

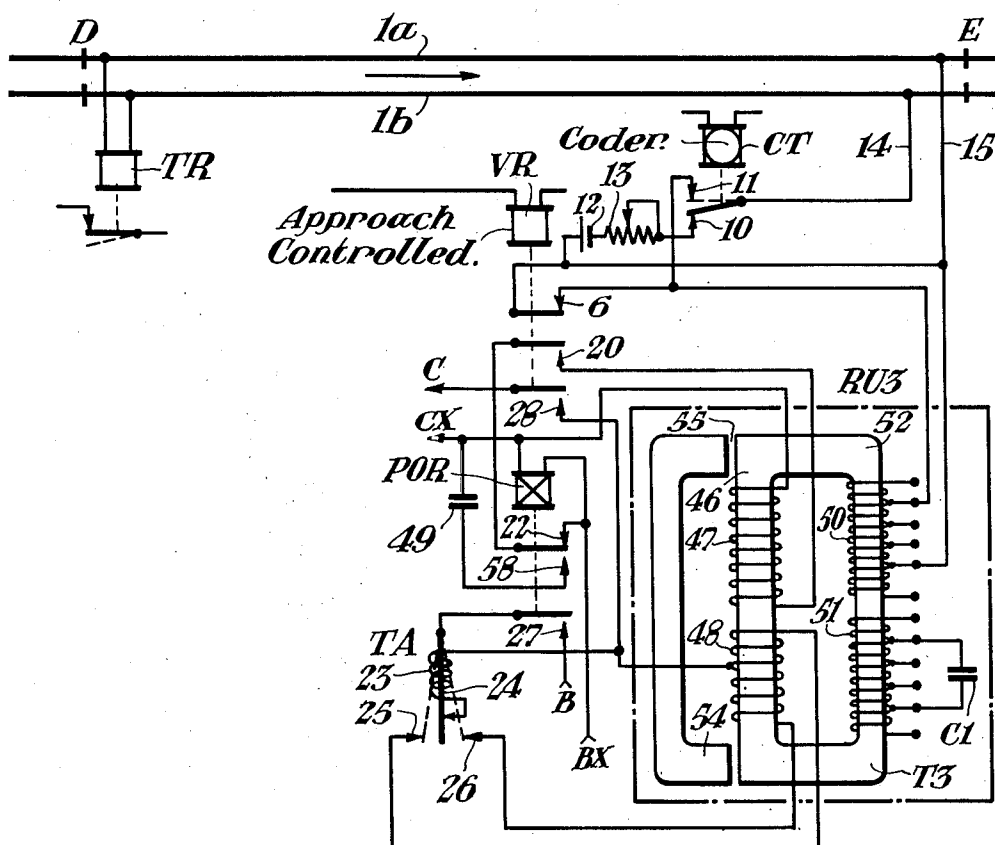
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RAILWAY TRACK CIRCUIT APPARATUS

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RAILWAY TRACK CIRCUIT APPARATUS

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3 Claims. (Cl. 246—34)

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Our invention relates to railway track circuit apparatus, and more particularly to track circuit apparatus for automatically regulating the power consumed by an alternating current track circuit.

The present application is a division of our copending application for Letters Patent of the United States, Serial No. 644,474, filed April 24, 1946, for Railway track circuit apparatus.

In alternating current track circuits using a limiting resistor or reactor of fixed impedance, the current drawn by a track circuit may increase considerably as a train moves through the track section. This is particularly true on long track circuits adjusted to supply at least a given minimum value of the axle or train shunt current for a train at the entrance end of the section when the ballast resistance is at a given minimum value. When such track circuits are coded for operation of cab signals an excessive value of current tends to deteriorate the contacts of the code transmitter. Also, the most satisfactory operation of cab signal equipment obtains when the track circuit current is maintained at substantially the required minimum working or axle current level because currents of a larger value tend to cause code distortion. Again, when the successive track circuits of a signal system are supplied from a transmission line, the voltage regulation of such line may be poor due to the large variation in the total load drawn by the track circuits when a large number of trains occupy the different track circuits and also due to variations of the ballast resistance as caused by changing weather. Poor regulation of the line voltage tends to impair the operation of the signal system. In many instances a stand-by source of power is provided for a track circuit and for alternating current track circuits such stand-by facilities usually include a tuned alternator operable to convert direct current into alternating current of the same frequency as that of the normal alternating current source. Under such circumstances current limiting and regulating means suitable for the normal source consisting of a generator and a transmission line may not be satisfactory when the tuned alternator is used.

Accordingly, a feature of our invention is the provision of novel and improved alternating current track circuit apparatus for automatically regulating the power drawn by the track circuit.

Another feature of our invention is the provision of improved track circuit apparatus to automatically control the power fed into a track

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circuit to limit the amount of current drawn with a train at the exit end of the circuit to approximately the amount taken when the train is at the entrance end of the section and thereby prevent excessive current being handled at the contacts of a code transmitter.

