F. RHEA.

BLOCK SIGNAL SYSTEM.

APPLICATION FILED APR. 6, 1909.

925,026. Patented June 15, 1909.

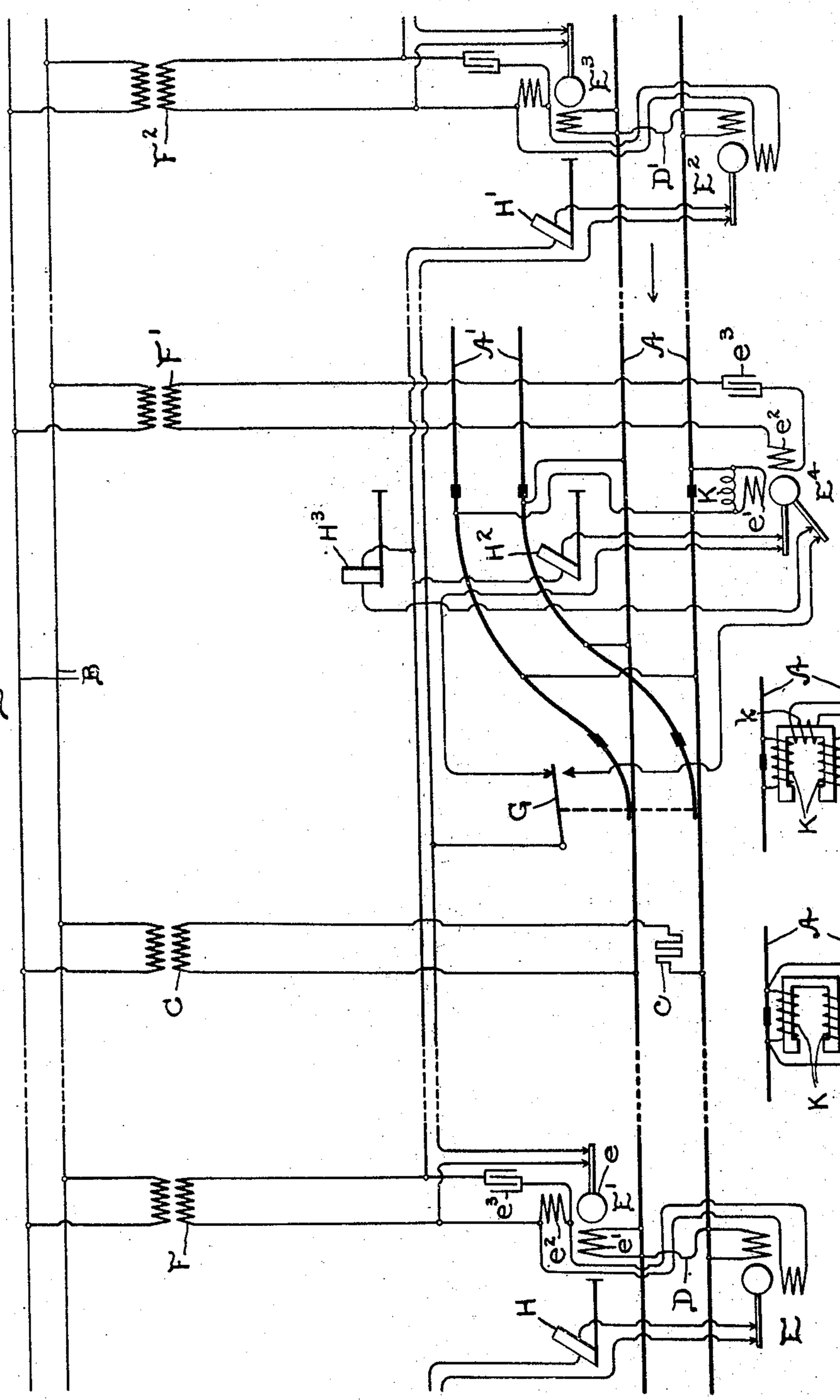


Fig. 1

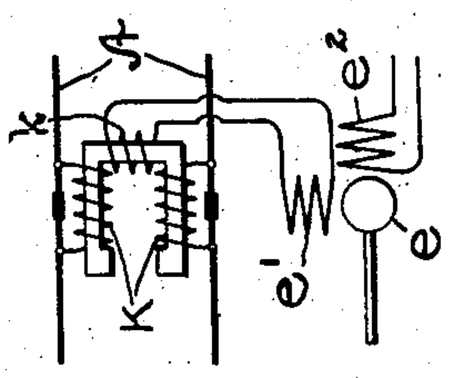


Fig. 2

Witnesses:
Irving E. Steers.
J. Ellis Glen.

Inventor
Frank Rhea,
by Albert G. Davis
Atty.

