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J. S. HOLLIDAY.

BLOCK SIGNALING SYSTEM.

APPLICATION FILED FEB. 21, 1908.

Patented Oct. 6, 1908.

2 SHEETS—SHEET 1.

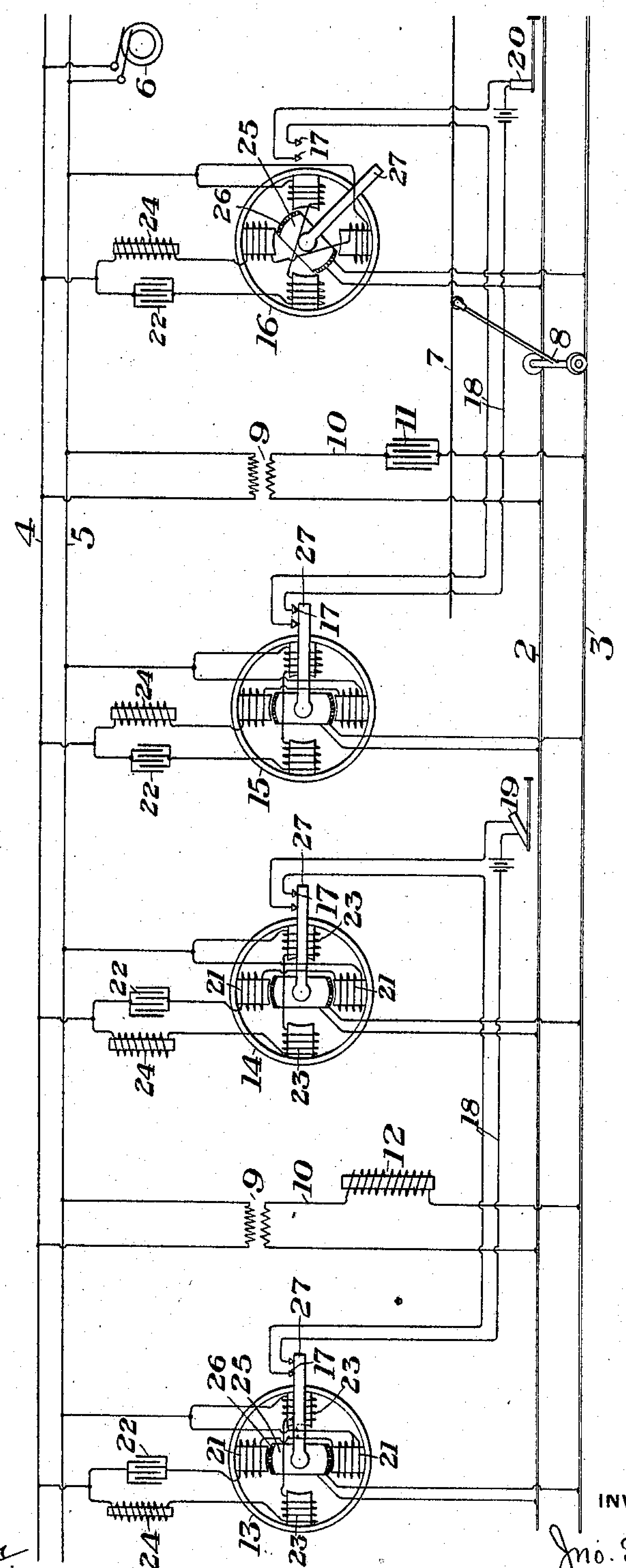

Fig.1.

