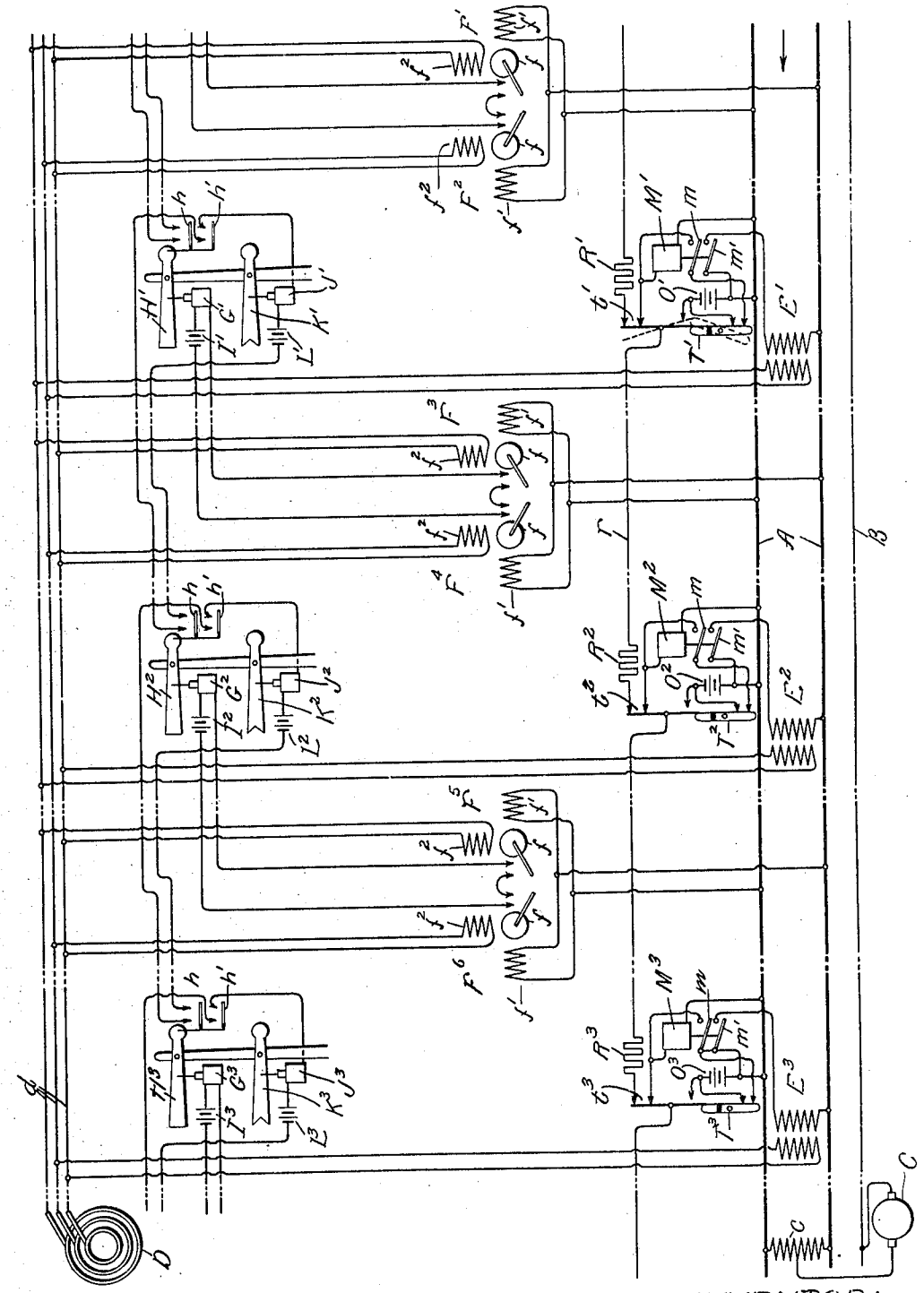
No. 856,440. PATENTED JUNE 11, 1907.

E. F. BLISS.

BLOCK SIGNAL SYSTEM.

APPLICATION FILED DEC. 5, 1906.



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UNITED STATES PATENT OFFICE.

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BLOCK-SIGNAL SYSTEM.

No. 856,440. Specification of Letters Patent. Patented June 11, 1907.

Application filed December 5, 1906. Serial No. 346,422.