# UNITED STATES PATENT OFFICE.

FRANK RHEA, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

## BLOCK-SIGNAL SYSTEM.

No. 925,026. Specification of Letters Patent. Patented June 15, 1909.

Application filed April 6, 1909. Serial No. 488,271.

*To all whom it may concern:*

Be it known that I, FRANK RHEA, 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 alternating current block signal systems for electric roads, and its object is to provide means for reducing the number of track circuits ordinarily required for the proper control of signal indications, particularly at cross-overs, sidings, etc. It is ordinarily the practice to provide separate track circuits for each signal operation, and this practice often results in producing a large number of short track circuits. In alternating current systems it is desirable to keep the number of track circuits as small as possible. In what is known as the inductive bond system, each additional track circuit means two additional bonds, which are expensive, and in any system an extra transformer is required for each additional track circuit and the current consumed is increased. By my invention I am enabled to obtain with perfect definiteness at any point on an existing track circuit a control of the signals by a car passing that point without adding another track circuit for accomplishing this result.

My invention consists in inserting at the desired point in the track circuit a reactive winding, and employing the voltage drop in this winding for actuating the track relay for initiating an additional signal movement.

My invention is particularly advantageous for use at cross-overs, sidings, etc., and may also be used advantageously in many other cases, as, for instance, in single-track operation where it is desired to stagger the signals, and where the distance between adjacent signals for operation in the same direction is not greater than can conveniently and efficiently be operated by a single-track circuit.

My invention will best be understood by reference to the accompanying drawing, in which—

Figure 1 shows diagrammatically a block signal system arranged in accordance with my invention; and Figs. 2 and 3 show modifications in the arrangement of the reactive winding.

In Fig. 1, A represents the track rails of an electric railway. B represents a transmission circuit from which the alternating current is supplied to the signal circuits. C represents a transformer having its primary connected to the transmission circuit B, and its secondary connected across the track 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 to prevent saturation of the transformer by unbalanced power current in the track rails. D and $D^1$ represent conductors cross-connecting the rails on opposite sides of the transformer C. In practice these conductors would be substantially equidistant from the transformer. These conductors form with the transformer and the track rails closed track circuits. Relays $E^1$ and $E^2$ are placed at the ends of the two track circuits supplied from transformer C. These relays are shown diagrammatically of the two-phase induction type, comprising a short-circuited secondary member *e*, which carries the relay contacts, a winding $e^1$ connected in shunt to a short length of rail adjacent to the cross-connecting conductor, and a second winding $e^2$ supplied with current from the transmission circuit through a transformer F. A phase controlling device, such as a condenser $e^3$, may be employed, if necessary, to obtain the proper phase displacement between the currents in the relay windings $e^1$ and $e^2$.

The track circuit and relay arrangement thus far described form no part of my invention, which is not limited to any specific arrangement of track circuit, and while the system shown is of a type which requires no insulated joints for separating one block from the next, my invention is also applicable to the inductive bond system.

At a point in the track circuit between transformer C and relay $E^2$ a reactive winding K is inserted in one of the track rails. In shunt to this reactive winding is connected the track winding $e^1$ of the relay $E^4$, which is consequently energized by the voltage drop in the reactive winding K. The impedance of the reactive winding K need not be large,—in fact it need not amount to more than the impedance of one or two hundred feet of rail, so that its presence in the track circuit does not materially increase the total impedance

of the track circuit. Furthermore, the relay $E^4$ does not deprive the relay $E^2$ of any current, but merely utilizes the small voltage drop due to that current in passing. As many additional reactive coils and relays as desired may therefore be added to the track circuit without impairing the operation of the relay at the end of the track circuit.

In Fig. 1, I have shown the relay $E^4$ connected for protecting the junction between a branch track or siding $A^1$ and the main track A. The branch track may or may not be provided with signals.

G represents a contact on the track switch.

$H^1$ represents a signal for the block extending between the cross-connecting conductors $D^1$ and D, the direction of traffic being shown by the arrow. This signal $H^1$ is controlled in the usual manner by relays $E^1$ and $E^2$.

$H^2$ represents a signal for the main track at the fouling point between the main track and the siding.

$H^3$ represents a signal for the branch track for protecting the fouling point.