WITNESSES

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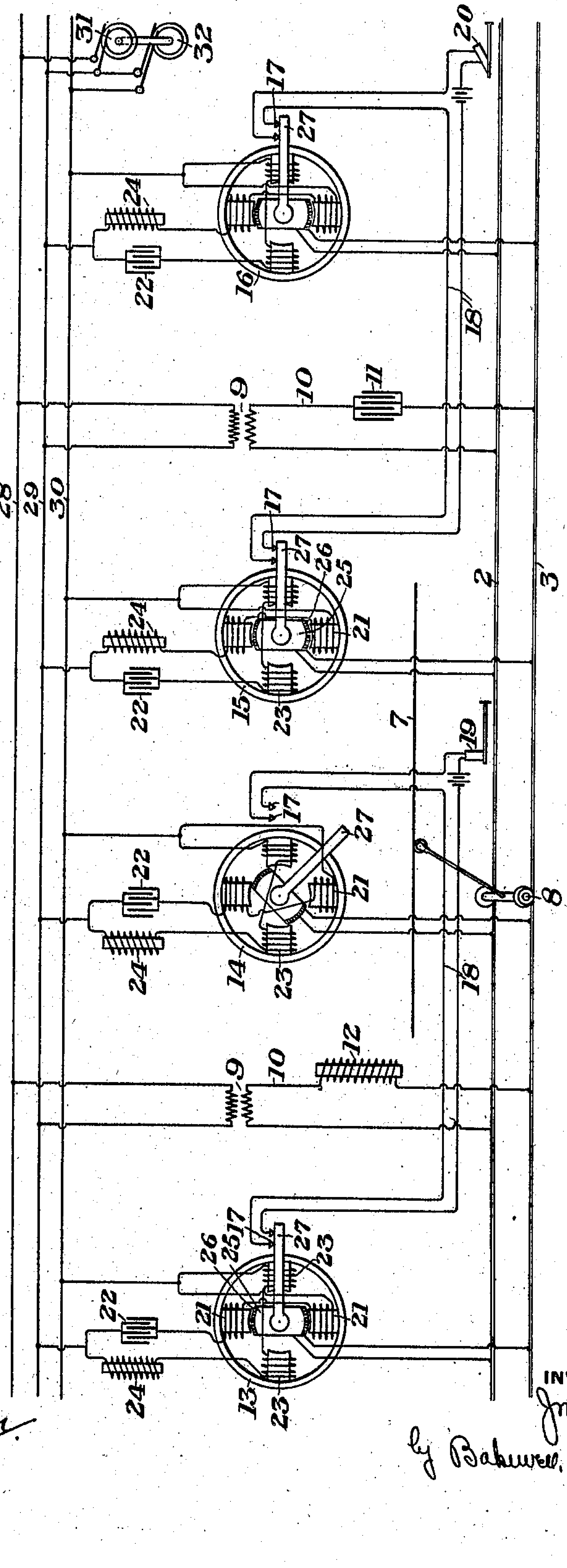
2 SHEETS—SHEET 2.

Fig. 2.



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UNITED STATES PATENT OFFICE.

JOHN S. HOLLIDAY, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO THE UNION SWITCH & SIGNAL COMPANY, OF SWISSVALE, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

BLOCK-SIGNALING SYSTEM.

No. 900,370. Specification of Letters Patent. Patented Oct. 6, 1908.

Application filed February 21, 1908. Serial No. 417,009.

To all whom it may concern:

Be it known that I, JOHN S. HOLLIDAY, of Wilkinsburg, Allegheny county, Pennsylvania, have invented a new and useful Improvement in Block-Signaling Systems, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figures 1 and 2 are diagrammatic representations of a signaling system embodying my invention.

My invention has relation to electric block signaling systems, particularly designed for use on railways employing electric propulsion, and more particularly to that class of said systems in which the track rails instead of being divided into insulated blocks or sections, are electrically continuous for all currents, both propulsion and signaling.

The object of my invention is to provide a system of this character which shall be simple in its wiring and general arrangement, and in which the signal controlling-relays are of such character as not to be affected by any currents except those which are intended to operate them.

The precise nature of my invention will be best understood by reference to the accompanying drawings, in which I have shown diagrammatically one embodiment thereof, and which will now be described, it being premised, however, that various changes may be made therein by those skilled in the art without departing from my invention as defined in the appended claims.

In these drawings, the numerals 2 and 3 designate the track rails, which are electrically continuous for all currents both propulsion and signaling. Hence, the terms "block" and "section" as used herein, are not intended to designate separate insulated blocks or sections of the track rails, but are used for convenience to designate the portions of the track situated between adjacent signals.

4 and 5 designate the transmission lines for a single-phase signaling current, supplied by an alternator 6.

7 designates the usual third rail or overhead conductor for supplying the propulsion current, which may be either a direct current or an alternating current.

8 is a diagrammatic representation of a car or train occupying one of the two blocks or sections shown in the drawing.

9 designates signal-phase transformers for supplying signaling currents from the transmission line to the track rails, the primaries of these transformers being connected across the transmission line and their secondaries being connected across the track rails. These transformers are preferably located at the central portions of the respective blocks. In one branch of a conductor 10 leading from the secondary of one transformer to one of the track rails, is a condenser or capacity 11, while in the corresponding conductor leading from the secondary of the transformer in the adjacent blocks is an inductance coil or device 12. Throughout the system adjacent transformers will in this manner have their secondaries connected to one of the track rails, the one through a condenser or other capacity device, and the adjacent ones through inductances, the inductances and capacities being preferably so adjusted as to give a difference in phase in the current supplied to adjacent blocks of about ninety degrees.

