June 7, 1927. 1,631,808

R. M. GILSON

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Aug. 19, 1924 2 Sheets-Sheet 1

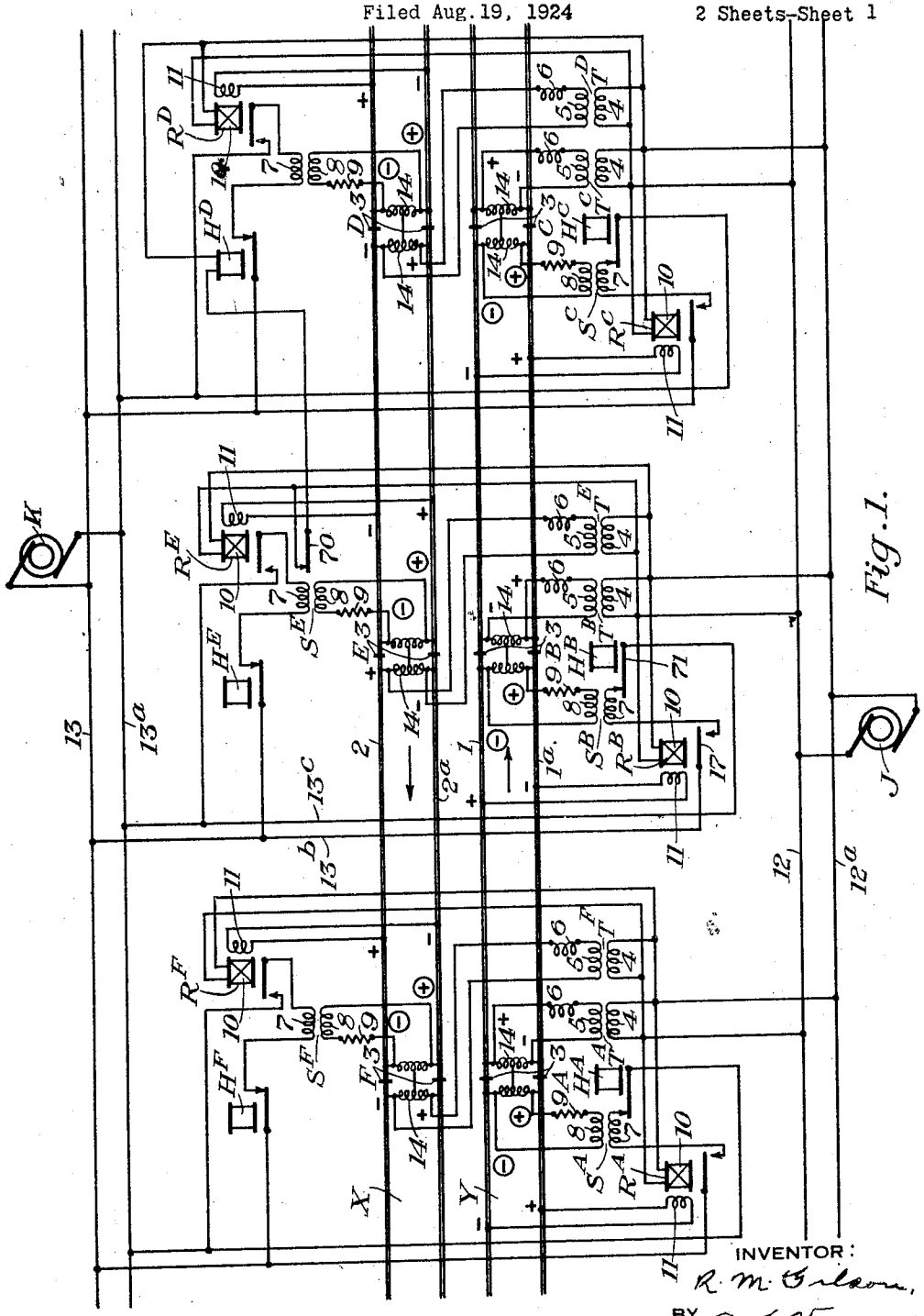


Fig. 1.

