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C. B. SHIELDS

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CAB SIGNAL APPARATUS

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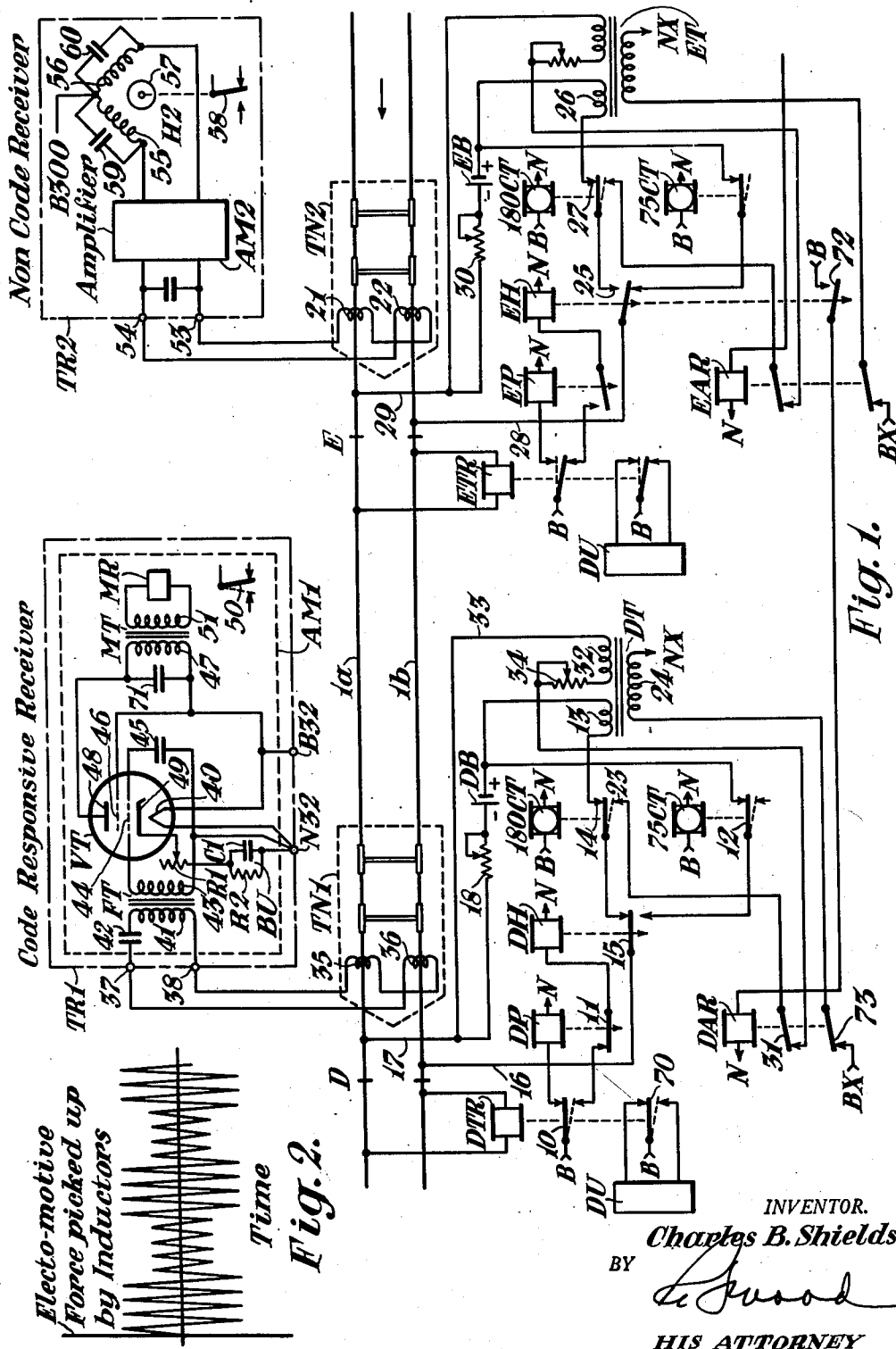


Fig. 2.

Fig. 1.

INVENTOR.

