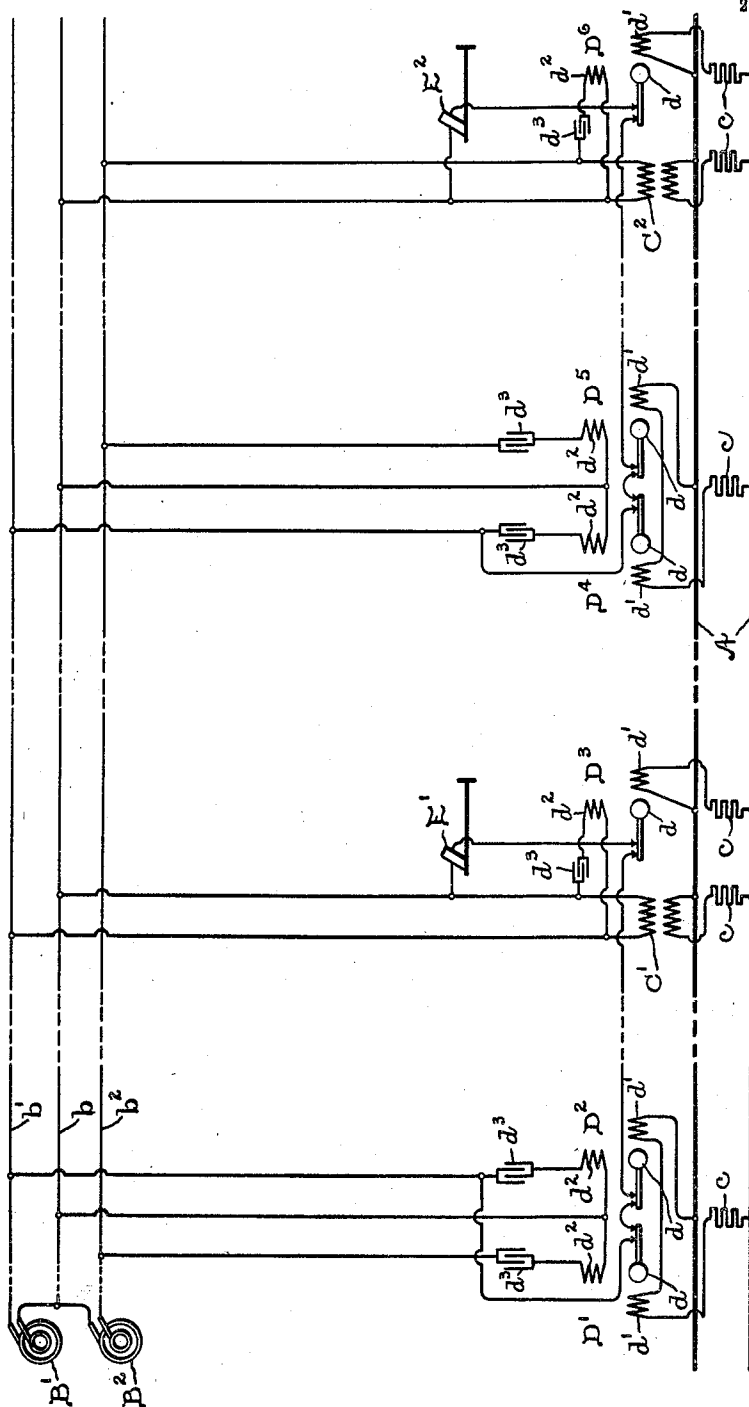


937,737.

Patented Oct. 19, 1909.