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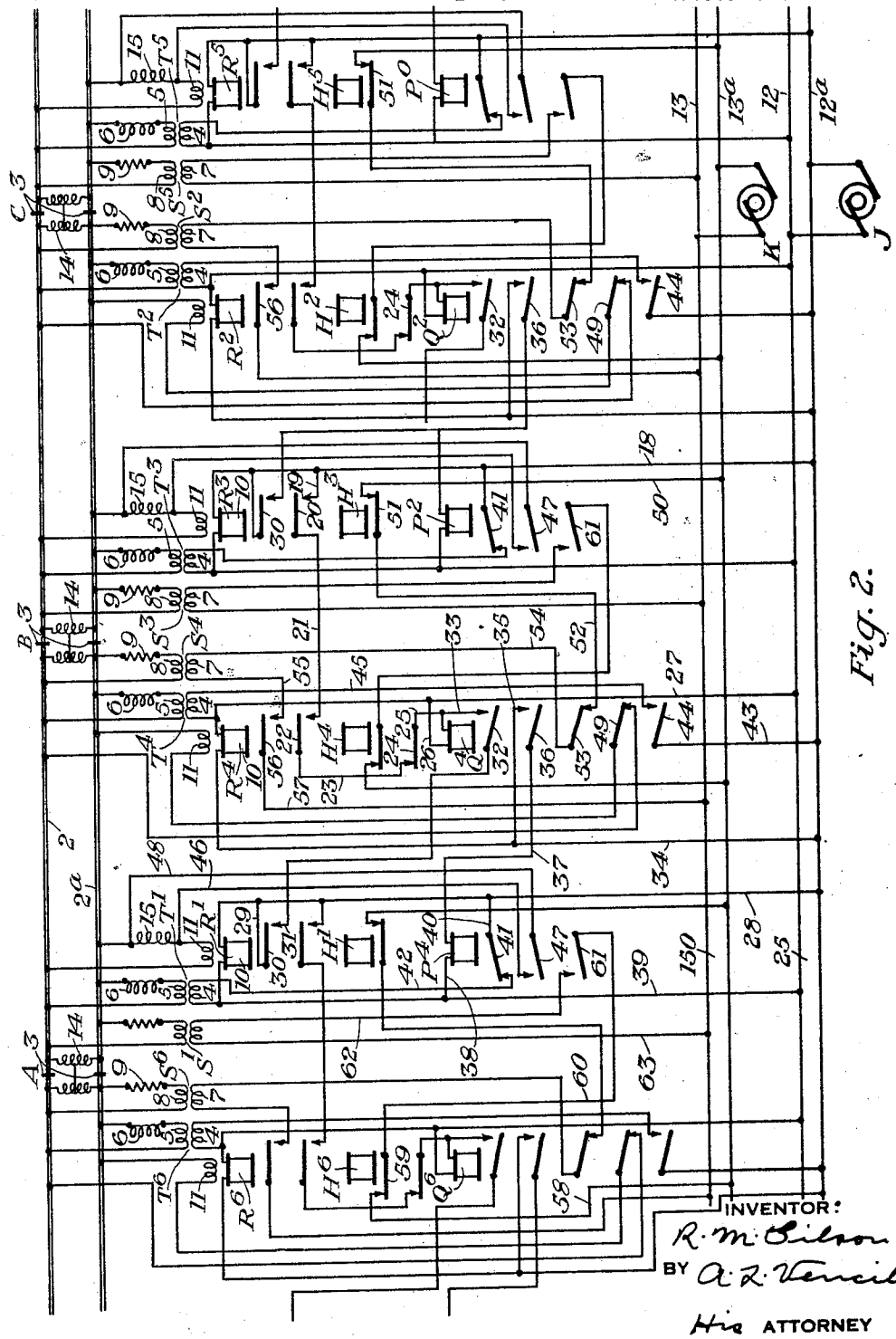


Fig. 2.