Charles B. Shields

BY

[Signature]

HIS ATTORNEY

UNITED STATES PATENT OFFICE

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CAB SIGNAL APPARATUS

Charles B. Shields, Penn Township, Allegheny County, Pa., assignor to Westinghouse Air Brake Company, a corporation of Pennsylvania

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7 Claims. (Cl. 246—63)

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My invention relates to cab signal apparatus, and more particularly to apparatus for operating both cab signal apparatus responsive to coded energy and cab signal apparatus responsive to non-coded energy.

There are two general types of continuous inductive cab signal systems in extensive use. One system uses alternating current coded by being periodically interrupted or varied at one or more code rates and the other system uses non-coded alternating current. In both of these types of systems track circuits are used, the track circuits being provided with means for supplying to the rails at the exit end of the track section an alternating current which is governed according to traffic conditions in advance of the section. Inductors are mounted on the train for inductive relation with the rails and the electromotive forces picked up by the inductors due to the alternating current flowing in the rails are applied to receiving apparatus or receiver responsive to the alternating electromotive forces. The receiver in turn governs the cab signal and other train control devices.

Some railroads may have divisions equipped with a cab signal system using coded alternating current and other divisions on which a system using non-coded alternating current is installed. On such a railroad a locomotive which is to be operated over the different divisions must be equipped with both forms of receiving apparatus if the cab signals are to be used. Again, a railroad may have a stretch of trackway that is used by the differently equipped locomotives. Also, a railroad having a cab signal installation in which non-coded alternating current is used may find it desirable to convert such an installation to a system using coded alternating current or vice versa. The conversion of such an installation requires some period of time and during the conversion period the locomotives must be equipped with both the old and the new form of receiving apparatus if cab signal protection is to be obtained during the conversion period.

In view of the foregoing conditions, a main object of my invention is the provision of improved apparatus which is operable to effectively influence both train carried receiving apparatus responsive to coded alternating current and receiving apparatus responsive to non-coded alternating current.

A more specific feature of my invention is the provision of improved trackway apparatus operable to cyclically supply to the rails of a track section alternating current having a predeter-

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mined root mean square value and alternating current having a root mean square value which is higher than said predetermined value by a given variation. In other words, during one half of a code period alternating current of a given low energy level is supplied to the rails and during the second half of the code period alternating current of a given high energy level is supplied to the rails, the difference between the low and high energy levels being at least equal to a given predetermined variation.

Other features, objects and advantages of my invention will appear as the specification progresses.

In practicing the invention the locomotives which operate over a division of a railroad equipped with a coded cab signal system would be equipped with receiving apparatus responsive to such coded alternating current and the locomotives which operate over a division on which a cab signal system using non-coded energy is installed would be equipped with receiving apparatus responsive to non-coded energy. A territory or stretch of track which is to be used in common by the different locomotives would be equipped with trackway apparatus embodying the invention and which trackway apparatus is operable to supply alternating current in a form that effectively influences both types of train carried receiving apparatus. The track of this territory or stretch that is to be used by all of the locomotives is formed into track sections each of which is provided with track circuit apparatus that includes a battery and a transformer as a source of supply, the transformer having three windings one of which is energized from an alternating current source of a convenient frequency, and the other two of which windings are used as secondary windings. One of the secondary windings is proportioned to supply a relatively low voltage and the other secondary winding is proportioned to supply a relatively high voltage. The low voltage secondary winding is connected across the rails in series with the track battery over a first position contact of a coding means. The high voltage secondary winding is connected across the rails over a second position contact of the coding means. Thus a low energy level alternating current is superimposed on the direct current of the battery during the one half of each code period that the first position contact of the coding means is closed and alternating current of a high energy level is supplied to the rails during the second half of each code period that the second position contact of the

coding means is closed. This results in an alternating current flowing in the rails at all times. During one half of each code period the energy level of the alternating current is of a low level and during the other half of each code period the energy level raises to a relatively high value there being at least a predetermined variation between the high and low energy levels of the alternating current. The low energy level for the alternating current is made sufficient to effectively influence the non-coded train carried receiving apparatus while the variation between the high and the low energy levels of the two half code periods is made sufficient to effectively influence the code responsive train carried receiving apparatus.

I shall describe one form of apparatus embodying my invention and shall then point out the novel features thereof in claims.

