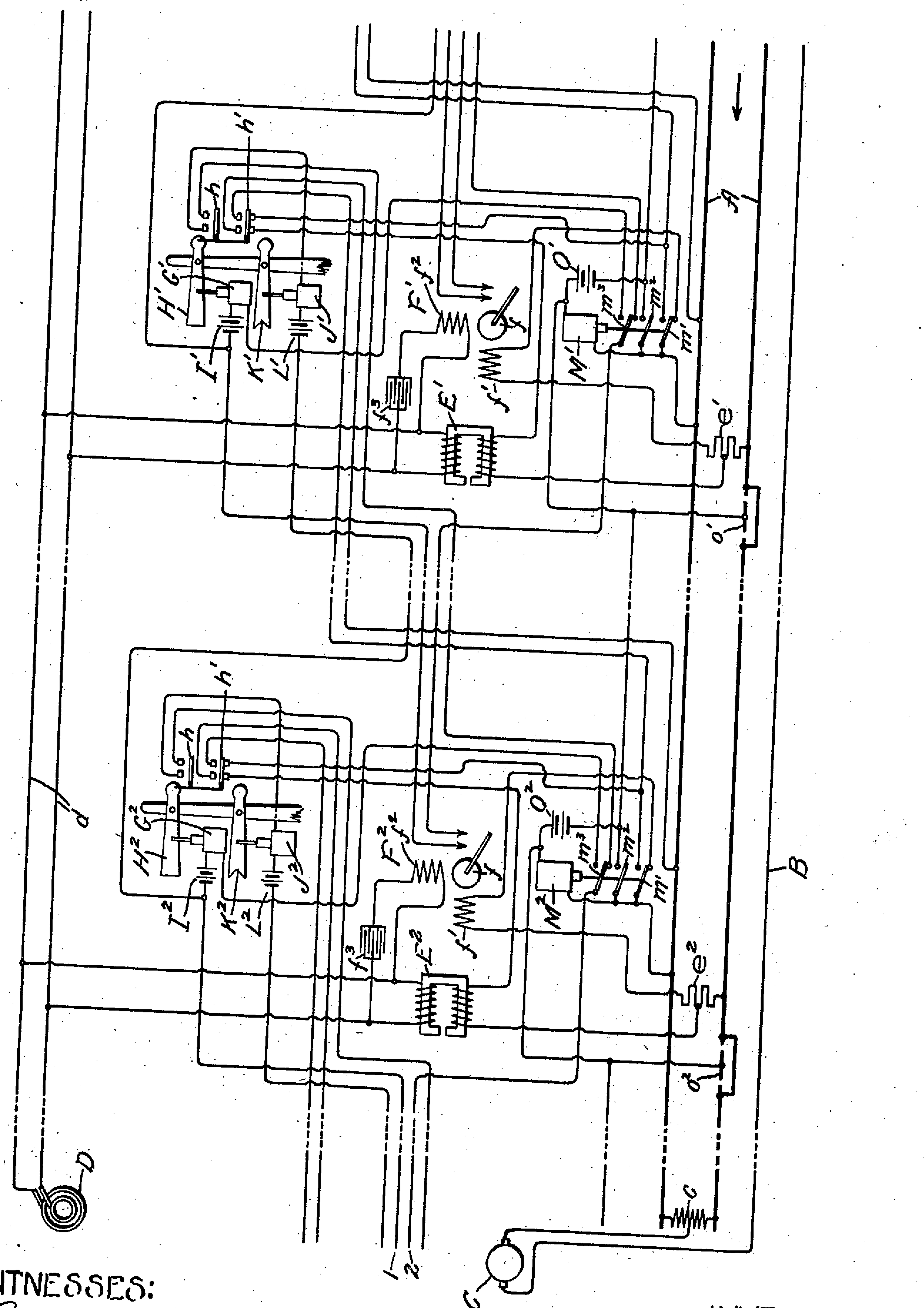
No. 859,219. PATENTED JULY 9, 1907.

L. A. HAWKINS.

BLOCK SIGNAL SYSTEM.

APPLICATION FILED DEC. 5, 1906.



WITNESSES:

George A. Thornton.

J. Ellis Glen.

INVENTOR:

Laurence A. Hawkins,

By Albert G. Davis,

Att'y.

UNITED STATES PATENT OFFICE.

LAURENCE A. HAWKINS, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

BLOCK-SIGNAL SYSTEM.

No. 859,219. Specification of Letters Patent. Patented July 9, 1907.