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Patented June 7, 1927. 1,631,808

UNITED STATES PATENT OFFICE.

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RAILWAY-TRAFFIC-CONTROLLING APPARATUS.

Application filed August 19, 1924. Serial No. 732,927.

My invention relates to railway traffic controlling apparatus, and particularly to apparatus of the type comprising train carried governing mechanism controlled by energy received from the trackway. More particularly, my invention relates to apparatus of the type in which alternating currents of two different frequencies are present in the trackway, current of one frequency being used to control the trackway apparatus and current of the other frequency being used to control the train carried governing mechanism.

I will describe two forms of trackway apparatus embodying my invention, and will then point out the novel features thereof in claims.

In the accompanying drawings, Fig. 1 is a diagrammatic view showing one form of apparatus applied to a double track railway and embodying my invention. Fig. 2 is a view showing a stretch of single track provided with trackway apparatus embodying my invention.

Similar reference characters refer to similar parts in both views.

Referring first to Fig. 1, the reference characters X and Y designate the two tracks of a double track railway, over each of which tracks traffic normally moves in the direction indicated by the arrows. The two rails 1 and 1^a of track Y are divided, by means of insulated joints 3, into a plurality of successive track sections A—B, B—C, etc. Similarly the track rails 2 and 2^a of track X are divided by means of insulated joints 3, into a plurality of successive sections D—E, E—F, etc. As here shown, the junction of each two sections of track X is opposite the junction of two sections of track Y, although this particular arrangement is not essential.

Each of the tracks X and Y is intended for use in a railway system having electric propulsion, and for this reason impedance bonds 14 of a usual and well known form are provided at the junction of each two adjacent track sections for the purpose of conducting propulsion current around the insulated joints 3. The apparatus of my invention is equally well suited, however, for use on a steam road, in which case the bonds 14 would of course be omitted.

Means are provided for at times supplying each track section of each track with alternating currents of two different frequencies. For this purpose a transmission line comprising two line wires 13 and 13^a is supplied with alternating current of one frequency from a suitable source such as an alternator K. A second transmission line comprising two line wires 12 and 12^a is constantly supplied with alternating current of a different frequency from a suitable source such as an alternator J. Current supplied from line wires 13 and 13^a is used to control train carried governing mechanism of some suitable type and I shall hereafter call such current the "train governing current". Alternating current supplied to the trackway from line wires 12 and 12^a is used to control trackway apparatus and I shall hereafter term such current the "track circuit current". The train governing current is preferably, though not necessarily, of higher frequency than the track circuit current.

Track circuit current is supplied to the rails of each section through the medium of a track transformer designated by the reference character T with an exponent corresponding to the location and having a secondary winding 5 connected across the terminals of the impedance bond 14 adjacent the entrance end of the section. An impedance 6 is interposed between the secondary 5 of each transformer T and one rail of the associated section in the usual manner. The primary 4 of each track transformer T is constantly supplied with track circuit current from line wires 12 and 12^a.

Train governing current is supplied to the rails of each section through the medium of a train governing transformer designated by the reference character S with an appropriate exponent and having a secondary winding 8 connected with the terminals of the impedance bond 14 adjacent the exit end of the section. An impedance 9 is interposed between the secondary 8 of each transformer S and one rail of the corresponding section in accordance with standard practice. The supply of train governing current to each transformer S will be explained in detail hereinafter.

Each track section is further provided with a track relay designated by the reference character R with an exponent corresponding to the location and comprising two

windings 10 and 11. One winding 10 of the relay R is constantly supplied with current from line wires 12 and 12a. The remaining winding 11 of each track relay R is constantly connected across the rails adjacent the exit end of the associated section. Inasmuch as each track relay can be effectively energized only when currents of the same frequency are supplied to its two windings 10 and 11, it follows that these relays will not normally respond to train governing current in the track rails.