In the accompanying drawings, Fig. 1 is a diagrammatic view showing one form of apparatus embodying my invention when applied to a stretch of railway through which locomotives equipped with train carried receiving apparatus responsive to coded alternating current and locomotives equipped with train carried receiving apparatus responsive to non-coded alternating current operate. Fig. 2 is a diagram illustrating the characteristics of the electromotive forces applied to the train carried receiving apparatus by the trackway apparatus of Fig. 1.

Referring to Fig. 1, the reference characters 1a and 1b designate the track rails of a railroad over which traffic normally moves in the direction indicated by an arrow and which rails are formed into track sections by the usual insulated rail joints. Only the one section D—E and the adjacent ends of the adjoining sections are shown since these are sufficient for a full understanding of my invention. Each section is provided with a track circuit which includes a track relay connected across the rails at the entrance end of the section and a power source means connected across the rails at the exit end of the section. The track relay is a direct current code following relay identified by the reference character TR plus a prefix corresponding to its location. The power source means of each track circuit includes a track battery and a track transformer together with a coding means. The track battery is identified by the reference character B plus a prefix corresponding to the location and the transformer is indicated at T plus a prefix corresponding to the location. The coding means will be more fully described shortly.

Each track relay governs code detecting means which as here shown comprises two slow release relays and a decoding unit, the relays being identified by the reference characters P and H plus a prefix corresponding to the location and the decoding unit being shown conventionally at DU. Thus at each junction of the track sections there is located a trackway apparatus which comprises the track relay and its associated relays for the section in advance and the power source means for the track circuit of the section to the rear. In addition, the trackway apparatus at each junction location includes an approach controlled relay which is identified by the reference character AR plus a prefix corresponding to the location.

Looking at the location D, for example, the track relay DTR for the section in advance controls a slow release relay DP, the relay DP being supplied with an energizing pulse of current from

a source, the terminals of which are indicated at B and N, over a circuit completed at the front contact 10 of the track relay DTR. A second slow release relay DH is supplied with an energizing pulse of current over a circuit including back contact 10 of the track relay DTR and front contact 11 of the relay DP. Consequently the relays DP and DH are recurrently energized in response to code operation of the relay DTR and are retained picked up due to the slow release characteristics of the relays.

The relay DTR also governs a decoding unit DU over a contact 12, the arrangement being such that the decoding unit DU is effectively energized only when the relay DTR is operated at a preselected code rate which, as will appear hereinafter, is taken to be a rate of 180 cycles per minute.

The relay DH governs the supply of current to the track circuit of section D—E. With relay DH picked up, a circuit is formed for supplying coded current to the rails of the section D—E, the circuit being traced from the positive terminal of battery DB through a first secondary winding 13 of track transformer DT, a front or first position contact 14 of a coder 130CT, front contact 15 of relay DH, lead wire 16, rail 1b of section D—E and thence through the rail 1a, assuming that the train shown conventionally at TN1 is not present in the section D—E, the winding of track relay ETR at the entrance end of the section, rail 1a, lead wire 17 and a limiting resistor 18 to the negative terminal of battery DB. The coder 130CT may be any one of several known forms and it is here shown as of the relay type having an operating winding which is continuously supplied with current from the B—N source, and which coder when thus energized is operated to actuate the contact member alternately to engage the first position contact 14 and a second position contact 23 at a selected code rate. Preferably the coder 130CT is proportioned to operate its contact member at a code rate of 180 times per minute, such code rate being that in common use in cab signal systems, but some other code rate can be used. A primary winding 24 of the transformer DT is connected to a suitable source of alternating current, the terminals of which are indicated at BX and NX through a circuit completed at back contact 13 of relay DAR. This source of alternating current may be of any suitable frequency such as the usual 60 cycle commercial current, or it may be of a frequency of the order of 100 cycles per second which is commonly used in railway signal installations. Thus, an alternating current pulse from the secondary winding 13 of the transformer DT is superimposed on the code pulse of direct current from the battery DB during the code period that the contact 14 of coder 130CT is closed when the approach controlled relay DAR is released. The direct current component of this pulse of energy supplied to the rails causes operation of the track relay ETR, and the alternating current component is available for control of cab signals as will appear when the operation of the apparatus is described.

With the track relay ETR for the section D—E following code, its associated relays EP and EH are energized and picked up in the same manner that the relays DP and DH are picked up in response to code operation of the track relay DTR. Furthermore, the track relay ETR governs a de-

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coding unit DU in the same manner that the track relay DTR governs its decoding unit DU.

