

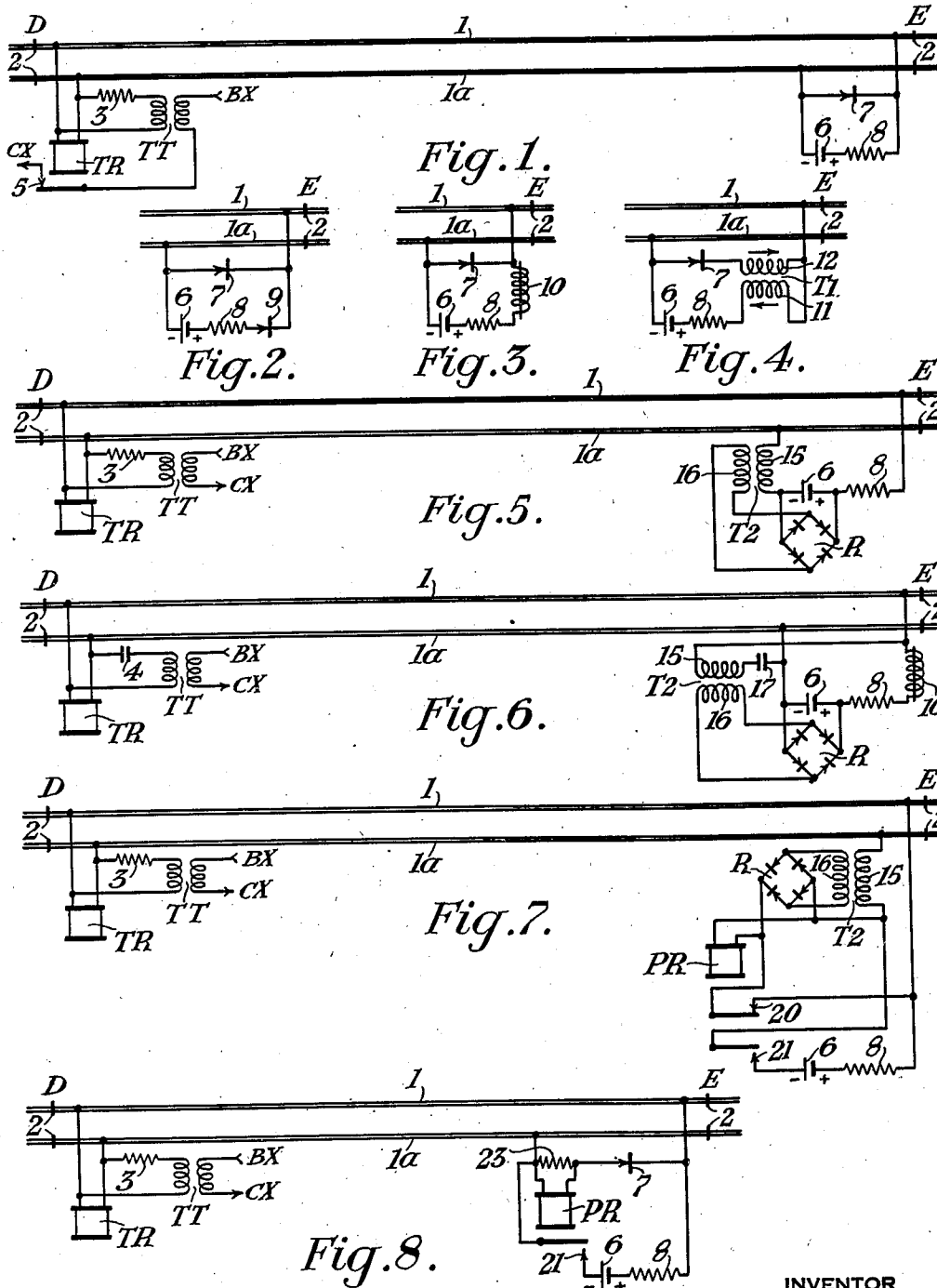
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RAILWAY TRACK CIRCUIT APPARATUS

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RAILWAY TRACK CIRCUIT APPARATUS

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My invention relates to railway track circuit apparatus; and it has particular reference to the organization of such apparatus into railway track circuits of the class wherein alternating current supplied at the relay end of a circuit is utilized to control a direct current track relay.