Each track section is also provided with a line relay designated by the reference character H with a suitable distinguishing exponent, which relay, as here shown, is located at the entrance end of the associated section. Relay H^D for section D—E is provided with a circuit which includes contact 70 of track relay R^E for the same section, so that relay H^D is de-energized whenever the associated section is occupied by a train. The control of relay H^D may be carried farther in advance if desired. The circuits for the remaining line relays H may be similar to the circuit for relay H^D, but are omitted to simplify the drawing. Each train governing transformer S is supplied with train governing current when the associated track relay R is de-energized and the adjacent line relay H is energized. It will thus be plain that each train governing transformer S is normally disconnected from its energizing source but is connected with such source when the corresponding section is occupied provided the next section in advance is unoccupied.

As shown in the drawing all parts of the apparatus are in the normal conditions, that is, the conditions corresponding to the unoccupied condition of the tracks X and Y. This being so, each track section is supplied wth track circuit current from the associated track transformer T, all track relays are energized, all line relays H are energized, but the circuit for each train governing transformer S is open at the back contact 17 of the corresponding track relay. I will now assume that a train passes over track Y moving in the direction of the arrow. As this train enters section A—B, track relay R^B becomes de-energized. The closing of back contact 17 thereon completes the circuit for the primary 7 of train governing transformer S^B and train governing current is thus supplied to section A—B by transformer S^B. If, however, when a train enters section A—B, section B—C is already occupied, the opening of the front contact 71 of line relay H^B will interrupt the primary circuit for transformer S^B and so the closing of back contact 17 of track relay R^B will not result in supplying train governing current to section A—B.

The trackway apparatus herein shown and described is suitable for co-operation with train carried governing mechanism arranged to be responsive to train governing current in the trackway, that is, current of the frequency of alternator K. This governing mechanism is preferably arranged to give a less restrictive indication when the portion of trackway occupied by the train is being supplied with train governing current, and to display a more restrictive indication when the supply of train governing current to such portion of track is interrupted. In certain systems suitable for co-operation in this manner the train carried governing mechanism is controlled by the trackway current through the medium of suitable pick-up apparatus carried on the train in advance of the front axle. It is obvious that in systems of this character the source of train governing current must at all times be located in advance of the train, as otherwise the train governing current would be shunted away from the receiving apparatus by the wheels and axles of the train itself.

Under certain conditions of operation, with the circuits illustrated in Fig. 1, train governing current may be supplied to a track section under unsafe conditions in advance. For example, I will assume that relay H^B is de-energized as by the presence of a train on track Y in section B—C, so that a train entering section A—B will not close the circuit for transformer S^B and the train will receive a more restrictive indication. If under these conditions relay R^F is de-energized, train governing current is supplied by transformer S^F to section E—F and this current, flowing down the rails of section E—F to point E, flows into secondary 5 of transformer T^E. As a result train governing current is induced in primary 4 of transformer T^E from which it may flow through line wires 12 and 12a to track transformer T^A. The latter transformer would then in turn supply train governing current to the rails of section A—B. It will be observed, however, that this track transformer T^A is connected with the rails at the entrance end of the section A—B and therefore the train occupying section A—B, under the conditions outlined above, will not be affected by the train governing current improperly supplied to section A—B as just explained. That is to say, this train governing current is supplied to the section in rear of the train and will therefore be shunted by the wheels and axles of the train so that it has no effect on the receiving apparatus located in advance of the front axle of the train.

Similarly, should relay R^E be de-energized improperly, and section A—B be occupied, track circuit current would flow from transformer T^D, through the rails of section D—E, to transformer S^E, thence through wires 13b and 13c, to transformer S^B and

hence to winding 11 of relay R^B. Winding 10 of this relay is constantly supplied with track circuit current from line wires 12 and 12^a and therefore relay R^B would be energized under these conditions if the magnitude of the stray track circuit current in winding 11 were sufficiently large. This stray current would however be extremely small due to the impedance of the rails of section D—E, and impedance 9 associated with transformers S^E and S^E, and so it would not ordinarily be of sufficient magnitude to energize relay R^B. It will be observed however, that, should relay R^B be improperly energized by such stray current, the circuit for transformer S^B would be opened (at contact 17 of relay R^B), and the supply of stray current to winding 11 of relay R^B would be interrupted. It is, therefore, impossible with my invention for relay R^B to be held in the energized condition by such stray current.

