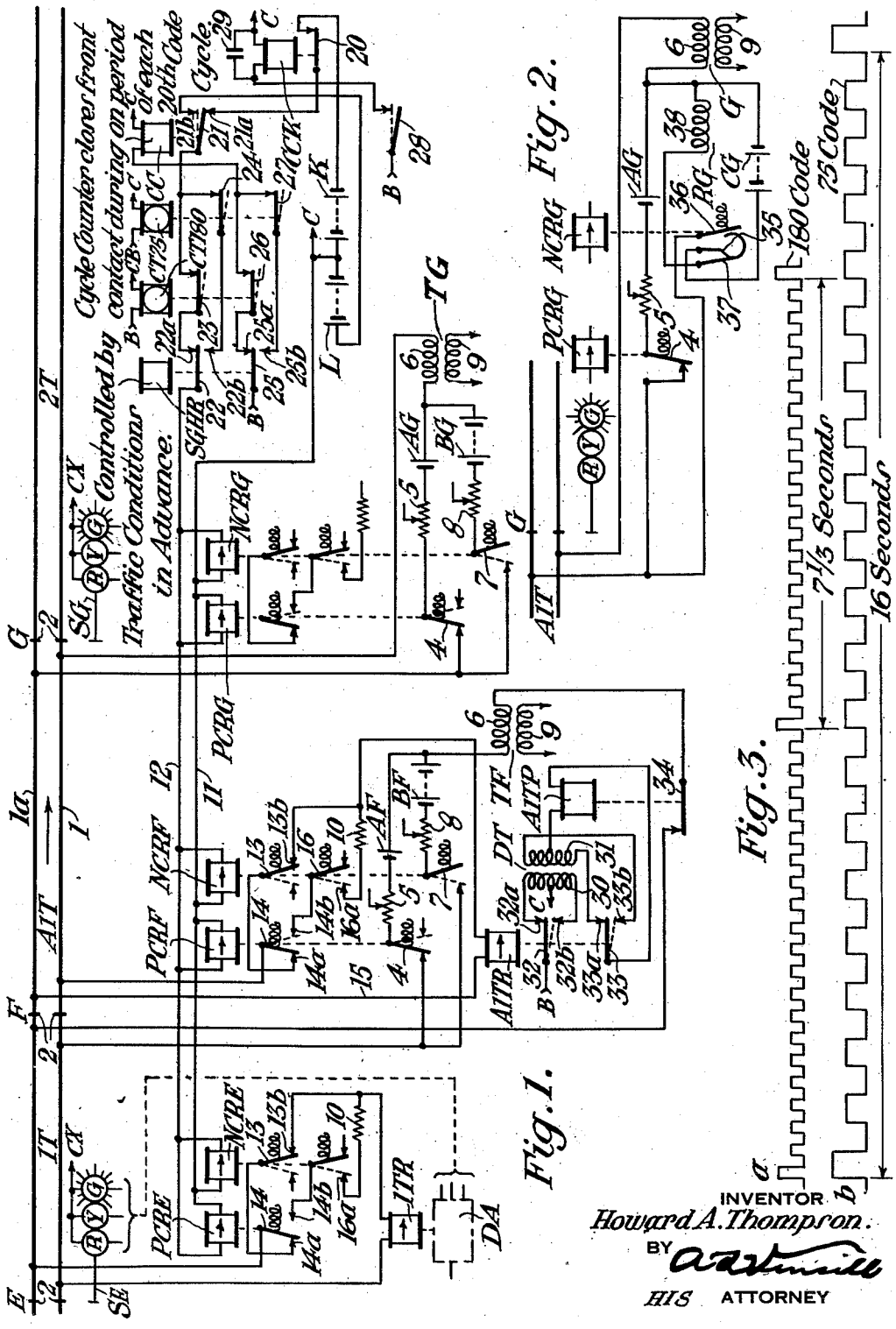
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RAILWAY TRAFFIC CONTROLLING APPARATUS

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RAILWAY TRAFFIC CONTROLLING APPARATUS

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My invention relates to railway traffic controlling apparatus, and particularly to apparatus employing track circuits supplied with periodically interrupted or coded current for controlling wayside and/or cab signals.

