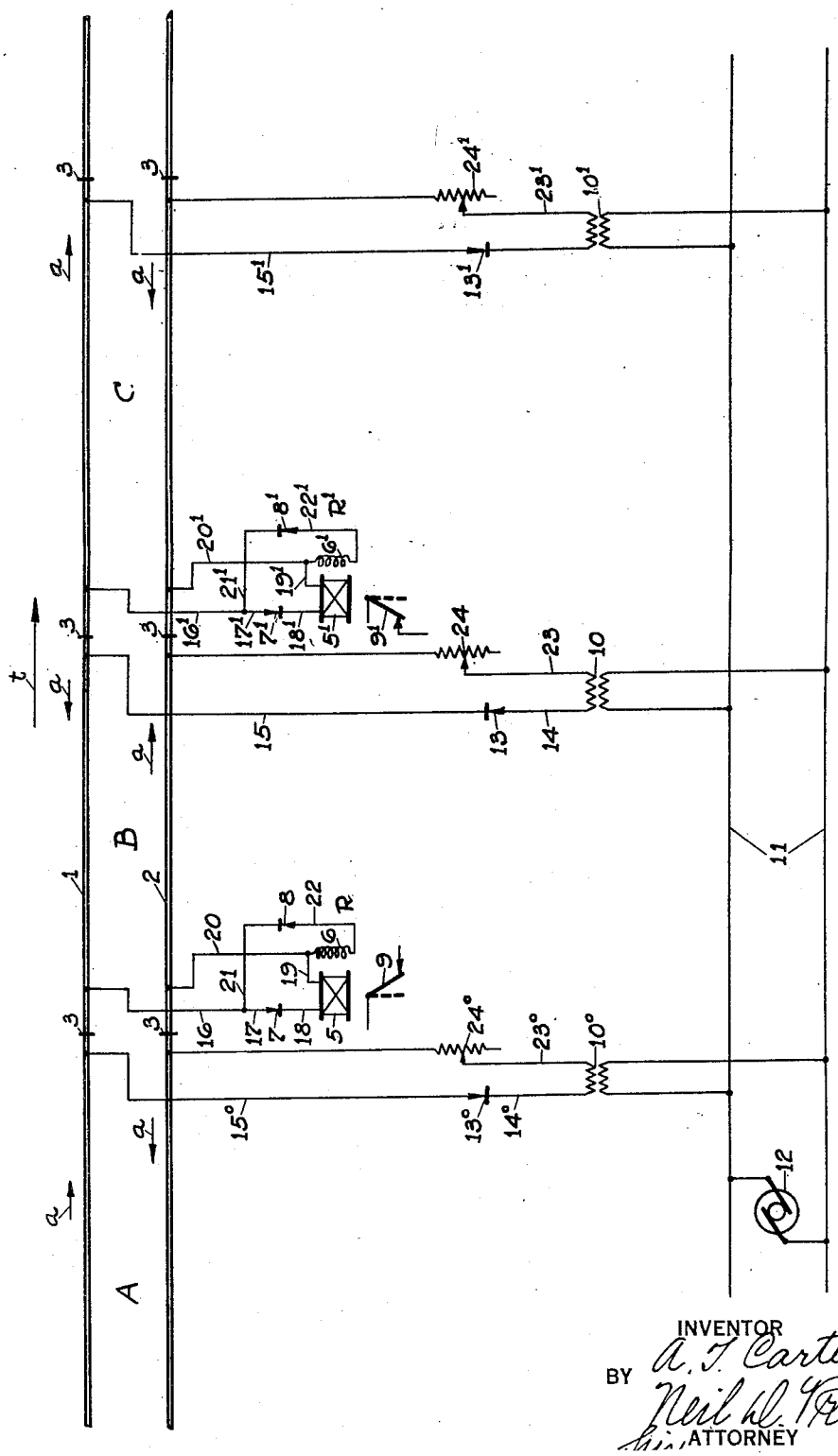
Sept. 22, 1931. A. T. CARTER 1,824,119

RAILWAY TRACK CIRCUIT

Filed Jan. 11, 1930



INVENTOR
A. T. Carter,
BY Neil W. Preston,
ATTORNEY

Patented Sept. 22, 1931

1,824,119

UNITED STATES PATENT OFFICE

AINSLIE T. CARTER, OF COLDWATER, NEW YORK, ASSIGNOR TO GENERAL RAILWAY SIGNAL COMPANY, OF ROCHESTER, NEW YORK

RAILWAY TRACK CIRCUIT

Application filed January 11, 1930. Serial No. 420,253.

This invention relates to alternating current track circuits for railway signalling, and more particularly to an arrangement or organization for such alternating current track circuits to obtain inherent protection against broken-down insulated joints.

In the well-known normally closed track circuit, commonly used in railway signalling for block signal systems, interlocking, automatic train control, and the like, it is desirable to provide what is commonly known as broken-down joint protection, that is, provide such an organization of devices and circuits that failure of the insulated joints in the track rails between adjacent circuit sections will not cause improper energization of the track relay of one section by current supplied from the adjacent section, and tend to prevent the proper shunting or deenergization of this track relay by a train.

One object of the present invention is to provide such broken-down joint protection for single phase alternating current track circuits. Generally speaking, and by way of explanation but not limitation, the invention contemplates using two-element two-position alternating current track relays of the induction type in combination with rectifiers in series with the windings of these relays and in the transformer connections feeding the track circuits, in such a way that each track relay will close its contact when energized by the alternating current supplied to its track circuit, but will open its contacts when energized by the alternating current leaking around the insulating joints from an adjacent track circuit.