The relative polarity of the track circuit current in each track section at a given instant is indicated by the plus and minus signs not enclosed in circles, and the relative polarity of the train governing current at the same instant is indicated by such plus and minus signs enclosed in circles. It will be clear from the drawing that the train governing currents in all the track sections are of the same relative polarity, whereas the relative polarity of the track circuit current in each section is opposite to that of the track circuit current in the two adjacent sections of the same track and the same as that of the track circuit current in the corresponding section of the other track. In explaining the reason for this arrangement, I will assume that sections E—D and A—B are both unoccupied but that relays R^E and R^B are both improperly open. Under these conditions transformer T^D will cause track circuit current to be induced in line wires 13 and 13^a through transformer S^E, and transformer T^A will cause track circuit current to be induced in line wires 13 and 13^a through transformer S^B. These two track circuit currents are of opposite instantaneous polarities, however, and therefore will neutralize each other so that no track circuit current will actually be present in the train governing line wires 13 and 13^a. Furthermore, train governing currents induced in the track circuit line wires 12 and 12^a will counteract each other in a similar manner.

Referring now to Fig. 2, the reference characters 2 and 2^a designate the track rails of a stretch of single track over which traffic moves in both directions. These rails are divided as before into a plurality of successive track sections A—B, B—C, etc. Each track section is provided with two track relays each designated by the reference character R with a suitable distinguishing exponent and one located at each end of the section. Each track relay comprises two windings 10 and 11, one of which windings, 10, is constantly supplied with alternating current from a suitable source such as an alternator J over line wires 12 and 12^a. Each track section is further provided with two track transformers, each designated by the reference character T with an appropriate exponent. One such track transformer is located adjacent each end of each section and has a secondary winding 5 constantly connected through an impedance 6 across the rails of the section for supplying track circuit current to the section. A train governing transformer having a secondary winding 8 constantly connected through an impedance 9 with the rails of the section is located adjacent each end of each section. Each such train governing transformer is designated by the reference character S with a suitable distinguishing exponent. Associated with each track relay R is a line relay designated by the reference character H with a distinguishing exponent. These line relays are controlled in accordance with the usual practice in absolute permissive block signaling systems, and since the control of these relays forms no part of my present invention I have omitted the circuits from the drawing for the sake of simplicity. For purposes of the present disclosure it is sufficient to state that all line relays are normally energized. When a train moving from the left to right leaves the first passing siding to the left of the portion of track shown in the drawing, line relays H^6, H^4, H^2, etc. which govern traffic from right to left are de-energized and remain in this condition until the train has passed the first passing siding to the right of point C. Similarly, when a train moving from right to left leaves the passing siding to the right of point C, relays H^5, H^3 and H' etc. which govern traffic from left to right, become de-energized and remain in this condition until the train passes the first passing siding to the left of point A. Each H relay is further controlled so that when the corresponding section becomes unoccupied the H relay for the direction in which the train is moving becomes energized.

