May 3, 1927. 1,626,928

P. H. GEIGER

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Nov. 24, 1923 3 Sheets-Sheet 1

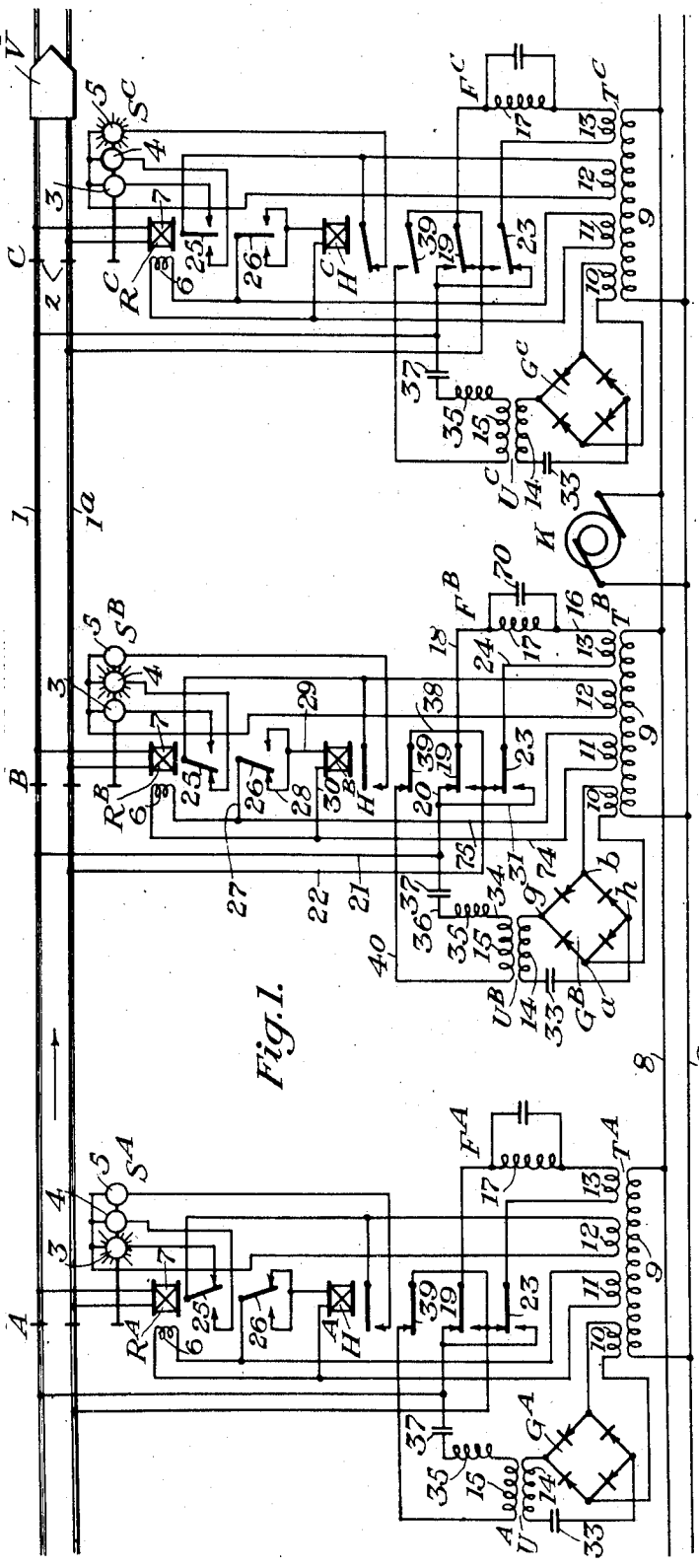


Fig. 1.

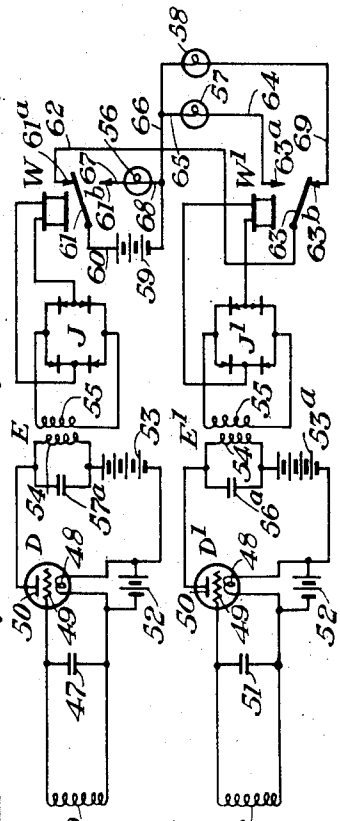


Fig. 2.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Nov. 24, 1923 3 Sheets-Sheet 2