One object of my invention is to provide means for periodically increasing the voltage of the coded energy supplied to the track circuits to increase their shunting sensitivity without unduly increasing the wear on the contacts of the relays employed to interrupt or code the track circuit current.

Another object of my invention is to provide a sensitive shunting track circuit requiring a minimum amount of track circuit power.

According to my invention, I provide in connection with each track circuit two polar biased code repeating relays one of which responds only to current of positive polarity and the other of which responds only to current of negative polarity. When either relay is energized, an "on" period of a code cycle is established, but the voltage impressed on the track circuit when the negative relay is energized is considerably higher than that impressed on the track circuit when the other relay is energized. The necessary track circuit energy may be obtained either from suitable batteries or from an impulse transformer. The code repeating relays for several track circuits may all be controlled in multiple over a single line circuit which is arranged to be supplied with coded current of positive or negative polarity depending upon whether one or another contact of a cycle counting relay is closed. The cycle counting relay is energized in step with the coded current supplied to the code repeating relays over the line circuit, and is arranged to cyclically operate its contacts in such manner that said other contact will become closed, usually for one cycle say every tenth or twentieth code cycle, and said one contact will be closed during the remainder of the time. When the positive code repeating relay is energized, the track relay for the associated track circuit is connected directly to the track circuit, whereas, when the negative code repeating relay is energized, a resistor unit is connected in series with the track relay to prevent its over energization. The selection of the different codes to the line circuit may be made by the usual home relay. The operation of the counting relay may be checked by a checking relay which acts to open the line circuit when it becomes deenergized. This checking relay may be controlled over a contact of the counting relay which is closed only when said one contact is closed, and this relay is made sufficiently slow releasing by a condenser or otherwise so that it holds its front contact closed as long as the counting relay continues to cyclically operate its contacts.

Other objects and characteristic features of my invention will become apparent as the description proceeds.

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

In the accompanying drawing, Fig. 1 is a diagrammatic view showing one form of apparatus embodying my invention. Fig. 2 is a diagrammatic view showing a modification of a portion of the apparatus illustrated in Fig. 1, and also embodying my invention. Fig. 3 is a diagrammatic view showing the nature of the coded track circuit current obtained with my invention.

Similar reference characters refer to similar parts in all views.

Referring first to Fig. 1, the reference characters 1 and 1*a* designate the track rails of a stretch of railway track over which traffic normally moves in the direction indicated by the arrow, that is to say, from left to right in the drawing. These rails are divided, by means of insulated joints 2, into blocks, only one of which E—G is shown complete in the drawing, and this block, in turn, is further divided at point F by means of other insulated joints 2 to form two sections 1T and A1T separated by a cut section.

Traffic entering each block is controlled by a signal designated by the reference character S with a distinguishing suffix corresponding to the location. These signals may be of any suitable type, but in the well-known form here shown these signals are color light signals and each comprises a red lamp R, a yellow lamp Y, and a green lamp G, which lamps when illuminated indicate "stop," "approach" and "clear" respectively.

Associated with block E—G is a line circuit comprising two line wires 11 and 12. This line circuit is arranged to be supplied with current of positive polarity from a suitable source such as a battery K, or with current of negative polarity from a suitable source such as a battery L according as the back contact 21—21*a* or the front contact 21—21*b* of a cycle counting relay CC is closed, and the current thus supplied to the line circuit is arranged to be periodically interrupted or coded by the contact 23 of a coding device CT—180 or the contact 24 of a coding device CT—75 according as the front contact 22—22*a*

or the back contact 22—22*b* of a signal control relay SGHR is closed.

The signal control relay SGHR is the usual home relay employed generally in coded three indication signaling systems, and is controlled by traffic conditions in advance, through the medium of well-known apparatus not shown, in such manner that this relay will be energized when signal SG is displaying approach or clear, but will be deenergized when this signal is displaying stop. One form of apparatus which may be used for controlling relay SGHR is shown, for example, in Letters Patent of the United States No. 2,218,120, granted to Frank H. Nicholson et al. on October 15, 1940, for Railway traffic controlling apparatus, wherein the relay H corresponds to the relay SGHR herein.