Each section is also provided with a stick relay designated by the reference character Q with a suitable exponent and located adjacent the right hand end of the section. A repeater relay designated by the reference character P with an exponent corresponding to the location is provided for each track section and is located adjacent the left hand end of the section. Referring particularly to stick relay Q^4, this relay is provided with a pick-up circuit from which current flows from line wire 12^a, through wires 18 and 19, back contact 20 of relay R^3, wire 21, back

contact 22 of relay R^4, wire 23, front contact 24 of relay H^4, wire 25, winding of relay Q^4, and wires 26 and 27 to line wire 12. This circuit is closed only when relays R^3 and R^4 are de-energized and relay H^4 is energized, as when a train moving from right to left enters section A—B. Relay H^4 will then open its front contact and interrupt the circuit just traced, but relay Q^4 will be maintained in its energized conditions as long as any part of the train occupies section A—B by virtue of the stick circuit which may be traced from line wire 12^a, through wires 28 and 29, back contact 30 of relay R', wire 31, front contact 32 of relay Q^4, wire 33, winding of relay Q^4, and wires 26 and 27 to line wire 12. When relay Q^4 is energized, current flows from line wire 12^a, through wires 34 and 35, front contact 36 of relay Q^4, wire 37, winding of relay P^4, and wires 38 and 39 to line wire 12. Relay P^4 is therefore energized only when relay Q^4 is energized. Track circuit current is at times supplied to the primary 4 of track transformer T', over a circuit which passes from line wire 12^a, through wires 28 and 40, back contact 41 of relay P^4, wire 42, winding 4 of transformer T', and wire 39 to line wire 12. This circuit is closed whenever relay P^4 is deenergized. The track transformer T^4 located at the right hand end of section A—B is supplied with track circuit current, when relay Q^4 is energized, over a circuit which passes from line wire 12^a through wire 43, front contact 44 of relay Q^4, wire 45, primary winding 4 of transformer T^4, and wire 27 to line wire 12.

The second winding 11 of relay R' is connected through an impedance 15 across the rails 2 and 2^a of section A—B adjacent point A. When relay P^4 is energized, however, a path of low resistance is closed around impedance 15, which path is through wire 46, front contact 47 of relay P^4 and wire 48. When this path is closed, winding 11 of relay R' is connected directly across the rails of section A—B. When relay Q^4 is de-energized, winding 11 of relay R^4 is connected across the rails of section A—B adjacent point B through back contact 49, but when relay Q^4 is energized this winding 11 is completely disconnected from the rails.

Train governing current is supplied to the track rails from an alternator K over line wires 13 and 13^a and through transformers S. For example, the circuit for transformer S^4 may be traced from line wire 13^a, through wire 50, front contact 51 of relay H^3, wire 52, back contact 53 of relay Q^4, wire 54, primary 7 of transformer S^4, wire 55, back contact 56 of relay R^4, and wire 57 to line wire 13. This circuit is closed only when relays Q^4 and R^4 are de-energized and relay H^3 is energized. When relay P^4 is energized and relay H^6 is also energized, train governing current is supplied from line wire 13^a, through wire 58, front contact 59 of relay R^6, front contact 61 of relay P^4, wire 62, primary 7 of transformer S', and wire 63 to line wire 13.

As shown in the drawing all parts of the apparatus are in their normal positions, that is, the positons corresponding to the unoccupied condition of the stretch of track here shown. Under this condition the track transformer T located at the left hand end of each track section is supplying track circuit current to the corresponding section, but the circuit for the track transformer located at the right hand end of each section is interrupted at a front contact of the corresponding stick relay. All track relays are energized, all line relays H are energized, and all stick relays Q and repeater relays P are de-energized. The impedance 15 associated with the track relay at the left hand end of each section is connected in series with the corresponding relay because the low resistance path around this impedance is open, and winding 11 of the other track relay for each section is connected across the rails by the associated stick relay Q. All train governing transformers S are de-energized.

I will now assume that a train moving from left to right passes through the stretch of track shown in the drawing. As this train left the passing siding to the left of point A, line relays H^6, H^4 and H^2 became de-energized. As the train enters section A—B, relays R' and R^4 become de-energized and relay H' also becomes de-energized. Relays Q^4 and P^4 are unaffected, but the closing of back contact 56 of track relay R^4 completes the circuit for transformer S^4 which thereupon supplies train governing current to section A—B. As the train progresses into section B—C, relays R^3 and R^2 become de-energized and relay H^3 becomes de-energized. The closing of back contact 56 of relay R^2 completes the circuit for transformer S^2 which then supplies train governing current to section B—C, and the de-energization of relay H^3 interrupts the circuit for transformers S^4 and so discontinues the supply of train governing current to section A—B. As the rear of the train passes out of section A—B relays R' and R^4 become energized but the remaining apparatus is unaffected. As the train passes out of section B—C relays R^3 and R^2 become energized, and as the train enters the passing siding to the right of point C the energization of relays H^6, H^4 and H^2 returns the apparatus to its normal position.

