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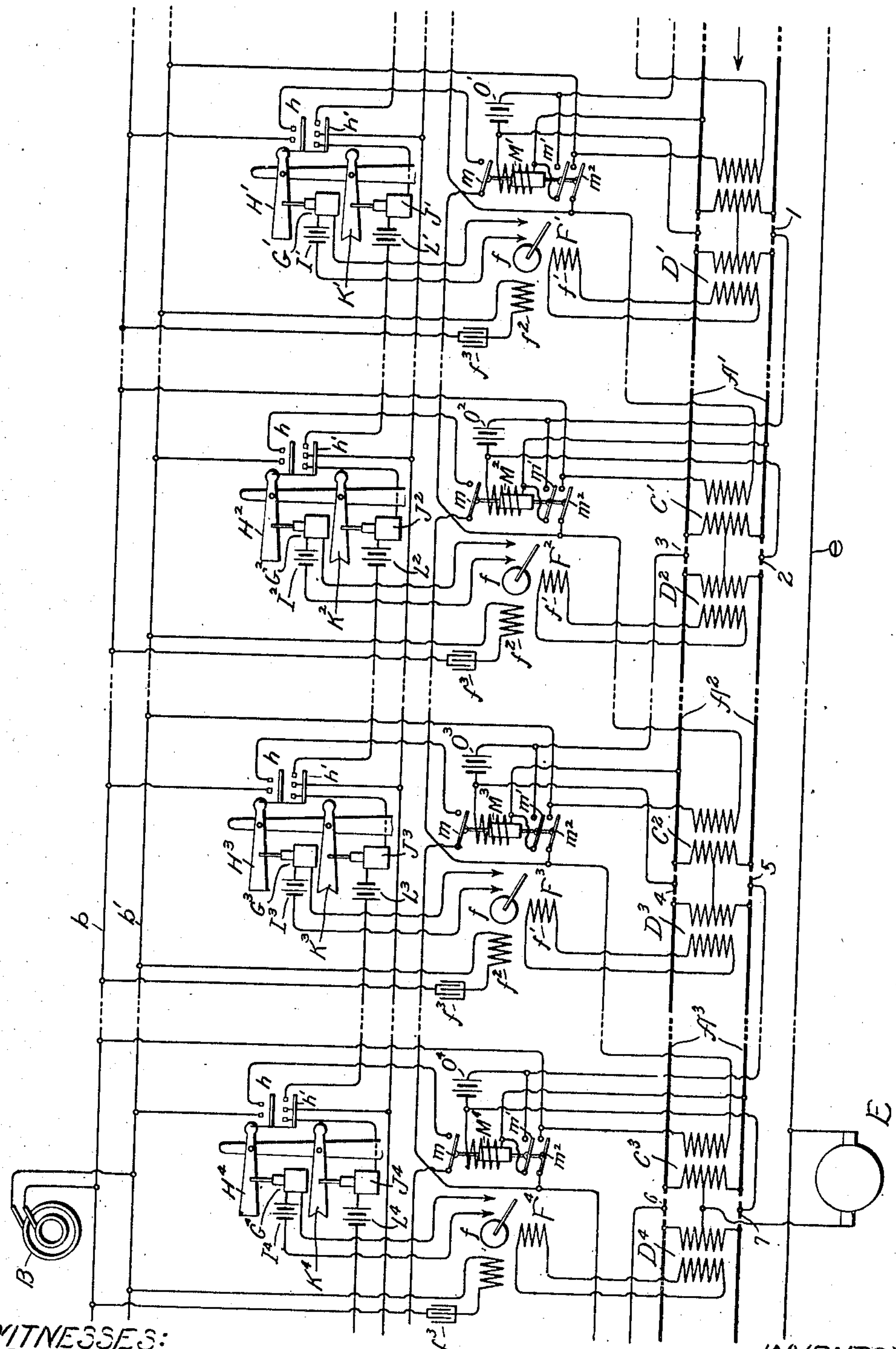
L. A. HAWKINS.

BLOCK SIGNAL SYSTEM.

APPLICATION FILED JAN. 10, 1907.



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UNITED STATES PATENT OFFICE.

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BLOCK-SIGNAL SYSTEM.