The moding device CT—180 is constantly supplied with current from a suitable source the terminals of which are indicated by the reference characters B and C, and this coding device constantly opens and closes its contact 23 at the rate of 180 times per minute. The coding device CT—75 is likewise constantly supplied with current from the terminals B and C and constantly opens and closes its contact 24 at the rate of 75 times per minute. It will be seen, therefore, that when the relay SGHR is picked up so that its front contact 22—22*a* is closed, the line circuit comprising the line wires 11 and 12 will be supplied with direct current which is periodically interrupted or coded at the rate of 180 times per minute, but that, when relay SGHR is released so that its back contact 22—22*b* is closed, the line circuit will then be supplied with direct current which is periodically interrupted or coded at the rate of 75 times per minute. It will also be seen that each code cycle will consist of an "off" and "on" period of substantially equal duration.

The cycle counting relay CC is arranged to be supplied with current which is coded in step with that supplied to the line circuit, by means of two energizing circuits, one of which passes from terminal B through front contact 25—25*a* of relay SGHR, front contact 26 of coding device CT—180, and the winding of relay CC to terminal C, and the other of which passes from terminal B through back contact 25—25*b* of relay SGHR, contact 27 of coding device CT—75, and the winding of relay CC to terminal C. This relay is so constructed that when energized by coded current it will close its contact 21—21*b* and open its contact 21—21*a* for a predetermined period of time, preferably one code cycle, each time a predetermined number of code cycles are supplied thereto. For example, for purposes of my present invention I shall assume that relay CC closes its front contact 21—21*b* and opens its back contact 21—21*a* for one code cycle every twentieth code cycle.

Since relay CC is supplied with current which is coded in step with the current supplied to the line circuit, and since as was pointed out hereinbefore, the line circuit is supplied with current of positive polarity from battery K or current of negative polarity from battery L during the "on" period of each code cycle according as contact 21—21*a* or contact 21—21*b* of relay CC is closed, it will be apparent that the line circuit will be supplied with negative energy during the "on" period of each succeeding twentieth code cycle and with positive energy during the "on" periods of the other code cycles.

Associated with relay CC is a checking relay CCK which is energized from the source B—C over a front contact 28 of relay CC. Contact 28 of relay CCK becomes closed each time contact 21—21*b* of relay CC becomes closed, and it follows, therefore, that relay CCK will become energized during the "on" period of each succeeding twentieth code cycle supplied to the line circuit. This relay is made sufficiently slow releasing by means of an electrolytic condenser 29 connected in multiple therewith so that it will hold its front contact 20 continuously closed so long as relay CC continues to cyclically operate its contacts every twentieth code cycle. The contact 20 is connected in the circuit over which the positive polarity code is supplied to the line circuit, and it will be obvious therefore that if the cycle counting relay should cease to operate for any reason, the positive code impulses will be interrupted and thereby stop all coding action.

The line circuit supplies coded current to a plurality of biased polar code repeating relays, a pair of which is provided at each of the locations E, F and G. The two relays at each location are designated by the reference characters PCR and NCR, respectively, with a suffix corresponding to the location, and are so constructed that each of the relays PCR will respond only to the positive polarity code, while each of the relays NCR will respond only to the negative polarity code. It will be apparent, therefore, that when coded current is being supplied to the line circuit, the contacts of the relays NCR will become operated once every twentieth code cycle while the contacts of the relays PCR will become operated once during each of the other nineteen intervening code cycles.

The relays PCRG and NCRG at location G control the supply of coded current to a track circuit for section AIT. This track circuit includes a track relay AITR connected across the rails of the section at the entrance end of the section in a manner which will be made clear presently, and one or the other of two sources of track circuit current, here shown as batteries AG and BG, connected across the rails at the exit end of the section. The battery AG will usually have a relatively low voltage, and is illustrated as comprising a single cell. The battery BG, however, will usually have a somewhat higher voltage and is accordingly illustrated as a multi-cell battery. In practice, the voltage of the source AG will depend upon that required to cause proper operation of the track relay AITR taking into consideration the length of the track circuit, the ballast and rail resistances, etc., while the voltage of the battery BG will preferably be sufficiently high to break through any high resistance film which might be formed between the wheels and the rails, and which would decrease the shunting sensitivity of the track circuit if not broken through, such for example, as that caused by excessive sanding of the rails, rust formations, or the like.