I will now assume that a train moving from right to left passes along the track. As such train leaves the first passing siding to the right of point C, relays H', H^3 and H^5, etc. become de-energized but the remain-

ing apparatus remains unchanged. As the train enters section B—C it causes the de-energization of relays R^2 and R^3. Relay H^2 also becomes de-energized, but subsequent to the de-energization of relay R^2 and prior to the opening of front contact 24 of relay H^2 the pick up circuit for relay Q^2 is closed. The relay Q^2 is subsequently held in its energized condition over its stick circuit which includes its own front contact 32 and back contact 30 of relay R^3. The closing of front contact 36 of relay Q^2 closes the circuit for relay P^2 which thereupon closes its front contact. The opening of back contact 49 of relay Q^2 disconnects winding 11 of relay R^2 from the rails, and the closing of front contact 44 of relay Q^2 supplies alternating current to the primary 4 of track transformer T^2. Similarly, the opening of back contact 41 of relay P^2 opens the circuit for transformer T^3, and the closing of front contact 47 of relay P^2 completes the shunt around impedance 15 and connects winding 11 of relay R^3 directly to the rails of section B—C. The de-energization of relay R^2 does not complete the circuit for train governing transformer S^2 because the circuit for this transformer is open at front contact 51 of relay H^5 and also at back contact 53 of relay Q^2. The closing of front contact 61 of relay P^2 completes the circuit for primary 7 of transformer S^3 because relay H^4 is energized, and under these conditions section B—C is supplied with train governing current from transformer S^3. As the train moves through section A—B the operation of the apparatus is the same as just described for section B—C. As the train moves out of section B—C track circuit current supplied to the rails by transformer T^2 energizes relay R^3 which results in the de-energization of relay Q^2 and hence of relay P^2. Relay R^2 is thereupon reconnected with the rails, the shunt around impedance 15 for relay R^3 is opened, and transformer T^3 is energized. At the same time track transformer T^2 is de-energized. The operation of the apparatus as the train passes out of section A—B will be readily understood without further explanation. When the train reaches the passing siding to the left of point A, relays H', H^3 and H^5 again become energized to return the apparatus to its normal condition.

It should be pointed out that with the apparatus shown in Fig. 2 the track circuit current is at all times supplied to an occupied track section by a track transformer located in the rear of the train irrespective of the direction of travel of such train. It follows that any stray train governing current present in the transmission line for generator J or induced in any of the connections or circuits intended for track circuit current will not be effective to produce an improper indication in the train governing mechanism for the reason that such current will be shunted away from the receiving apparatus by the wheels and axles of the train.

Although I have herein shown and described only two forms of trackway apparatus embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention what I claim is:

1. In combination, a section of railway track along which traffic moves in one direction, a source of alternating track circuit current of one frequency connected with the rails adjacent the entrance end of said section, means controlled by traffic conditions in advance of said section for supplying alternating train governing current of a different frequency to the rails adjacent the exit end of the section, and a track relay receiving energy from the rails adjacent the exit end of said section and responsive to said track circuit current but not to said train governing current.

2. In combination, two sections of railway track, a track circuit for each section comprising a track transformer connected with the rails adjacent the entrance end of the section and a track relay connected with the rails adjacent the exit end of the section, a single transmission line for supplying alternating track circuit current of one frequency to both said transformers, and means for at times supplying alternating train governing current of a different frequency to the rails of each section adjacent the exit end of the section.