2 SHEETS—SHEET 1.

Fig. 1



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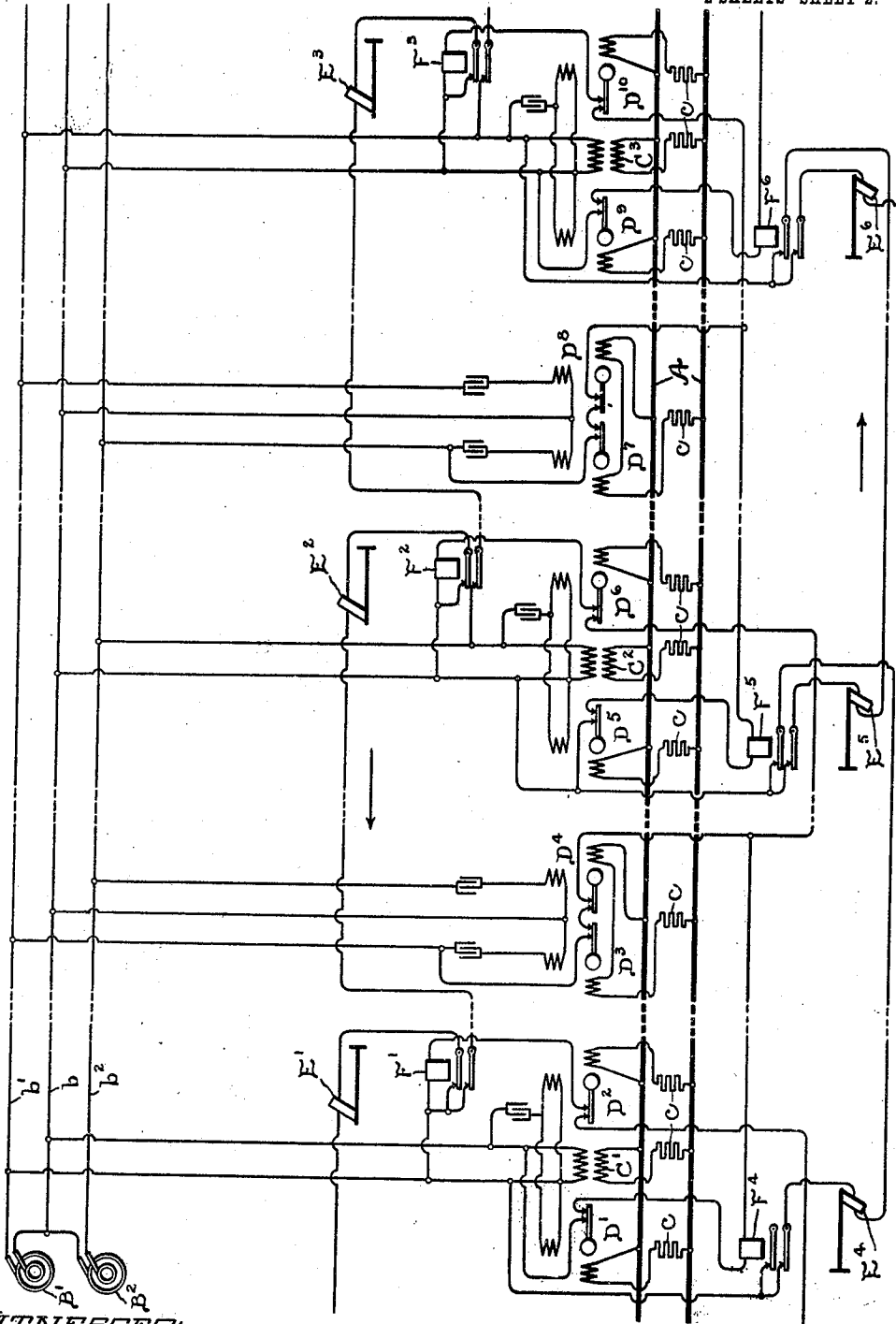
L. A. HAWKINS.
BLOCK SIGNAL SYSTEM.
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937,737.

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2 SHEETS—SHEET 2.

Fig. 2



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UNITED STATES PATENT OFFICE.

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BLOCK-SIGNAL SYSTEM.

937,737.

Specification of Letters Patent.

Patented Oct. 19, 1909.

Application filed March 11, 1909. Serial No. 482,637.

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 electric roads having both rails conductively continuous for all currents, and consists in an improvement in the system disclosed in my prior application, Serial No. 329,347, filed August 6, 1906.