The relays PCRG and NCRG control the supply of current from the batteries AG and BG to the rails of section AIT in such manner that when relay PCRG is energized so that its reverse contacts are closed, battery AG will be connected with the rails over reverse contact 4 of this relay in series with a current limiting resistance 5 and the secondary winding 6 of a transformer TG, whereas when relay NCRG is energized so that its reverse contacts are closed, battery BG will then be connected with the rails 1 and 1*a* of section AIT in series with reverse contact 7, a current limiting resistance 8 and the secondary

winding 6 of transformer TG. It will be seen, therefore, that the rails 1 and 1a of section A1T will be periodically supplied with low voltage energy from battery AG nineteen out of every twenty code cycles and with high voltage energy from battery BG during every twentieth code cycle. This track circuit energy is shown diagrammatically in Fig. 3 where the curve *a* represents the energy for the 180 code and the curve *b* represents the energy for the 75 code.

The transformer TG is provided for the purpose of supplying train controlling current to the rails of section A1T, and the primary 9 of this transformer may be connected with any suitable source of train controlling current in accordance with well-known practice.

The relays PCRF and NCRF at location F function to selectively connect the track relay A1TR to the rails 1 and 1a of section A1T in such manner that when these rails are being supplied with low voltage track circuit energy, the relay will be connected directly with the rails, whereas, when the rails are being supplied with high voltage track circuit energy, the track relay will then be connected to the rails in series with a resistance 10 which functions to prevent over energization of the track relay due to the high voltage. That is to say, when the rails of track section A1T are being supplied with low voltage energy from battery AG, relay PCRF will be energized and relay NCRF will be deenergized, and under these conditions one terminal of relay A1TR will be connected with rail 1a over a wire 15 and the other terminal of this relay will be connected with the rail 1 over normal contact 13—13b of relay NCRF and reverse contact 14—14a of relay PCRF, whereas, when the rails of track section A1T are being supplied with high voltage energy from battery BG, the one terminal of relay A1TR will be connected with rail 1a over wire 15 as before, but the other terminal will then be connected with rail 1 over resistance 10, reverse contact 16—16a of relay NCRF and normal contact 14—14b of relay PCRF.

The coded energy supplied to the track relay A1TR over the track circuit just described causes this relay to close its front contacts during the "on" period of each code cycle for a time interval substantially equal to that of the "on" period and to close its back contacts during the "off" period of each code cycle, thereby repeating the coding action of the relay PCRG or the relay NCRG, as the case may be.

Associated with the track relay A1TR is a decoding transformer DT comprising a center tapped primary winding 30 and a center tapped secondary winding 31. When track relay A1TR is energized, direct current is supplied to the upper half of the primary winding 30 over front contact 32—32a, whereas, when track relay A1TR is deenergized, direct current is then supplied to the lower half of the primary winding 30 over back contact 32—32b. The parts are so arranged that the current thus supplied to the two halves of the primary winding will flow through these halves in opposite directions, and it will be seen therefore that the operation of the track relay in response to the coded energy supplied thereto causes an alternating voltage to be induced in the secondary winding 31 having a frequency equal to the code frequency. This voltage is mechanically rectified by the contacts 33—33a and 33—33b of relay A1TR, and the resulting unidirectional current is supplied to a track repeater relay A1TP, whereby this relay will be energized or deenergized according as relay A1TR is or is not supplied with coded current.

The relay A1TP together with the relays PCRF and NCRF control the supply of track circuit energy to a track circuit for section 1T, which latter track circuit is similar in all respects to that just described for section A1T except for the fact that this track circuit includes front contact 34 of relay A1TP whereby the supply of track circuit current to section 1T will be cut off whenever track section A1T is occupied, as will appear more fully hereinafter. The track relay for this track circuit is designated 1TR while the two sources of track circuit energy for this track circuit are designated AF and BF, respectively. The connections for the track relay 1TR to the rails of section 1T are controlled by the relays PCRE and NCRE in the same manner that the connections for the track relay A1TR with the rails of section A1T are controlled by the relays PCRF and NCRF. Since the track circuit for section 1T is similar to that for section A1T, it is believed to be unnecessary to describe this track circuit in further detail herein.