To all whom it may concern:

Be it known that I, ELMER F. BLISS, 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 in which rails are employed as return conductor for the power-current.

My invention, in one aspect, consists in an improvement in the system described in a former application filed by me September 19, 1906, Serial No. 335,209, in which I described a signal system in which the rails are conductively continuous for all currents, and transformers of different phase are connected across the rails at intervals, with track-relays at points between the transformers arranged to respond only to an alternating-current of a certain phase. By supplying currents of different phase through adjacent transformers, the current supplied by one transformer is prevented from actuating a relay which it is not intended to actuate, without the use of inductive bonds or other devices for separating adjacent blocks. By using current of high frequency, to which the rails offer a high impedance, the leakage-current, from each transformer to other blocks than that which it is not intended to supply, is comparatively small, and the point at which a train shunts a track-relay is made sufficiently definite for practical purposes. A definite shunting point is further assured by arranging the transformers at the ends of each block and the relay in the center.

The object of my invention is to increase the efficiency of the system described in my former application, while maintaining all its advantages. I accomplish this result by arranging the transformers with normally-open circuits and providing means controlled by a moving train for closing the circuits of a plurality of transformers ahead of the train. Thus, as far as the transformer circuits are concerned, the operation is precisely the same as in the system described in my former application, while the rest of the transformers are open-circuited and consequently are wasting no current.

Another feature of my invention consists in the arrangement of the devices for closing the circuits of the transformers ahead of the train, whereby a plurality of transformers may be controlled through a single conductor, or pair of conductors.

My invention will best be understood by reference to the accompanying drawing, which shows diagrammatically a block signal system arranged in accordance with my invention.

In the drawing A represents the track-rails, which are made conductively continuous throughout their length.

B represents the third-rail, or other supply-conductor, which is connected to one terminal of the power-generator C, the other terminal of which may be connected to the rails A through the differential choke-coil *c*. The generator C may produce direct current or alternating-current of low frequency.

D represents a high-frequency three-phase generator, which is connected to the transmission-wires *d*, from which the signal-currents are supplied to the track-rails through transformers E^1, E^2, E^3, etc. These transformers have their primaries connected to the line-wires *d*; adjacent transformers being connected to different phases. The transformer secondaries are connected across the track-rails. Either the primary or secondary winding of each transformer is normally open-circuited. In the drawing I have shown a break in the circuit of each secondary.

F^1, F^2, F^3, etc., represent relays which are connected in pairs across the rails at points between the transformers. These relays are designed to respond to alternating-current of a certain phase only. I have shown diagrammatically relays of the induction type, each comprising a short-circuited secondary member *f*, carrying the relay contacts, and two coöperating windings f^1 and f^2, the first of which is connected across the rails, and the other of which is supplied with alternating-current independently of the track-rails. It will be seen that when two adjacent transformers, as for instance, transformers E^1 and E^2, have their secondary circuits closed, the track-windings f^1 of the relays F^3 and F^4 will be traversed by a current corresponding to the resultant of the currents supplied to the rails by the two transformers; while, if either transformer should be cut off from the relays, either by being short-

circuited by a train, or by a broken rail, the current through the relay windings f^1 would correspond in phase to that of the other transformer alone. The relay windings f^2 are supplied with current of such a phase that when both windings f^1 are traversed by the resultant current from the two adjacent transformers, both relays produce torque and close their contacts, while if either transformer is cut off from the relays, one of the two relays will have no torque whatever, and will open its contacts. This arrangement of the relays and their operation is fully described in my former application above referred to. The contacts of both relays F^3 and F^4 are included in series in the circuit of the operating mechanism G^1 of the home signal H^1.

I^1 represents the source of current for the operating mechanism.

K^1, K^2, etc., represent distant signals which are provided with operating mechanisms J^1 and J^2, which are supplied from any suitable sources of current L^1, L^2, etc. For controlling these distant signals the home signals are provided with contacts h, h^1, in the usual manner.

M^1, M^2, etc., represent magnets, which, when energized, close the circuits of the transformers E^1, E^2, etc., respectively. Each of these magnets is provided with two armatures m and m^1.

O^1, O^2, represent batteries, or other suitable sources of current for supplying the magnets M^1, M^2, etc.

