L. A. HAWKINS.

BLOCK SIGNAL SYSTEM.

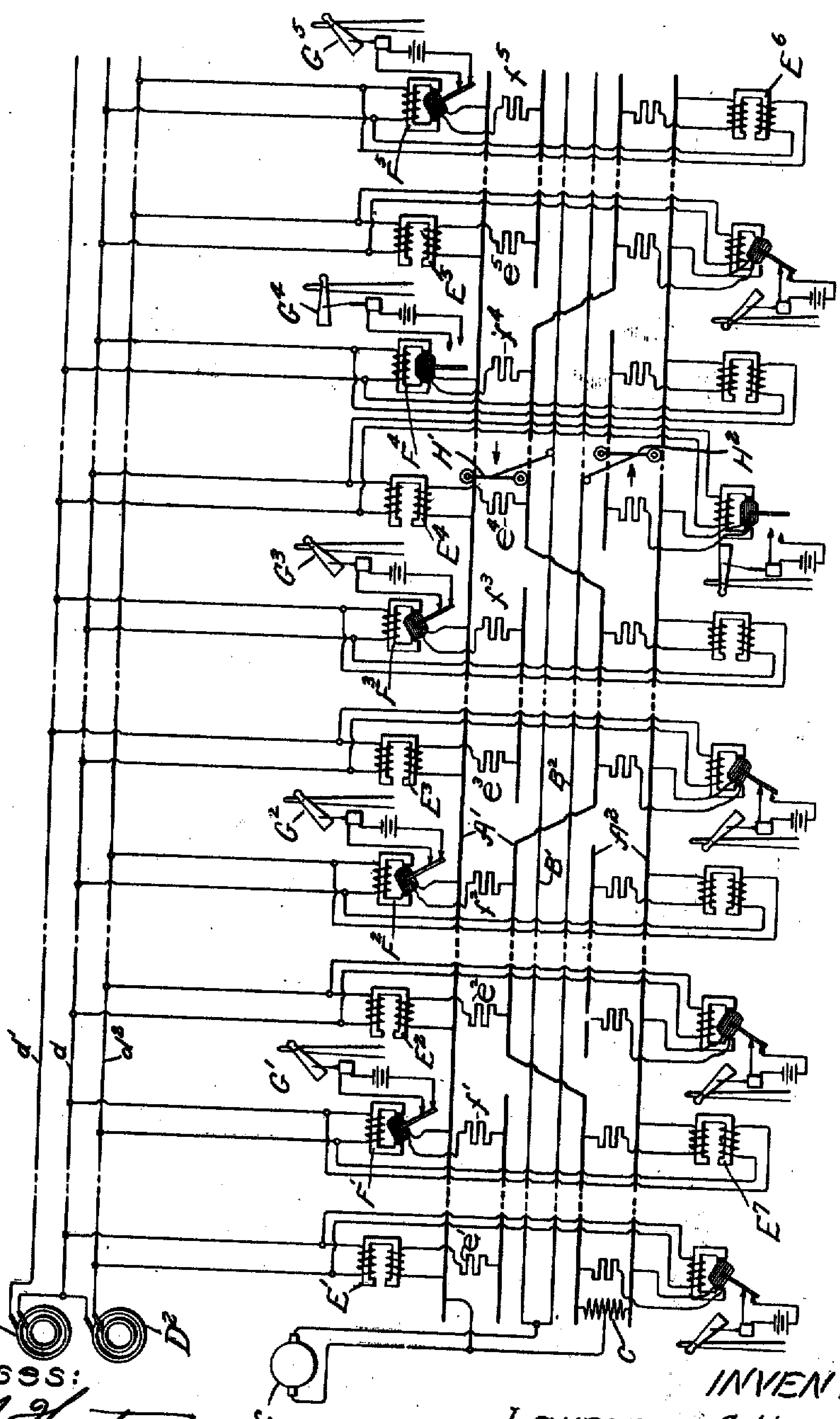
APPLICATION FILED SEPT. 21, 1906. RENEWED OCT. 17, 1908.

929,591.

Patented July 27, 1909.

2 SHEETS—SHEET 1.

Fig. 1.