The track relay 1TR controls the signal SE through the usual decoding apparatus indicated diagrammatically in the drawing by the dotted rectangle DA. This decoding apparatus may, for example, be similar to that shown in the previously referred to Nicholson et al. Patent No. 2,128,120, and it is believed, therefore, that for purposes of the present application it is sufficient to point out that the lamp G, Y or R of signal SE will be lit to indicate "clear," "approach," or "stop" according as relay 1TR is supplied with 180 code, 75 code, or the supply of code is cut off by the presence of a train in section 1T.

As shown in the drawing, the sections 1T, A1T and the section 2T immediately to the right of section A1T are all unoccupied. Under these conditions, relay SGHR is energized, so that lamp G of signal SA is illuminated to indicate proceed. Furthermore, with relay SGHR energized, the line circuit is being supplied with 180 code which causes the relays PCRG and NCRG to function to supply 180 code to the rails of section A1T. Since section A1T is unoccupied, track relay A1TR will follow the code supplied to the rails of this section, and relay A1TP will therefore be energized. With relay A1TP energized, the relays PCRF and NCRF will function to supply 180 code to the rails of section 1T, and relay 1TR will follow this code and will thus cause signal SE to display its clear aspect.

In explaining the operation of the apparatus as a whole, I shall assume that a train moves from left to right over the stretch of track shown in the drawing. When the train enters section 1T, the train shunt will cut off the supply of coded current to the track relay 1TR, and this track relay will therefore become deenergized, and will thus cause signal SE to display its stop aspect. When the train enters section A1T, track relay A1TR will become deenergized which in turn will deenergize relay A1TP. Relay A1TP will therefore open its front contact and will thus cut off the supply of coded current to the rails of section 1T. Track relay 1TR will therefore now remain deenergized and will cause signal SE to continue to display its stop aspect even though the train completely vacates section 1T.

When the train enters section 2T, relay SGHR

will become deenergized and will cause signal SG to display its stop aspect. The deenergization of relay SGHR will also cut off the supply of 180 code to the line circuit and will cause 75 code to be supplied to the line circuit, and hence to the rails of section A!T through the action of the code repeating relays PCRG and NCRG. As soon as the train vacates section A!T, this 75 code will cause relay A!TR to again become energized. Relay A!TP will therefore again become energized, whereupon 75 code will be supplied to the rails of section !T. This latter code will cause relay !T to again become energized and will thus cause signal SE to display its approach aspect.

When the train vacates the block next in advance of the block EG, relay AGHR will again become energized and will cause signal SG to display its approach aspect. Furthermore, 180 code will again be supplied to the line circuit and hence to both track sections A!T and !T, whereupon signal SE will display its clear aspect. All parts will then be restored to the positions in which they are shown in the drawing.

It is generally considered that the greatest difficulty in shunting track circuits where a high rail to wheel resistance exists due, for example, to excessive rust on the rails, or the like, is encountered with light locomotives. As long as a locomotive or a train is moving over rails having high rail to wheel resistance, it is very likely to produce at least intermittent shunts, and these intermittent shunts will produce a signal which is flashing from one position to another. Such a signal is considered to be reasonably safe, and the most dangerous condition occurs when the locomotive or train comes to rest without shunting the track circuit.

When the coded track circuit described hereinbefore is used, a high degree of shunting sensitivity is obtained because every twentieth impulse of the code will be a high voltage impulse which will break through the high rail to wheel resistance on at least one axle of the vehicle. If only the high voltage impulses are shunted, this will result in a signal which flashes from one position to another, which as was pointed out above is considered safe. However, it has been found that if the voltage of every twentieth code cycle impulse is sufficiently high to break through the high resistance film between the rail and the wheels, the shunt path so obtained will be of sufficiently low resistance so that even the low voltage "on" periods of the code cycles will thereafter be shunted.

