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TRACK CIRCUIT APPARATUS

Original Filed July 14, 1934

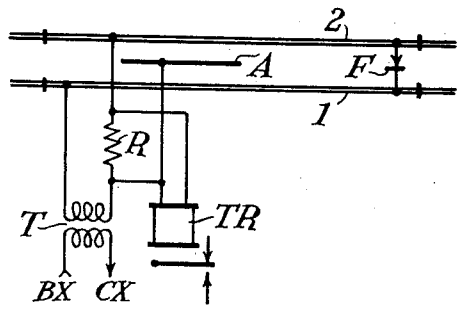

Fig. 1.

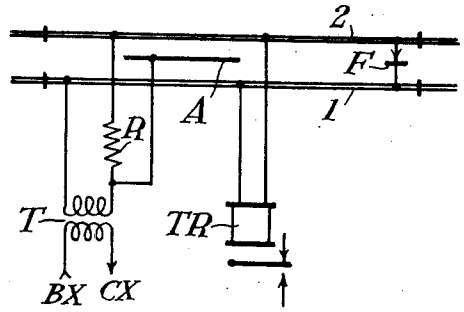

Fig. 2.

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TRACK CIRCUIT APPARATUS

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10 Claims. (Cl. 246—34)

Our invention relates to track circuit apparatus and more specifically to apparatus for increasing the shunting sensitivity of track circuits.

We will describe two forms of track circuit apparatus embodying our invention, and will then point out the novel features thereof in claims.

Fig. 1 of the accompanying drawing is a diagrammatic view showing one form of apparatus embodying our invention. Fig. 2 is a diagrammatic view showing a modified form of the apparatus illustrated in Fig. 1, and also embodying our invention.

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

The present application is a division of our application Serial No. 735,210, filed July 14, 1934, for Track circuit apparatus.

Referring to Fig. 1, the reference characters 1 and 2 designate the rails of a section of railway track. Connected across the rails at one end of the section is the secondary winding of a track transformer T which supplies current through a limiting resistor R to the rails of the track. The primary winding of transformer T is energized from a source of alternating current having the terminals BX—CX. In contact with the track ballast is a conductor A, which is electrically connected with that terminal of resistor R which makes connection with the secondary. Conductor A is preferably a scrap rail of suitable length spiked to the same ties which support the rails 1 and 2, in a manner to simulate as closely as possible the type of junction which exists between the rails 1 and 2 and the supporting ties and ballast. That is, the connection of conductor A with the ballast should be such that a given length of this conductor will have a resistance to ground of approximately the same value as exists between a corresponding length of either rail 1 or rail 2, to ground. It is not essential that conductor A be in the form of a rail, as any suitable bared conductor, such, for example, as a copper or iron wire making contact with the ballast through the ties, or in any other suitable manner, can be used. For example, an insulated wire bared at those portions which are spiked or otherwise fastened to the ties, can also be used.

Experience with track circuit operation appears to indicate that the major portion of the track ballast resistance is probably concentrated in a comparatively thin film which forms the junction between a rail and its supporting ties, as well as, to some extent, in a second film at the area of contact of a tie with the ballast in which it is imbedded. Based on these observations, the particular location of conductor A with respect to rails 1 and 2 is relatively unimportant, provided that substantial contact with the rail supporting ties is obtained for the purpose of establishing a film resistance condition at the conductor-tie junction which will closely approximate the film resistance condition at the rail-tie junction, under different conditions of ballast resistance. Ballast conductor A can be placed on the outside of rail 1 or rail 2, if desired, or it can take the form of a guard rail. If the ballast conductor is placed near to rail 2, trunking or other covering or insulation should be used in order to avoid accidental short-circuits with rail 2 which might result in over-energization of the track relay.

It will be noted that the track relay TR is located at the same end of the track circuit as the track current source T and is connected across the terminals of resistor R. Relay TR is an ordinary direct current relay, and is operated in part from the potential drop across the limiting resistor R. This potential drop, although supplied from the alternating current source BX—CX, has a prominent unidirectional component due to the rectifier load F which is connected across the rails at the other end of the track circuit. Because of the connection of ballast conductor A between resistor R and the track transformer secondary, relay TR also receives energy from the potential drop across the ballast path which is in parallel with resistor R, and which includes conductor A.

Resistor R should be of such a value that under infinite ballast conditions, relay TR will receive normal energy. Consequently, as the ballast resistance decreases, the equivalent resistance of resistor R and the ballast conductor path in parallel therewith will decrease also, and the current drawn from transformer T will therefore increase. As a result, the drop across the equivalent resistance will remain substantially the same whether the ballast is wet or dry, so that the track relay energization will also remain approximately at its normal value, and shunting sensitivity will accordingly be increased.

Referring now to Fig. 2, relay TR in this figure is connected directly across the track rails, rather than across resistor R, as in Fig. 1. The operation of the circuit of Fig. 2 is otherwise the same as that of Fig. 1, namely, a change in ballast resistance changes the amount of current flowing over the path which includes the ballast conductor A, whereby the drop across re-

sistor R and the voltage impressed across the rails remain substantially constant.