No. 856,467. Specification of Letters Patent. Patented June 11, 1907.

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To all whom it may concern:

Be it known that I, LAURENCE A. HAWKINS, 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 railways, and its object is to provide a novel system, which is more economical in the amount of current required to operate the signals than the systems heretofore employed.

In electrically-operated railways provided with signal systems, it is ordinarily desirable to employ the rails both for the power-current and for the signal circuits. With this object in view, it has been proposed heretofore to divide the rails to form the signal-blocks to employ alternating-current for the signal-current in the track-circuits, and to provide inductive windings and connections cross-connecting the rails of each block at both ends and connecting adjacent blocks to each other. These inductive windings serve to prevent the flow of the alternating signal current from one block to another, while affording a path for the direct power current. The secondary winding of the transformer that supplied the alternating signal current to a block may be employed at the inductive winding at one end of the block, and the primary winding of a transformer at the other end of the block, to the secondary of which the track relay is connected, may form the other inductive winding; or inductive bonds may be used independent of the supply transformer and relay, and connected in parallel with them. In either case the efficiency of transmission from the source to the relay is exceedingly low. If the transformer windings are used for the inductive connection, these windings must be of large cross-section to carry the power-current, and, to prevent saturation by the power-current, these windings must have a small number of turns and the core must be large in cross section, and interrupted by the air-gap. Such a transformer is necessarily inefficient. If inductive bonds are used in parallel to the transformer and relay, these must have a small number of turns and a magnetic circuit of small reluctance to prevent saturation by the power current, and consequently their inductance is comparatively small, so that they form shunts of comparatively low impedance to both the transformer and relay. On account of this low efficiency of transmission the amount of power that is required for operating a block-signal system of this character is very great.

By my invention I am enabled greatly to reduce the amount of power required, since, instead of supplying the signal-current to all the blocks all the time, I so arrange the system that current is supplied to a block only when it is necessary to clear a signal, or to maintain it at clear position in front of an approaching train. To secure this result I arrange the signals so that they stand normally at danger, and provide a novel control system for the signals, which renders possible the result mentioned above.

In all prior normal danger signal systems, of which I am aware, either current flows continually in all the track-circuits,—the signal operating circuits alone being open, or the track-circuit is normally open. Neither of these arrangements can be employed in my system, for if current is continually flowing in all the track-circuits, the desired saving in power is not secured, while opening the track-circuits is impossible, since the track-circuits form the return path for the power current.

By my invention I maintain the track-circuits permanently closed, but place normally-open contacts in the supply-circuits for the several track-circuits. Thus, the return path for the power-current is not interfered with, and yet no current is employed in the signal-circuits as long as no trains are running. By providing means controlled by an approaching train for closing the contact in the supply-circuit of a block ahead of the train, the signal for that block may be cleared and held at clear until the train enters the block. The amount of current that is required is directly proportional to the number of trains running, and is never greater than is necessary to give an indication to each train of the condition of the block or blocks immediately ahead of it. Consequently, the power consumption is reduced to the minimum.

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.

The track rails are divided to form signal-blocks A^1, A^2, etc.

B represents an alternating-current generator, which supplies the signal-current for the track-circuits through the line-wires b b^1, which extend along the track.

C^1, C^2, etc., represent transformers, the primaries of which are connected to the line-wires b b^1, but are normally open-circuited, as will be hereafter explained, and the secondaries of which are connected across the rails of a block.

D^1 D^2, etc., represent transformers, the primaries of which are connected across the rails at the other ends of the blocks, and the secondaries of which are connected to the track-relays, which will shortly be described. In the system as shown in the drawing, the secondary windings of the transformer C^1 C^2, etc., and the primary windings of the transformers D^1 D^2, etc., form the inductive connections between the opposite rails of each block and between adjacent blocks. The connection between adjacent blocks is preferably made at the central points of these windings, as indicated on the drawings, so that the power-current in each half of each winding is neutralized more or less completely by the power-current in the other half of the same winding.

e represents the third-rail, or other conductor of power-current, which is connected to one terminal of the power-generator E. The other terminal of the power-generator may be connected to the track-rails at the point of interconnection of any two adjacent blocks, as shown.