Still another feature of our invention is the provision of improved alternating current track circuit apparatus operable to maintain a substantially constant output to the track circuit regardless of variations of voltage from the current source.

Another feature of our invention is the provision of improved alternating current track circuit apparatus incorporating novel means to improve the regulation of a transmission line feeding a series of such track circuits.

Again, a feature of our invention is the provision of novel track circuit apparatus of the type here involved to provide substantially the same regulation for a stand-by source using a tuned alternator as that provided for a normal source using a remote generator and a transmission line.

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

The foregoing features, objects and advantages of our invention are attained through the provision of a novel and improved circuit network for connecting the power source to the track rails of the track section, the connection to the rails being ordinarily adjacent the exit of the track section. This circuit network includes a saturating transformer and a capacitor associated in such a manner as to form what might be termed an automatic regulating unit. Also, the devices of the network are associated in such a manner as to limit the current drawn from the source, notwithstanding variations of load conditions, and to regulate the power factor of the power drawn.

We shall describe one form of apparatus embodying our invention, and shall then point out the novel features thereof in claims.

The accompanying drawing is a diagrammatic view showing one form of apparatus embodying our invention when used with a coded track circuit having both a direct current and an alternating current source, the direct current being used to operate a direct current code following track relay and the alternating current being used to operate cab signals of a train traversing the section. The direct current and alternating current are fed alternately through front and

back contacts of the coder. Also, stand-by facilities including a tuned alternator are provided for at times supplying the alternating current.

It is to be understood that our invention is not limited to track circuits and this application serves to illustrate the many places the apparatus is useful.

Referring to the drawing, the reference characters 1a and 1b designate the track rails of a railway over which traffic normally moves in the direction indicated by an arrow and which rails are formed with an insulated track section D—E and which track section may be one section of a series of sections of a signal system. This track section D—E is provided with a track circuit which includes a power supply connected across the rails adjacent exit end E of the section and a track relay connected across the rails adjacent the entrance end D of the section.

The power supply provides both coded direct current and alternating current, the direct current being used to operate a track relay TR and the alternating current being used to operate the cab signals of a train moving through the section. A coder CT is powered from any convenient source not shown and is constantly operated to alternately close back contact 10 and front contact 11 at a predetermined code rate, such as, for example, 75 times per minute. Each time back contact 10 is closed a pulse of direct current is supplied from a track battery 12 to the track circuit, current flowing from battery 12 through a limiting resistor 13, back contact 10 of the coder, lead wire 14, rail 1b, winding of the track relay TR, rail 1a and lead wire 15 to the other terminal of the battery 12. Such pulse of direct current serves to operate the track relay TR which is a direct current code following track relay of the usual type. Thus the track relay TR is operated at a predetermined code rate when the section D—E is unoccupied and is shunted when a train occupies the section. The relay TR would control wayside signal circuits in any of the well-known arrangements, such signal circuits being omitted since they form no part of our present invention.

An approach controlled relay VR is included in the apparatus, the relay VR being controlled in any of the several well-known approach control circuit arrangements and it is sufficient for this application to point out that relay VR is energized when the section D—E is unoccupied and is deenergized in response to a train entering the section. With the relay VR picked up closing front contact 6, the track rails 1a and 1b are shunted through front contact 11 of the coder CT and front contact 6 of relay VR and such shunting serves to improve the code operation of the track relay TR in the manner well understood.

Approach relay VR also governs the connection of the alternating current source to the track rails. The normal source of alternating current includes a generator and a transmission line not shown, the terminals of the source being indicated at BX and CX. The source BX—CX supplies alternating current of any suitable frequency, such as 100 cycles per second, but some other frequency can be used. The connection of the alternating current source to the track circuit of the section D—E includes a circuit network comprising a power-off relay POR and an automatic regulating unit RU3.

The apparatus also includes a stand-by alternating current source comprising a tuned alter-

nator TA and a direct current supply such as a battery having terminals B and C. The tuned alternator TA may be of any one of several different types and this alternator is shown conventionally as including an operating winding 23 and a tuned reed armature 24, the arrangement being such that when winding 23 is energized the armature 24 is vibrated at a predetermined frequency, the armature alternately engaging contacts 25 and 26 each vibration. The winding 23 is supplied with power from a suitable source of direct current having terminals B and C, the circuit including back contact 27 of relay POR and back contact 28 of approach relay VR.

The power-off relay POR is of the usual alternating current type and its winding is connected across the terminals BX and CX to energize this relay so long as the normal source of alternating current is active and to deenergize the relay when there is a loss of such power.

The regulating unit RU3 comprises a so-called reactor type transformer T3 and a capacitor C1.