In that prior application I disclosed a system in which sources of alternating-current are connected across the rails at intervals, the currents from adjacent sources differing in frequency, and relays are connected across the rails in pairs between adjacent sources, the two relays in each pair responding selectively to the currents in the two adjacent sources, respectively. Since in such a system the usual insulated joints are dispensed with, it is necessary, for defining the block lengths, to rely upon the operation of a relay when a car reaches a certain position with respect thereto. As I pointed out in my prior application, it is possible by employing currents of high frequency, such, for instance, as 250 and 300 cycles, and using a transformer of good regulation placed at the entrance of the block, to define the limits of the block within a comparatively few feet.

In the system of my prior application, the use of high frequency currents is of particular value for obtaining the definiteness of block-length, but if it is desired to operate the signal mechanisms from the transmission circuit of the signal system, the use of high-frequency current has the objection of making necessary especially designed apparatus, which is somewhat less efficient with respect to current consumption than similar apparatus designed for lower frequency.

The object of my present invention is to make it possible to employ currents of lower frequency without sacrificing the definiteness of the block-length or increasing the power consumption in the track circuits. My invention consists in the addition of an extra relay placed near to the source at the entrance of the block on the side on which a car approaches the source, and employing this relay to control the signal for the block

jointly with the two relays on the other side of the source. With this arrangement it is the extra relay which determines the point at which the signal goes to danger; and since this relay may be placed much nearer to the source than the other relays, the point at which it operates is fixed within correspondingly narrow limits, because the variation, under different weather conditions, of the point occupied by a car, when the relay operates, varies almost directly with the distance of the relay from the source.

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

Figure 1 shows diagrammatically a signal system arranged in accordance with my invention applied to one track of a double-track system, while Fig. 2 shows my invention applied to a single-track road.

In Fig. 1, A represents the rails of an electric railway, which may both be bonded throughout their length in the usual manner, so that they are conductively continuous for all currents. B¹ and B² represent alternating-current generators of different frequencies, as, for instance, of 60 and 90 cycles. b¹, b and b² represent transmission wires, the wire b acting as common return for both frequencies. C¹ and C² represent transformers, the primaries of which are connected to the transmission wires, while their secondaries are connected across the track in series with resistances or impedances c. Adjacent transformers are connected to different pairs of line wires, so as to supply currents at different frequencies to the track rails. The resistances c are for the purpose of preventing saturation of the transformers by unbalanced power-current, and also for limiting the current drawn from a transformer when a car stands across the secondary terminals. D¹ to D⁶ represent the track relays. I have indicated these relays diagrammatically as of the two-phase induction type comprising a short-circuited secondary member d carrying the relay contacts, a primary winding d¹ connected across the track rails, and a second cooperating primary winding d² supplied from the transmission circuit. Phase controlling devices, such as condensers d³, may be employed, if necessary, to give a sufficient phase displacement between the currents in the primary

windings d^1 and d^2 . Resistances c are connected in series with the relay track windings d^1 , in order to prevent saturation from unbalanced power current. As is well known in the art, relays of this type having one winding supplied independently of the track circuit with current of a certain frequency will respond only to current in the track of corresponding frequency. For instance, since the windings d^2 of relays D^2 , D^3 and D^4 are supplied with current from the same generator B^1 , to which the transformer C^1 is connected, these relays will respond to the current delivered to the track by this transformer, but will not respond to current of the frequency of generator B^2 . Similarly relays D^5 and D^6 will respond to current from transformer C^2 , and not to current from transformer C^1 . Relays D^4 and D^5 have their track windings connected across the rails approximately midway between the transformers C^1 and C^2 . Relays D^1 and D^2 are similarly connected between transformer C^1 and the transformer next to the left (not shown), which is of the same frequency of transformer C^2 . The relay D^3 is placed adjacent to transformer C^1 on the side on which a car approaches the transformers. The direction of traffic is shown by the arrow. The distance from relay D^3 to transformer C^1 need not be more than 10% of the distance from the transformer of the relays D^1 and D^2 . It is only essential that the distance between relay D^3 and transformer C^1 shall be great enough to insure that relay D^3 shall always open its contacts before relay D^2 is deenergized. Relay D^6 is similarly placed with respect to transformer C^2 . The signals E^1 and E^2 are placed near relays D^3 and D^6 , respectively, a few feet back of the points at which these relays are connected across the track. The signal E^1 is controlled by relays D^1 , D^2 and D^3 , while the signal E^2 is controlled by relays D^4 , D^5 and D^6 . While relays D^3 and D^6 are shown as of the same type as the other relays, it is not essential that these particular relays should be selective as to frequency, but it is sufficient if they are not affected by the power-current.