Relays F^1, F^2, etc. are provided, which are arranged to respond to alternating-current of a given frequency only. I have indicated diagrammatically relays of the well-known induction type, each comprising a short-circuited secondary member f carrying the relay contacts, and two co-operating windings f^1 and f^2; the first connected to the secondary of one of the transformers D^1 or D^2, and the other supplied independently of the track-circuits with alternating-current of the proper phase for producing a torque on the short-circuited secondary member. For this purpose I have shown in series with each of the windings F^2 a condenser f^3, but it will be understood that the desired phase-adjustment may be obtained in any other suitable manner. The relay F^1, when energized, closes the circuit of the operating mechanism G^1 of the home signal H^1. The operating mechanism, which is indicated diagrammatically, may be of any well-known type, and is supplied from any suitable source of current indicated by the battery I^1. Each home signal is provided with contacts h and h^1.

K^1 represents a distant signal provided with an operating mechanism J^1 supplied from any suitable source of current L^1.

M^1, M^2, etc., represent electromagnets which are arranged to be controlled by a moving train, as will hereafter be explained, and which, when energized, close the circuits of the transformers C^1, C^2, etc., respectively. The magnets M^1, M^2, etc., each have three armatures m m^1 m^2, and are supplied from sources of current O^1, O^2, etc.

1, 2, 3, etc., represent short insulated contact rails in circuit with the magnets M^1 M^2, etc., by means of which a moving train is enabled to control these magnets. These contact-rails are simply for the purpose of enabling a train to control the circuits of these magnets, and any other suitable form of contact controllable by a passing train may be substituted for these contact rails. When contact rails are used, they are preferably placed between adjacent blocks, so as to reduce the number of insulated joints required.

Normally, all signal circuits are open, with the exception of the windings f^2 of the track-relays, and consequently the signal operating mechanisms, relays, and magnets, are deenergized and occupy the positions shown in the drawing. But when a train enters a block,—for instance, the block A^1, it connects the rail-contact 1 to the lower rail A^1, and thereby closes the circuit of the magnet M^2. This circuit may be traced from the left-hand terminal to the battery O^2, through the magnet winding M^2, to the lower rail A^1, through this rail and the wheels of the train to contact-rail 1, and thence to the right-hand terminal of the battery. Magnet M^2 is consequently momentarily energized and draws up its armatures. The armature m^1 closes a maintaining-circuit for the magnet M^2, while armature m^2 closes the primary circuit of the transformer C^2. This circuit may be traced from line-wire b^1, through the primary winding of transformer C^2, armature m^2, to line-wire b. Transformer C^2 consequently supplies current to the block A^2, and if this block is not occupied by a train, and if no rail is broken, winding f^1 of relay F^2 will be energized so as to produce a torque in this relay, and cause it to close its contacts. This energizes the operating mechanism G^2 of home-signal H^2, which draws the signal to clear position. When this signal reaches clear position, its movable contact h bridges the stationary contacts, thereby closing the circuit of transformer C^3. This circuit may be traced from line-wire b through the primary of transformer C^3, through contact m of magnet M^2, and through contact h of home-signal H^2 to line-wire b^1. Transformer C^3 then supplies current to the track-rails A^3, and if this block is unoccupied, relay winding f^1 of relay F^3 is energized, thereby clearing signal H^3. When signal H^3 clears, although its contacts h engages the stationary contacts, it does not close the circuit of the next transformer in advance, since this circuit is open at the contact m of magnet M^3, so that the closing of contact h is of no effect. Contact h^1 of signal H^3, when it engages the stationary contacts, closes the circuit of the operating mechanism of distant-signal K^2. This circuit may be traced from the left-hand terminal of battery L^2, through contact h^1 of signal H^3 and contact h^1 of signal H^2 to operating mechanism J^2, and thence to the right-hand terminal of the battery L^2. Thus home-signals H^2 and H^3 and distant-signal K^2 are clear. Home-signal H^1 is, of course, maintained at danger, since relay F^1 is de-energized by the presence of a train in block A^1; and since signal H^1 is at danger, signal K^1 must also remain at danger, as its circuit cannot be closed unless signal H^1 is clear.

