L. A. HAWKINS.

BLOCK SIGNAL SYSTEM.

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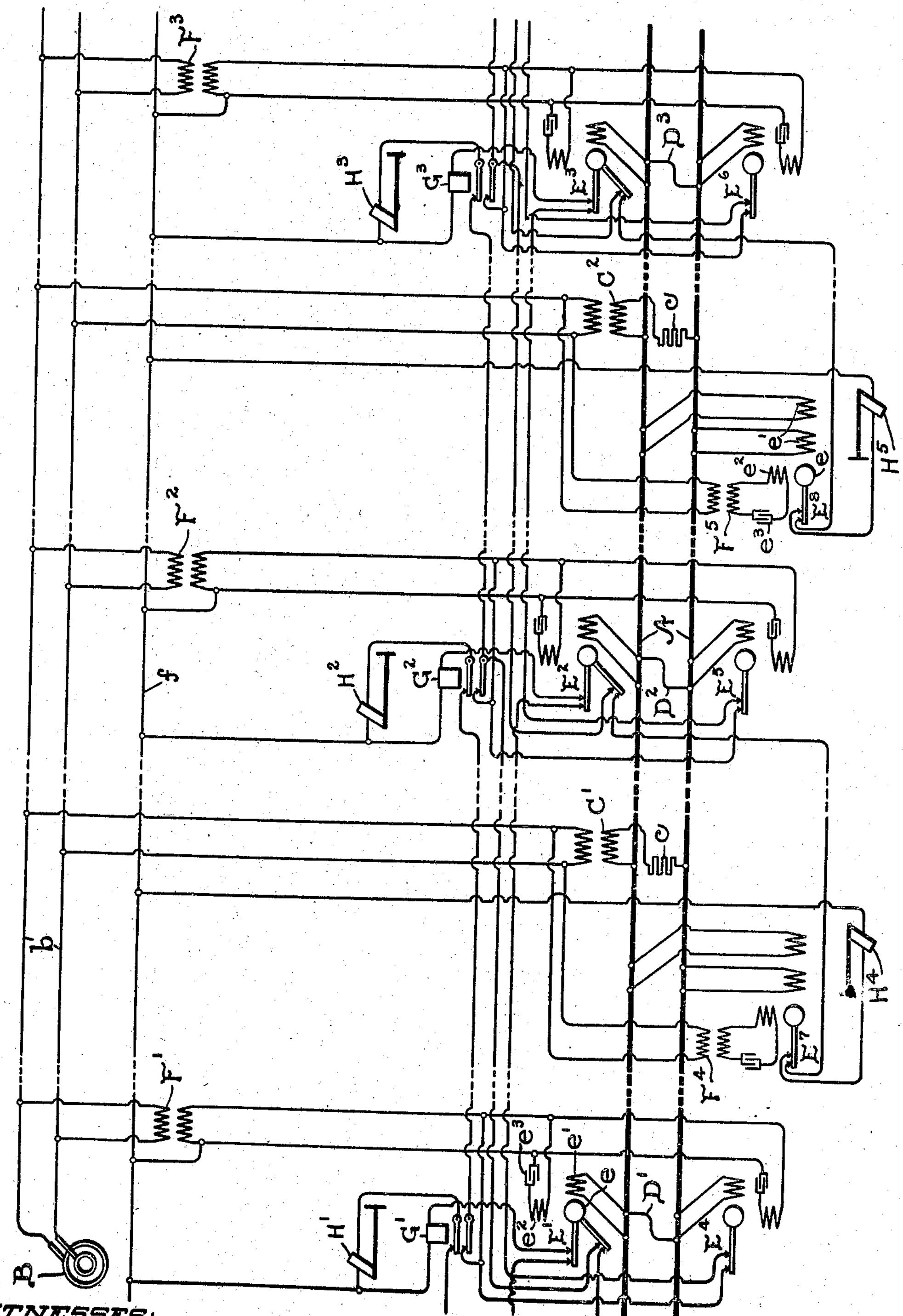
**937,439.** Patented Oct. 19, 1909.

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## BLOCK-SIGNAL SYSTEM.