It has been proposed heretofore to control a direct current track relay by supplying alternating current to the track rails at the relay end of a track circuit and by shunting one-half of each wave of such current away from the track relay by connecting an asymmetrical unit across the track rails at the other end of the circuit. Such circuits may, for example, be advantageously employed at highway crossings where an alternating current source located at or near a crossing is utilized to operate highway crossing warning devices and it is desired to employ such source to operate the track relays of adjacent track circuits. By supplying the alternating current to the trackway at the relay end of such circuits, it is possible to avoid the initial and maintenance expense of line wires and line transformers that would be required if the alternating energy were applied at the end of the circuits remote from the intersection. Such circuits are also advantageously employed at other locations since it has been found that they provide materially improved shunting characteristics over ordinary direct current track circuits and still provide adequate broken rail protection. However, such circuits are dependent upon the integrity of the alternating current source and hence are subject to power failures of the alternating current source with the result that if the power fails, the circuits cannot function in the usual manner to control traffic over the protected stretch of trackway.

In view of the above-mentioned and other important considerations, it is an object of my present invention to incorporate in track circuits of the class mentioned means for protecting against alternating current power failures.

Another object of my invention is the provision of track circuits of the class mentioned and incorporating means for utilizing the asymmetrical unit and the source of alternating current connected to these track rails at the two ends of a track circuit respectively, for charging a stand-by source of power.

A further object of my invention is the provision of track circuits of the class mentioned and incorporating novel and improved means for normally disconnecting a stand-by source of power from the track rails but connecting such

source to the track rails in the event of a failure of the alternating current power.

The above-mentioned and other important objects and characteristic features of my invention which will become readily apparent from the following description, are attained in accordance with my invention by providing at the end of the section remote from the track relay, an asymmetrical unit and a stand-by source of power connected respectively across the track rails over individual circuit paths. In certain forms of my invention later to be described, a full-wave rectifier is connected across the track rails to function as an asymmetrical unit for the applied alternating trackway energy and additional means are provided for connecting the input terminals of such rectifier to receive energy from the track rails for charging the stand-by source of power. In other forms of my invention, a power-off relay is incorporated into the apparatus in such manner as to be energized in response to the applied alternating trackway energy and such relay when deenergized functions to connect the stand-by source of power to the track rails.

I shall describe several 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 illustrating a preferred form of apparatus embodying my invention. Figs. 2, 3 and 4 are each diagrammatic views illustrating modifications of a portion of the apparatus represented in Fig. 1, each also embodying my invention. Fig. 5 is a diagrammatic view illustrating a modified arrangement of the apparatus shown in Fig. 1 and also embodying my invention. Fig. 6 is a diagrammatic view showing a modified form of the apparatus illustrated in Fig. 5 and also embodying my invention. Figs. 7 and 8 are diagrammatic views illustrating further modifications of the apparatus shown in Fig. 1, each also embodying my invention.

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

Referring first to Fig. 1, the reference characters 1 and 1a designate the track rails of a stretch of railway track, which rails are divided by means of the usual insulated joints 2 to form an insulated track section D—E. Located at one end, as for example, end D, of this section are a direct current track relay TR and a transformer TT. The winding of relay TR and the secondary winding of transformer TT are connected in multiple across the rails 1 and 1a of the sec-

tion adjacent end D, and preferably an impedance, which may be a non-inductive resistor 3 (see Fig. 1) or a condenser 4 (see Fig. 6), is interposed between the secondary winding of transformer TT and one of the track rails. As shown in Fig. 1, the primary winding of transformer TT is connected to a suitable source of alternating current, such as a generator not shown but having its opposite terminals designated in the drawing by the reference characters BX and CX, over a front contact 5 of relay TR.

