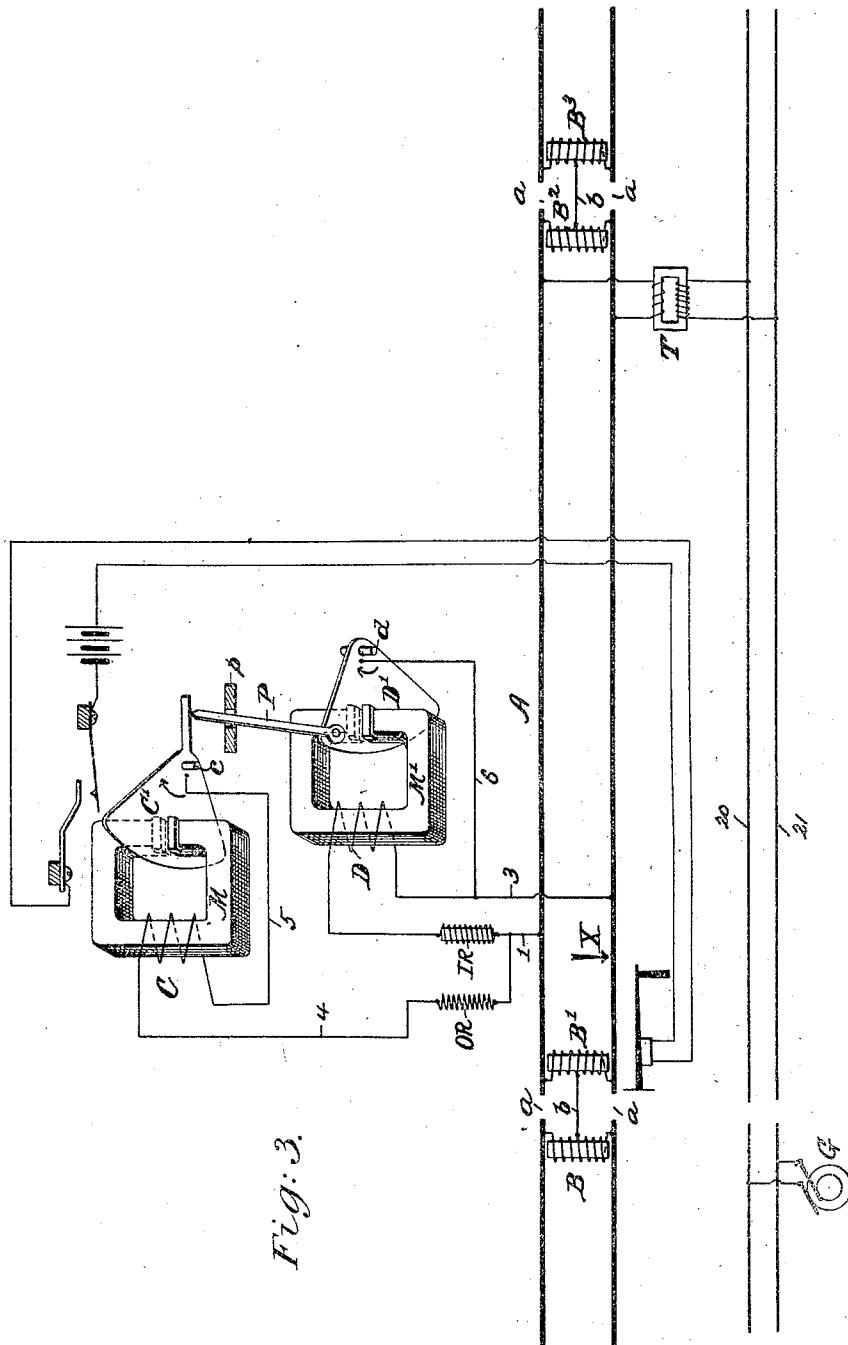


Fig. 3.

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UNITED STATES PATENT OFFICE.

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

SIGNALING SYSTEM FOR ELECTRIC RAILWAYS.

No. 849,173.

Specification of Letters Patent.

Patented April 2, 1907.

Application filed January 3, 1907. Serial No. 350,594.

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 Signaling Systems for Electric Railways, of which the following is a specification.

My invention relates to signaling systems for electric railways and to the relays used in such systems, particularly when the system is applied to electric railways a track-rail or the track-rails of which are used as part of the return path or conductor for the alternating car-propulsion current.