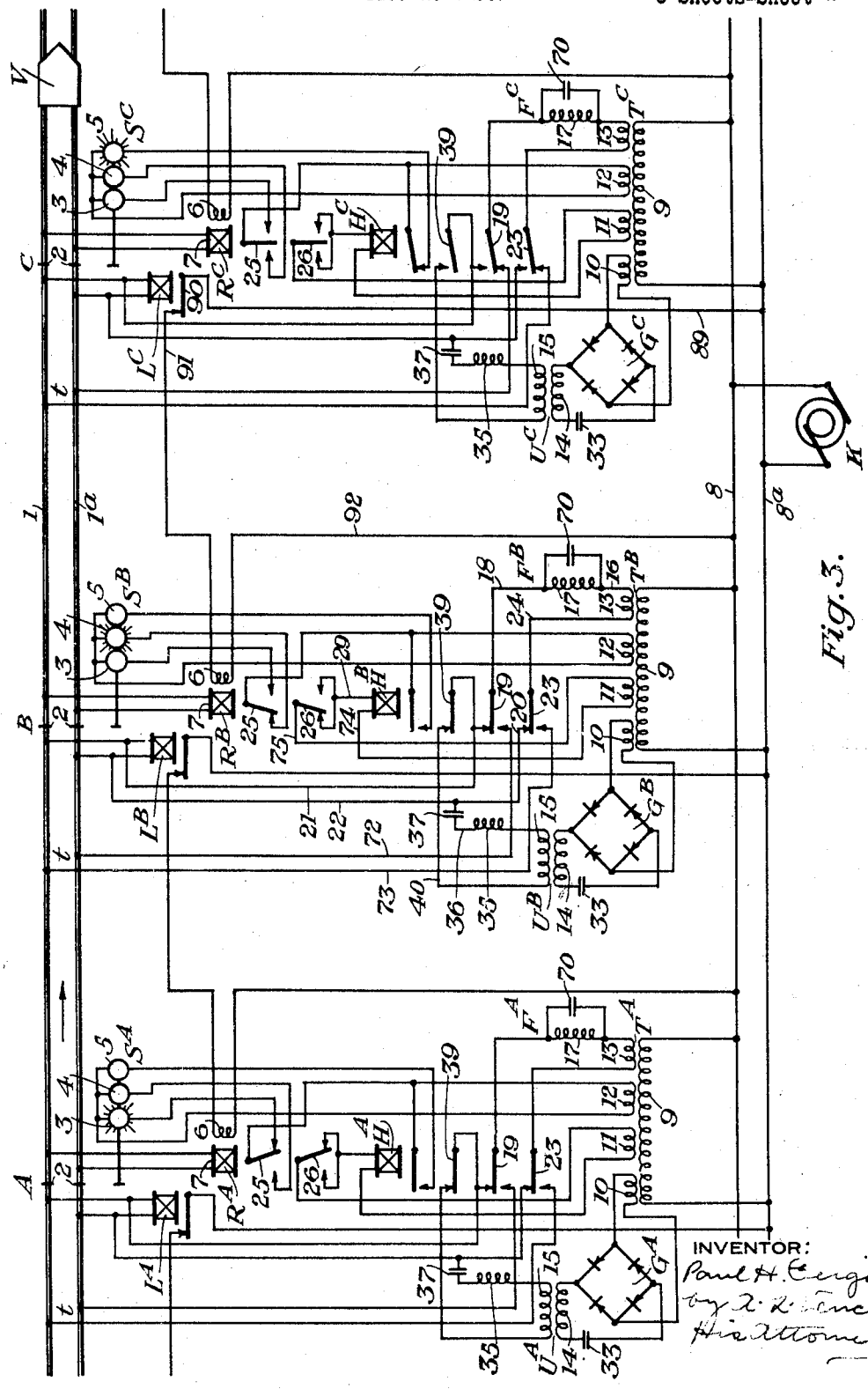


Fig. 3.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Nov. 24. 1923 3 Sheets-Sheet 3

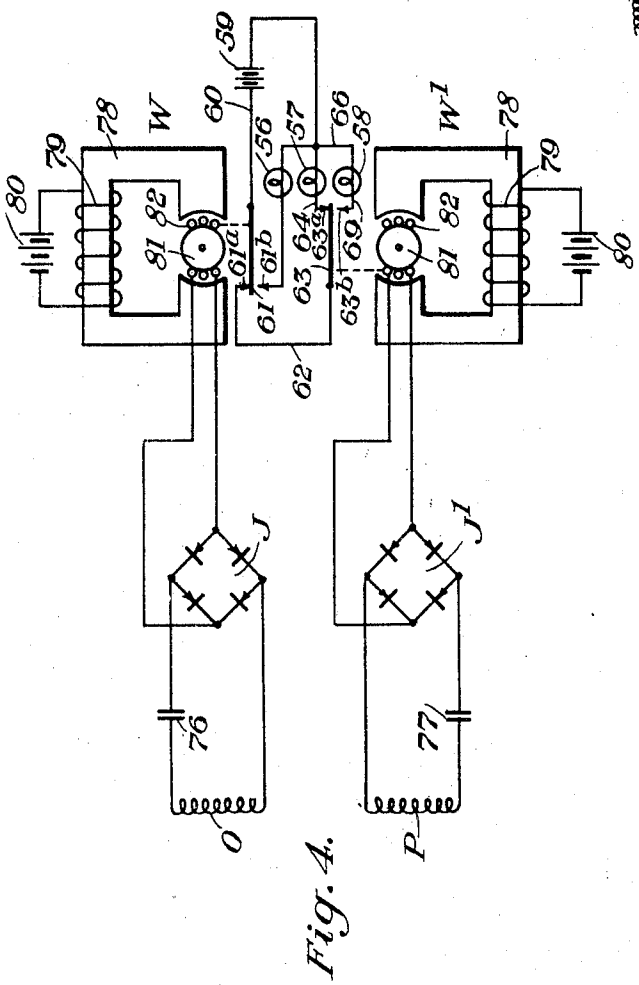


Fig. 4.