One advantage of apparatus embodying my invention is that comparatively long track circuits may be used with relatively low ballast resistance and still obtain a high degree of shunting sensitivity because the voltage of the "on" periods of the high voltage cycles may be made considerably higher than would be practical where every code cycle is made high voltage, and this may be done without excessive wear of the coder contacts because of the small number of high voltage cycles which are used.

It should be particularly pointed out that in practice it may be desirable to modify the code pattern so that the high voltage code cycles occur less frequently or more frequently than every 20 cycles. For example, they may be made to occur every fifth, every tenth or every thirtieth code cycle. Furthermore, in order to more readily deenergize the checking relay it might be of advantage to cause two successive code cycles to have a high voltage instead of only one code cycle. In other words, my invention is not limited to the specific code pattern shown.

Referring now to Fig. 2, there is here illustrated an alternative arrangement which may be used to supply the high voltage impulses to the track circuits in place of the arrangement previously described. As here shown, the battery BG has been replaced by a battery CG and a reactor RG, and the contact 7 of relay NCRG has been replaced by a continuity transfer contact comprising a fixed contact member 35 and two movable contact fingers 36 and 37. When relay NCRG is deenergized, the movable contact finger 37 is held into engagement with the fixed contact member 35 to close a normal contact 35—37, and under these conditions, the primary winding 38 of the reactor is connected in series with battery CG over a circuit which will be obvious from an inspection of the drawing. When, however, relay NCRG becomes energized, the contact finger 36 moves into engagement with the movable finger 37 and pushes it out of engagement with the fixed contact finger 35 to thereby close a normal contact 36—37 and to open the contact 35—37, it being obvious that the contact 35—37 does not become opened until after the contact 36—37 becomes closed. The opening of contact 36—37 interrupts the supply of current from the battery CG to the reactor 38, while the closing of contact 36—37 causes the energy stored in the reactor to be discharged into the track circuit and thus produce a high voltage impulse in the track circuit.

The operation of the remainder of the apparatus when modified as indicated in Fig. 2 is similar to that previously described and will be apparent from the foregoing description and from an inspection of the drawing without further detailed description.

Although I have herein shown and described only two 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. In combination, a section of railway track, means for supplying coded signaling energy consisting of alternate "on" and "off" periods to the rails of said section, a track relay connected to the rails of said section and responsive to said coded energy, and means for periodically increasing the voltage of the impulses of coded energy to increase the shunting sensitivity of the track circuit formed by said track relay and the rails of said section.

2. In combination, a section of railway track, means for supplying coded signaling energy consisting of alternate "on" and "off" periods to the rails of said section, a track relay connected to the rails of said section and responsive to said coded energy, means for periodically increasing the voltage of the impulses of coded energy to increase the shunting sensitivity of the track circuit formed by said track relay and the rails of said section, and means for preventing over energization of said track relay in response to the energy impulses of increased voltage.

3. In combination, a section of railway track, means for supplying coded signaling energy consisting of alternate "on" and "off" periods to the rails of said section, a track relay connected to the rails of said section and responsive to said coded energy, means for periodically increasing

the voltage of the impulses of coded energy to increase the shunting sensitivity of the track circuit formed by said track relay and the rails of said section, and means for connecting an impedance in series with said track relay between the relay and the rails of said section each time a high voltage energy impulse is supplied to the rails to prevent over energization of said track relay.

4. In combination, a section of railway track, a source of high voltage track circuit energy and a source of low voltage track circuit energy, means for supplying to the rails of said section coded signaling energy consisting of alternate "on" and "off" periods first from said source of low voltage energy for a predetermined number of code cycles and then from said source of high voltage energy for at least one code cycle, and signaling means responsive to the coded energy supplied to the rails.

5. In combination, a section of railway track, a source of high voltage track circuit energy and a source of low voltage track circuit energy, means for supplying to the rails of said section coded signaling energy consisting of alternate "on" and "off" periods first from said source of low voltage energy for a predetermined number of code cycles and then from said source of high voltage energy for at least one code cycle, and a track relay connected with the rails of said section and responsive to said coded energy.

