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F. B. COREY.

BLOCK SIGNAL SYSTEM.

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Witnesses.

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BLOCK-SIGNAL SYSTEM.

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To all whom it may concern:

Be it known that I, FRED B. COREY, 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; and its object is to provide a novel system particularly adapted for operation by alternating current.

In block-signal systems in which home and distant signals are used the operating mechanism for the signals, as is well understood, should be so arranged that when a train is in a block the home signal at the entrance to that block and the distant signal at the entrance to the preceding block should be at "danger." These two signals are on different semaphore-posts and the length of a block apart. When direct current is employed as the source for the track-circuits and signal-controlling relays, two methods are in common use for securing the proper operation of the home and distant signals. In one of these systems a relay at the entrance to a block controls the circuit of the operating mechanism for the home signal at that point and also the circuit for the operating mechanism of the distant signal at the entrance to the preceding block. With this arrangement it is necessary that the circuit of the operating mechanism for the distant signal should extend the length of the block. In another arrangement the necessity for these circuits, each one extending the length of a block, is done away with by the use of a polarized relay for controlling the circuit of the operating mechanism of the distant signal. By the use of the polarized relay the relays for the operating mechanisms for all the signals may be placed at the same points at which the signals themselves are placed. It is evident that this latter system possesses a number of advantages over the former, both as regards cost of installation and maintenance.

When alternating current is employed as the source for operating the signal mechanisms, it is evident that a polarized relay cannot be used, such relays being suited to direct current only. In certain cases alternating current has several advantages over direct current for use in such systems. In the case of an electric railway where the rails act as return-conductor for the trolley-current the current in the rails interferes with the proper operation of the signal-relays when direct current is used in the track-circuit. When alternating current is used, it is possible to employ relays for the signals which are not affected by direct current.

By my invention I provide a system in which alternating current may be used with its attendant advantages and in which all the advantages of the direct-current system without wires may be obtained.

My invention will best be understood by reference to the accompanying drawing, in which A A′ A″ represent three blocks of a railway.

It will be seen that only one of the rails is divided into blocks, the other rail being continuous throughout all the blocks, so as to serve as return-conductor for trolley-current.

a represents a line-wire connected to a source of alternating current and connected to the continuous rail through the primaries of the transformers E E′. With this arrangement the continuous rail acts as return-conductor for the alternating current also; but a separate return-conductor may be employed, if preferred.

S and S′ represent two semaphore-posts at the entrance to blocks A and A′, respectively. Each post carries a home signal H and a distant signal D, the signals for the block A being the home signal H on semaphore-post S and the distant signal D′ on semaphore-post S′. Thus when a car is in block A, as indicated by C, signals H and D′ should be at "danger," as shown, while signal H′ is at safety position, since no car is in block A′. The secondaries of transformers E and E′ are connected to the rail-circuits through reversing-switches K and K′. By means of these switches the phase of the currents in the rail-circuits relative to the current in line-wire *a* may be reversed. To the other ends of the blocks are connected the primaries of the transformers F and F′. These transformers serve a double purpose. By their use higher voltage may be obtained for operating the relays than could be impressed upon the rails, and in the second place they prevent the passage of direct current from the rails to the relays and consequent interference with the operation of the

relays. To the secondaries of transformers F F' are connected relay-coils I I'. These relays control the circuits of the coils *i i'*, which when relays I I' are energized are connected to the batteries or other sources of current B B'. Coils *i i'* control the operating-rods *h h'* for the home signals H H', the connection between these rods and the signals being omitted for the sake of simplicity. Rods *h h'* also control the phase-changing switches K K' for a purpose which will be hereinafter explained.

d d' represent the operating-rods for the distant signals D and D' and are controlled by the coils *j j'*, which are connected to batteries B B' through switch-contacts controlled by the relays J J'. The relays J J' are reverse-current relays depending for their operation upon the relative directions or phases of currents in the stationary and movable windings. The stationary winding is connected between line-wire *a* and the return-rail, and the phase of the current in the stationary winding consequently depends upon the current in line-wire *a*. The movable coil is connected in shunt to the primary or secondary of transformers F F', and the phase or direction of current in the moving coils therefore is dependent upon the phase of the currents in the rail-circuits.

As has been already explained, the relative phase of the currents in the rail-circuits to the currents in the line conductor *a* is controlled by the phase-changing switches K K', the relative phase being reversed when switch K or K', as the case may be, is shifted from one position to the other.

The operation is then as follows: With the car C in block A the primary of transformer F is short-circuited. No current consequently flows in the secondary of transformer F, and relay I is not energized. It allows its armature to fall, opening the circuit of coil *i*, which allows its armature to fall, permitting signal H to go to "danger" by gravity and shifting reversing-switch K to its lower position. Further, there is no current in the movable winding of relay J, and consequently there is no turning effort in this relay. The circuit of coil *j* is accordingly open, and distant signal D is allowed to go to "danger" under gravity. On the other hand, since there is no car in the block A' transformer F' is energized, relay I' holds up its armature, maintaining the circuit of coil *i'* closed and holding signal H' at "safety." The movable winding of relay J' is also energized, but is so connected with reference to the stationary winding that when switch K, controlled by signal H, is in its lower position, as shown, the relative phases of the currents in the movable and stationary windings of relay J' are such that the movable winding tends to turn in a counter-clockwise direction and remains against its stop, thereby opening the circuit of coil *j'* and allowing distant signal D' to go to "danger" by gravity. This condition of affairs continues as long as car C is in block A. When car C leaves block A, transformer F is again energized, energizing relay I, which draws up its armature, closing the circuit of coil *i*. Coil *i* consequently draws up its armature, restoring signal H to safety position and at the same time shifting the switch K to its upper position. By this movement of switch K the phase of current in block A' relative to the current in line-wire *a* is reversed, and the direction of torque of relay J' is consequently reversed. The movable coil of relay J' tends to rotate in a clockwise direction, and thereby closes the circuit of coil *j'*, which draws up its armature and restores distant signal D' to "safety." Signals H and D' consequently properly indicate that block A is "clear." Distant signal D, however, still remains at "danger," since by the operation of the home signal one block ahead the current in the movable winding of relay J is in such a direction that the relay remains against its stop, maintaining open-circuited the coil *j*. Distant signal D is not restored to "safety" until the car has passed out of the block ahead of block A and the home signal at the entrance of that block has gone to "safety," reversing the direction of current through the movable coil or relay J.