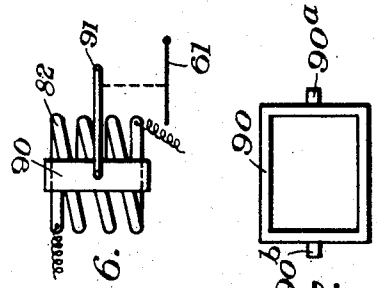


Fig. 6.

Fig. 7.

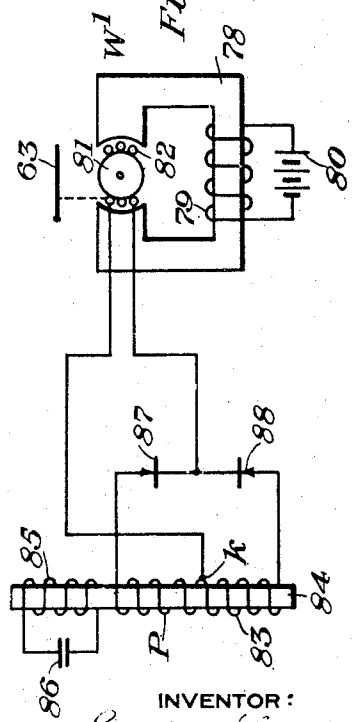


Fig. 5.

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Patented May 3, 1927. 1,626,928

UNITED STATES PATENT OFFICE.

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RAILWAY-TRAFFIC-CONTROLLING APPARATUS.

Application filed November 24, 1923. Serial No. 676,731.

My invention relates to railway traffic controlling apparatus of the type comprising train carried governing apparatus controlled by energy received from the trackway.

I will describe several forms of 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 illustrating one form of trackway apparatus embodying my invention. Fig. 2 is a view showing one form of train carried governing apparatus adapted to co-operate with trackway apparatus shown in Fig. 1. Fig. 3 is a view showing one modification of the apparatus shown in Fig. 1 and also embodying my invention. Figs. 4 and 5 are views showing two modifiations of the train carried apparatus of Fig. 2 and also embodying my invention. Figs. 6 and 7 are detail views showing the construction of relay W of Fig. 4.

Similar reference characters refer to similar parts in each of the several views.

Referring first to Fig. 1, the reference characters 1 and 1^a designate the track rails of a railway over which traffic normally moves in the direction indicated by the arrow. These track rails are divided by means of insulated joints 2 into a plurality of successive track sections A—B, B—C, etc. Each such track section is provided with a track relay designated by the reference character R with a suitable exponent. Each track relay comprises two windings 6 and 7. One winding 7 of each track relay R is connected across the rails adjacent the entrance end of the section. The remaining winding 6 of each track relay is constantly supplied with alternating current from secondary 11 of an associated line transformer designated by the reference character T with an exponent corresponding to the location. The primary winding 9 of each transformer T is constantly supplied with alternating current from some suitable source such as a generator K over line wires 8 and 8^a. It is therefore clear that contacts 25 and 26 of each track relay are responsive to the relative polarity of the alternating current which is supplied, as will be hereinafter explained, to the rails of the corresponding section.

Associated with each track relay R is an auxiliary relay designated by the reference character H with an exponent corresponding to the location. Referring particularly to relay H^B, this relay is de-energized when the corresponding track relay R^B is de-energized, but is energized when relay R^B is energized in either direction, the circuit for the relay passing from secondary 11 of transformer T^B, through wires 75 and 27, contact 26 of track relay R^B in the reverse or normal position, wires 28 and 29, winding of relay H^B, and wires 30 and 74 back to secondary 11 of transformer T^B.

The supply of track circuit current to each track section is controlled by the auxiliary relay for the section next in advance. For example, when relay H^B is de-energized a circuit is closed over which current flows from secondry 13 of transformer T^B, through wire 16, impedance 17 and condenser 70 in multiple, wire 18, back contact 19 of relay H^B, wire 22, rail 1^a of section A—B, through winding 7 of relay R^A or the wheels and axles of a train occupying section A—B, to rail 1 of the section, thence by wires 21, 20 and 31, back contact 23 of relay H^B, and wire 24 back to secondary 13 of transformer T^B. When this circuit is closed section A—B is supplied with track circuit current of one relative polarity which I will hereinafter term "reverse relative polarity". When relay H^B is energized, track circuit current flows from secondary 13 of transformer T^B, through wire 16, impedance 17 and condenser 70 in multiple, wire 18, front contact 19 of relay H^B, wires 20 and 21 to rail 1 of section A—B, thence as before to rail 1^a of the section, and wire 22, front contact 23 of relay H^B, and wire 24 back to secondary 13 of transformer T^B. When this circuit is closed section A—B is supplied with track circuit current of the other relative polarity which I will term "normal relative polarity". The frequency of each of these currents is of course the same as the frequency of the generator K. I shall hereinafter refer to this frequency as "low" frequency.