6. In combination, a section of railway track, means for supplying to the rails of said section coded signaling energy consisting of spaced current impulses the voltage of which impulses is cyclically increased to break down any high resistance paths which may exist between the rails and the wheels of a vehicle traversing the rails to increase the ability of the wheels and axles to form a shunt between the rails, and signaling means responsive to said signaling energy.

7. In combination, a section of railway track, a line circuit, means for supplying to said line circuit coded energy consisting of alternate "on" and "off" periods recurring at a rate which depends upon traffic conditions in advance, means for reversing the polarity of the energy supplied to said line circuit for at least one code cycle each time said line circuit is supplied with a predetermined number of code cycles, means controlled by the coded energy supplied to said line circuit for supplying the rails of said section with coded signaling energy at one or another voltage according as said line circuit is supplied with energy of one relative polarity or the other, and signaling means responsive to the coded energy supplied to said rails.

8. In combination, a section of railway track, a line circuit, means for supplying to said line circuit coded energy consisting of alternate "on" and "off" periods recurring at a rate which depends upon traffic conditions in advance, means for reversing the polarity of the energy supplied to said line circuit for at least one code cycle each time said line circuit is supplied with a predetermined number of code cycles, means controlled by the coded energy supplied to said line circuit for supplying the rails of said section with coded signaling energy at one or another voltage according as said line circuit is supplied with energy of one relative polarity or the other, and a track relay connected to the rails of said section and responsive to the coded energy supplied thereto.

9. In combination, a stretch of railway track divided into blocks subdivided at a cut section to form track sections, a line circuit associated with each block, means for supplying to said line circuit coded energy consisting of alternate "on" and "off" periods recurring at a rate controlled by traffic conditions in advance, means for reversing the polarity of the coded energy for at least one code cycle each time said line circuit is supplied with a predetermined number of code cycles, a pair of code repeating relays connected to said line circuit at each end of said block and at said cut section location, the one said relay of each pair being responsive only to the coded energy of normal polarity and the other said relay of each pair being responsive only to the coded energy of reverse relative polarity, means controlled by the code following relays at the exit end of each section for supplying to the rails of the associated section coded signaling energy having a high voltage or a low voltage according as the coded energy supplied to the line circuit is of normal or reverse relative polarity, a track relay at the entrance end of each section, means controlled by the code following relays at the entrance end of each section for connecting the associated track relay directly with the section or through current limiting means according as the rails are supplied with low or high voltage coded signaling energy.

10. In combination, a stretch of railway track divided into blocks subdivided at a cut section to form track sections, a line circuit associated with each block, means for supplying to said line circuit coded energy consisting of alternate "on" and "off" periods recurring at a rate controlled by traffic conditions in advance, means for reversing the polarity of the coded energy for at least one code cycle each time said line circuit is supplied with a predetermined number of code cycles, a pair of code repeating relays connected to said line circuit at each end of each block and at said cut section location, the one said relay of each pair being responsive only to the coded energy of normal polarity and the other said relay of each pair being responsive only to the coded energy of reverse relative polarity, means controlled by the code following relays at the exit end of each section for supplying to the rails of the associated section coded signaling energy having a high voltage or a low voltage according as the coded energy supplied to the line circuit is of normal or reverse relative polarity, a track relay at the entrance end of each section, means controlled by the code following relays at the entrance end of each section for connecting the associated track relay directly with the section or through current limiting means according as the rails are supplied with low or high voltage coded signaling energy, and means controlled by the track relay for the section at the exit end of each block for interrupting the supply of energy to the other section of each block when said first mentioned block is occupied.

11. In combination, a section of railway track, a line circuit for said section, means for supplying to said line circuit coded energy consisting of alternate "on" and "off" periods recurring at a rate controlled by traffic conditions in advance, a cycle counting relay energized in step with the current impulses supplied to said line circuit and provided with a first contact which becomes closed for at least one code cycle each time said relay is energized by a predetermined number of code cycles and with a second contact closed the remainder of the time, means controlled by said first and second contacts for causing the

coded energy supplied to the line circuit to have one relative polarity or the other according as said first or said second contact is closed, and means controlled by said line circuit for supplying coded energy of relatively high or relatively low voltage to the rails of said section according as said line circuit is supplied with coded energy of said one or said other relative polarity.