Application filed December 5, 1906. Serial No. 346,382.

To all whom it may concern:

Be it known that I, LAURENCE A. HAWKINS, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Block-Signal Systems, of which the following is a specification.

My invention relates to block-signal systems for electrically operated roads employing the rails as return conductor for the power current, and consists in an improvement in the system described in my former application, filed November 8, 1906, Serial No. 342,455.

In my former application I described a signal system operating on the normal danger plan, in which both rails were made conductive for all currents without inductive bonds or special connections, and normally open-circuited transformers were connected across the rails at intervals, with means controlled by a moving train for closing a circuit of the transformer ahead of the train to supply current to a track relay, so as to clear the signal for the block which the train is about to enter.

My invention consists in a modification of this system, particularly adapted for the control of signals arranged to give clear, caution and danger indications, and in one aspect consists in so arranging the system that a plurality of transformers have their circuits closed ahead of the train. I secure this result by providing a magnet controlled by a moving train to close the circuit of a transformer ahead of the train in the same manner as in my former application, so that the signal for the block ahead of the train is cleared if the block is unoccupied. And I further provide contacts controlled by the signal for closing the circuit of a second transformer, so as to supply current to a second block in advance of the first, and provide a relay responsive to current from the second transformer to control the signals to indicate the position of the second block. In this manner, home and distant signals, or three-position signals, may be controlled so as to indicate the condition of two blocks ahead of the train,—or in other words, to give clear, caution and danger indications. If the second transformer above mentioned, is adjacent to the first relay, the current from this transformer will maintain the first relay energized, so that the relay is not gradually short-circuited by an approaching train, as in my former application, but is maintained energized until the train enters the block; at which point means are provided for positively deënergizing the relay. This feature of my invention, consisting in connecting the relay after it is energized to a second source of current, renders the block perfectly definite at its entrance end, and is not limited to signal systems arranged to give three indications, but might be used to advantage where only home signals are employed.

My invention further comprises a number of other features, which will be definitely pointed out in the appended claims, and which will best be understood by reference to the accompanying drawing, which shows a signal system arranged in accordance with my invention.

In the drawing, A represents the track rails, which are conductively continuous for all currents, no inductive bonds, or similar device, being required for my system; B represents the third rail, or other working conductor, which is connected to one terminal of the source of power current indicated by the generator C. This generator may supply either direct current or low frequency alternating current. Its other terminal is connected to the rails through the differential choke coil *c*.

D represents an alternating current generator which furnishes the current for the signal circuits, and is preferably a high frequency generator.

d represents line-wires extending from the generator C along the track.

Current is supplied to the track-rails through transformers E^1 E^2, the primaries of which are connected to the line-wires *d*, and the secondaries of which are connected across the track-rails. These transformers are normally open-circuited on either the primary or secondary side. On the drawing I have shown them open-circuited on the secondary side. One secondary terminal is connected to the lower rail A, through a resistance, e^1 or e^2, to reduce the flow of power current through the transformer winding.

F^1 and F^2 represent relays of any suitable type responsive to alternating current of a given frequency, and not to the power current. I have illustrated these relays diagrammatically, as of the well known induction type, each comprising a short-circuited secondary member *f* carrying the relay contact-arm, and two coöperating windings, one of which, f^1, is connected across the track-rails through a resistance e^1 so as to be supplied with current through the rails when the circuit of an adjacent transformer is closed, and the other, f^2, is supplied with current of the same frequency and different phase independently of the track-circuits.

I have indicated a condenser f^3 for the purpose of obtaining the desired phase-displacement in the two windings f^1 and f^2, but this may be obtained in any other suitable manner. Each relay controls the circuit of the operating mechanism of a home and distant signal. Thus, the relay F^2 has its contacts included in the circuit of the operating mechanism G^1 of the home signal H^1, and of a distant signal not shown on the drawing. These circuits will be described in detail hereafter.

I^1 represents the source of current for the operating mechanism G^1. Each home signal is provided with contacts $h\ h^1$ for purposes which will be hereinafter explained.

K^1 and K^2 represent distant signals with operating mechanisms J^1 and J^2 supplied from the current sources L^1 and L^2, respectively.

M^1 and M^2 represent magnets provided with three armatures m^1, m^2 and m^3 supplied from sources of current O^1 and O^2. The magnets M^1, M^2, etc., are connected to short-circuit insulated rail sections o^1, o^2, etc., which are inserted in one of the track rails and bridged by a conductor, so that the conductive continuity of the rail is not interfered with. The insulated rail-section, as is shown, forms a convenient arrangement for closing a circuit by a moving train without the use of moving contacts, but it will be understood that the only purpose of these insulated sections is to form a contact device closed by a passing train, and any other suitable form of train-operated circuit closer may be substituted for these insulated sections.