Means are also provided for at times supplying the rails with a track circuit current the frequency of which is different from that supplied by secondary 13. To accomplish this result each section is provided with a double wave rectifier designated by the reference character G with a distinguishing

exponent. This rectifier may be of any suitable form and as here shown is a copper oxide rectifier of the type described in an application for United States Letters Patent, Serial No. 1111 filed January 7, 1925 by Lars O. Grondahl for uni-directional current carrying devices, this application being a continuation of an earlier application, Serial No. 541733, filed March 7, 1922, by Lars O. Grondahl and Frank H. Nicholson relating to the same subject-matter. Referring particularly to rectifier G^B, the input terminals *a* and *b* of this rectifier are connected across secondary 10 of transformer T^B and the output terminals *g* and *h* are connected with primary 14 of an auxiliary transformer U^B. A condenser 33 is interposed between winding 14 and rectifier G^B for the purpose of counter-acting the reactive impedance of the winding 14 in its tendency to smooth out the pulsations of the current supplied by rectifier G. With this arrangement the alternating current supplied by secondary 10 of transformer T^B is changed by rectifier G^B into a pulsating uni-directional current the periodicity of which is twice the frequency of generator K. When this pulsating current flows through primary 14 of transformer U^B there is induced in the secondary 15 of this transformer an alternating electromotive force, the frequency of which is the same as the periodicity of the pulsating current flowing in primary 14 and hence is twice the frequency of generator K. I shall hereinafter refer to this frequency as "high" frequency.

When relay H^B is energized, secondary 15 of transformer U^B is connected with section A—B over a circuit which passes from secondary 15 through wire 34, impedance 35, wire 36, condenser 37, wire 21, rail 1 of section A—B, winding 7 of relay R^A or the wheels and axles of a train in the section, rail 1^a, wires 22 and 38, front contact 39 of relay H^B, and wire 40 back to secondary 15 of transformer U^B. Under these conditions, in addition to the track circuit current of normal relative polarity supplied to section A—B at the frequency of generator K by secondary 13 of transformer T^B, there is also supplied to section A—B by transformer U^B a track circuit current of twice the frequency of generator K. By means of reactive impedance 35 and condenser 37 the circuit including secondary 15 of transformer T^B is tuned to approximate resonance at twice the frequency of generator K. As a result this circuit offers a low impedance to the high frequency current but a high impedance to any low frequency current which may be flowing in the circuit.

The impedance 17 and condenser 70 which are inserted in circuit with secondary 13 are tuned to an approximate resonance at twice the frequency of generator K. The impedance 17 and condenser 70 therefore constitute a filter designated by the reference character F^B. The purpose of this filter is three-fold. First, it offers a high impedance to any high frequency current flowing through the circuit of secondary 13; second, it limits the output of secondary 13 when its terminals are short-circuited by the wheels and axles of a train occupying section A—B; third, it displaces the phase of the current flowing through the rails of section A—B with respect to the electromotive force supplied by secondary 13 and hence with respect to the current supplied by transformer U^B. This phase displacement is desirable to prevent improper operation of some types of track relays R which operate on the induction motor principle.

Located at the entrance end of each section is a trackway signal designated by the reference character S with an exponent corresponding to the location. Each signal S, as here shown, comprises three light units 3, 4 and 5 adapted when energized to indicate "proceed", "caution" or "stop", respectively. Each signal is controlled by the associated track relay in such manner that when this relay is energized in the normal direction contacts 25 and 26 are swung to the right and unit 3 is energized, when the associated track relay is energized in the reverse direction the contacts 25 and 26 are swung to the left and unit 4 is energized, and when the associated track relay is de-energized, contacts 25 and 26 assume an intermediate position, thus de-energizing the associated auxiliary relay H and energizing unit 5. Energy is supplied to the various units of each signal S from a secondary 12 of the associated line transformer T as will be clear from the drawing.

As shown in the drawing the section to the right of point C is occupied by a train V. Track relay R^C is therefore de-energized. As a result contact 26 of relay R^C occupies an intermediate position and interrupts the circuit for relay H^C which therefore becomes de-energized. The circuit for unit 5 of signal S^C is therefore closed and this signal displays a stop indication. At the same time the de-energization of relay H^C disconnects transformer U^C from the rails of section B—C and therefore interrupts the supply of high frequency current to this section. The circuit for secondary 13 of transformer T^C is closed however at back contacts 19 and 23 of relay H^C and section B—C is therefore supplied with low frequency track circuit current of reverse relative polarity. As a result relay R^B is energized in the reverse direction thus completing the circuit for unit 4 of signal S^B which displays a caution indication. The closing of reverse contact 26 of relay R^B also completes the circuit for relay H^B which is

therefore energized. Low frequency track circuit current of normal relative polarity is therefore supplied to the rails of section A—B by secondary 13 of transformer T^B, and high frequency track circuit current is also supplied to the rails of this section by transformer U^B. The low frequency track circuit current of normal relative polarity supplied to relay R^A picks up this relay in the normal direction thereby completing the circuit for unit 3 of signal S^A and causing this signal to display a proceed indication. Relay H^A is also energized and the supply of track circuit current to the section to the left of A is the same as that just described for section A—B.

Referring now to Fig. 3, the supply of low frequency track circuit current of normal relative polarity, and the supply of high frequency track circuit current, are controlled in the same manner as explained in connection with Fig. 1. When relay H^B is de-energized, however, low frequency track circuit current is supplied to section A—B over a circuit which passes from secondary 13 of transformer T^B, through wire 16, filter F^B, wire 18, back contact 19 of relay H^B, wire 72, rail 1^a of section A—B, winding 7 of track relay R^A or the wheels and axles of a train in the section, rail 1, wire 73, back contact 23 of relay H^B, wire 24 back to secondary 13 of transformer T^B. When relay H^B is de-energized, therefore, section A—B is supplied with low frequency track circuit current of reverse relative polarity between the entrance end of the section and an intermediate point t in the section. The control of relays H and signals S are the same as in Fig. 1.