In the event the approach controlled relay DAR at location D is deenergized and released, in a manner to be explained hereinafter, a circuit for connecting the secondary winding 32 of the track transformer DT to the rails is completed, this circuit being traced from the right-hand terminal of secondary winding 32 through lead wires 33 and 17 to the rail 1a, and from the left-hand terminal of the secondary winding 32 through resistor 34, back contact 31 of relay DAR, second position contact 23 of coder 180CT, front contact 15 of relay DH and lead wire 16 to rail 1b. Thus, under this condition of the apparatus at the location D, pulses of alternating current from the secondary winding 32 are supplied to the rails during the half code period that the coder contact 23 is closed. The utility of this code pulse of alternating current will also be explained hereinafter.

In the event the section in advance of section D—E is occupied and the track relay DTR is shunted, the relays DP and DH are released, and with relay DH released closing its back contact 15, a pulse of direct current from the battery DB is supplied to the rails of the section D—E through a connection which extends from the positive terminal of battery DB through a front or first position contact 12 of a coder 75CT, back contact 15 of relay DH, lead wire 16, rail 1b, track relay ETR, assuming the train TN1 is not present, rail 1a and lead wire 17 and resistor 18 to battery DB. The coder 75CT is similar in construction to the coder 180CT except it is proportioned to operate its contact member to alternately engage its first and second position contacts at a code rate of 75 times per minute. Thus, when the section in advance of section D—E is occupied, code pulses of direct current of the 75 code rate are applied to the rails of the section D—E but no coded alternating current is applied to the rails. It follows that the direct current code following track relay ETR is operated at the 180 code rate when the section in advance of section D—E is unoccupied and is operated at the 75 code rate when the section in advance is occupied.

With the track relay ETR operated at either of the code rates, the associated code detecting relays EP and EH are energized and picked up, but the decoding unit DU associated with the relay ETR is effectively energized only when the relay ETR is operated at the 180 code rate.

The relay DH and the decoding unit DU at the location D and the relay EH and the decoding unit at the location E would be used for the control of wayside signals not shown, the wayside signals and the circuits being omitted in order to simplify the drawing since these circuits and wayside signals are not a part of my present invention.

The relay EH and the approach controlled relay EAR at location E govern circuits for the supply of current to the rails of the section next in the rear of section D—E in the same manner that the relay DH and the approach controlled relay DAR control the code pulses of current applied to the rails of the section D—E and the description need not be repeated.

It is to be pointed out that the approach controlled relay DAR at location D may be governed by any one of several well-known arrangements of approach control and in the present application the relay DAR is normally energized and picked up over a line circuit including front

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contact 12 of relay EH so that when a train enters the section D—E and relay EH is released the relay DAR is deenergized and released closing its back contacts 31 and 13. In a similar manner the approach controlled relay EAR is normally energized and picked up, and is deenergized and released in response to a train entering the section next in the rear of section D—E.

The trains shown conventionally at TN1 and TN2 are each equipped with cab signal receiving apparatus responsive to alternating current flowing in the rails. Each train has mounted thereon a pair of inductors for receiving an electromotive force inductively due to alternating current supplied to the rails. For example, a pair of inductors 35 and 36 are mounted on train TN1 ahead of the leading pair of wheels for inductive relationship to the rails and thus these inductors pick up electromotive forces in response to alternating current flowing in the rails. Inductors 35 and 36 are connected in series in such a manner that the electromotive forces induced therein due to alternating current flowing in the rails in opposite directions at any given instant are additive. The inductors 35 and 36 are connected across the input terminals 37 and 38 of the receiving apparatus which is indicated as a whole by the dot and dash rectangle TR1. This receiving apparatus or receiver TR1 for train TN1 may be any one of several arrangements of receiving apparatus responsive to alternating current periodically interrupted or varied at a given code rate. The receiver TR1 may be, for example, similar to that disclosed in Letters Patent of the United States No. 2,462,454, granted February 22, 1949, to Leslie R. Allison, for Train Carried Cab Signal Apparatus, and reference is made to this patent for a full understanding of such receiving apparatus. It is sufficient for the present application to point out that the receiving apparatus TR1 includes an amplifier unit provided with a code following relay which is operated in response to the electromotive forces picked up by the inductors 35 and 36. The relay in turn is used to govern decoding means which in turn control cab signals and train control devices.