Signals H^2 and K^2, having been cleared, as above described, they remain at clear until the train passes from block A^1 to A^2. In doing so, the wheels of the train connect contact-rail 2 to lower rail A^1, thereby short-circuiting magnet M^2, and causing it to drop its armatures; connect contact-rail 3 to upper rail A^2, thereby energizing magnet M^3; and de-energize relay F^2 by short-circuiting the primary of transformer D^2. Relay F^2 consequently breaks the circuit of the operating mechanism of the signal H^2, restoring it to danger, and the contact h^1 of this signal breaks the circuit of distant-signal K^2, so as to cause it to go to danger also. Magnet M^2, by dropping its armatures, breaks the circuit of transformer C^2 at its armature m^2, and breaks the circuit of transformer C^3 at its armature m. The circuit of transformer C^3 is closed, however, at practically the same instant by the closing of armature m^2 of magnet M^3; so that relay F^3 is maintained energized and signal H^3 at clear. Furthermore, the closing of armature m of magnet M^3 results in clearing distant signal K^3, if the block next in advance is clear. In this manner the proper signals are always displayed in front of the train, but no current is used, except when it is required for displaying a signal.

Although I have shown my invention applied to separate home and distant-signals, it is obvious that it is equally applicable to one-arm three-position signals. Furthermore, I have shown the apparatus diagrammatically, and it will be understood that in practice any well known form of apparatus may be employed. Furthermore, the circuit-connections may be altered to suit different conditions. Accordingly, 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 an electrically-operated railway, track-rails divided to form signal-blocks, inductive windings cross-connecting the rails at both ends of each block and forming with the rails a permanently-closed track-circuit for each block, connections between the circuits of adjacent blocks adapted to form a return-path for the power-current, means controlled by a moving train for producing an alternating-current in a track-circuit ahead of the train, signals normally at danger, and a signal-controlling device for each track-circuit responsive to the alternating-current when supplied thereto.

2. In an electrically-operated railway, track-rails divided to form signal-blocks, inductive windings cross-connecting the rails at both ends of each block and forming with the track-rails a permanently-closed track-circuit for each block, connections between the track-circuits of adjacent blocks adapted to form a return-path for the power-current, normally-open circuits for supplying alternating-current to the several track-circuits, means controlled by a moving train for closing the supply-circuit for a track-circuit ahead of the train, signals normally at danger, and a signal-controlling device for each track-circuit responsive to the alternating-current when supplied thereto.

3. In an electrically-operated railway, track-rails divided to form signal blocks, inductive windings cross-connecting the rails at both ends of each block and forming with the track-rails a permanently-closed track-circuit for each block, connections between the track-circuits of adjacent blocks adapted to form a return-path for the power-current, circuits for supplying alternating-current to the several track-circuits, normally-open contacts included in said supply-circuits, electromagnets for closing said contacts controlled by an approaching train, signals normally at danger, and a signal-controlling device for each track-circuit responsive to the alternating-current when supplied thereto.

4. In an electrically-operated railway, track-rails divided to form signal-blocks, inductive windings cross-connecting the rails at both ends of each block and forming with the track-rails a permanently-closed track-circuit for each block, connections between the track-circuits of adjacent blocks adapted to form a return-path for the power-current, circuits for supplying alternating-current to the several track-circuits, normally-open contacts included in said supply-circuits, electromagnets for closing said contacts, circuit-connections for said magnets arranged to be closed momentarily by an approaching train, a maintaining-circuit for each magnet arranged to be closed when the magnet is en-

ergized, signals normally at danger, and a signal-controlling device for each track-circuit responsive to the alternating-current when supplied thereto.

5. In an electrically-operated railway, track-rails divided to form signal-blocks, inductive windings cross-connecting the rails at both ends of each block and forming with the track-rails a permanently-closed track-circuit for each block, connections between the track-circuits of adjacent blocks adapted to form a return-path for the power-current, circuits for supplying alternating-current to the several track-circuits, normally-open contacts included in said supply-circuits, electromagnets for closing said contacts, connections arranged to be closed by a train for momentarily energizing a magnet to close the supply-circuit for a block ahead of the train, a maintaining-circuit for the magnet arranged to be closed when the magnet is energized, connections for de-energizing the magnet when the train enters said block, a signal for the block normally at danger, and a device controlling the signal and responsive to the alternating-current when supplied to the track-circuit of the block.