The direction of traffic is indicated by the arrow. Normally, all the transformers E^1, E^2, etc., are open-circuited, and consequently, all the track-relays F^1, F^2, etc., are deënergized, and the signals stand at danger. The magnets M^1, M^2, etc., are also normally open-circuited, but whenever a train passes over an insulated section, one of these magnets is energized. Thus, for instance, if a train passes over the insulated section o^1, a circuit is closed from the lower terminal of battery O^2 to insulated section o^1, through the car axles to the upper rail A, through this rail to the magnet M^2, and thence to the upper terminal of the battery O^2. Magnet M^2 is thus energized and draws up its armatures. Now, let it be assumed that magnet M^1 has just been energized in the manner above described for the magnet M^2; it will then have drawn up its armatures, closing a maintaining circuit for itself through its armature m^2. The lower armature m^1 will have been shifted from its lower to its upper contact, thereby breaking the circuit of track-winding f^1 of relay F^1, and closing the secondary circuit of transformer E^1. Current then flows from this transformer through the track-rails to the track-winding f^1 of relay F^2; the circuit of this track-winding being closed through the armature m^1 of magnet M^2. The relay F^2 is consequently energized and closes its contact, provided both rails of the block between this relay and the transformer E^1 are intact, and provided no train is in the block or near enough to the relay on its farther side to shunt it effectually. This shunting distance or overlap is determined by the relative impedance of the rails and relay, and on the relay design. By using a high frequency current, to which the rails offer a high impedance, the relay may readily be designed so that this distance is not excessive. A circuit is then closed from the left-hand terminal of the battery I^1 through the contacts of relay F^2, through the armature m^3 of magnet M^1, and through the operating mechanism G^1 to the right-hand terminal of the battery. The operating mechanism G^1 is consequently energized and draws the signal H^1 to clear position. In moving to clear position, the contacts h, h^1, carried by the signal, engage the upper stationary contacts, thereby completing a circuit from the right-hand terminal of the secondary of transformer E^2, through contact h^1 of signal H^1, to the upper rail A. Transformer E^2 is thus connected across the track, and supplies current to the track rails. Part of this current passes directly through the track-winding f^1 of relay F^2, assisting in maintaining this relay energized, while part of the current passes to the left to the next track-relay, not shown, which owing to the high rail impedance, is not operatively energized by transformer E^1. If the track between the transformer E^2 and this track-relay is clear, the track-relay will be energized, connecting conductors 1 and 2, thereby closing the following circuit,—from the left-hand terminal of battery L^1, through conductor 1, to the track-relay, not shown, thence back through conductor 2, through armature m^3 of magnet M^2 and its back contact, to contact h of signal H^1, thence through the operating mechanism J^1 of the distant signal K^1, to the right-hand terminal of the battery L^1. The operating mechanism J^1 is thereby energized, and the signal K^1 cleared, showing that the track is clear ahead of the train for two blocks. It will be seen that the contact h^1, while closing the circuit of transformer E^2, breaks the circuit of transformer E^1. The purpose of this is simply economy of current. These contacts for opening the circuit of transformer E^1 might be omitted, but by their use, the transformer E^1 is open-circuited as soon as the signal H^1 is clear and the circuit of transformer E^2 closed, and while the train is still some distance away. Consequently, the high current which would be produced by a train short-circuiting this transformer is saved, and after the signal H^1 is cleared, the transformer E^1 is no longer needed for energizing the relay F^2, since this relay is then energized by the transformer E^2. It will, of course, be understood that the contact h^1 should close the circuit of transformer E^2 before opening the circuit of transformer E^1.

It will be seen that, although the track-relay to the left of transformer E^2 is energized, the home signal H^2 will not be affected, since the circuit of its operating mechanism G^2 is open at the armature m^3 of magnet M^2. It will also be seen that, although the relay F^2 is energized, the distant signal next to the right of those shown on the drawings, will not be energized, since its circuit is opened at the back contact of armature m^3 of magnet M^1. The purpose of this armature m^3 is to prevent any signals being operated, except those which are directly in front of an approaching train.