The operation of the system is as follows. With no car in the block, the signals stand at clear, as indicated. A car approaching from the right shunts the relay D^6 when its front wheels have passed a few feet beyond the signal E^2 , and within a few feet of the track connections of relay D^6 . The shunting of relay D^6 puts signal E^2 at danger. When the front wheels of the car have reached a point somewhere between relay D^6 and transformer C^2 , the relay D^5 supplied from transformer C^2 is also shunted, introducing another break in the control circuit of signal E^2 . After the car has passed transformer C^2 a certain distance relay D^6 is again ener-

gized, but this does not clear the signal E^2 , since the relay D^6 remains deenergized. Before the car reaches the point at which relays D^4 and D^5 are connected to the track, both of these relays are shunted. When the car has passed some distance beyond this point, relay D^6 picks up its contacts, but relay D^4 remains deenergized until after the car has passed a sufficient distance beyond transformer C^1 to allow the voltage of the current delivered by this transformer to the track to rise to a sufficient amount for effectively reenergizing the track winding of relay D^4 . Before this occurs, the signal E^1 has been put to danger by the successive deenergizing of relays D^3 and D^2 .

Two things should be noticed,—first, that since the signal E^2 is not cleared until the car has passed some distance beyond transformer C^1 , while signal E^1 was put at stop position when the car passed it, there is a natural overlap in the system, which affords an additional measure of protection. In many cases, as, for instance, on electric roads operating single cars with short braking distances, this overlap makes it possible to dispense entirely with the use of distant signals. This overlap is obtained without the use of an additional source of current for that purpose simply by connecting the relay D^3 , which controls the signal E^1 , across the rails of the same track circuit which supplies the relay D^4 controlling the signal E^2 .

In the second place, it should be noted that while the entering-end of the block is definitely fixed by the location of the extra relays close to the transformers, the outgoing-end is not so definitely fixed, since it is dependent upon the reenergization of a relay half a block-length from its source. This is not ordinarily of any importance, since it merely means a variation in the amount of overlap, and this overlap may be made greater under all conditions than the braking distance of the ordinary interurban car. If at any time it becomes important to fix the outgoing-end of the block as definitely as the entering-end, this can be done by adding another relay near the source at the exit-end of the block, and on the side on which a car leaves the source. The arrangement of transformers and track relays would then be as shown in Fig. 2, in which figure, however, the control circuits are adapted for operation on a single-track road with trains running in both directions. In this figure three transformers are shown, transformers C^1 and C^3 supplying current of the same frequency, while intermediate transformer C^2 supplies to the track current of the other frequency. It will be noted that the relative connections of transformers C^1 and C^3 are relatively reversed. This would also be shown in Fig. 1, were it not that only two transformers appear in this figure. The purpose of this re-