The transformer T3 is constructed with a three legged core structure, the middle leg 46 of which carries two primary windings 47 and 48 and is of a cross section such that it does not saturate at the current values used. The winding 47 serves as a primary winding for the normal alternating current source and as a charging winding for an arc suppressing capacitor 49 when the tuned alternator TA is used. The other winding 48 serves as a primary winding when power is received from the stand-by facilities. The output side of transformer T3 consists of two windings 50 and 51 mounted on an outside leg 52 of the core structure, the leg 52 being of a cross section such that it saturates at the current value used. The winding 50 is used as a secondary winding feeding into the track circuit, the winding having a series of intermediate terminals in order to permit a preselection of the voltage to be applied to the track circuit. The connection to the rails also includes front contact 11 of the coder CT to code the alternating current. The winding 51 is connected to the capacitor C1 and winding 51 is provided with taps to adjust the portion of the winding to be used for charging the capacitor. The winding 51 with capacitor C1 serves to correct the power factor of the energy drawn from the alternating current source.

The other leg 54 of the core structure of transformer TE serves as a leakage path, and this leg is provided with an adjustable air gap 55. This air gap can be made adjustable in any one of the several well-known ways. For example, non-magnetic spacers can be used in the air gap or the leg 54 can be pivoted around a hinge pin at one end and provided with a thumb screw at the other end to turn the leg around the pin to vary the air gap.

Normally, the power-off relay POR and approach relay VR are picked up and only coded direct current is supplied to the track circuit for operation of the track relay. When approach relay VR is released and the power-off relay POR is picked up the normal alternating current source having terminals BX and CX is connected to primary winding 47 and transformer T3 is excited and coded alternating current is applied to the track circuit from secondary winding 50. The connections are such that an axle current of at least the required minimum value is provided when the train is at the entrance end of the section under low ballast resistance conditions. The internal leakage reactance of trans-

former T3 serves in place of the usual series reactor.

Thus, the apparatus here disclosed supplies to the track circuit from the normal alternating current source, an approximately constant value of current to the rails under wet ballast conditions and over a relatively wide range of supply voltage and limits the voltage applied to the rails under dry ballast conditions.

In the event the normal alternating current source fails and relay POR is released, the stand-by facilities are brought into action upon the release of the approach relay VR. The closing of back contacts 27 and 28 of relays POR and VR, respectively, connects the operating winding of the tuned alternator TA to the direct current source and the alternator is operated to alternately supply direct current impulses to the two half portions of winding 43 of the transformer T3 and such current impulses induce an alternating voltage in secondary winding 50 with the result that an alternating current is fed to the track circuit. The regulating unit RU3 functions to limit the power supplied to the track circuit in much the same manner as explained when power was derived from the normal alternating current source.

It is to be noted that when relays VR and POR are released, closing back contacts 20 and 52, respectively, capacitor 49 is connected across winding 47 and serves to suppress sparking at the contacts of the tuned alternator.

Although we have herein shown and described only one form of railway track and circuit apparatus embodying our 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 our invention.

Having thus described our invention, what we claim is:

1. In a track circuit for a track section, the combination comprising, a normal source of alternating current, a stand-by source of alternating current including a tuned alternator and a source of direct current, a transformer having a non-saturating core leg carrying a first and a second primary winding and a saturating core leg carrying a first and a second secondary winding and a shunt magnetic leakage core leg, said first secondary winding connected across the rails of said section to supply current to said track circuit, a capacitor connected across said second secondary winding, a power-off relay operable to a first position when energized and biased to a second position when deenergized and said relay having connections to said normal source of alternating current to energize the relay as long as said normal source is active, a first circuit means including a first position contact of said power-off relay connected to said normal source to connect the normal alternating current source to said first primary winding, and a second circuit means including a second position contact of said power-off relay to connect said stand-

by source of alternating current to said second primary winding.

2. In a track circuit for a track section, the combination comprising, a normal source of alternating current, stand-by power facilities including a tuned alternator and a source of direct current; a transformer having a non-saturating core leg carrying a first and a second primary winding, a saturating core leg carrying a first and a second secondary winding and a shunt magnetic leakage core leg; a power-off relay normally energized by said normal current source, a first circuit means including a front contact of said relay to connect said normal current source to said first primary winding, a second circuit means including a back contact of said relay and contacts of said alternator to alternately energize the two half portions of said second primary winding from said direct current source, said first secondary winding having connections to the rails of said section to supply said track circuit with power when either said first or second primary winding is thus excited, and a capacitor connected to said second secondary winding.

3. In a track circuit for a track section, the combination comprising, a normal source of alternating current, stand-by power facilities including a tuned alternator and a source of direct current; a transformer having a non-saturating core leg carrying a first and a second primary winding, a saturating core leg carrying a first and a second secondary winding and a shunt magnetic leakage core leg; a power-off relay normally energized by said normal current source, a first circuit means including a front contact of said relay to connect said normal current source to said first primary winding, a second circuit means including a back contact of said relay and contacts of said alternator to alternately energize the two half portions of said second primary winding from said direct current source, said first secondary winding having connections to the rails of said section to supply said track circuit with power when either said first or second primary winding is thus excited, a first capacitor connected to said second secondary winding to govern the voltage applied to the rails by said first secondary winding, and a second capacitor connected across said first primary winding through a back contact of said power-off relay to reduce sparking at said tuned alternator contacts.

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