Located at the other end of section D—E are a stand-by source of power, such as a battery 6, and an asymmetrical unit 7. The battery 6 and asymmetrical unit 7 are connected respectively over individual circuit paths across the rails of section D—E adjacent end E, with the asymmetrical unit 7 poled in opposition to current flow from battery 6 and with a current limiting resistor 8 interposed between battery 6 and one track rail. If desired, there may be interposed in the circuit connection of the battery to the track rails another asymmetrical unit 9 poled in agreement with the flow of current from the battery (see Fig. 2), or an inductive reactor 10 (see Fig. 3) or a secondary winding 11 of a transformer T1 (see Fig. 4), which transformer has its primary winding 12 interposed in circuit with asymmetrical unit 7 and has its two windings 11 and 12 so arranged that a flow of current through winding 12 in one direction induces an electromotive force of the opposite direction in winding 11.

Normally, relay TR is energized so that the alternating current source is connected to transformer TT and as a result the rails of section D—E are supplied with alternating trackway energy. One-half of each wave of this alternating trackway energy is shunted away from relay TR by the asymmetrical unit 7, and the other half of each wave of the alternating current is blocked by unit 7 and consequently is forced through the winding of relay TR so that relay TR is maintained energized in response to the half-wave or pulsating unidirectional current traversing its winding. In Fig. 1, a portion of this half-wave current might also flow through battery 6 to charge such battery, but if asymmetrical unit 9, reactor 10, or transformer winding 11 (see Figs. 2, 3 and 4, respectively) is interposed between the battery and the track rails, then the flow of such half-wave current through the battery will be opposed.

When the apparatus represented in Fig. 1 is in its normal condition as illustrated in the drawing, and a train enters section D—E, the wheels and axles of the train form a shunt path for the applied alternating current and as a result both asymmetrical unit 7 and relay TR are shunted. Relay TR accordingly releases and opens its front contact 5 to disconnect transformer TT from the source of alternating current. The train in the section also provides a shunt path across the terminals of stand-by battery 6, and current is supplied from the battery to the track rails effective when the train vacates the section to pick up relay TR. When relay TR picks up due to current supplied from battery 6, front contact 5 of relay TR closes to connect transformer TT to the source of alternating current with the result that the apparatus illustrated in Fig. 1 is restored to its normal condition wherein relay TR is held energized in response to the half-wave current re-

ceived by the relay from transformer TT due to the action of asymmetrical unit 7.

In the event that the supply of alternating current to the rails of section D—E is interrupted due to a failure of the source of alternating current, relay TR is held energized by the unidirectional current supplied to the relay from battery 6, and the apparatus illustrated in Fig. 1 is conditioned to operate in response to current supplied from battery 6 until such time as the supply of alternating current to the rails of section D—E is restored. The apparatus represented in Fig. 1 accordingly is effective to govern traffic in section D—E during interruptions of the supply of alternating current to the rails of the section. It follows, therefore, that I have provided novel and improved track circuit apparatus utilizing alternating trackway energy applied at the relay end of a circuit to control a direct current track relay and incorporating means for utilizing a stand-by source of power to operate the track relay during a loss of power from the source of alternating current. In addition, it can be seen that my invention provides means for interrupting the supply of alternating current to the track rails during the interval that the section is occupied.

Fig. 5 illustrates a modification of the apparatus of Fig. 1 wherein the source of alternating current is connected constantly to transformer TT and hence such connection is independent of relay TR, and also wherein a full-wave rectifier R is employed as an asymmetrical unit for shunting one-half of each wave of the alternating current from relay TR. Referring now to Fig. 5, it can be seen that the output terminals of rectifier R are connected across the rails of section D—E in multiple with battery 6, with the rectifier poled in opposition to the flow of current from the battery. It follows that with the output terminals of rectifier R connected across the rails of section D—E, the rectifier provides two parallel paths of low resistance which shunt one-half of each wave of the alternating current away from both battery 6 and relay TR, while the other half-wave of each wave of this current traverses relay TR to hold such relay energized.