**937,439.** Specification of Letters Patent. **Patented Oct. 19, 1909.**

Application filed March 18, 1909. Serial No. 484,230.

*To all whom it may concern:*

Be it known that I, LAURENCE A. HAWKINS, a citizen of the United States, residing at Schenectady, in the 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 alternating current block signal systems for electric roads, and its object is to provide a novel arrangement of track circuits, whereby a single track circuit may suffice for controlling successively a plurality of different signal operations as the car reaches different points on the track circuit.

It has been customary heretofore to employ at least one track circuit for each signal operation,—that is, the track circuit does not extend farther than from one signal to the next. In passing through interlocking or through crossovers and sidings, the signals may be very close together, and the track circuits exceedingly short. In an alternating current signal system, the multiplication of track circuits is highly objectionable. For instance, if the system is of the type in which inductive bonds are used for conveying the power current from one block to another; additional track circuits mean additional inductive bonds, which may be exceedingly expensive. Furthermore, in any system additional transformers are required for additional track circuits, which not only increase the cost of the apparatus, but also increase the current consumption.

By my invention the necessary number of track circuits is greatly diminished, since it renders it unnecessary to start a new track circuit at each signal. In most cases the track circuit may be given the proper length for most efficient operation, without regard to the number of signal operations which must be successively controlled by a car in passing over that distance.

My invention consists in the addition to the usual closed track circuit of a relay or relays connected to the rails, and preferably in shunt to a portion of the track circuit, at any point or points where the passage of a car should initiate an additional signal movement.

My invention is applicable to the operation of signals guarding cross-overs and sidings in the middle of a block, and also to signal-track operation where it is desirable that the signals for controlling the traffic in opposite directions should be staggered with respect to each other, in order to provide the usual overlap. When the signals for the two directions of traffic have been staggered, it has been customary heretofore to employ a track circuit extending from a signal for one direction of traffic to the adjacent signal for the opposite direction of traffic. This involves two track circuits between adjacent signals for the same direction of traffic. By my invention the number of track circuits may be cut in half.

My invention will best be understood by reference to the accompanying drawing, which shows diagrammatically one type of signal system for a signal-track road arranged in accordance with my invention.

In the drawing A represents the track rails, both of which are indicated as conductively continuous for all currents throughout their length,—that is, bonded in the manner usual on electric railways. I have illustrated my invention applied to a system adapted for use on such a railway and having its track circuits not separated by insulated joints, but I wish it understood that in its broader aspects my invention is equally applicable to systems of the inductive bond type. Furthermore, when applied to an electric road with the rails conductively continuous, my invention is not limited to the particular type of system which I have selected for purposes of illustration, which type of system is that described in my prior application, Serial No. 435,861, filed June 1, 1908.

B represents an alternating current generator for supplying current to the transmission wires, from which the alternating current for the signal circuits is taken.

$C^1$ and $C^2$ represent transformers for supplying alternating current to the track circuits. Their primaries are connected to the transmission wires *b*, and their secondaries connected across the rails through a resistance or impedance *c*, which serves to limit the current drawn from the transformer when a car stands across its terminals, and also prevents saturation of the transformer by unbalanced power current.

$D^1$, $D^2$ and $D^3$ represent conductors connected across the rails at points between adjacent transformers. In the particular system shown these conductors form with the transformers and the track rails closed track circuits, each conductor and each transformer being common to two adjacent track circuits.

$E^1$ to $E^6$ represent track relays having their track windings connected in shunt to short lengths of rail adjacent to the cross-connecting conductors. These relays are illustrated diagrammatically as of the two-phase induction type, comprising a short-circuited secondary member $e$ carrying the relay contacts, a track winding $e^1$, and a second winding $e^2$ supplied with current directly from the transmission wires through the transformers $F^1$, $F^2$, etc. Phase controlling devices, such as condensers $e^3$, may be employed, if necessary, to produce the proper phase displacement between the currents in the windings $e^1$ and $e^2$. The points on the rails, to which each of the conductors $D^1$, $D^2$, etc., is connected are not exactly opposite, but are somewhat displaced, so that adjacent track circuits slightly overlap to insure the shunting of the relay on one side of the conductors before the relay on the other side of the conductor is energized. The arrangement of track circuits, as far as described, is identical with that disclosed in my earlier application, above referred to.