The alternating car-propulsion current for commercial reasons is of a low frequency, and generally the alternating signaling-current is of a relatively higher frequency; and my invention has for an object a relay for the signaling systems on such railroads which will prevent or avoid the wrong clearing of a railway-signal through the influence of the alternating propulsion-current on the relay.

I will describe a relay embodying my invention and then point out the novel features thereof in claims, as well as novel combinations existing in the signaling system in which the relay is used and the electric railway to which it is applied.

In the accompanying drawings, Figures 1, 2, and 3 are diagrammatic views each representing a portion of an electric railway the track-rails of which are divided by insulation to form block-sections and form part of the return-path and a signaling system applied thereto comprising relays embodying my invention.

The several figures illustrate different operations of the relay due to different conditions.

Referring to the drawings, A designates a portion of a railway-track of an electric railway which is divided by insulation *a* to form block-sections. As shown both rails are provided with insulation to form block-sections, though, if desired, only one rail may be so divided. Both arrangements are well known in the art.

In the drawings I have shown one block-section and portions of two others. As the rails (one or both) are to be included in the return-path for the car-propulsion current,

which for the purposes of this invention should be alternating and of a low frequency, provision is made for conducting the propulsion-current around insulation-points by means of reactance-bonds.

In the drawings I have diagrammatically illustrated what is known in the art as the "balanced" type of reactance-bond. B B' B" B", &c., designate such bonds. These bonds, as is well known, comprise a core and a winding or windings, all the turns of which are in the same direction and in close inductive relation. Such a type of bond is illustrated in United States Patent No. 838,916, granted December 18, 1906, to L. H. Thullen. In this type of bond the propulsion-current is made to flow through two equal parts of the winding or two windings of the same number of turns in reverse directions, so that the propulsion-current produces no magnetizing effect on the core of the bond. As shown, the windings of two adjacent bonds are connected by a conductor *b*, or there may be a plurality of such conductors. By this arrangement of track the propulsion-current in its return through the rails and the windings in the manner stated will not magnetize the cores of the reactance-bonds, thus leaving them free to act as impedances for the alternating signaling-current, which is of a higher frequency than the car-propulsion current. I have not illustrated the alternating-current generator for the car-propulsion current or the trolley or third rail, as these are well known in the art.

The signaling system applied to the railway comprises a railway signal or signals for each block-section and a track-circuit for each block-section to control one operation of the railway signal or signals. I have not illustrated any railway-signal, and any of the well-known types of automatic signal may be used. I have indicated a part of the "local circuit" which includes the operating mechanism of the railway-signal.

Each track-circuit comprises a source of alternating current and a relay. The source of alternating current for the track-circuit of each block-section is in the form of a transformer T, the secondary of which is connected with the track-rails of the block-section, while the primary thereof may be in multiple circuit with mains 20 21, extending along

the track from a generator G. As hereinbefore stated, the alternating signaling-current should be of a higher frequency than the alternating power-current.

5 The relay of each track-circuit comprises two coils, a movable element, here shown as a vane or armature operated by each coil, one of which movable elements directly controls the local circuit, while the second movable
10 element is mechanically connected with the first and acts (a) as a circuit maker and breaker for one of the coils and (b) under certain conditions to move the element directly controlling the signal-circuit to open the local
15 circuit. Preferably the circuit of the first coil is continued through the second movable element. In the drawings in order that my invention may be understood I have separately illustrated the two coils and movable
20 elements, making it appear that there are two separate relays. In practice, however, the parts are all combined to form a single relay.

C designates one coil of the relay, and D the other coil, and each coil is located on a core
25 constructed as set forth in United States Patent No. 823,086, granted June 12, 1906. Each core when energized through its core operates a movable element, which I shall hereinafter designate a "vane." M M' designate the cores, and C' D' designate the
30 vanes. Each vane is moved when its coil is energized in the manner described in the said patent.

The vane C' directly controls the local circuit and when moved in one direction on its
35 pivot *c* (see the arrow) closes the contacts in the local circuit for the railway-signal, and when it moves in a reverse direction by gravity or otherwise, which will be when its coil is deenergized, in any manner, as by a shunt
40 around the coil, these contacts are opened. The vane D' is mechanically connected with the vane C' in any desired manner, and the connection is such that when the vane D' moves on its pivot *d* in the direction of the
45 arrow, due to its coil being energized, it tends to move the vane C' to open the contacts in the local circuit. When an excess amount of low-frequency current energizes the coil D, it
50 actually moves the vane C' to open the local circuit. As shown in the drawings, the mechanical connection employed is a rod P, suitably connected with the vane D', moving
55 through a suitable guide *p* and having an engagement or contact with the vane C'. The mechanical connection is also such that should the vane D' have a reverse movement such movement will act to open the circuit on the
60 coil C, and thus cause a reverse movement of the vane C' to open the local circuit.