In addition, rectifier R of Fig. 5 is connected to receive energy from the rails of section D—E for charging stand-by battery 6. To do this, the input terminals of rectifier R are connected across a secondary winding 16 of a transformer T2, which transformer may have its primary winding 15 interposed in the connection of one rail and one output terminal of rectifier R (see Fig. 5) or may have its primary winding 15 connected through a condenser 17 directly across the rails of section D—E (see Fig. 6). In either case, it is apparent that the electromotive forces induced in secondary winding 16 due to the flow of current through winding 15 will be rectified by rectifier R into and supplied to battery 6 as unidirectional energy whereby the battery is charged.

The operation of the apparatus of Figs. 5 and 6 will readily be apparent from an inspection of the drawing together with the foregoing description of the operation of the apparatus represented in Fig. 1, and further detailed description is believed to be unnecessary except to point out that in Fig. 6, inductive reactor 10 is interposed in the common connection of one terminal of battery 6 and one terminal of rectifier R to one of the track rails, and this reactor accord-

ingly functions to assist rectifier R in blocking one-half of each wave of the alternating current to force such half-wave current through relay TR and to prevent such current from flowing through battery 6.

Fig. 7 illustrates a modification of the apparatus of Fig. 1 wherein the output terminals of full-wave rectifier R are connected across the rails of section D—E over a circuit including a normally closed front contact 20 of a power-off relay PR, and the stand-by battery 6 is connected across the rails of section D—E at such times as back contact 21 of relay PR is closed. The power-off relay PR is connected across the output terminals of rectifier R, which rectifier has its input terminals connected across secondary winding 16 of transformer T2 and the primary winding 15 of this transformer is interposed between one rail and one output terminal of rectifier R.

Normally, alternating trackway energy is supplied to the rails of section D—E of Fig. 7 and as a result relays TR and PR are both held energized, the former relay being energized by the half-waves of the alternating current that are blocked by rectifier R and the latter relay being energized by the rectified current supply from rectifier R in response to the electromotive forces induced in winding 16 of transformer T2 due to the flow of current through winding 15 when current is shunted by rectifier R away from relay TR.

When a train enters section D—E of Fig. 7, the applied alternating current is shunted away from both relay TR and rectifier R. Relays TR and PR accordingly release, and back contact 21 of relay PR completes an obvious circuit path which includes primary winding 15 of transformer T2 and over which battery 6 is connected to the rails of the section. After the train vacates the section, relay TR is first energized by current supplied from battery 6 to the track rails over the above-mentioned circuit path, and this path also provides a circuit for shunting away from relay TR the alternating current supplied to the track rails. The flow of alternating current through primary winding 15 of transformer T2, however, induces in secondary winding 16 of transformer T2 an alternating current which is supplied through rectifier R to relay PR as unidirectional current, and as a result relay PR picks up to open back contact 21 and disconnect battery 6 from the track rails, and to close front contact 20 and thereby connect the output terminals of rectifier R across the track rails. The apparatus of Fig. 7 is thus restored to its normal condition wherein relay TR is held energized in response to the half-waves of current that are blocked by rectifier R.

In the event of a failure of the alternating current source of Fig. 7, relay PR is caused to become released to disconnect the output terminals of rectifier R from the rails of section D—E and to connect battery 6 to the track rails over back contact 21. Relay TR accordingly is held energized in response to the battery current supplied to the rails of the section and as a result protection is afforded to railway traffic on the stretch during power failures of the alternating current source. When the alternating current source again become effective to supply energy to the rails of section D—E, relay PR becomes energized in the manner explained in detail hereinbefore due to the flow of alternating current through the circuit path connecting battery 6 to the track rails, and relay PR accordingly picks

up to restore the apparatus of Fig. 7 to its normal condition wherein relays TR and PR are held energized by the half-waves of current that are respectively blocked and passed by rectifier R.

In Fig. 8, another modification of the apparatus of Fig. 1 is represented wherein power-off relay PR is connected in series with asymmetrical unit 7 across the rails of section D—E, and hence this relay is energized by the half-waves of current that are shunted by unit 7 away from relay TR. Preferably, a resistor 23 is connected across the terminals of relay PR to prevent the relay from "chattering" in response to the pulsations of current traversing its winding. The relay TR is held energized by the alternate half-waves of the alternating current that are blocked by unit 7 from traversing the winding of relay PR, and it follows that relays PR and TR are each energized by unidirectional current flowing in their respective windings upon the supply of alternating current to the rails of section D—E.