12. In combination, a section of railway track, a line circuit for said section, means for supplying to said line circuit coded energy consisting of alternate "on" and "off" periods recurring at a rate controlled by traffic conditions in advance, a cycle counting relay energized in step with the current impulses supplied to said line circuit and provided with a first and a second contact which become closed for at least one code cycle each time said cycle counting relay is energized by a predetermined number of code cycles and with a third contact closed the remainder of the time, a checking relay energized over a circuit which becomes closed whenever said first contact becomes closed and sufficiently slow releasing to remain energized as long as said cycle counting relay continues to cyclically operate its contacts, means controlled by said second and third contacts for causing the coded energy supplied to the line circuit to have one relative polarity or the other according as said second or said third contact is closed, means for interrupting the supply of coded current to the line circuit if said checking relay becomes deenergized, and means controlled by said line circuit for supplying high voltage or low voltage coded energy to the rails of said section according as said line circuit is supplied with coded energy of said one or said other relative polarity.

13. In combination, a section of railway track, a line circuit, means for supplying to said line circuit coded energy consisting of alternate "on" and "off" periods recurring at a rate which depends upon traffic conditions in advance, means for reversing the polarity of the "on" period of at least one code cycle each time said line circuit is supplied with a predetermined number of code cycles, a pair of code following relays connected to said line circuit at each end of said section, the one relay of each pair being responsive only to coded energy of normal relative polarity and the other relay being only responsive to coded energy of reverse polarity, a source of relatively low voltage energy and a source of high voltage energy, means for connecting the low voltage source or the high voltage source with the rails of said section according as the one or the other code following relay at the exit end of said section is energized, a track relay, an impedance, and means for connecting said relay directly with the rails of said section or in series with said impedance according as the one or the other code following relay at the entrance end of said section is energized.

14. In combination, a section of railway track, a line circuit for said section, a cycle counting relay responsive to coded energy consisting of alternate "on" and "off" periods and provided with a first contact which becomes closed for at least one code cycle each time said relay is supplied with a predetermined number of code cycles and with a second contact which is closed at all other times, two coding devices one effective when energized to periodically operate its contacts at one rate and the other effective when energized to operate its contacts at another rate, a fourth relay controlled by traffic conditions in advance, means controlled by said one coding device for supplying coded current of one polarity or the other to said line circuit when said fourth relay is energized according as said second or said first contact of said cycle counting relay is then closed, means controlled by said other coding device for supplying coded current of one polarity or the other to said line circuit when said fourth relay is deenergized according as said second or said first contact of said cycle counting relay is then closed, means controlled by said fourth relay and said two coding devices for supplying said cycle counting relay with coded current in step with that supplied to the line circuit, and means controlled by the coded current supplied to said line circuit for supplying high or low voltage energy to the rails of said section according as said line circuit is supplied with coded current of said other or said one polarity.

15. In combination, a section of railway track, a line circuit for said section, a cycle counting relay responsive to coded energy consisting of alternate "on" and "off" periods and provided with a first contact which becomes closed for at least one code cycle each time said relay is supplied with a predetermined number of code cycles and with a second contact which is closed at all other times, two coding devices one effective when energized to periodically operate its contacts at one rate and the other effective when energized to operate its contacts at another rate, a fourth relay controlled by traffic conditions in advance, means controlled by said one coding device for supplying coded current of one polarity or the other to said line circuit when said fourth relay is energized according as said second or said first contact of said cycle counting relay is then closed, means controlled by said other coding device for supplying coded current of one polarity or the other to said line circuit when said fourth relay is deenergized according as said second or said first contact of said cycle counting relay is then closed, means controlled by said fourth relay and said two coding devices for supplying said cycle counting relay with coded current in step with that supplied to the line circuit, a pair of code following relays connected to said line circuit, the one said relay being responsive only to coded current of said one polarity and the other relay being responsive only to coded current of said other polarity, a first source of relatively low voltage energy and a second source of relatively high voltage energy, and means for supplying current to the rails of said section from said first or said second source according as the one or the other of said code following relays is energized.

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