13, 14, 15 and 16 designate signal controlling relays. Two of these relays are shown as employed for each block, and having the contacts 17 of the local signaling circuits controlled thereby in series with each other.

18 designates the local circuits, and 19 and 20 the signals which guard the entrances to the respective blocks and which are controlled by the circuits 18.

The relays 13, 14, 15 and 16 are of the synchroscopic type, each having two field windings, one of these windings consisting of two coils 21, which are in series with each other and with a capacity 22 across the transmission lines 4 and 5. The other winding consists of two coils 23, which are at ninety degrees from the coils 21, and which are also connected in series with each other and with an inductance 24. The rotor element 25 of each relay has a winding 26, which is connected across the track rails 2 and 3.

27 designates the contact controlling arms of the relays, which are actuated by the rotor elements thereof to control the signal circuits 18.

The operation is as follows:—It will be

seen that the current in the coils 23 of each relay will be in phase with the current supplied to that block by the transformer 9, while the currents in the coils 21 will be in quadrature with the current supplied by that transformer, but will be in phase with the current supplied to the track by the transformers of the adjacent blocks or sections. As indicated in the drawings, the respective coils are so connected that the coils 23 which are energized by the current supplied to that block actuate the rotor elements of the relays of that block to hold the signal circuits 18 closed and the signals in clear position, since the currents in coils 23 and the current supplied to the rotor by the transformer of this block reach their maximum at the same time. The currents in the coils 21 being in quadrature with the current in the rotor coils of these relays supplied by the transformer of that block, it follows that the current from the adjacent transformers which are in phase with the current in coils 21 will have no tendency to close the relays. Therefore, the relays will not be closed by the currents from the adjacent transformers, but will be closed only by the current from the transformer which is located in their own block or section. When the propulsion current employed is a direct current, it will be entirely without effect upon these relays; and when this current is an alternating current it may have a different frequency than the frequency used in the signaling circuit, so that there will be no interference between the signaling and propulsion currents. When alternating current is used for the propulsion current, I preferably employ three conductors 28, 29 and 30 in the transmission line as shown in Fig. 2, the conductors 28 and 29 being connected to one generator 31, and the conductors 29 and 30 to a second generator 32 of the same frequency, and having its armature mounted on the same shaft as the armature of the generator 31. The two field windings of the relays are connected across the conductors 29 and 30 and the primaries of the transformers being connected across the conductors 28 and 29. In this manner, there is prevented any tendency of the relays to operate by reason of current set up in the primaries of the transformers by propulsion current flowing across the track rails through the secondaries of the transformer and through the rotor windings of the relays. This is because any currents so generated in the transformer primaries flow into the conductors 28 and 29, while the field windings of the relays are connected across the conductors 29 and 30.

Supposing a train to enter the block which is controlled by the signal 20, as soon as the train has approached within a sufficient distance of the relay 16, it will short-circuit that relay, thereby opening the signal circuit 18 and setting the signal at danger. The signal-controlling contacts 17 of the two relays of each block being in series, the circuit 18 will remain open so long as a train is in any part of that block, and the train will therefore be protected by the danger signal behind it. As the train passes into the next block, it retains control of the relay 15 until it has gained control of the relay 14, so that it is protected by the signal 20 until the signal 19 has been set at danger.

The coils or windings of the relays can be so adjusted that they will be short-circuited by a train at any desired distance, this depending upon the impedance of the rails, the power factor of the system, and various other factors, which must be determined in advance by the signal engineer in accordance with the usual practice. Owing to the fact, however, that the impedance of the rails will necessarily vary somewhat from time to time according to the track conditions, more or less overlapping of the blocks occurs which makes it necessary to set the signals back of the entrance to the respective blocks a sufficient distance to prevent their going to danger in the face of an approaching train; that is to say, the signal 19 should be set back a sufficient distance behind the entrance to the block which it protects so that the train will have passed or be passing such signal before the relay 14 is short-circuited by the train.

When there is no train in either block, each relay is receiving current from the transformer of that block, and also slight currents from the transformers of adjacent blocks, these latter currents, however, being in phase with the currents in the coils 21 tend to open to the relays, but are ineffective for that purpose because they are much weaker than the currents from the transformer of the same block. When a train in the block protected by the signal 20, for instance, short circuits the transformer of that block, current from that transformer no longer passes to the relay 14, and the action tending to hold that relay closed is increased to that extent. Therefore the relay 14 will not open as soon as would otherwise occur. When the train has passed the relay 14, and has cut off from that relay the current from the transformer of that block, the current from the transformer between the relays 15 and 16 will tend to assist gravity in holding the relay 14 open. The coils 21 may, however, be omitted.