R^1, R^2, etc., represent resistances included in the conductor r to which the magnets M^1, M^2, etc., are connected, and T^1, T^2, etc., are track instruments controlling contact members t^1, t^2, etc.

The direction of traffic is as shown by the arrow. Normally all the circuits are open, and the signals stand at danger, as shown; but when the train reaches a track instrument, as, for instance, T^1, it moves it momentarily into the position shown in dotted lines; thereby opening the circuit of the conductor r and connecting the portion of the conductor ahead of the train to the upper terminal of the battery O^1. The lower terminal of this battery is connected to the upper rail A. Magnets M^2, M^3, etc., are connected between the conductor r and the rail A, and consequently, are supplied with current from the battery O^1. The voltage of the battery O^1 and the resistances R^2, R^3, etc., included in the conductor r are so proportioned that three magnets M^2, M^3, and one other, not shown, will be momentarily energized from battery O^1 sufficiently to pull up their armatures, while magnets farther away will not be so energized. When the magnet M^2 pulls up its armature, its upper armature m closes a maintaining circuit for the magnet M^2, which may be traced from the upper terminal of battery O^2, through the track instrument T^2, through armature m, magnet M^2, to the upper rail A, and thence to the lower terminal of the battery O^2. At the same time the armature m^1 connects the upper terminal of the secondary of transformer E^2 to the upper rail A, thereby closing the circuit of the transformer across the rails. Similarly, each magnet, when it is energized by a momentary current-flow, closes a maintaining circuit for itself, and closes the circuit of the adjacent transformer. Now, let it be assumed that magnets M^1, M^2 and M^3 have been energized in the manner that has just been described. Then all three transformers, E^1, E^2 and E^3 have their circuits closed, energizing relays F^3, F^4, F^5 and F^6, provided no train is between the transformers E^1 and E^2, or between transformers E^2 and E^3. Under these circumstances home signals H^1 and H^2 will be cleared, thereby closing the circuit of the operating mechanism of distant signal K^1 through the contact h of signal H^2, and contact h^1 of signal H^1. Thus, both home and distant signals H^1 and K^1 are cleared ahead of the approaching train, indicating that two blocks ahead are clear. If, however, a train is in the block between transformers E^2 and E^3, then one or both of relays F^5, F^6, will not pick up its armature, so that neither signal H^2 or K^1 will clear. Consequently, an approaching train will be informed that the block ahead is clear, but the next block is occupied. If a train is between transformers E^1 and E^2, then one or both of relays F^3 and F^4 will fail to pick up its armature, so that neither signal H^1 nor K^1 will clear. If signal H^1, or if signals H^1 and K^1 are cleared, they remain clear until the train comes close enough to transformer E^1 to pull down its voltage, so as to deënergize one of the relays F^3 or F^4, or else until the train reaches the track instrument T^1, when the track instrument is moved to the position shown in dotted lines, breaking the maintaining circuit of magnet M^1 and consequently opening the circuit of transformer E^1. In either case, when either relay F^3 or F^4 is deënergized, the signal H^1 is put at danger, while, when the train reaches the track instrument, the magnet M^1 is deënergized, and at the same time the battery O^1 is connected momentarily to the magnets M^2 and M^3, as has been explained.

While I have shown the adjacent transformers as supplied with currents of different phase, their currents may be made to differ in other characters, if preferred; such as in frequency. Furthermore, although I have shown track instruments for closing the circuits of the magnets controlling the transformer circuits, any other arrangement, whereby a moving train is enabled to close a circuit, may be employed in place of the track instruments. It will be noted that if, due to temperature variations or other

causes, more than three magnets, M^1, M^2, etc., should be energized ahead of a train the only result would be the unnecessary waste of a certain amount of signal current, while if only two should be energized, the train would receive a caution signal instead of clear. Such variation could consequently cause no serious result. But it will be understood that other circuit connections employing a greater number of wires might be used if it were desired always to insure the energization of no more and no less than three magnets.

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 electric railway having both rails conductively continuous for all currents, normally open-circuited sources of alternating-current connected at intervals across the rails, adjacent sources being of different character, means controlled by a moving train for closing the circuits of a plurality of said sources ahead of the train, and signal-controlling devices responsive to the currents supplied to the rails by said sources.