The signals H^1 and k^1, having been cleared, as above described, no further changes occur until the train reaches the insulated section o^1. When this is reached, the magnet M^1 is short-circuited by the train and drops its armatures. The armature m^3, consequently, opens the circuit of operating mechanism G^1, so that signal H^1 is allowed to return to danger by its counter-weight. In thus moving to danger position, it breaks the circuit of transformer E^2 at contact h^1, thereby de-energizing the track-relay F^2, which accordingly drops its armature. At the same time, the presence of the train on the insulated section o^1 serves to complete the circuit of magnet M^2, as has been heretofore explained, so that its armatures are drawn up, establishing a new connection for the secondary of transfomer E^2 to the track-rails, so as to maintain the track-relay to the left of this transformer energized. Relay F^2, however, is not energized, although transformer E^2 is still connected to the track, since the armature m^1 of magnet M^2 in closing the circuit of the transformer, opens the circuit of the track-winding f^1 of the relay F^2. The signal H^1, in going to danger, has opened the circuit of the operating mechanism J^1 of the signal K^1 at the contact h, so that the distant signal K^1 goes to danger, together with the signal H^1

While I have indicated batteries as the sources of current for the signal operating mechanisms and for the magnets M^1, M^2, etc., it will be understood that any suitable source of current, either direct or alternating, may be used for these devices.

It will further be understood that I have shown the signal operating mechanisms, relays and magnets diagrammatically, and that in practice, any well known constructions may be employed.

Furthermore, although I have shown my invention applied to separate home and distant signals for giving the desired indications, it will be understood that my invention is equally applicable to one-arm, three-position signals.

Accordingly, I do not desire to limit myself to the particular construction and arrangement of parts here shown, but aim in the appended claims to cover all modifications which are within the scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is,—

1. In combination with an electrically-operated road having both rails conductively continuous for all currents, normally open-circuited transformers connected at intervals across the rails, means controlled by a moving train for closing the circuit of a plurality of transformers ahead of the train, and signal-controlling devices responsive to the voltage impressed on the rails by said transformers.

2. In combination with an electrically-operated road having both rails conductively continuous for all currents, normally open-circuited transformers connected at intervals across the rails, means controlled by a moving train for closing the circuit of a plurality of transformers ahead of the train, signal-controlling devices responsive to the voltage impressed on the rails by said transformers, and signals controlled by said devices adapted to give clear, caution and danger indications.

3. In combination with an electrically-operated road having both rails conductively continuous for all currents, normally open-circuited transformers connected at intervals across the rails, means controlled by a moving train for closing the circuit of a plurality of transformers ahead of the train, means responsive to the current supplied to the rails by the transformer nearest the train for indicating the condition of the block ahead of the train, and means responsive to the current supplied to the rails by a second transformer for indicating the condition of a second block ahead of the train.

4. In combination with an electrically-operated road having both rails conductively continuous for all currents, normally open-circuited transformers connected at intervals across the rails, means controlled by a moving train for closing the circuit of a plurality of transformers ahead of the train, a track relay responsive to the current supplied to the rails by the transformer nearest the train, a home signal for the block ahead of the train, controlled by said relay, a second track-relay responsive to the current suplied to the rails by a second transformer, and a distant signal controlled by said second relay.

5. In combination with an electrically-operated road having both rails conductively continuous for all currents, normally open-circuited transformers connected at intervals across the rails, means controlled by a moving train for closing the circuit of a transformer ahead of the train, signal devices responsive to the current supplied to the rails by said transformer, and means controlled by said devices for closing the circuit of a second transformer.

6. In combination with an electrically-operated road having both rails conductively continuous for all currents, normally open-circuited transformers connected at intervals across the rails, means controlled by a moving train for closing the circuit of a transformer ahead of the train, signal devices responsive to the current supplied to the rails by said transformer, means controlled by said devices for closing the circuit of a second transformer, and other signal devices responsive to the current supplied to the rails by the second transformer.

7. In combination with an electrically-operated road having both rails conductively continuous for all currents, normally open-circuited transformers connected at intervals across the rails, means controlled by a moving train for closing the circuit of a transformer ahead of the train, signal devices responsive to the current supplied to the rails by said transformer for indicating the condition of the block ahead of the train, means controlled by said signal devices for closing the circuit of a second transformer ahead of the first, and signal devices responsive to the current supplied to the rails by the second transformer for indicating the condition of a second block ahead of the train.

8. In combination with an electrically-operated road having both rails conductively continuous for all currents, normally open-circuited transformers connected at intervals across the rails, means controlled by a moving train for closing the circuit of a transformer ahead of the train, a track relay responsive to the voltage impressed on the rails by said transformer, a home signal for the block ahead of the train controlled by said relay, contacts controlled by said signal for closing the circuit of a second transformer ahead of the first, a second track relay responsive to the voltage impressed on the rails by the second transformer, and a distant signal controlled by the second relay.