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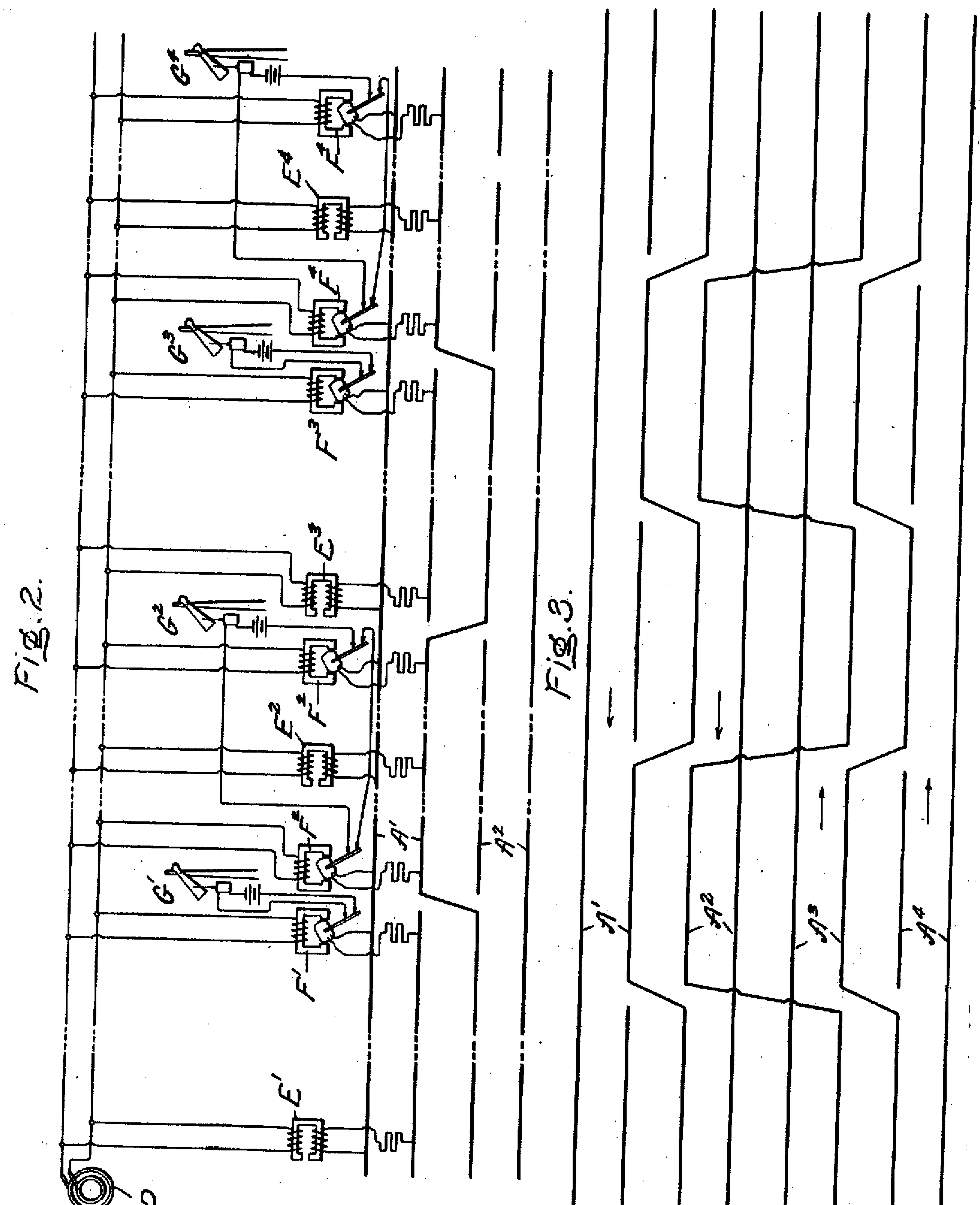

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UNITED STATES PATENT OFFICE.

LAURENCE A. HAWKINS, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

BLOCK-SIGNAL SYSTEM.

No. 929,591. Specification of Letters Patent. Patented July 27, 1909.

Application filed September 21, 1906, Serial No. 335,579. Renewed October 17, 1908. Serial No. 458,300.

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 railways employing the rails as return conductor for the power current. When the rails must be used both for the power-current and for the signal-current two arrangements of rail connections have been proposed heretofore. In one of these systems one rail is continuous to transmit power-current, and the other rail is sectioned to divide the track into blocks. In the other arrangement one or both rails are sectioned, and inductive bonds are employed between adjacent blocks to permit the flow of power-current, while preventing the flow of signal-current. The first of these arrangements utilizes only half of the rails as return conductor, while the second arrangement involves the use of large and exceedingly costly bonds.

By my invention, in the case of a road having a plurality of parallel tracks, nearly all of the rails are employed as return conductor, without resorting to inductive bonds or special devices of any kind.

My invention consists in sectionaling one rail of each track and connecting rail sections of different tracks to form a continuous conductor for the power-current. For instance, in a double-track road alternate sections of each track may be connected with the adjacent sections of the other track, so as to form a continuous conductor. Thus, three-fourths of the rails are utilized as return conductor. If more than two tracks are employed, a still greater proportion of rails may be employed.

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

Figure 1 shows a double-track electric railway with the track circuits arranged in accordance with my invention; Fig. 2 shows a similar arrangement of rail connections with the signal-circuits modified; and Fig. 3 shows the rail connections for four parallel tracks.