The amplifying unit of the receiving apparatus TR1 is indicated as a whole by the dash rectangle AM1 and this amplifying unit includes as essential elements an input or filter transformer FT, an electron tube VT, a master or output transformer MT, and a code following relay MR, together with a proper source of power. Preferable the power source for the receiving apparatus TR1 is the 32 volt train lighting source, the terminals of which are indicated in the drawing at B32 and N32, terminal B32 being the positive terminal.

The tube VT is shown as an indirectly heated tetrode, the heater 40 of which is connected directly across the power source so that the tube is constantly heated. The tube VT is designed and constructed for operation from a 32 volt source, but it is to be understood that the invention is not limited to this type of tube and other types of tubes can be used.

The input transformer FT is provided with a first winding 41 which, in series with a capacitor 42, is connected across the input terminals 37 and 38 for receiving the electromotive forces from the inductors. A second winding 43 of this transformer is included in a tuned circuit comprising control grid 44 of the tube VT and a capacitor 45, the tube VT being preferably of a construction

such that two terminals are provided for the control grid 44, one connected to each end of the grid. The two circuits associated with the transformer FT are tuned to resonance at the frequency of the alternating current supplied to the rails and current of some other frequency flowing in the rails is substantially suppressed insofar as the effect on the receiving apparatus is concerned.

A screen grid 46 of the tube is connected to the positive terminal B32 and the tube is provided with an anode-cathode circuit that extends from terminal B32 through a primary winding 47 of the master transformer MT, anode 48 and tube space to cathode 49, a resistor R1, and a biasing unit BU to the negative terminal N32. The biasing unit BU consists of a resistor R2 and a capacitor C1 in multiple. The winding 47 is provided with a by-pass capacitor 71.

The lower terminal of the winding 43 of the filter transformer FT is connected to the negative terminal of the power source. The parts are preferably proportioned for the anode-cathode current to have a substantially zero value when no electromotive force is impressed upon the receiving terminals of the apparatus.

The relay MR is preferably a stick polar relay operated to reversely actuate its polar armature 50 in response to electromotive forces of opposite polarity and of a given value applied to the relay winding, and which winding is connected across a secondary winding 51 of the output transformer MT. Thus the relay MR is operated to one position by the electromotive force induced in secondary winding 51 due to an increase in the anode current flowing in primary winding 47, and is operated to its second position due to the electromotive force induced in secondary winding 51 due to a decrease in the anode current, the relay being operated only when the variation of the anode current equals a predetermined value. In other words, the relay MR is operated in response to variations in the anode current of the tube VT of a predetermined magnitude. That is to say, the relay MR is operated in response to variations in the direct current component of the anode current for the tube VT, the alternating component of the anode current being by-passed by the capacitor 71. Consequently when the anode current for the tube VT is not varied and when the variation is less than a predetermined value, the relay MR remains at the position at which it was last moved.

As explained in the aforementioned Allison patent the relay MR by its operation governs the decoding means for the cab signal apparatus, the decoding means being controlled according to the rate at which the relay MR is operated.

Similarly, the train TN2 is provided with two inductors 21 and 22 which are connected to the input terminals 53 and 54 of the train carried receiving apparatus or receiver TR2 for supplying to the receiving apparatus the electromotive forces picked up due to the alternating current flowing in the rails.

The receiving apparatus or receiver for the train TN2 is indicated as a whole by the dot and dash rectangle TR2, and it may take any one of several different arrangements, and it may be similar to that disclosed in Letters Patent of the United States No. 1,566,331, granted December 22, 1925, to Lloyd V. Lewis, for Railway Traffic Controlling Apparatus, reference being made to this patent for a full understanding of such train carried receiving apparatus.

It is sufficient for the present application to

point out that the receiver TR2 includes an amplifier AM2 and a relay H2, the relay H2 in turn governing the cab signals and other train control devices. The amplifier AM2 is shown conventionally and it is of the electron tube type and as disclosed in the aforementioned Lewis patent, it comprises two separate two-stage amplifiers the input circuits of which are connected in multiple across the input terminals 53 and 54 and which amplifiers are arranged for the output of one amplifier to be shifted in phase with respect to the output of the other amplifier.