The two parts of the relay are identical in construction and operation and will respond to alternating currents of any frequency; but
65 it will be apparent that unless both parts are responsive to an alternating current the relay

will not be operated to close the local circuit. For example, if for any reason the vane D' becomes inoperative then the vane C' could not be operated by an alternating current of any frequency, because its circuit would be
70 open at the mechanical connection between the two vanes. In order that the relay may be selectively operated—that is to say, have the relay respond to the alternating signaling-current in the normal or usual operation of
75 the system and not to the alternating propulsion-current—to close the local circuit, I provide means which act to impede the flow of the low-frequency alternating current in one of the two coils, so that the alternating
80 signaling-current will be stronger in one coil than the other. In other words, there will be a preponderance of the alternating signaling-current in one of the coils. These means may be independent of the other parts of the
85 relay, or they may be included in the construction of the relay itself, or one of the two coils may be made to offer more impedance than the other.

In the drawings I have shown the two coils
90 in multiple circuit with the track-rails. In the circuit of the coil C, I have included a non-inductive ohmic resistance O R, and in the circuit of the coil D, I have included an inductive resistance I R. The resistance O
95 R may be dispensed with, if desired. As is well known, an inductive resistance impedes the flow of an alternating current by its reactance, which varies in direct proportion to the frequencies. Therefore the inductive
100 resistance I R will to a large extent impede the flow of the alternating signaling-current in the coil D, and consequently there will be but a slight torque of the vane D', due to the signaling-current. However, this slight
105 movement is availed of to close the circuit through the coil C.

The circuit for the coil D may be traced as follows: From one track-rail it is wire 1, inductive resistance I R, wire 2, coil D, and
110 wire 3 to other track-rail. The circuit for the coil C is wire 1, ohmic resistance O R, wire 4, coil C, wire 5, vane C', rod P, and vane D' and wire 6 to other track-rail. Thus
115 it will be seen that the circuit of the coil C is closed only when the vane D' has moved the mechanical connection sufficiently to engage the vane C'.

In the usual operation of the railway and signaling system the propulsion-current will
120 flow along the track-rails in its return to the generator and will not flow to any extent in any multiple circuits. For example, the leads from the relays and transformers, owing to the rails offering a path of least
125 resistance, and the alternating signaling-current will flow through the coils C and D to produce movements of their vanes C' D', and as more of the signaling-current will flow through the coil C than the coil D, owing to
130

the inductive resistance I R being in circuit with the coil D, the vane C' will be moved to close the local circuit of the railway-signal. This, however, will not take place until the vane D' has been moved sufficiently to engage the vane C'.

Fig. 1 illustrates the position of the parts of relay when no car or train is in a block-section. Fig. 2 illustrates the position of the parts of the relay when a car or train is in a block-section and the alternating signaling-current from the transformer is short-circuited from the coils C and D. These two figures illustrate what may be termed the "normal" or "usual" operation of the system.

Fig. 3 illustrates what may be termed an "unusual" condition—to wit, a break or other unusual resistance in one of the track-rails at the point X such as to cause a difference of potential of the power-current to exist between the track-rails of the block-section. With this difference of potential existing the propulsion-current would find a path through both the coils C and D; but as the inductive resistance I R will offer less opposition to the flow of low-frequency than high-frequency current, while the action of non-inductive resistance O R is unaffected by frequency, relatively more current will flow in the circuit of the coil D, and consequently there will be a stronger pull on the vane D', which acting through the mechanical connection will cause a movement of the vane C' to open the local circuit. In other words, in the event of the unusual condition illustrated in Fig. 3 there will be a preponderance of the low-frequency current in the coil D. Also, in the case of Fig. 2, should there be any difference in potential of power-current in the rails of a block-section occupied by a train (see Fig. 2) and should such difference of potential cause a current to flow in the coils C and D the same operation would occur as hereinbefore stated. Thus it will be seen that in the normal or usual operation of the railway and signaling system the relay will operate in the usual way; but should some unusual condition in the track arise which might cause the propulsion-current to flow the relay would be operated (if at all) to open the local circuit rather than close it, and thus indicate the dangerous condition. Also should the vane D' become inoperative for any reason the local circuit will not be closed and the signal indicate the dangerous condition, inasmuch as the circuit for the coil C is carried through the mechanical connection between the two vanes. Thus it will be seen that an advantage is obtained in having two vanes and a mechanical connection between the two; for the reason that the vane and coil affected or operated by the low-frequency current must be in operable condition to close the circuit through the coil C. If, therefore, the vane D' is not moved upward