It will be understood that I have shown the operating mechanisms for the signals diagrammatically and that any well-known forms of operating mechanisms may be used in the arrangement that I have shown and described. Accordingly I do not desire to limit myself to the particular construction and arrangement of parts here shown, since changes which do not depart from the spirit of my invention and which are within the scope of the appended claims will be obvious to those skilled in the art.

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

1. In a block-signal system, a source of alternating current connected to one end of a block, two relays connected to the other end of the block, one of said relays being responsive to a flow of alternating current and the other being responsive to a reversal of current in the block relative to the source, means for reversing the current in the block relative to the source, and signals controlled by said relays.

2. In a block-signal system having home and distant signals, a source of alternating current connected to a block, means controlled by the home signal of the following block for reversing the connections of said source to said block, a relay connected to the other end of said block and responsive to alternating-current flow, a home signal controlled by said relay, a second relay connected to said block and responsive to a reversal

of current in said block relative to said source, and a distant signal controlled by said second relay.

3. In a block-signal system, a source of alternating current connected to one end of each block, a relay connected to the other end of each block, a home signal controlled by each relay, means controlled by each home signal for reversing the relative connections of said source to the preceding block, a second relay connected to each block and responsive to a reversal of current in the block relative to the source, and a distant signal controlled by each of said second relays.

4. In a block-signal system, a source of alternating current connected to a block, means for reversing the connections of said source to the block, a relay having two relatively movable windings, one of said windings being connected to said source and the other to said block, and a signal controlled by said relay.

5. In a block-signal system, a plurality of blocks, a source of alternating current connected to each block, a relay responsive to alternating-current flow connected to each block, a home signal controlled by each of said relays, a switch controlled by each home signal and arranged to reverse the connections of said source to the preceding block, a relay for each block having two relatively movable windings, one of said windings being connected to said source and the other to said block, and a distant signal controlled by each of the latter relays.

6. In a block-signal system having home and distant signals, a source of alternating current connected to a block, a switch controlled by the home signal of the following block arranged to reverse the connections of said source to said block, a relay connected through a transformer to the other end of said block and responsive to current-flow, a home signal controlled by said relay, a second relay comected to said block and responsive to a reversal of current in said block relative to said source, and a distant signal controlled by said second relay.

7. In a block-signal system, a source of alternating current connected to the track-circuit of a block, means for reversing the connections of said source to the track-circuit, a relay having two coöperating windings, one of said windings being connected to and supplied with current from said track-circuit, and the other being supplied with alternating current of the same frequency independently of said track-circuit, and a signal controlled by said relay.

8. In a railway block-signaling system, having a closed alternating-current track-circuit for controlling the signals, a plurality of block-sections, distant and home signals for each block, a relay controlled partly by said track-circuit and partly by an external circuit, and means whereby one of the signal mechanisms of a distant block may affect the track-circuit so as to reversely actuate the said relay.

9. In a railway block-signaling system having an alternating-current track-circuit for controlling the signals, a plurality of block-sections, home and distant signals for each block, a relay having two coils traversed respectively by two alternating currents having a predetermined phase relation to one another whereby an adjacent distant signal is caused to assume one position of indication, and means for so changing the said phase relation that the said distant signal is caused to assume another position of indication.

10. In a railway block-signaling system having a plurality of block-sections, each block comprising a track-circuit, home and distant signals for each block, a source of alternating-current supply for each track-circuit, a relay adapted to respond in the movement of its armature to the presence or absence in its coils of current derived from the said source, and by such movement adapted to control the home signal, another relay for each block having one coil in circuit with the current source of the track-circuit and another coil supplied with alternating current derived from a source other than the track-circuit, and means for changing the phase relation of the current in the two coils.

11. In a railway block-signaling system having a plurality of block-sections, each block comprising a track-circuit, home and distant signals for each block, a source of alternating-current supply for each track-circuit, a relay adapted to respond in the movement of its armature to the presence or absence in its coils of current derived from the said source, and by such movement adapted to control the home signal, another relay for each block having one coil in circuit with the current source of the track-circuit and another coil supplied with alternating current derived from a source other than the track-circuit, and means operated by a succeeding home signal for changing the phase relation of the current in the two coils of the relay, the said relay being adapted to respond in the movement of its armature to the said changes in the phase relations of the two currents in its coils, to control an adjacent distant signal.

In witness whereof I have hereunto set my hand this 15th day of February, 1904.

FRED B COREY.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.