When the switch is thrown for the main track, as indicated on the drawing, and when the block between the cross-connected conductors D and $D^1$ is unoccupied, signals $H^1$ and $H^2$ are at clear, while the signal $H^3$ is at stop, its circuit being open at the track switch G. A car entering the block shunts the relay $E^2$ and puts signal $H^1$ at stop. It does not affect the signal $H^2$ until it reaches the insulated joint around which the reactive winding K is connected. As soon, however, as it passes over this insulated joint, it shunts the relay $E^4$ and puts signal $H^2$ at stop. Both relays $E^2$ and $E^4$ remain shunted until the car has passed some distance beyond transformer C. Before reaching this transformer, however, relay $E^1$ has been shunted so that neither signal $H^1$ nor $H^2$ is cleared until the car has passed the cross-connecting conductor D, so that relay $E^1$ is reënergized. Passing into the next block, the car shunts relay E and puts signal H at stop. If a car is on the track $A^1$, and wishes to run onto the main track, the track switch is thrown to its other position. The movement of the switch contact G opens the circuit of signal $H^2$, and closes the circuit of signal $H^3$ through the contacts of relays $E^4$ and $E^1$. The signal $H^2$ is therefore set at stop and signal $H^3$ is cleared, and the car can run onto the main track, the signal $H^3$ going to stop as soon as the car passes the insulated joints at the end of the branch track $A^1$.

The particular application of the relay $E^4$ and reactive winding K is only one of many which will be obvious to those skilled in the art. It will be observed that ordinarily, in order to obtain the operation of signals $H^1$ and $H^2$ specified above, it would be necessary to provide a complete track circuit between the two signals, which is avoided by the use of the reactive winding and extra relay.

In Fig. 1, I have shown only one reactive winding K inserted on one rail. It is in general advantageous to employ two windings mounted on a common core and inserted in opposite rails, as indicated in Fig. 2. The advantage of this arrangement is that the effect of the power current is opposed in the two windings, so that the tendency to saturation is decreased. The relay may be provided with two track windings $e^1$ connected in shunt to the two reactive windings, respectively, so as to be energized by the voltage drop in both reactive windings. Instead of impressing the voltage drop in the reactive windings on the relay windings directly by the shunt connection of Fig. 2, it may be impressed indirectly through an auxiliary secondary winding $k$ on the core of the reactive windings K, as shown in Fig. 3., This arrangement of Fig. 3 has the advantage that no power current can reach the relay track winding, but is less efficient, due to losses in the magnetic core, through which the voltage is induced in the winding $k$.

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 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 and supplied with current therefrom through the track rails, a reactive winding inserted in the track circuit at a point intermediate said relay and said source, and a track relay energized by the voltage drop in said reactive winding and having its contacts connected in a control circuit other than that in which are connected the contacts of 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 and supplied with current therefrom through the track rails, a reactive winding in the track circuit at a point intermediate said relay and said source, and a track relay having a winding connected in shunt to said reactive winding and having its contacts connected in a control circuit other than that in which are connected the contacts of 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 and supplied with cur-

rent therefrom through the track rails, two reactive windings mounted on a common magnetic core and inserted in the track circuit at two approximately opposite points intermediate said relay and said source, and a track relay energized by the voltage drop in both of said reactive windings and having its contacts connected in a control circuit other than that in which are connected the contacts of the first relay.

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 and supplied with current therefrom through the track rails, two reactive windings mounted on a common magnetic core and inserted in the track circuit at two approximately opposite points intermediate said relay and said source, and a track relay having two windings connected in shunt to the two reactive windings and having its contacts connected in a control circuit other than that in which are connected the contacts of the first relay.

5. In combination with an electric railway, a block system in which the track circuits are not separated by insulated joints, comprising sources of alternating current connected across the rails at intervals, conductors cross-connecting the rails at points between said sources and forming with the sources and the rails closed track circuits, track relays operatively related to said track circuits at the ends remote from the sources and supplied with current therefrom, a reactive winding inserted in a track circuit at a point intermediate the relay and the source, and a track relay energized by the voltage drop in said reactive winding and having its contacts connected in a control circuit other than that in which are connected the contacts of the relay at the end of the 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 sources of alternating current connected across the rails at intervals, conductors cross-connecting the rails at points between said sources and forming with the sources and the rails closed track circuits, track relays operatively related to said track circuits at the ends remote from the sources and supplied with current therefrom, a reactive winding inserted in a track circuit at a point intermediate the relay and the source, and a track relay having a winding connected in shunt to said reactive winding and having its contacts connected in a control circuit other than that in which are connected the contacts of the relay at the end 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 sources of alternating current connected across the rails at intervals, conductors cross-connecting the rails at points between said sources and forming with the sources and the rails closed track circuits, track relays operatively related to said track circuits at the ends remote from the sources and supplied with current therefrom, two reactive windings on a common magnetic core inserted in a track circuit at two approximately opposite points intermediate said relay and said source, and a track relay energized by the voltage drop in both said reactive windings and having its contacts connected in a control circuit other than that in which are connected the contacts of the relay at the end of said track circuit.

In witness whereof, I have hereunto set my hand this 5th day of April, 1909.

FRANK RHEA.

Witnesses:

FRED B. COREY,

HELEN ORFORD.