3. In combination, two parallel sections of railway track over which traffic normally moves in opposite directions, a track circuit for each section comprising a track transformer connected with the rails adjacent the entrance end of the section and a track relay connected with the rails adjacent the exit end of the section, a single transmission line for supplying alternating track circuit current of one frequency to both said transformers, and means for at times supplying alternating train governing current of a different frequency to the rails of each section adjacent the exit end of the section.

4. In combination, two successive sections of railway track, means for supplying each section with train controlling governing current of one frequency adjacent the exit end of the section, a track circuit for each section including a track relay located at the exit end of the section and a track transformer located at the entrance end of the section, and a single transmission line for supplying track circuit current to said transformer, said transformers being so connected that the currents supplied to the two said sec-

tions thereby are of opposite relative polarities in the two sections at a given instant.

5. In combination, two sections of railway track, a track transformer for each section connected with the rails adjacent the entrance end of the section trackway apparatus including a track relay for each section connected across the rails adjacent the exit end of the section, a single transmission line for supplying alternating current of one frequency to both said transformers, and means for each section controlled by the associated track relay and by traffic conditions in advance for supplying alternating train governing current of a different frequency to the rails of each section adjacent the exit end of such section.

6. In combination, two successive sections of railway track, two track transformers one connected with the rails adjacent the entrance end of each section, a single transmission line for supplying alternating current of one frequency to both said transformers, two two-element track relays each having one winding constantly supplied with energy from said transmission line and the other windings connected across the rails adjacent the exit ends of said two sections respectively, means for supplying alternating train governing current of a different frequency to the rails of each section adjacent the exit end of the section, and means for each section for preventing the energization of the corresponding relay by said train governing current.

7. In combination, two parallel railway tracks each divided into a plurality of successive sections and a train governing transformer for each section connected across the rails adjacent the exit end of the section, a first transmission line for supplying alternating train governing current of one frequency to all said train governing transformers, the circuits being such that the train governing currents in all said sections are of the same relative polarity at a given instant, a track transformer for each section connected with the rails adjacent the entrance end of the section, and a second transmission line for supplying alternating track circuit current of a different frequency to all said track transformers, the circuits being such that at a given instant the track circuit current in any section of either track is of the same relative polarity as the track circuit current in the adjacent section of the other track and of the opposite relative polarity to the track circuit currents in the two adjacent sections of the same track.

8. In combination, a section of railway track, a source of alternating track circuit current of one frequency connected with the rails adjacent the entrance end of said section, a relay responsive to traffic conditions in advance of said section, means controlled by said relay for supplying alternating train governing current of a different frequency to the rails adjacent the exit end of said section, and a track relay receiving energy from the rails adjacent the exit end of said section and responsive to said track circuit current but not to said train governing current.

9. In combination, a railway track divided into sections, a source of alternating track circuit current of one frequency connected with the rails adjacent the entrance end of each section, a track relay for each section connected with the rails adjacent the exit end of each section, and means controlled by each track relay for supplying alternating train governing current of a different frequency to the rails adjacent the exit end of the section next in the rear.

10. In combination, a railway track divided into sections, a source of alternating track circuit current of one frequency connected with the rails adjacent the entrance end of each section, a track relay for each section connected with the rails adjacent the exit end of each section, and means controlled by each track relay for supplying alternating train governing current of a different frequency to the rails adjacent the exit end of the section next in the rear each track relay being responsive to track circuit current but not to train governing current.

11. In combination, a railway track divided into sections, a source of alternating track circuit current of one frequency connected with the rails adjacent the entrance end of each section, a track relay for each section connected with the rails adjacent the exit end of each section, and means controlled by each track relay for supplying alternating train governing current of a different frequency to the rails adjacent the exit end of the section next in the rear each track relay being responsive to track circuit current but not to train governing current, and the train governing current being of the same frequency in each section.

In testimony whereof I affix my signature.

ROBERT M. GILSON.