for any reason, the coil C is ineffective to move the vane C' to close the local circuit; but if the vane D' is moved upward by an excessive amount of low-frequency current it causes the vane C' to move to open the local circuit. Thus it will be seen that under no conditions will the low-frequency current operate the relay to close the local circuit.

What I claim as my invention is—

1. The combination with an electric railway the trackway of which is used for the return of an alternating propulsion-current and is divided to form block-sections, of a signaling system therefor, said signaling system comprising a railway-signal for each block-section, and a track-circuit for each block-section for controlling the railway-signal, and each track-circuit comprising a source of alternating current of higher frequency than the propulsion-current, and a relay having two coils which when energized by a preponderance of the signaling-current will close a local circuit for the railway-signal and when energized by a preponderance of the propulsion-current will open the local circuit.

2. The combination with an electric railway the trackway of which is used for the return of an alternating propulsion-current and is divided to form block-sections, of a signaling system therefor, said signaling system comprising a railway-signal for each block-section, and a track-circuit for each block-section for controlling the railway-signal, and each track-circuit comprising a source of alternating current of higher frequency than the propulsion-current, and a relay having two coils, a movable element for each core, and a mechanical connection between the two coils, whereby when both coils are energized by the alternating signaling-current and one by a preponderance thereof the relay will operate to close a local circuit for a railway-signal and when both coils are energized by the alternating propulsion-current and one by a preponderance thereof will operate the relay to open the local circuit.

3. The combination with an electric railway the trackway of which is used for the return of an alternating propulsion-current and is divided to form block-sections, of a signaling system therefor, said signaling system comprising a railway-signal for each block-section, a track-circuit for each block-section for controlling the railway-signal and each track-circuit comprising a source of alternating current of higher frequency than the propulsion-current, and a relay having two coils arranged in multiple circuit with the track-rails and one of said circuits having more reactance than the other, whereby when one of the coils is energized by a preponderance of the alternating signaling-current the relay will operate to close a circuit on the railway-signal and when the other

coil is energized by a preponderance of the alternating propulsion-current the relay will operate to open the circuit of the railway-signal.

5 4. In combination with a signaling system for railways, relays for controlling the signals thereof, each relay comprising two coils, a vane movable by each coil, one of said vanes controlling contacts by its movements in response to the absence or presence in its coil of a high-frequency alternating current, and the second of said vanes mechanically connected with the first vane and controlling the circuit of the coil for the first vane.

15 5. The combination with conductors having impressed thereon an alternating current of high frequency and an alternating current of low frequency, of a relay having two coils both of which are connected with said conductors in multiple circuit, means in the circuit of one coil for selecting between the two currents, a vane for each coil, one of which in one of its movements closes the circuit through the coil of the first vane and causes a movement of the first vane when the coil of the second vane is energized by a preponderance of the low-frequency current.

20 6. The combination with an electric railway the trackway of which is used to conduct alternating propulsion-current and is divided to form block-sections, of a signaling system therefor, said signaling system comprising a railway-signal for each block-section and a track-circuit for each block-section, and each track-circuit comprising a source of

alternating current of higher frequency than the propulsion-current and a relay which responds to the high-frequency current to close a local circuit for the railway-signal, and said relay comprising means which when energized by the propulsion-current will not close the local circuit.

7. In combination with a signaling system for railways, relays for controlling the signals thereof, each relay comprising two coils, means movable in response to the action of both coils for closing a circuit under the influence of current of one frequency, and means responsive to changes in frequency for causing one of said coils to preponderate to open the circuit under the influence of current of a lower frequency.

8. In combination with a signaling system for railways, relays for controlling the signals thereof, each relay comprising two coils, means actuated by both coils to control a circuit, and means responsive to changes in frequency permitting said coils to cooperate and close the said circuit when energized by current of one frequency but causing one coil to operate to open the circuit when energized by a preponderance of current of a lower frequency.

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

JACOB B. STRUBLE.

Witnesses:

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