In conclusion, it will be noted that the track circuits herein disclosed provide a shunting sensitivity under dry ballast conditions which is much greater than that provided by the ordinary track circuit. The shunting sensitivity under conditions of wet ballast can be at least as high as that which is normally obtained. By properly proportioning the parts, the energization of relay TR can actually be made to decrease under dry weather conditions, so that the shunting sensitivity will be lowest under the condition of wet ballast. This situation is the reverse of that obtaining with ordinary track circuits, which are usually more difficult to shunt when the ballast is dry. In the usual type of track circuit, for reasons which will be clear to those versed in the art of track-circuiting, the optimum value of train shunt resistance which can be depended on for shunting is that which is equivalent to the total minimum ballast resistance of the track circuit. In the track circuit which we have provided, however, due to the fact that a part of the current for operating the track relay is supplied through the ballast resistance in multiple with the remaining part which is supplied through the physical resistor R, the optimum value of train shunt resistance which can be depended on for shunting can be made substantially higher than the aforementioned total minimum ballast resistance of the track circuit.

Although we have herein shown and described only two forms of 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 combination, a section of railway track, a source of alternating current connected across the rails at one end of said section, a half-wave rectifier connected across the rails at the other end of said section, an impedance connected between said source and one rail of said track, a ballast conductor in contact with the track ballast and joined electrically with said impedance at the connection between said impedance and said source, and a direct current relay energized from the potential drop across said impedance.

2. In combination, a section of railway track, a source of alternating current connected across the rails at one end of said section, a half-wave rectifier connected across the rails at the other end of said section, an impedance connected between said source and one rail of said track, a ballast conductor in contact with the track ballast and joined electrically with said impedance at the connection between said impedance and said source, and a direct current relay receiving energy from the rails of said track section.

3. In combination, a section of railway track, a source of alternating current connected across the rails at one part of said track, an asymmetric unit connected across said rails at another part of said track, an impedance connected between said source and one rail of said track, a ballast conductor in contact with the track ballast and joined electrically with said impedance at the connection between said impedance and said source, and a direct current relay energized from the potential drop across said impedance.

4. In combination, a section of railway track, a source of alternating current connected across the rails at one part of said track, an asymmetric unit connected across the rails at another part of said track, a resistor connected between said source and one rail of said track, a ballast conductor in contact with the track ballast and joined electrically with said resistor at the connection between said resistor and said source, and a direct current relay receiving energy from the rails of said track section.

5. In combination, a section of railway track, a source of alternating current connected across the rails at one end of the section, a half-wave rectifier connected across the rails at the other end of the section for causing unidirectional energy to be supplied from said source to the rails of said section, a current-limiting device connected between said source and one rail of said track, a ballast conductor in contact with the track ballast and joined electrically with said device at the connection between said device and said source, and a direct current relay controlled by the unidirectional energy supplied from said source to the rails of said section.

6. In combination, a section of railway track, a source of alternating current connected across the rails at one part of said track, an asymmetric unit connected across the rails at another part of said track, a current-limiting device connected between said source and one rail of said track, and a conductor in contact with the track ballast and joined electrically with said device at the connection between said device and said source for varying the effectiveness of said device when the resistance of said track ballast changes.

7. In combination, a section of railway track, a source of alternating current connected across the rails at one part of said track, means associated with another part of said track for causing unidirectional energy to be supplied from said source to the rails of said section, a current-limiting device connected between said source and one rail of said track, and a conductor in contact with the track ballast and joined electrically with said device at the connection between said device and said source for varying the effectiveness of said device in accordance with changes in the resistance of said track ballast to thereby control the unidirectional energy supplied to said track.

8. In combination, a section of railway track, a source of alternating current connected across the rails at one part of said track, an asymmetric unit connected across the rails at another part of said track, a current-limiting device connected between said source and one rail of said track, and a conductor in contact with the track ballast and connected with said source in such manner as to by-pass a portion of the current flowing to said one rail over said current-limiting device when said track ballast is wet.

9. In combination, a section of railway track, a source of alternating current connected across the rails at one part of said track, an asymmetric unit connected across the rails at another part of said track, a current-limiting device connected between said source and one rail of said track, a conductor in contact with the track ballast and connected with said source in such manner as to by-pass a portion of the current flowing to said one rail over said current-limiting device when said track ballast is wet, and a direct current load energized from the potential drop across said current-limiting device.

10. In combination, a section of railway track, a source of alternating current connected across the rails at one part of said track, an asymmetric unit connected across the rails at another part of said track, a current-limiting device connected between said source and one rail of said track, a conductor in contact with the track ballast and connected with said source in such manner as to by-pass a portion of the current flowing to said one rail over said current-limiting device when said track ballast is wet, and a direct current load receiving energy from the rails of said section.

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