The advantages of my invention will be apparent to those skilled in the art. By means of the synchroscopic relays of the character described, the operation of the relays by propulsion or other stray currents, or by currents from other transformers is prevented. By using track rails which are electrically continuous for all currents, I avoid the necessity for the expensive bonding which is necessary where the track rails are divided into insulated blocks or sections.

It will be obvious that my invention is susceptible of many changes. Thus, any suitable means may be provided for producing the split-phase currents in the two windings of the relays, and for bringing the currents supplied by the transformers into phase with one or the other windings of the relays. The relays themselves may be of any approved construction, together with the arrangement of the contacts controlled thereby and controlling the signals.

I claim:—

1. In a block signaling system, track rails which are electrically continuous for all currents, synchroscopic relays each having a movable element connected across the track rails, and means for impressing signaling currents upon the track rails, said currents being in phase in each block with the current in one field winding of the relays for that block; substantially as described.

2. In a block signaling system, track rails which are electrically continuous for all currents, relays having each a coil or winding connected across the track rails, and two other windings at an angle to each other, means for supplying said windings with currents which differ in phase by substantially the same angle as the angle between the different windings, and means for impressing upon the track rails currents which differ in phase in adjacent blocks by an angle corresponding approximately to the angle of difference between the two windings of the relays; substantially as described.

3. In a block signaling system, track rails which are electrically continuous for all currents, transformers for supplying signaling current to the track rails, means whereby the currents supplied by adjacent transformers are of different phase, relays having one winding connected across the track rails and two other sets of windings at an angle to each other, and means for supplying currents of different phase to the last named windings; substantially as described.

4. In a block signaling system, track rails which are electrically continuous for all currents, transformers for impressing signaling currents upon the track rails, means for causing the currents impressed upon adjacent blocks to differ in phase from each other by substantially ninety degrees, relays having one set of coils connected across the track rails, and two other windings approximately ninety degrees from each other, and means for supplying currents to the last named windings differing in phase by approximately ninety degrees; substantially as described.

5. In a block signaling system, track rails which are electrically continuous for all currents, a transformer connected across the track rails for supplying signaling current to each block at an intermediate portion thereof, means whereby the current supplied by adjacent transformers will differ in phase, a pair of relays for each block having their contacts in series with each other in the signal-controlling circuit, said relays each having one winding connected across the track rails, and two other windings at an angle to each other, and means for supplying currents of different phase to the last named windings; substantially as described.

6. In a block signaling system, a signal-controlling relay having three windings, one winding of each relay being connected across the track rails and the other two windings being connected to supply conductors, means for supplying the last named windings with currents of different phase, and means for supplying the track rails with currents of different phase in adjacent blocks thereof; substantially as described.

7. In a block signaling system, track rails which are electrically continuous for all currents, relays having a winding connected across the track rails, and a second winding connected with supply conductors, and means for impressing upon the track rails currents which are in phase in each block with the current in the fields of the relays of that block, but are in quadrature with the currents in the fields of the relays of adjacent blocks; substantially as described.

8. In an electric signaling system for use on roads employing alternating propulsion current, a single phase transmission line, signal-controlling relays, each having one winding connected directly to the transmission line and another winding connected to the track rails, and transformers for impressing signaling currents upon the track rails, said transmission line having three conductors, the transformers being connected across two of said conductors and the relay windings being connected across one of said conductors and the third conductor; substantially as described.

9. In an electric signaling system, a single phase transmission line for the signaling currents, said line having three conductors, two of which are connected to one generator, and one of these two and the third being connected to a second generator of like frequency, signal-controlling relays having windings connected across two of the said conductors, and transformers for supplying current to the track rails and having their primaries connected across one of said two conductors and the third conductor; substantially as described.

10. In an electric signaling system, track rails which are electrically continuous for all currents, synchroscopic relays in each block, each relay having its rotor connected to the track and its fields connected to a source of two-phase current, a transformer in each

block supplying current to the track, the transformer of one block having its primary connected so as to receive one phase of the two-phase current, and the transformer of adjacent blocks having their primaries connected so as to receive the other phase; substantially as described.

In testimony whereof, I have hereunto set my hand.

JOHN S. HOLLIDAY.

Witnesses:
L. FREDERIC HOWARD,
DANIEL J. McCARTHY.