In addition to the track relays already mentioned, track relays $E^7$ and $E^8$ are provided at intermediate points on the track circuits. The exact location of these relays will be determined by operating conditions. They are indicated as not very far distant from the transformers $C^1$ and $C^2$. These relays are preferably provided with two track windings $e^1$, which are connected in shunt to opposite short lengths of rail. While the two windings are not essential, they are advantageous, since by their use the length of rail spanned by a single winding may be cut in half, and furthermore, such power current as flows through the two windings produces opposite magnetizing effects in the two coils, so that the tendency to saturation is reduced.

$G^1$, $G^2$ and $G^3$ represent line relays controlled by the track relays in the manner which will be explained.

$H^1$, $H^2$ and $H^3$ represent signals for controlling traffic in one direction, and $H^4$ and $H^5$ represent signals for traffic in the opposite direction. The signals $H^1$, $H^2$ and $H^3$ are placed at the ends of the track circuits,—that is, near the cross-connecting conductors $D^1$, $D^2$ and $D^3$. The signals $H^4$ and $H^5$ are placed at the track relays $E^7$ and $E^8$. It is the location of these signals which determines the position of the track relays. Ordinarily it is desirable that the signal $H^4$, for instance, should be put approximately midway between signals $H^1$ and $H^2$, and this brings the relay $E^7$ not far from the transformer $C^1$, if that transformer is placed about half way between signals $H^1$ and $H^2$, as is ordinarily preferable. If a greater overlap is desired, the relay $E^7$ and signal $H^4$ would be moved farther away from the transformer $C^1$, so as to introduce a greater distance between signals $H^2$ and $H^4$.

It will be seen that the operating circuit of signal $H^3$ extends through the upper contact of line relay $G^3$, lower contact of line relay $G^2$, secondary of transformer $F^2$, and through the common return wire $f$ to signal $H^3$. Line relay $G^3$ is controlled by track relay $E^3$ and track relay $E^5$, its circuit passing through the contacts of these two relays in series, and then through the secondary of transformer $F^2$ and common return wire $f$. Similarly, line relay $G^2$ is controlled by track relays $E^2$ and $E^4$. Since a car between conductors $D^2$ and $D^3$ will deënergize one of the two relays $E^5$ and $E^3$, and a car between conductors $D^2$ and $D^1$ will deënergize one of the two relays $E^2$ and $E^4$, it follows that a car at any point between conductors $D^3$ and $D^1$ will deënergize one of the line relays $G^2$ and $G^3$, and therefore will hold the signal $H^3$ at stop. The operating circuit of signal $H^4$ extends through relay $E^7$, relay $E^2$, lower contact of line relay $G^3$, secondary of transformer $F^3$ and common return wire $f$, back to the signal mechanism. A car between conductor $D^1$ and relay $E^7$, while holding signal $H^3$ at danger, will have no effect on signal $H^4$. As soon as it passes relay $E^7$, however, it shunts this relay and puts signal $H^4$ at stop. It will hold this signal at stop until it passes conductor $D^3$, since while it is between transformer $C^1$ and conductor $D^2$, relay $E^2$ is deënergized, and while it is between conductors $D^2$ and $D^3$, relay $E^5$ or relay $E^3$ is deënergized, and consequently line relay $D^3$ will be deënergized. The zone of control for the signals controlling traffic from right to left is thus a distance twice in length the distance between transformers, while the zone of control for signals controlling the traffic from left to right is only a little over one and a half times the distance between adjacent transformers. The number of track circuits is only half that ordinarily employed for controlling such an arrangement of signals, as is shown, while the same signal operations with regard to overlap are obtained as with the usual number of track circuits.