The relay H2 is of the induction motor type having two stationary windings 55 and 56 and a rotor 57, and to which rotor a contact member 58 is operatively connected. One winding 55 in multiple with a capacitor 59 is interposed between a power source terminal indicated at B300, and the anodes of the tubes of one of the two separate amplifiers for energization of the winding 55 in response to the alternating current produced in the output of this amplifier. The other winding 56 in multiple with a capacitor 60 is interposed between the B300 power terminal and the anodes of the tubes of the other amplifier and is energized by the alternating component of the anode current of this amplifier. The connections of the two separate amplifiers are arranged so that the currents supplied to the two relay windings 55 and 56 are shifted in phase and it follows that the rotor 57 is rotated from its biased position to its other position when the output currents of the amplifiers are of a predetermined value. Consequently, the contact member 58 of the relay H2 is operated from a biased position to a second position when the alternating current supplied to the input terminals 53 and 54 of the receiving apparatus TR2 has a predetermined root mean square value, the contact member 58 being held in the second position as long as the alternating current applied to the input terminals does not fall below this root mean square value.

In describing the operation of the apparatus, I shall first consider the operation of the receiving apparatus for the train TN1, and I shall assume that the train TN1 is moving through the section D—E when the section next in advance is unoccupied. Under this traffic condition, the relay DH is picked up and the approach controlled relay DAR is released. During one code period of coder 130CT, the alternating voltage from secondary winding 13 is supplied to the rails causing a given value of alternating current to flow in the rails, the current flowing down one rail and through the wheels and axles of the train and back the opposite rail. As explained hereinbefore, the alternating voltage of the secondary winding 13 is of a low value and the electromotive force picked up by the inductors 35 and 36 due to the low value of alternating current when applied to the amplifier AM1 creates a variation in the anode current of the tube VT which induces a voltage in the secondary winding 51 of the transformer MT of a value too small to operate the relay MR. That is to say, the alternating current supplied to the rails from the secondary winding 13 during this code period is ineffective to operate the relay MR of the train TN1. During the code period the contact 23 of coder 130CT is closed, alternating current from the secondary winding 32 is supplied to the rails. The value of this current is greater than that supplied by the secondary winding 13 and the variation of the anode current caused by the electro-

motive force picked up by the inductors is great enough to cause a variation in the anode current for the tube VT that induces an impulse of electromotive force in secondary winding 51 great enough to cause operation of the relay MR. To put it another way, the increase in the anode current at the beginning of the code pulse of current supplied by the secondary winding 32 is great enough so that the electromotive force induced in secondary winding 51 is great enough to operate the relay MR to a corresponding position. At the end of this code period, the coder shifts its contacts and current is no longer supplied by the secondary winding 32, and the decrease in the anode current caused to flow in the tube VT is great enough to induce an impulse in secondary winding 51 sufficient to operate the relay MR back to its first position. Consequently the relay MR is operated at the 180 code rate and a clear cab signal is provided to indicate that the section next in advance is unoccupied.

I shall next assume that the section next in advance of section D—E is occupied and the relay DH is released during the time the train TN1 is moving through the section D—E. Under this traffic condition the secondary windings 13 and 32 of the transformer DT are disconnected at front contact 45 of relay DH and only pulses of direct current from the battery DB of the 75 code are applied to the rails with the result the relay MR of the train TN1 is inactive and a slow speed cab signal is provided to indicate that the section next in advance is occupied. Similarly, if another train occupies section D—E in advance of the train TN1, the train in advance shunts all current away from the train TN1 and the relay MR is inactive and a slow speed cab signal is provided. It is to be pointed out that the cab signal system here under consideration is of the type that provides only the two indications, a clear cab signal when at least one section in advance is unoccupied, and a slow speed cab signal when the section next in advance is occupied, and also when the section being traveled is occupied by a train ahead.