When a train occupies section D—E of Fig. 8, the alternating current flowing in the track rails is shunted by the wheels and axles of the train away from both relays PR and TR, and both relays consequently are released until such time as the train vacates the section and the alternating current supplied to the rails becomes effective to reenergize relays TR and PR. In the event of a failure of the alternating current source, relay PR is released to connect battery 6 to the rails of section D—E over back contact 21, and the unidirectional current supplied from the battery to the track rails holds relay TR energized. This unidirectional current is blocked from traversing the winding of relay PR by asymmetrical unit 7 which is poled in opposition to the flow of current from battery 6, and it follows that battery 6 is connected by relay PR to the track rails to energize relay TR whenever relay PR is released due to a failure of the alternating current power. The apparatus of Fig. 8 accordingly is effective to energize relay TR from the stand-by source of power during alternating current power failures and it follows that no interference of the control established by relay TR over traffic in the section is effected by an interruption of the alternating current power. When the alternating current source again becomes effective to supply alternating current to the rails of section D—E, relay PR picks up to disconnect battery 6 from the track rails, and relay TR is held energized by the half-waves of alternating current that are blocked by unit 7 away from relay PR. It follows that since the stand-by source is disconnected from the track rails of the section at all times except when the section is occupied or during a failure of the alternating current power, the active life of the stand-by source is relatively long and such course need be replaced only at relatively long intervals of time.

Although I have herein shown and described only a few forms of railway track circuit 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, a source of alternating current and a direct current relay both connected across the track rails at one end of the section, a full-wave rectifier, circuit means for connecting the output termi-

nals of said full-wave rectifier across the track rails at the other end of said section whereby said rectifier shunts one-half cycle of the alternating current away from said relay, other means for connecting the input terminals of said rectifier to receive energy from the rails of said section, a power-off relay connected across the output terminals of said rectifier and normally energized in response to energy received by said rectifier from the rails of said section, a battery, and circuit means effective when said power-off relay is released for connecting said battery across the track rails at said other end of said section.

2. In combination, a section of railway track, a source of alternating current and a direct current track relay connected in multiple across the rails at one end of said section, a rectifier connected across the rails at the other end of said section to shunt one-half of each wave of the alternating current from said track relay, another relay energized in response to current shunted by said rectifier away from said track relay, and a battery connected over a back contact of said other relay to the rails at said other end of said section, said battery being poled in opposition to said rectifier.

3. In combination, a section of railway track, a source of alternating current and a direct current relay both connected across the track rails at one end of said section, a source of unidirectional current and a rectifier, circuit means for connecting said unidirectional current source and said rectifier respectively across the rails at the other end of said section over individual circuit paths, said rectifier shunting from said relay one-

half of each wave of the alternating current and being poled in opposition to current flow from said unidirectional current source, and means deriving current from the track rails at said other end of said section and cooperating with said rectifier for at times disconnecting said unidirectional current source from said rails.

4. In combination, a section of railway track, a source of alternating current and a direct current relay both connected across the track rails at one end of said section, a source of unidirectional current and a rectifier, circuit means for connecting said unidirectional current source and said rectifier respectively across the rails at the other end of said section over individual circuit paths, said rectifier shunting from said relay one-half of each wave of the alternating current and being poled in opposition to current flow from said unidirectional current source, and means deriving alternating current from the track rails at said other end in response to the half-wave pulses of current shunted by said rectifier from said relay for at times disconnecting said unidirectional current source from said track rails.

5. In combination, a section of railway track, a source of alternating current and a direct current relay both connected across the track rails at one end of said section, another relay and an asymmetrical unit connected in series across the track rails at the other end of said section, and a battery connected over a back contact of said other relay to the rails of said section, said battery being poled in opposition to said asymmetrical unit.

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