versal is to prevent any current from transformer C³ affecting the relay D³, which is intended to respond only to current from transformer C¹. Because of the relative reversal of connections of transformers C¹ and C³, any current from transformer C³, which reaches relay D³, although of the proper frequency for operating the relay, will be in the wrong direction,—that is, will produce a current in the relay which tends to open its contacts, and will, therefore, be on the side of safety. The signals E¹, E² and E³ are for traffic from right to left, and signals E⁴, E⁵ and E⁶ for traffic from left to right. A pair of relays, as D³ and D⁴, are placed approximately midway between adjacent transformers C¹ and C², while extra relays, D¹ and D² are placed on each side of the transformer C¹. Line relays F¹ to F⁶ are indicated in this figure for controlling the signals E¹ to E⁶. It will be seen that the circuit of signal E³, for instance, extends from line-wire b, through the upper contact of line-relay F³, through signal mechanism E³, and through the lower contact of line-relay F² to line-wire b². The signal E³, therefore, stands at stop, whenever either relay F³ or F² is deenergized. Relay F³ is controlled by relays D¹⁰, D⁸ and D⁷, while F² is controlled by relays D⁶, D⁴ and D³. Signal E³ is, therefore, at stop with a car at any point between relay D¹⁰ and a point beyond transformer C¹ at a sufficient distance to allow relay D³ to be energized. Similarly, signal E⁴ is controlled by line-relays F⁴ and F⁵, which, in turn, are controlled by relays D¹, D⁴ and D³ and by relays D⁵, D⁸ and D⁷, respectively, so that signal E⁴ is at stop position with a car anywhere between relay D¹ and a point sufficiently beyond transformer C³ to enable relay D⁸ to be energized. Thus, it will be seen that a car passing signal E⁴, moving from left to right, throws signal E⁴ to stop, and, after advancing a few feet farther, throws signal E³ to stop. A car passing signal E³, moving from right to left, throws signal E⁴ to stop before it reaches transformer C³, signal E⁵ being already at stop. If two cars moving in opposite directions should pass signals E³ and E⁴ at the same time, they would be stopped at signals E² and E⁵, respectively. The distance between signals E² and E⁵ will ordinarily be sufficient for adequate protection on roads operating single cars in which the braking distance is comparatively short. For roads operating heavy trains with long braking distances, it would ordinarily be desirable that the control circuit for the signals for one direction of traffic should be extended through the contacts of another line-relay, so as to extend the zone of control in the manner well understood in the art. It will be noted that in Fig. 1 all the signal

mechanisms are shown supplied from the generator B¹. This is sometimes desirable in cases where one of the frequencies is standard, as 60 cycles, and the other is not, and there is an advantage in using standard apparatus. In other cases it is advantageous to supply a portion of the signal mechanisms from each of the two frequencies; as shown in Fig. 2, since this arrangement divides the load more equally between the two generators.

My invention permits of various other modifications and adaptations to meet varying conditions, and accordingly I do not desire to limit myself to the particular connection and arrangement of parts shown, but aim in the appended claims to cover all modifications which are within the scope of my invention.

I do not in this application make any claim to a block-signal system for railways having both rails conductively continuous for all currents, in which adjacent sources of current for the track circuits are of different character and the relays are selectively responsive to current of one character only, nor do I make any claim to a system for such railways having the relays arranged in pairs between adjacent sources, since these matters form the subject-matter of my prior application, Serial No. 329,347, above referred to.

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, a block signal system comprising signals for the blocks, sources of alternating current connected across the rails at intervals, the currents from adjacent sources differing in character, a pair of relays connected across the rails between adjacent sources, and selectively responsive to current from the two adjacent sources respectively, and a relay connected across the rails near a source on the side on which the cars approach said source and controlling a signal jointly with the pair of relays on the other side of said source.

2. In combination with an electric railway having both rails conductively continuous for all currents, a block signal system comprising signals for the blocks, sources of alternating current connected across the rails at intervals, the currents from adjacent sources differing in frequency, a pair of relays connected across the rails between adjacent sources and selectively responsive to current from the adjacent sources respectively, and a relay connected across the rails near a source on the side on which the cars approach said source and controlling a signal jointly with the pair of relays on the other side of said source.

3. In combination with an electric railway having both rails conductively continuous

for all currents, a block signal system comprising signals for the blocks, sources of alternating current connected across the rails at intervals, the currents from adjacent sources differing in character, a pair of relays connected across the rails between adjacent sources, and selectively responsive to current from the two adjacent sources respectively, and a relay connected across the rails near a source on the side on which the cars approach said source and controlling a signal jointly with the pair of relays on the other side of said source, said signal being located adjacent to said relay.

4. In combination with an electric railway having both rails conductively continuous for all currents, a block signal system comprising signals for the blocks, sources of alternating current connected across the rails at intervals, the currents from adjacent sources differing in frequency, a pair of relays connected across the rails between adjacent sources and selectively responsive to current from the two adjacent sources respectively, and a relay connected across the rails near a source on the side on which the cars approach said source and controlling a signal jointly with the pair of relays on the other side of said source, said signal being located adjacent to said relay.