9. In combination with an electrically-operated road having both rails conductively continuous for all currents, normally open-circuited transformers connected at intervals across the rails, means controlled by a moving train for closing the circuit of a transformer ahead of the train, a track relay connected to the rails ahead of the transformer, and means controlled by said relay for closing the circuit of a second transformer adjacent to said relay.

10. In combination with an electrically-operated road having both rails conductively continuous for all currents, normally open-circuited transformers connected at intervals across the rails, means controlled by a moving train for closing the circuit of a transformer ahead of the train, a track relay connected to the rails ahead of the transformer, means controlled by said relay for closing the circuit of a second transformer adjacent to said relay, and connections whereby said relay is deënergized when the train reaches the first transformer.

11. In combination with an electrically-operated road having both rails conductively continuous for all currents, normally open-circuited transformers connected at intervals across the rails, means controlled by a moving train for closing the circuit of a transformer ahead of the train, a track relay connected to the rails ahead of the transformer, means controlled by said relay for closing the circuit of a second transformer adjacent to said relay, and connections whereby the circuits of the first transformer and of the relay are opened when the train reaches the first transformer.

12. In combination with an electrically-operated road having both rails conductively continuous for all currents, a transformer connected across the rails, normally open contacts in circuit with said transformer, a magnet for closing said contacts, connections from said magnet to a source of current arranged to be closed by an approaching train, a track-relay responsive to the current supplied to the rails by said transformer, means controlled by the relay for connecting the relay to a second source of current, a signal controlled by said relay, and means for deënergizing said relay when the train enters the block controlled by said signal.

13. In combination with an electrically-operated road having both rails conductively continuous for all currents, a transformer connected at intervals across the rails, normally open contacts in circuit with said transformer, a magnet for closing said contacts, connections from said magnet to a source of current arranged to be closed by an approaching train, a track relay responsive to the current supplied to the rails by said transformer, means controlled by the relay for connecting the relay to a second source of current, a signal controlled by said relay, and means for deënergizing both the contact-closing magnet and the track relay when the train enters the block controlled by said signal.

14. In combination with an electrically-operated road having both rails conductively continuous for all currents, a normally open-circuited transformer connected across the track rails, means controlled by an approaching train for closing the circuit of said transformer, a track relay responsive to the current supplied to the rails by said transformer, means controlled by the relay for connecting the relay to a second source of current, a signal controlled by said relay, and means for deënergizing said relay when the train enters the block controlled by said signal.

15. In combination with an electrically-operated road having both rails conductively continuous for all currents, a normally open-circuited transformer connected across the track rails, means controlled by an approaching train for closing the circuit of said transformer, a track relay responsive to the current supplied to the rails by said transformer, means controlled by the relay for connecting the relay to a second source of current, a signal controlled by said relay, and means for opening the circuit of said transformer and disconnecting said relay from the second source when the train enters the block controlled by said signal.

16. In combination with an electrically-operated road employing the rails as return conductor for the power current, normally open-circuited transformers connected at intervals across the rails, electromagnets for closing the circuits of said transformers arranged to be successively energized and deënergized by a moving train, track relays responsive to the current supplied to the rails by said transformers when their circuits are closed, signals controlled by said relays, and contacts in the signal-operating circuits controlled by said electromagnets and controlling the signals jointly with the relay contacts.

17. In combination with an electrically-operated road having both rails conductively continuous for all currents, normally open-circuited transformers connected at intervals across the rails, means controlled by a moving train for closing the circuit of a transformer ahead of the train, a track-relay responsive to the current from the transformer, means controlled by the relay for connecting the relay to a second source of current, means for opening the circuit of said transformer when the relay is connected to the second source, and means controlled by the further movement of the train for disconnecting the relay from the second source.

18. In combination with an electrically-operated road having both rails conductively continuous for all currents, normally open-circuited transformers connected at intervals across the rails, means controlled by a moving train for closing the circuit of a transformer ahead of the train, a track relay responsive to the current from the transformer, a signal controlled by said relay, contacts controlled by said signal for connecting said relay to a second source of current and for opening the circuit of said transformer, and means for disconnecting said relay from said second source when the train enters the block guarded by said signal.

In witness whereof, I have hereunto set my hand this 3rd day of December, 1906.

LAURENCE A. HAWKINS.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.