Referring first to Fig. 1, A^1 and A^2 represent the rails of two parallel tracks, each of which has one rail continuous and the other sectioned. B^1 and B^2 represent the supply conductors for the power-current, which are connected to one terminal of the power-generator C. This generator, which may supply either direct or low-frequency alternating-current, has its other terminal connected directly to one rail of one track and to both rails of the other track through the differential choke-coil *c*. D^1 and D^2 represent high-frequency alternating-current generators, the frequency of the currents delivered by the two being different. d, d^1 and d^2 represent line-wires supplied from these generators; the wire d being a common return for the currents of both frequencies. The signal-currents are supplied to the blocks by transformers, the primaries of which are connected to the line-wires d, d^1 and d^2, while the secondaries are connected to the track. Thus transformer E^1, supplying the left-hand block in the track A^1, has its primary connected to line-wires d and d^2, and its secondary connected across the track-rails through a small resistance e^1, which may be employed to reduce the flow of power-current through the transformer secondary. A relay F^1 is connected to the other end of the block, and is of a type which responds only to current of the frequency supplied to the block by the transformer E^1. For this purpose a relay having two co-acting windings, one connected to the track and the other supplied independently of the track circuit with current of the same frequency, is employed. I have shown a relay in which the two windings are relatively movable, but it will be understood that any other suitable form of relay, such as the well known induction type, may be employed instead. The relay F^1 controls the signal G^1 for that block.

It will be seen that every other block of each track has its sectional rail connected at both ends to the adjacent sectional rails of the other track, so as to form a continuous conductor, making with the two continuous rails, three return conductors for the power-current, thereby utilizing three-fourths of the rail material. The block to which transformer E^2 and relay F^2 are connected is consequently in electrical connection with the block to which transformer E^4 and relay F^4 are connected. In order to prevent current from the transformer E^4 affecting the relay F^2, transformers E^4 and E^2 are connected to line-wires of different frequencies, and the relay F^2 is connected to the same line-wires as transformer E^2. Consequently, this relay, while responsive to the current supplied by transformer E^2 is not affected by the current supplied by transformer E^4. The nearest transformer of the same frequency as relay F^2, which is in electrical connection with it, is three blocks away. This distance is too great for any effective current-flow, and even this transformer can be arranged so that it cannot operate relay F^2 by reversing its connections to the track. This reverse connection is shown in transformers E^6 and E^7 of track A^2. Thus, the relay is as effectively protected from any currents which can cause it to produce a false indication as if its block were electrically insulated from all others.

The operation of the system is as follows: With a train in a block, as indicated at H^1 proceeding in the direction of the arrow, relay F^4 is short-circuited and signal G^4 is at danger. As soon as the train passes out of that block into the next one, the short circuit is removed and the relay F^4 will clear its signal, while the relay F^3 will put its signal at danger. A train at the point indicated by H^1 will not affect the relay F^2 if a high frequency current is employed for the signal circuits, since the rails offer a high impedance to the flow of alternating-current and the train is a block or more away from the relay F^2, until it passes upon the block supplied by transformer E^3, when it is no longer in position to shunt the relay F^2. Thus, the signal apparatus for each block operates precisely as though the block were entirely isolated from all others, still at the same time a third conductor is secured for the power-current.

In order to prevent false indications, due to failures of insulating joints, the relays and transformers of the blocks having their sectional rails insulated, may be connected as shown. For instance, a failure of the insulating joint between relay F^2 and transformer E^3 will do no harm, since the transformer is connected to a source of different frequency from the relay, while a break in the insulating joint between relay F^3 and transformer E^4, is taken care of by the fact that transformers E^3 and E^4 are reversely connected so that the only effect of current through relay F^3 from transformer F^4 would be to hold the signal in open-circuit position.

Now, referring to Fig. 2, an arrangement is shown in which leakage-current is decreased, so that only one frequency need be employed if there is an objection to the employment of two. In this figure, the transformers E^2 and E^4 which supply the blocks, the sectional rails of which are electrically connected, have their secondaries connected to the centers of the blocks, and two relays are provided, one at each end of the block, with their contacts in series, so that either relay can put the signal at danger. With this arrangement each relay is separated from its own transformer by half a block length, while it is separated from the next transformer, to which it is electrically connected, by a distance equal to a block and a half. Consequently, leakage-currents,—that is, currents which flow from one transformer through relays other than that of the same block, are reduced; and furthermore, owing to the proportional distance between each relay and its own transformer, and between the same relay and the next nearest transformer, a single frequency may be employed for all the signal-circuits with perfect safety. Furthermore, the transformers E^2 and E^4 may be oppositely connected, so that the nearest transformer which could send a current through relay F^2, which would tend to hold it in clear position, would be distant three and one-half blocks. With even a low-frequency alternating-current this distance is, of course, entirely too great for interference, with one relay by current from the transformer of another block. Furthermore, there is less likelihood with this arrangement of a train in one block short-circuiting a relay two blocks ahead. For instance, with a train in the block supplied by transformer E^4, the distance between relay F^2 and its transformer is only one-half a block-length, while the distance between the relay and the train is a full block-length; whereas the relay in Fig. 1 may be equally distant from its transformer and the train in another block. Consequently, whether one or two frequencies are used, the arrangement of Fig. 2 possesses advantages, if alternating-current of not very high frequency is employed. If, however, high frequency is employed for the signal-circuits, the arrangement of Fig. 1 is as positive as that of Fig. 2, so that the arrangement of Fig. 2 then possesses no advantages, unless it is desired to do away with more than one frequency. In Fig. 2, for the sake of simplicity, both the power-circuit and the signal-circuits for the second track are omitted. The circuits for the second track would be precisely like those of the first track.