5. In combination with an electric railway having both rails conductively continuous for all currents, a block signal system comprising signals for the blocks, sources of alternating current connected across the rails at intervals, the currents from adjacent sources differing in character, and two relays connected across the rails on opposite sides of a source, one at a distance therefrom and the other adjacent thereto, the further relay being responsive only to current from said source and both relays controlling the same signal.

6. In combination with an electric railway having both rails conductively continuous for all currents, a block signal system comprising signals for the blocks, sources of alternating current connected across the rails at intervals, the currents from adjacent sources differing in character, and two relays connected across the rails on opposite sides of a source one at a distance therefrom and the other adjacent thereto, the further relay being responsive only to current from said source and both relays controlling the same signal, the said signal being located near the relay adjacent to the source.

7. In combination with an electric railway having both rails conductively continuous for all currents, a block signal system comprising signals for the blocks, sources of alternating current connected across the rails at intervals, the currents from adjacent sources differing in frequency, and two relays connected across the rails on opposite

sides of a source one at a distance therefrom and the other adjacent thereto, both responsive only to current from said source and both controlling the same signal.

8. In combination with an electric railway having both rails conductively continuous for all currents, a block signal system comprising signals for the blocks, sources of alternating current connected across the rails at intervals, the currents from adjacent sources differing in frequency, and two relays connected across the rails on opposite sides of a source one at a distance therefrom and the other adjacent thereto, both responsive only to current from said source and both controlling the same signal, the said signal being located near the relay adjacent to the source.

9. In combination with an electric railway having both rails conductively continuous for all currents, a block signal system for controlling traffic in both directions on a single track comprising sources of alternating current connected across the rails at intervals, the currents from adjacent sources differing in character, track relays connected across the rails in pairs between adjacent sources, the relays of each pair being selectively responsive to current from the two adjacent sources respectively, two track relays near each source on opposite sides thereof, and signals for opposite directions of traffic near to and controlled by the last named relays respectively, the direction of traffic controlled by each signal being from the relay toward the adjacent source.

10. In combination with an electric railway having both rails conductively continuous for all currents, a block signal system for controlling traffic in both directions on a single track comprising sources of alternating current connected across the rails at intervals, the currents from adjacent sources differing in character, track relays connected across the rails in pairs between adjacent sources, the relays of each pair being selectively responsive to current from the two adjacent sources respectively, two track relays near each source on opposite sides thereof, and signals for opposite directions of traffic near to and controlled by the last named relays respectively, the direction of traffic controlled by each signal being from the relay toward the adjacent source and each signal being controlled jointly by the relay which it is near and the next two pairs of relays beyond the adjacent source.

11. In combination with an electric railway having both rails conductively continuous for all currents, a block signal system comprising signals for the blocks, sources of alternating current connected across the rails at intervals, the currents from adjacent sources differing in character, relays connected across the rails between two adjacent

sources, and a relay connected across the rails near to one of said sources on the opposite side from the first-mentioned relays and controlling a signal jointly with the first-mentioned relays.

12. In combination with an electric railway having both rails conductively continuous for all currents, a block signal system comprising signals for the blocks, sources of alternating current connected across the rails at intervals, the currents from adjacent sources differing in character, relays connected across the rails between adjacent sources, and a relay connected across the rails near to and in the rear of the rear source of said two sources and controlling a signal jointly with the first-mentioned relays, the signal being placed near the latter relay.

13. 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 supplied with current therefrom through the track rails, and a second track relay having a winding con-

nected across the rails at a point between the source and the first relay, the contacts of the two relays being connected in different control circuits.

14. In combination with an electric railway having both rails conductively continuous for all currents, sources of alternating current connected across the rails at intervals, a pair of track relays supplied with current from the rails between each two adjacent sources, each of said relays responding to current from only one of the adjacent sources, signals each controlled by one of said pairs of relays, and a relay connected across the rails between a source and a pair of relays and controlling the signal controlled by the pair of relays on the other side of said source, whereby the zones of control of adjacent signals are caused to overlap.

In witness whereof, I have hereunto set my hand this 9th day of March, 1909.

LAURENCE A. HAWKINS.

Witnesses:

BENJAMIN B. HULL,
HELEN ORFORD.