I shall next describe the operation of the receiving apparatus for the train TN2, and in this connection I shall assume that the train TN1 is not present and that the train TN2 moves from the position shown in Fig. 1 to enter the section D—E while the section in advance of D—E is unoccupied. Under this traffic condition the trackway apparatus at location D functions to supply alternating current from the secondary winding 13 to the rails during the code period the contact 44 of coder 138CT is closed and to supply alternating current from the secondary winding 32 of transformer DT to the rails during the code period that the contact 23 of coder 138CT is closed. In response to this rail current, the electromotive force picked up by the inductors 21 and 22 of the train TN2 is of the form indicated by Fig. 2. That is, during one half code period the alternating current in the rails has a relatively low energy level and during the other half code period the alternating current flowing in the rails has a relatively high energy level. The parts of the receiving apparatus TR2 of train TN2 are proportioned for the relay H2 to be operated in response to the output of the amplifiers when the low energy level electromotive force is applied to the input terminals 53 and 54 and consequently it will be held in this position also during the half code period that the alternating current is of

the high energy level. Thus relay H2 of the train TN2 is held in its operated position continuously during the time the train is moving through the section D—E when alternating current first from secondary winding 13 and then from secondary winding 32 is supplied to the rails through the trackway apparatus at location D.

In the event the section in advance of section D—E is occupied and relay DH is released when the train TN2 moves into the section D—E, only code pulses of direct current are supplied to the rails and thus the relay H2 is deenergized and moves to its biased position to effect a slow speed cab signal for the train TN2.

It is to be pointed out that when either train TN1 or train TN2 moves out of the section D—E and coded direct current is supplied to the rails, this coded direct current of either the 75 code or the 180 code is effective to operate the track relay ETR so that the apparatus is restored to its normal position.

Although I have herein shown and described but one form of cab signal 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 through which trains equipped with cab signal apparatus responsive to alternating current flowing in the track rails are operated; said cab signal apparatus of at least one of said trains including an inductor, an amplifier and a relay operable in response to a preselected root mean square value of alternating current of a selected frequency flowing in the rails; said cab signal apparatus of at least one other of said trains including an inductor, an amplifier and a relay operable in response to a given code rate of occurrence of a given variation of the root mean square value of the alternating current of said selected frequency flowing in the rails; said given variations being in the form of a square wave type modulation of said alternating current of said selected frequency; an alternating current source of said selected frequency, a coding device operable to cyclically operate a pair of contacts at said given code rate, circuit means including said source and said pair of contacts for cyclically supplying to the rails of said section alternating current of a high and a low energy level, the modulation of said alternating current being of the square wave type, said low energy level of current being of at least said preselected root mean square value, and said high energy level of current being of a root mean square value greater than said preselected value by at least said given variation.

2. In combination, a section of railway track through which trains equipped with cab signal apparatus responsive to an alternating electromotive force are operated, each of said trains having an inductor connected to its cab signal apparatus and mounted for inductive relation to the track rails, said cab signal apparatus of at least one of said trains including an amplifier and a relay operable in response to an alternating electromotive force of a selected frequency and having at least a given root mean square value supplied thereto, said cab signal apparatus of at least one other train including an am-

plifier and a relay operable in response to an alternating electromotive force of said selected frequency and having at least a given variation in its root mean square value occurring at a given code rate and in the form of a square wave supplied thereto, a source of alternating current of said selected frequency, a coding device operable to alternately close a first and a second contact at said given code rate, a transformer having a primary winding receiving current from said source and provided with a first and a second secondary winding, circuit means including said first and second contacts to alternately connect said first and second secondary windings to the rails of said section, said first secondary winding supplying current effective to induce in the inductor of a train an electromotive force having said given root mean square value, and said second secondary winding supplying current effective to induce in the inductor of a train an electromotive force having a root mean square value greater than said given value by at least said given variation, said given variation being in the form of a square wave modulation of said alternating electromotive force of said selected frequency.

3. In combination, a section of railway track through which trains equipped with cab signal apparatus responsive to an alternating electromotive force are operated; the apparatus of a certain one of said trains including an amplifier and a relay and being operative to provide a clear signal indication only when an alternating electromotive force of a selected frequency and of at least a preselected root mean square value is applied thereto; the apparatus of a certain other one of said trains including an amplifier and a relay and being operative to provide a clear signal indication only when an alternating electromotive force of said selected frequency and having a given code rate of a given variation in its root mean square value is applied thereto, said given variation occurring in the form of a square wave modulation of said alternating electromotive force of said selected frequency, a source of alternating current of said selected frequency, a coding device operable to alternately close a first and a second contact at said given code rate, a transformer having a primary winding receiving current from said source and provided with a first and a second secondary winding, a first and a second circuit means including said first and second contacts respectively to connect said first and second secondary windings respectively to the rails of said section, each said train provided with an inductor connected to its cab signal apparatus and mounted for inductive relation to the track rails, said first secondary winding supplying a current effective to induce in the inductor of a train an electromotive force of said preselected root mean square value, and said second secondary winding supplying a current effective to induce in the inductor of a train an electromotive force having a root mean square value greater than said preselected value by at least said given variation.