In Fig. 3 the connections for four parallel tracks are shown, the signal circuits being omitted entirely, since the arrangement of either Fig. 1 or 2 might be employed. In this figure the tracks A^1 and A^2 have their sectional rails connected precisely as in Figs. 1 and 2, and tracks A^3 and A^4 have their sectional rails similarly connected; but in addition to this, the remaining sections of track A^2 are connected in series with the remaining sections of track A^3, so as to form still an other continuous conductor. Thus, with four parallel tracks, seven-eighths of the rails are usefully employed as return for the power current. The reason that the remaining sections of tracks A^1 and A^4 are not connected to form still another conductor is that, if this connection were made and trains were in the positions indicated by the four arrows, each train would shunt the signal directly ahead of it, so that all four trains would have signals at danger in front of them and traffic would be interrupted. Furthermore, with trains in other positions, leakage-currents would flow from one track to another which might interfere with the proper operation of the circuit. But it is always possible, by means of my invention, to connect the sectional rails without interference so as to form a number of continuous conductors—only one less than the number of tracks.

I do not desire to limit myself to the particular connections 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 the combination of sources of current of different character connected across the rails, a continuous rail circuit between the sources, and relays connected across the rails between the sources, for such a combination is comprised in the subject-matter of my prior application, Serial No. 329,347, filed Aug. 6, 1906.

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

1. In an electric railway employing track-rails as return conductor for the power-current, a plurality of parallel tracks each having one rail conductively continuous for all currents and the other sectioned to form signal blocks, and connections conductive for all currents between rail sections of different tracks arranged to form with said sections a continuous conductor for power-current independent of the continuous rails.

2. In an electric railway employing the track-rails as return conductor for the power-current, a plurality of parallel tracks each having one rail conductively continuous for all currents and the other sectioned to form signal-blocks, and connections conductive for all currents between both ends of alternate rail-sections of one track and the adjacent ends of adjacent sections of another track, said connections forming with said rail-sections a continuous conductor for power-current independent of the continuous rails.

3. In an electric railway employing the track-rails as return conductor for the power-current, a plurality of parallel tracks each having one rail sectioned to form signal-blocks, connections between both ends of alternate rail sections on one track to the adjacent ends of adjacent sections of another track, sources of current connected to the rails of the several blocks, the sources connected to adjacent blocks of the same track, the sectional rails of which are electrically connected, differing in character, and signal-controlling relays connected to the rails, the relays connected to said electrically-connected adjacent blocks being responsive only to currents of the character supplied to those blocks.

4. In an electric railway employing the track-rails as return conductor for the power-current, a plurality of parallel tracks each having one rail sectioned to form signal blocks, connections between both ends of alternate rail sections of one track to the adjacent ends of adjacent sections of another track, sources of alternating current connected to the rails of the several blocks, the sources connected to adjacent blocks of the same track, the sectional rails of which are electrically connected, being of different frequency, and signal-controlling relays connected to the rails, the relays connected to said electrically-connected adjacent blocks being responsive to currents of only one frequency.

5. In an electric railway employing the track-rails as return conductor for the power-current, a plurality of parallel tracks each having one rail sectioned to form signal-blocks, connections between both ends of alternate-rail sections of one track to the adjacent ends of adjacent sections of another track, sources of current connected to the rails of the several blocks, those blocks, the sectional rails of which are connected to other blocks, having their sources connected to their centers, and signal-controlling relays connected to the rails, the blocks having their sources connected to their centers being arranged with a relay at each end.

6. In an electric railway employing the track-rails as return conductor for the power-current, a plurality of parallel tracks each having one rail conductively continuous for all currents and the other sectioned to form signal blocks, and connections conductive for all currents between rail sections of different tracks arranged to form with said sections a number of independent continuous conductors for the power-current one less than the number of tracks.

In witness whereof, I have hereunto set my hand this 20th day of September, 1906.

LAURENCE A. HAWKINS.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.