It will thus be seen that the supply of track circuit current to section A—B is as follows: When section B—C is occupied low frequency current of reverse relative polarity is supplied to section A—B from the entrance end to an intermediate point in the section, and the supply of high frequency track circuit current is completely discontinued, and when section B—C is unoccupied, section A—B is supplied with low frequency current of normal relative polarity and with high frequency current throughout the length of the section.

In order to assure the de-energization of each track relay when the section next in advance is being supplied with track circuit current at point t, and a train is occupying the associated section between the exit end of the section and point t, I provide each section with an auxiliary track relay designated by the reference character L with an exponent corresponding to the location, and connected across the rails adjacent the exit end of the section. Each track relay L controls the supply of current to winding 6 of the track relay R connected with the entrance end of the corresponding section. Referring particularly to relay R^B, the circuit for this relay passes from line wire 8^a, through wire 89, front contact 90 of track relay L^C, wire 91, winding 6 of relay R^B, and wire 92 back to line wire 8. It is thus plain that relay R^B will be positively de-energized when a train occupies any portion of section B—C.

In the form of train carried governing apparatus illustrated in Fig. 2, the reference characters O and P designate two pick-up coils carried on the train and in inductive relation with the track rails. The energy induced in each of these pick-up coils O and P is amplified by some suitable form of amplifying apparatus here illustrated as electron tubes D and D′, respectively. Each of the amplifying devices D and D′ is provided with a filament 48, a grid 49 and a plate 50. Some suitable source of energy, as a battery 52 is provided for heating the filament 48 of each tube. Pick-up coil O is connected across filament 48 and grid 49 of tube D, and in similar manner pick-up coil P is connected across filament 48 and grid 49 of tube D′. The grid circuit of tube D is tuned to approximate resonance at the frequency of generator K by means of a condenser 47, and the grid circuit of tube D′ is tuned to approximate resonance at twice the frequency of generator K by means of condenser 51. Tube D is provided with a plate circuit including a source of direct current such as a battery 53 and the primary winding 54 of a transformer E, which winding is tuned, by means of a condenser 57^a, to resonance at the frequency of generator K. The secondary 55 of transformer E is connected through a rectifier J with the winding of a relay W. The plate circuit for tube D′ includes primary 54 of a transformer E′, similar to transformer E and a battery 53^a. Primary 54 of transformer E′ is tuned to resonance at twice the frequency of generator K by means of a condenser 56^a shunted across the winding. The secondary 55 of transformer E′ is connected through a rectifier J′ to the winding of relay W′.

It will be clear from the foregoing that when the train occupies a stretch of track which is supplied with low frequency track circuit current, that is, with track circuit current of the frequency of generator K, there will be induced in pick-up coil O an electromotive force which will be amplified by tube D and will cause a pulsating unidirectional current of similar frequency to be supplied to primary 54 of transformer E. The resulting alternating current induced in secondary 55 of transformer E is rectified by rectifier J, thus energizing relay W. Due to the tuning of the grid circuit and the plate circuit of tube D high frequency track

circuit current, that is, track circuit current which is supplied to the rails of a section by secondary 10 of a line transformer T in Figs. 1 or 3 will have no effect on relay W. This high frequency track circuit current will however induce in pick-up coil P a voltage which is effective to energize relay W', and due to the tuning of the grid circuit and the plate circuit of tube D', relay W' will not be affected by the presence of low frequency track circuit current in the stretch of track occupied by the train.

The relays W and W' may control any suitable form of governing apparatus. As shown in the drawing this apparatus comprises three indicators such as electric lamps 56, 57 and 58. These lamps may be provided with suitable indicia to inform the engineman of traffic conditions in advance. Lamp 57 is provided with a circuit which passes from a source of energy, here shown as a battery 59, through wire 60, front contact 61—61[a] of relay W, wire 62, front contact 63—63[a] of relay W', wire 64, lamp 57, and wires 65 and 66 back to battery 59. This circuit is closed only when relays W and W' are both energized, that is, when the train occupies a stretch of track which is being supplied simultaneously with low frequency and high frequency track circuit current, under which conditions lamp 57 is lighted to display a proceed indication. Lamp 58 is provided with a circuit which passes from battery 59, through wire 60, front contact 61—61[a] of relay W, wire 62, back contact 63—63[b] of relay W', wire 69, lamp 58 and wire 66 back to battery 59. This circuit is closed only when relay W is energized and relay W' is de-energized, that is, when the portion of track occupied by the train is being supplied with low frequency track circuit current but not with high frequency track circuit current. Under these conditions lamp 58 is lighted to display a caution indication. When the supply of low frequency current to the portion of track occupied by the train is interrupted, relay W is de-energized and current flows from battery 59, through wire 60, back contact 61—61[b] of relay W, wire 67, lamp 56, and wires 68 and 66 back to battery 59, thus displaying a stop indication.