6. In an electrically-operated railway, track-rails divided to form signal-blocks, inductive windings cross-connecting the rails at both ends of each block and forming with the track-rails a permanently-closed track-circuit for each block, connections between the track-circuits of adjacent blocks adapted to form a return path for the power-current, normally-open circuits for supplying alternating-current to the several track-circuits, means controlled by a moving train for closing the supply-circuit for a track-circuit ahead of the train, signals normally at danger, and a signal-controlling relay for each track-circuit having two co-operating windings, one supplied with current from the track-circuit when its supply-circuit is closed and the other normally energized by alternating-current supplied independently of the track-circuit.

7. In an electrically-operated railway, track-rails divided to form signal-blocks, inductive windings cross-connecting the rails at both ends of each block and forming with the rails a permanently closed track-circuit for each block, connections between the track-circuits of adjacent blocks adapted to form a return path for the power-current, normally-open circuits for supplying alternating-current to the several track-circuits, signals normally at danger adapted to give caution and clear indications, means controlled by a moving train for closing the supply-circuit for a block ahead of the train, and means controlled by the signal mechanism of a block for closing the supply-circuit of a second block ahead.

8. In an electrically-operated railway, track-rails divided to form signal-blocks, inductive windings cross-connecting the rails at both ends of each block and forming with the rails a permanently-closed track-circuit for each block, connections between adjacent blocks adapted to form a return path for the power-current, normally-open circuits for supplying alternating-current to the several track-circuits, means controlled by a moving train for closing the supply-circuit for a track-circuit ahead of the train, a device responsive to the alternating-current supplied to the track-circuit, a signal controlled by said device, and means controlled by the signal for closing the supply-circuit for the track-circuit next in advance.

9. In an electrically-operated railway, track-rails divided to form signal-blocks, a transformer for each block having its primary normally open-circuited and its secondary connected across the rails at one end of a block, a second transformer for each block having its primary connected across the track-rails at the other end of the block, a signal-controlling relay for each block connected to the secondary of the second transformer, connections between the transformer-windings at adjacent ends of adjacent blocks adapted to form a path for the power-current, and means controlled by an approaching train for closing the primary circuit of the first transformer of a block ahead of the train.

10. In an electrically-operated railway, track-rails divided to form signal-blocks, a transformer for each block having its primary normally open-circuited and its secondary connected across the rails at one end of a block, a second transformer for each block having its primary connected across the track-rails at the other end of the block, a signal-controlling relay for each block connected to the secondary of the second transformer, connections between the transformer windings at adjacent ends of adjacent blocks adapted to form a path for the power-current, means controlled by an approaching train for closing the primary circuit of the first transformer of a block ahead of the train, a signal for each block controlled by the relay, and means controlled by the signal for closing the primary circuit of the first transformer of the block next in advance.

11. In an electrically-operated railway, track-rails divided to form signal-blocks, a transformer for each block having its primary normally open-circuited and its secondary connected across the rails at one end of a block, a second transformer for each block having its primary connected across the track-rails at the other end of the block, a signal-controlling relay for each block connected to the secondary of the second transformer, connections between the transformer windings at adjacent ends of adjacent

blocks, adapted to form a path for the power-current, an electromagnet for each block arranged when energized to close the primary circuit of the first transformer, and circuit connections for said magnet arranged to be closed by an approaching train.

12. In an electrically-operated railway, track-rails divided to form signal-blocks, inductive windings cross-connecting the rails at both ends of each block and forming with the track-rails a permanently-closed track-circuit for each block, connections between the track-circuits of adjacent blocks adapted to form a return-path for the power-current, circuits for supplying alternating-current to the several track-circuits, normally-open contacts included in said supply-circuits, electromagnets for closing said contacts, short insulated sections inserted in the track-rails and connected to said magnets, and a signal-controlling device for each track-circuit responsive to the alternating-current when supplied thereto.

In witness whereof, I have hereunto set my hand this 8th day of January, 1907.

LAURENCE A. HAWKINS.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.