2. In combination with an electric railway having both rails conductively continuous for all currents, normally open-circuited sources of alternating-current connected at intervals across the rails, adjacent sources being of different character, electromagnets for closing the circuits of said sources, means controlled by a moving train for closing the circuits of a plurality of said magnets, and signal-controlling devices responsive to the currents supplied to the rails by said sources.

3. In combination with an electric railway having both rails conductively continuous for all currents, normally open-circuited sources of alternating-current connected at intervals across the rails, adjacent sources being of different character, electromagnets for closing the circuits of said sources, a normally open contact in series with a plurality of said magnets arranged to be closed by a moving train, and signal-controlling devices responsive to the currents supplied to the rails by said sources.

4. In combination with an electric railway having both rails conductively continuous for all currents, normally open-circuited sources of alternating-current connected at intervals across the rails, adjacent sources being of different character, means controlled by a moving train for closing the circuits of a plurality of said sources ahead of the train, signals normally at danger, and signal-controlling devices connected across the rails between adjacent sources and operative to close a signal only when supplied with current from both adjacent sources.

5. In combination with an electric railway having both rails conductively continuous for all currents, a polyphase transmission system extending along the way, normally open-circuited tronsformers having their primaries connected to said transmission system and their secondaries connected at intervals across the track, adjacent transformers being connected to different phases of said system, means controlled by a moving train for closing the circuits of a plurality of transformers ahead of the train, and signal-controlling devices connected across the rails between the transformers and responsive only to the resultant current from both adjacent transformers.

6. In combination with an electric railway having both rails conductively continuous for all currents, a transmission system comprising more than two conductors extending along the way, means for impressing voltages differing in character upon different pairs of said conductors, normally open-circuited transformers having their primaries connected to said system and their secondaries connected at intervals across the rails, adjacent transformers having their primaries connected across different pairs of conductors, means controlled by a moving train for closing the circuits of a plurality of transformers ahead of the train, signals normally at danger, and signal-controlling devices connected across the rails at points between the transformers and operative to clear a signal only when supplied with current from both adjacent transformers.

7. In combination with an electric railway having both rails conductively continuous for all currents, means controlled by a moving train for impressing on the rails at intervals ahead of the train a plurality of voltages differing in character, and signal-controlling devices connected across the rails and responsive only to alternating-current of a predetermined character.

8. In combination with an electrically-operated railway havingboth rails conductively continuous for all currents, normally open-circuited transformers having their secondaries connected at intervals across the rails, connections for impressing voltages differing in character on adjacent transformer primaries, means controlled by a moving train from closing the circuits of a plurality of transformers ahead of the train, and signal-controlling devices connected across the rails at points between the transformers and responsive only to alternating-current of a predetermined character.

9. In combination with an electric railway having both rails conductively continuous for all currents, means controlled by a moving train for impressing on the rails at intervals

ahead of the train a plurality of voltages of different phase, and signal-controlling devices connected across the rails and responsive only to alternating current of a certain phase.

10. In combination with an electric railway employing the rails as return conductor for the power-current, normally open-circuited transformers having their secondaries connected at intervals across the rails for supplying current thereto, electromagnets for closing the circuits of the several transformers, a circuit extending along the way comprising conductors of appreciable resistance, means controlled by a moving train for connecting said circuit to a source of current, and connections from said electromagnets to said circuit whereby a predetermined number of said electromagnets adjacent to said source are energized.

11. In combination with an electric railway employing the rails as return conductor for the power-current, normally open-circuited transformers having their secondaries connected at intervals across the rails for supplying signal current thereto, electromagnets for closing the circuits of the several transformers, a circuit extending along the way to which said electromagnets are connected in parallel, said circuit being of appreciable resistance between said electromagnets, and means controlled by a moving train for impressing a voltage on said circuit adjacent to said train.

12. In combination with an electric railway employing the rails as return conductor for the power-current, normally open-circuited transformers having their secondaries connected at intervals across the rails for supplying signal current thereto, electromagnets for closing the circuits of the several transformers, a circuit extending along the way comprising conductors of appreciable resistance, means controlled by a moving train for breaking said circuit adjacent to the train and connecting the portion of the circuit ahead of the train to a source of current, and connections from said electromagnets to said circuit whereby a predetermined number of said electromagnets adjacent to said source are energized.

In witness whereof, I have hereunto set my hand this 4th day of December, 1906.

ELMER F. BLISS.

Witnesses:
BENJAMIN B. HULL,
HELEN URFORD.