As a train equipped with the apparatus illustrated in Fig. 2 passes through the stretch of track shown in Fig. 1 with a train V occupying the section to the right of C, the operation of the apparatus is as follows: As the train proceeds through the stretch it will be supplied with both high frequency and low frequency track circuit current as far as point B. Relays W and W' are therefore both energized and lamp 57 is lighted to give the engineman a proceed indication. As the train enters section B—C the interruption of the supply of high frequency track circuit current causes relay W' to become de-energized whereas relay W continues to be energized by low frequency track circuit current. Lamp 58 is therefore energized and a caution indication is received aboard the train. In the section to the right of C both the high frequency and low frequency track circuit currents are cut off by train V and so as the following train enters this section both relays W and W' are de-energized and lamp 56 is lighted to display a stop indication.

If a train equipped with the apparatus shown in Fig. 2 traverses the stretch of track shown in Fig. 3 with train V in the position shown, it will receive a proceed indication as far as point B, a caution indication between point B and point *t* in section B—C, and a stop indication to the right of this point *t*. It is obvious that point *t* may be located at any desired distance from point C so that it may be possible for the engineman to stop the train before entering the occupied section to the right of point C.

With relays W and W' constructed as shown in Fig. 4 the amplifying apparatus of Fig. 2 may be omitted. Referring particularly to relay W this relay is of the D'Arsonval moving coil type comprising a U-shaped magnetizable core 78 and a movable winding 82 interposed between the legs of this core. As shown in detail in Figs. 6 and 7, this coil 82 is supported in a suitable frame 90 pivotally supported at points 90[a] and 90[b] and provided with an arm 91 for operating a movable contact member 61. The reluctance of the magnetic circuit including core 78 may be reduced by means of a fixed magnetizable member 81 placed within the winding 82. A winding 79 supplied with current from a battery 80 serves to create a magnetic flux in core 78. The movable winding 82 of relay W is connected by means of a rectifier J with pick-up coil O, the circuit including the pick-up coil being tuned to resonance at the frequency of generator K as by a condenser 76. It will be plain that alternating current of the proper frequency induced in pick-up coil O will be translated by rectifier J into a pulsating uni-directional current which will flow through movable coil 82 of relay W. The reaction of this current and the flux through core 78 causes contact member 61 to be moved into the position shown in the drawing against the bias exerted by gravity thus closing its front contact 61—61[a]. When relay W is not being supplied with such pulsating current, as when the train occupies a stretch of track to which the supply of low frequency track circuit current is interrupted, member 61 moves downward under the influence of gravity to close its back contact 61—61[b]. Relay W' is similar to relay

W and its movable coil 82 is supplied with current through rectifier J′ from coil P. The pick-up coil P is tuned by means of condenser 77 to resonance at twice the frequency of generator K. Relays constructed in this manner are highly sensitive and may be made to operate on the small amounts of power transferred by induction from the track rails to the pick-up coils. Relays W and W′ of Fig. 4 control indicators 56, 57 and 58 in the same manner as in Fig. 2 and the operation of this apparatus will be understood without further explanation.

If the frequency of the track circuit currents are so chosen that iron core pick-up coils may be used, the pick-up circuits may be tuned as shown in Fig. 5. In this view the pick-up coil P comprises a magnetic core 84 and a winding 83 thereon. The core 84 also carries an auxiliary winding 85 which is tuned to resonance, by means of condenser 86 at the frequency of the current which it is desired to pick-up. The two terminals of winding 83 are connected by means of asymmetrical units 87 and 88 with one terminal of the movable winding 82 of relay W′. The other terminal of winding 82 is connected with the electrical midpoint *k* of winding 83. I have discovered that pick-up apparatus constructed in this manner is highly efficient.

Although I have herein shown and described only a few forms of 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. Railway traffic controlling apparatus comprising means responsive to traffic conditions in advance for at times supplying periodic current at one frequency to the track rails of a section, and for at times supplying said rails with alternating current of one relative polarity or the other at another frequency, and governing means responsive to said currents.

2. Railway traffic controlling apparatus comprising a stretch of railway track, means responsive to traffic conditions in advance for at times supplying periodic current of one relative polarity or the other at one frequency to the rails of the stretch, and for at times also supplying said stretch with periodic current at a different frequency, and governing means responsive to said currents.

3. Railway traffic controlling apparatus comprising a stretch of railway track, a circuit tuned to approximate resonance at one frequency for supplying periodic current of one relative polarity or the other to the trackway, a circuit tuned to approximate resonance at a different frequency for at times supplying periodic current to the trackway, and governing means responsive to said currents.

4. Railway traffic controlling apparatus comprising a stretch of railway track, a circuit tuned to approximate resonance at one frequency for supplying periodic current of one polarity or the other to the trackway, a circuit tuned to approximate resonance at a different frequency for at times supplying periodic current to the trackway, and train carried governing means responsive to said current.

5. Railway traffic controlling apparatus comprising a stretch of railway track, a source of periodic energy, means for at times supplying current of one frequency from said source to said stretch, and means for at times supplying said stretch with current of a different frequency from said source.

6. In combination, a stretch of railway track, and a single source of energy arranged to at times supply said stretch with periodic currents of two different periodicities simultaneously.

7. In combination, a stretch of railway track, a double wave rectifier having output terminals and input terminals, means for supplying alternating current to the input terminals of said rectifier, a transformer having its primary winding connected with the output terminals of said rectifier, and means responsive to traffic conditions for at times connecting the secondary winding of said transformer with the rails of said stretch.