It will be noted that the addition of the relay $E^7$, for instance, to the track circuit if it is connected in shunt to a length of rail, as shown in no way affects the operation of relay $E^4$, since the relay $E^7$ withdraws no current from the track circuit, but merely utilizes a part of it, as it passes. Thus, if other signal operations are required between conductor $D^1$ and the transformer $C^1$, as many additional relays may be shunted across short portions of rail at the necessary points as there are signal operations required. The applicability of my invention to various conditions arising at cross-overs, sidings, etc., will be obvious to those skilled in the art. Accordingly, I do not desire to limit myself to the particular connections and arrangements of parts here shown, but aim in the appended claims to cover all modifications 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 a block signal system comprising signals for the blocks with control circuits therefor, a source of alternating current connected across the track, a track relay at a distance from the source supplied with current therefrom through the track rails, and a second track relay located at a point intermediate the source and the first track relay and having a winding energized by the current flow past that point from the source to the first relay.

2. In a block signal system comprising signals for the blocks with control circuits therefor, a source of alternating current connected across the track, a track relay at a distance from the source supplied with current therefrom through the track rails, and a second track relay located at a point intermediate the source and the first track relay and having a winding energized by the current flow in both rails past that point between the source and the first relay.

3. In a block signal system comprising signals for the blocks with control circuits therefor, a source of alternating current connected across the track, a track relay at a distance from the source supplied with current therefrom through the track rails, and a second track relay connected in shunt to a short length of the track circuit at a point intermediate the source and the first relay, the contacts of the two relays being connected in different control circuits.

4. In a block signal system comprising signals for the blocks with control circuits therefor, a source of alternating current connected across the track, a track relay at a distance from the source supplied with current therefrom through the track rails, and a second track relay connected in shunt to opposite short lengths of the track circuit at a point intermediate the source and the first relay, the contacts of the two relays being connected in different control circuits.

5. In combination with an electric railway, a block signal system in which the track circuits are not separated from each other by insulated joints, comprising signals for the blocks, control circuits therefor, sources of alternating current connected across the rails at intervals, conductors cross-connecting the rails at points between said sources and forming with said sources and the rails closed track circuits, track relays operatively related to said track circuits near said conductors, and a track relay connected in shunt to a portion of a track circuit at a point intermediate the source and the conductor and having its contacts connected in a control circuit other than that in which are connected the contacts of the relay near the conductor of said track circuit.

6. In combination with an electric railway, a block signal system in which the track circuits are not separated by insulated joints comprising signals for the blocks, control circuits therefor, sources of alternating current connected across the rails at intervals, conductors cross-connecting the rails at points between said sources and forming with said sources and the rails closed track circuits, track relays operatively related to said track circuits near said conductors, and a track relay connected in shunt to opposite portions of a track circuit at a point intermediate the source and the conductor and having its contacts connected in a control circuit other than that in which are connected the contacts of the relay near the conductor of said track circuit.

7. In combination with an electric railway, a block signal system in which the track circuits are not separated by insulated joints, comprising signals for the blocks, control circuits therefor, sources of alternating current connected across the rails at intervals, conductors cross-connecting the rails at points between said sources and forming with said sources and the rails closed track circuits, track relays operatively related to said track circuits near said conductors, and a track relay located at a point intermediate a source and a conductor and having a winding energized by the current flow past that point in the track circuit comprising said source and said conductor.

8. In combination with an electric railway, a block signal system in which the track circuits are not separated by insulated joints, comprising signals for the blocks, control circuits therefor, sources of alternating current connected across the rails at intervals, conductors cross-connecting the rails at points between said sources and forming with said sources and the rails closed track circuits, track relays operatively related to said track circuits near said conductors, and a track relay located at a point intermediate a source and a conductor and having a winding energized by the current flow in both rails past that point in the track circuit comprising said source and said conductor.

9. In a block signal system comprising signals for the blocks with control circuits

therefor, a source of alternating current connected across the track, a track relay at a distance from the source supplied with current therefrom through the track rails, and a second track relay connected to the rails at a point intermediate the source and the first relay and supplied with current from the said source, the contacts of the two relays being connected in different control circuits.

In witness whereof, I have hereunto set my hand this 17th day of March, 1909.

LAURENCE A. HAWKINS.

Witnesses:
HELEN ORFORD,
MARGARET E. WOOLLEY.