4. In combination, a track section, a source of alternating current of a selected frequency, a coding device operable to alternately close a first and a second contact at a given code rate, a transformer having a primary winding receiving current from said source and provided with a first and a second secondary winding, a first circuit including said first contact to connect said first secondary winding across the rails of

said section, a second circuit including said second contact to connect said second secondary winding across the rails of said section, said first secondary winding adapted to supply alternating current of at least a given low energy level to the rails, and said second secondary winding adapted to supply alternating current of at least a given high energy level to the rails and which high energy level is greater than said low energy level by at least said given variation, the form of said variation being on the order of a square wave modulation of said alternating current.

5. In combination, a track section through which trains normally move in a given direction, a code following direct current relay connected across the rails at the entrance end of said section, a battery, a source of alternating current of a selected frequency, a transformer having a primary winding receiving current from said alternating current source and provided with a first and a second secondary winding, a coding device operable to alternately close a first and a second contact at a given code rate, a first circuit including said first contact to connect said battery and said first secondary winding in series across the rails at the exit end of said section, a second circuit including said second contact to connect said second secondary winding across the rails at the exit end of said section, said battery supplying direct current for operating said relay when the section is unoccupied, said first and second secondary windings supplying alternating current of a low and high energy level respectively for operating cab signal apparatus responsive to non-coded alternating current of said selected frequency and having at least a given root mean square value and cab signal apparatus responsive to alternating current of said selected frequency and coded to have a given variation in its root mean square value, said given variation being in the form of a square wave modulation of said alternating current of said selected frequency.

6. In combination, a track section through which trains normally move in a given direction, a given one of said trains equipped with cab signal apparatus including an amplifier and a relay responsive to alternating current of a selected frequency and coded by being recurrently varied in its magnitude at a given code rate, said variation to be of at least a given value and in the form of a square wave type modulation of said alternating current of said selected frequency, another one of said trains equipped with cab signal apparatus including an amplifier and a relay responsive to alternating current of said selected frequency and non-coded and of at least a given magnitude, a source of alternating current of said selected frequency, transformer means receiving energy from said source and having a first and a second secondary winding, a coding device having a first and a second contact and operable to alternately close said contacts at said given code rate, a first circuit including said first contact to connect said first secondary winding across the rails of said section, a second circuit including said second contact to connect said second secondary winding across the rails of said section, said first secondary winding proportioned to supply alternating current of at least said given magnitude, said second secondary winding proportioned to supply alternating current having a magnitude which varies from said given magnitude by at least said given value, each of said trains equipped

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with an inductor connected to its cab signal apparatus and mounted for inductive relation to the rails to supply to the cab signal apparatus an alternating voltage having the characteristics of the alternating current supplied to the rails, said characteristics including said square wave modulation at said given code rate.

7. In combination, a section of railway track through which trains equipped with cab signal apparatus responsive to alternating current flowing in the track rails are operated; said cab signal apparatus of at least one of said trains including an inductor, an amplifier and a relay operable in response to a preselected root mean square value of alternating current of a selected frequency flowing in the rails; said cab signal apparatus of at least one other of said trains including an inductor, an amplifier and a relay operable in response to a given code rate of occurrence of a given variation of the root mean square value of the alternating current of said selected frequency flowing in the rails, said given variation being in the form of a square wave type modulation of said alternating current of said selected frequency; an alternating current source of said selected frequency, a coding device having a contact controlling member which is cyclically operated to a first and a second position at said given code rate, a transformer,

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circuit means including said contact member and said transformer to connect said source across the rails of said section, said circuit means including means controlled by said contact member to cause the alternating current supplied to the rails to be of a low or a high energy level according as said contact member is operated to its first or its second position, said low energy level of said current being of at least said preselected root mean square value, and said high energy level of said current being of a root mean square value greater than said preselected value by at least said given variation, said given variation occurring in the form of said square wave modulation of said alternating current.

CHARLES B. SHIELDS.

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