8. In combination, a stretch of railway track, a double wave rectifier having output terminals and input terminals, means for supplying alternating current to the input terminals of said rectifier, a transformer having its primary winding connected with the output terminals of said rectifier, means responsive to traffic conditions for at times connecting the secondary winding of said transformer with the rails of said stretch, and governing apparatus responsive to current in said rails.

9. In combination, a stretch of railway track, a double wave rectifier having output terminals and input terminals, means for supplying alternating current to the input terminals of said rectifier, a transformer having its primary winding connected with the output terminals of said rectifier, means responsive to traffic conditions for at times connecting the secondary winding of said transformer with the rails of said stretch, and train carried governing apparatus responsive to the frequency of the current in said rails.

10. In combination, a stretch of railway track, a double wave rectifier having output

terminals and input terminals, means for supplying alternating current to the input terminals of said rectifier, a transformer having its primary winding connected with the output terminals of said rectifier, and means responsive to traffic conditions for at times connecting the secondary winding of said transformer with the rails of said stretch, and for at times supplying said stretch with alternating current of the same frequency as that supplied to said rectifier, and governing apparatus responsive to the frequency of the current supplied to said stretch.

11. Railway traffic controlling apparatus comprising a stretch of railway track, means for at times supplying said stretch with periodic current of one relative polarity or the other at one frequency, a signal for said stretch controlled by such current, means for at times supplying said stretch with periodic current of a different frequency, and train carried means responsive to currents flowing in such stretch.

12. Railway traffic controlling apparatus comprising a stretch of railway track, a source of periodic energy, means responsive to traffic conditions for at times supplying said stretch with alternating current of one frequency from said source, a trackway signal controlled solely by said current, means for at times supplying said stretch with alternating current of a different frequency from said source, and train carried governing means controlled by both said currents.

13. Railway traffic controlling apparatus comprising a source of periodic energy, means for at times supplying the trackway with alternating current of one frequency, static means including a rectifier for at times supplying the trackway with alternating current of a different frequency from said source, two electro responsive devices selectively responsive to said currents, and governing means controlled by said devices.

14. Railway traffic controlling apparatus comprising a source of periodic energy, means for at times supplying the trackway with alternating current of one frequency, static means including a rectifier for at times supplying the trackway with alternating current of a different frequency from said source, two electric circuits each including means responsive to one of said currents, and governing apparatus controlled by said circuits.

15. Railway traffic controlling apparatus comprising a source of periodic energy, means for at times supplying the trackway with alternating current of one frequency, static means including a rectifier for at times supplying the trackway with alternating current of a different frequency from said source, two pick-up circuits on a train each tuned to approximate resonance at the frequency of one of said currents, an electro responsive device associated with each such pick-up circuit, means for transferring energy from each pick-up circuit to the associated device, and governing means controlled by said devices.

16. Railway traffic controlling apparatus comprising a source of periodic energy, means for at times supplying the trackway with alternating current of one frequency, static means including a rectifier for at times supplying the trackway with alternating current of a different frequency from said source, two pick-up circuits on a train each tuned to approximate resonance at the frequency of one of said currents, an electro responsive device associated with each such pick-up circuit, a rectifier for transferring energy from each said pick-up coil to the associated device, and governing means controlled by said devices.

17. Railway traffic controlling apparatus comprising a source of periodic energy, means for at times supplying the trackway with alternating current of one frequency, static means including a rectifier for at times supplying the trackway with alternating current of a different frequency from said source, means on a train for receiving current induced by said currents in the trackway, means for amplifying said induced currents, and governing means controlled by such amplified induced currents.

18. Railway traffic controlling apparatus comprising a source of periodic energy, means for at times supplying the trackway with alternating current of one frequency, static means including a rectifier for at times supplying the trackway with alternating current of a different frequency from said source, two electroresponsive devices on a train, two electric circuits for receiving energy from the trackway, and a rectifier in each said circuit for transferring energy directly from the associated circuit to one of said devices.

19. Railway traffic controlling apparatus comprising a source of periodic energy, means for at times supplying the trackway with alternating current of one frequency, static means including a rectifier for at times supplying the trackway with alternating current of a different frequency from said source, two pick-up coils on a train for receiving energy at different frequencies from the trackway, a relay for each such coil, and a rectifier for transferring energy from each such coil to the associated relay.

20. Railway traffic controlling apparatus comprising a source of periodic energy, means for at times supplying the trackway with alternating current of one frequency, static means including a rectifier for at times supplying the trackway with alternating current of a different frequency from said

source, two pick-up coils in inductive relation with the trackway and each tuned to approximate resonance at the frequency of one of said currents, a relay for each said coil, and a rectifier for transferring energy directly from each said coil to the associated relay.

21. In combination, a stretch of railway track, means for at times supplying said stretch with alternating current; a train carried relay comprising a magnetic circuit, means for producing a magnetic flux in said circuit, and a movable conductor interposed in the path of flux; a pick-up coil on the train in inductive relation with the trackway, a rectifier for transferring energy from said coil directly to said conductor, and governing means controlled by said conductor.

22. In combination, a stretch of railway track, means for at times supplying said stretch with alternating current; a magnetic core on a train in inductive relation with the trackway, a relay, a first winding on said core connected with said relay, a second winding on said core tuned to approximate resonance at the frequency of said current for tuning said first winding and its circuit to approximate resonance at the frequency of said current, and governing means controlled by said relay.

23. In combination, a stretch of railway track, means for at times supplying said stretch with alternating current, a magnetic core on a train in inductive relation with the trackway, a relay, governing means controlled by said relay, a first winding on said core having its electrical mid point connected with one terminal of said relay by means of a conductor, and having its two extremities connected with the remaining terminal of said relay through asymmetrical units, and a second winding on said core tuned to approximate resonance at the frequency of said current for tuning said first winding and its circuit to approximate resonance at the frequency of said current.

24. In combination, a stretch of railway track, means for at times supplying said stretch with alternating current; a magnetic core on a train in inductive relation with the trackway, a relay on said train, a first winding on said core connected with said relay, a rectifier interposed between said first winding and said relay, governing means controlled by said relay, and a second winding on said core tuned to approximate resonance at the frequency of said current, for tuning said first winding and its circuit to approximate resonance at the frequency of said current.

25. Railway traffic controlling apparatus comprising a source of periodic energy, means for at times supplying the trackway with alternating current of one frequency, static means including a rectifier for at times supplying the trackway with alternating current of a different frequency from said source, two pick-up coils in inductive relation with the trackway and each tuned to approximate resonance at the frequency of one of said currents, a relay for each said coil, comprising a magnetic circuit having a unidirectional flux flowing therethrough and a movable conductor in said circuit, a rectifier for transferring energy from each said coil to the said conductor of the associated relay, and governing means controlled by said movable conductors.

26. Railway traffic controlling apparatus comprising a stretch of railway track, means for at times supplying the entire stretch with alternating current of one frequency and for at times supplying a portion only of the stretch with alternating current of a different frequency, and train carried governing means responsive to such currents.

27. Railway traffic controlling apparatus comprising a stretch of railway track, means for at times supplying a portion only of said stretch with alternating current of one relative polarity at one frequency, and for at other times supplying the entire stretch with current of the other relative polarity at the same frequency and with alternating current of a different frequency and governing means controlled by said currents.

28. Railway traffic controlling apparatus comprising a stretch of railway track, means for at times supplying a portion only of said stretch with alternating current of one frequency and for at other times supplying the entire stretch with alternating current of two different frequencies from a single source of periodic energy, and train carried governing means responsive to such currents.

29. Railway traffic controlling apparatus comprising a stretch of railway track, means for at times supplying a portion only of said stretch with alternating current of one frequency and for at other times supplying the entire stretch with alternating current of said one frequency and also with current of a different frequency, a trackway signal controlled by current of said one frequency, and train carried governing means responsive to currents of both said frequencies.

30. In combination, a stretch of railway track, an alternating current transformer having two secondary windings, means for at times connecting one said secondary directly with said stretch, and static means for at other times supplying said stretch from said second winding with current of a frequency different from that supplied to said transformer, and train carried governing means controlled by current in said stretch.

31. Railway traffic controlling apparatus comprising a transformer having a primary

supplied with alternating current of one frequency and two secondary windings, a circuit tuned to resonance at said one frequency for at times connecting one said secondary with the trackway, an auxiliary transformer and a rectifier for at times supplying alternating current of a different frequency to the trackway from said secondary, and train carried governing means controlled by current in the trackway.

32. Railway traffic controlling apparatus comprising a transformer having a primary supplied with alternating current of one frequency and two secondary windings, a circuit tuned to resonance at said one frequency for at times connecting one said secondary with the trackway, an auxiliary transformer and a rectifier for at times supplying alternating current of a different frequency to the trackway from the second said secondary, and train carried governing means responsive to the frequency of the current in said trackway.

33. In combination, a forward and a rear section of railway track, a relay arranged to be de-energized only when said forward section is occupied, means including a front contact on said relay for supplying the entire rear section with alternating currents of two different frequencies simultaneously, means including a back contact of said relay for supplying a portion only of said rear section with alternating current of one only of such frequencies, and train carried governing means responsive to the frequency of the current in said section.

34. In combination, a forward and a rear section of railway track, a track relay for each end of said forward section, means for at times supplying current to a portion only of said forward section, means for supplying alternating current to the entire rear section when both said relays are energized but to a portion only of said rear section when either of said relays is de-energized, and train carried governing means responsive to current in the trackway.

35. In combination, a section of railway track, means for at times supplying track circuit current to one end of said section and for at other times supplying track circuit current to an intermediate point in the section, a track relay connected with the rails adjacent one end of said section, a second track relay connected with the rails adjacent the other end of such section and controlled by said first track relay, and governing means controlled by said second relay.

36. Train carried receiving apparatus comprising a magnetic core, a relay, a first winding on said core and connected to said relay, a second winding on said core having tuned impedance means in circuit therewith to tune the first winding and its circuit, and governing means controlled by said relay.

37. Train carried receiving apparatus comprising a magnetic core, a relay, governing means controlled by said relay, a first winding on said core, a plurality of asymmetric units connected between one terminal of said relay and the ends of said first winding, a conductor connecting the electrical mid-point of the winding to another terminal of the relay, and a second winding on said core having a condenser in circuit therewith for tuning said first winding and its circuit.

38. A train carried receiver, comprising a magnetic core, a relay, a first winding on said core connected with said relay, a rectifier interposed between said first winding and said relay, governing means controlled by said relay, and a second winding on said core having a condenser in circuit therewith for tuning said first winding and its circuit.

In testimony whereof I affix my signature.

PAUL H. GEIGER.