Further characteristic features, objects, and advantages of the invention will be in part apparent to those skilled in the art, and in part be pointed out as the description progresses.

The accompanying drawing shows in a simplified and diagrammatic manner one specific embodiment of the invention applied to two adjacent track circuits, no attempt having been made to illustrate any particular arrangement of circuits controlled by the track relays, since these track relays may be employed for an automatic block signal system, in an interlocking plant, for automatic train control, or for any other purpose in the railway signalling art, and since the particular use to which the track circuits of this invention are put is not material.

Referring to the accompanying drawing, the track rails 1 and 2, bonded together in the usual way, are divided by insulated joints 3 to form blocks or adjacent track circuit sections, of which the blocks B and C and the adjacent end of the block A have been shown. Since the parts and circuits associated with each of these track sections are the same, the same reference characters are used for the corresponding parts, with distinctive exponents.

Referring to the track section B, at one end of this section, preferably the entering end, the normal direction of traffic being from left to right as indicated by the arrow *t*, a two-element two-position alternating current relay R of the induction type, having windings 5 and 6, is connected across the track rails 1 and 2, with one or more rectifiers 7 and 8 in series with each winding, and disposed in an opposite polarity sense.

This relay R, shown conventionally, may be any one of the well-known two-element alternating current relays of the induction type, either comprising a rotor as an operating element, as shown and described, for example, in the application of W. K. Howe, Ser. No. 397,227, filed July 19, 1920, or using a vane as the operating element, such as shown and described for example, in the application of W. K. Howe, Ser. No. 556,990, filed April 27, 1922.

This relay R, as will be readily understood by those skilled in the art, is provided with contact fingers and stationary contacts, connected to the operating element of the relay, and biased by a counterweight or spring to an intermediate or neutral position, one such contact finger 9 has been shown diagrammatically.

When the two windings 5 and 6 of the track relay R are energized with two alternating or uni-directional pulsating currents,

suitably displaced in time phase, the contact finger 9 is moved from its neutral or deenergized position (shown by a dotted line) in one direction or the other, depending upon the relative phase displacement of the currents in the windings of the relay, to an energized or operated position, as will be readily understood by those skilled in the art. In the specific embodiment of the invention shown, the contact finger 9 of the relay R of the track section B closes its contact when operated to the right, whereas the contact finger 9^1 of the relay R^1 of the adjacent track section C, closes its contact when moved to the left. It should be understood that the effective energized condition of a track relay is that in which its contacts are closed, and that the primary function of the track relay is to open its contacts when a train is present on its track circuit section.

The rectifiers 7 and 8 may be of any suitable type, such as electrolytic, or of the copper-oxide dry plate type; but for the purposes of this invention, these rectifiers should provide a small amount of back-leak current, for reasons about to be explained, and if the type of rectifier used does not have this inherent characteristic, a shunt resistance of suitable value should be used.

At the other or exit end of the section B, is a transformer 10, having its primary energized by alternating current from a supply line 11, connected to an alternating current generator 12 or other suitable source. The secondary of this track transformer 10 is connected across the track rails 1 and 2 in the usual way, with the usual limiting resistance 24 or inductive or condensive or reactance, but in one or both of the leads is interposed a rectifier 13, so that the potential applied across the track rails is unidirectional and pulsating. These rectifiers 13 for adjacent track circuits are disposed in an opposite polarity sense; and these rectifiers 13 may be of the same type as the rectifier 7 and 8, or of a different type, but should provide a back-leak current.

Referring to the track circuit for the track section B, the current from the secondary of the track transformer 10 flows over a circuit which may be traced from the left hand side of this secondary, wire 14, rectifier 13, wire 15, track rail 1, wire 16, thence through the winding 5 of the relay 1, over wire 17, through rectifier 7, wire 18, winding 5, wire 19 to the wire 20 connected to the track rail 2, or through the winding 6 of the relay R, over wire 21, through rectifier 8, wire 22, winding 6 to the wire 20, thence along the track rail 2, limiting impedance 24, and wire 23, back to the other terminal of the transformer 10.

Assuming the rectifier 13 to be disposed in the polarity sense shown, it will be evident that the uni-directional pulsating current flows in the track rails 1 and 2 in the directions indicated by the arrows a; and it can be seen that this current for the adjacent track sections B and C is of opposite polarity. Referring to the track relay R, this uni-directional current passes freely, so to speak, through the winding 5 of this track relay, but only the back-leak component of this current provided by the rectifier 8, can pass through the other winding 6. Thus, the winding 6 of the relay R is made resistive relative to the winding 5, and an operating torque is developed the same as if the two windings of the relay R were energized by alternating currents displaced in time phase. It is assumed that this operating torque for the relay R is in a direction to move the contact finger 9 to its right-hand closed position.

Referring to the track relay R^1 for the track section C, the windings of this relay are energized with uni-directional pulsating current displaced in time phase in the same way, but on account of the reversal of the rectifier 13^1 for this track circuit, the winding 5^1 is resistive, relative to the winding 6^1, and other things being the same, the torque developed by the relay R^1 is in an opposite direction, moving the contact finger 9^1 to the left.

It will be evident that when a train enters the track section B or C, the corresponding track relay is shunted in the usual way, and opens its contacts.

Assuming now that the insulated joints 3, between the adjacent track sections B and C, deteriorate in resistance or break down, so that the current from the transformer 10 and rectifier 13, associated with the track section B may be supplied to the track relay R^1, associated with the track section C, it will be evident after a little consideration that the polarity of this current is such as to cause the relay R^1 to develop torque in a direction to move its contact finger 9^1 to the right, away from its circuit closing position. Consequently, if the insulated joints break down, or there is sufficient leakage current to interfere with the proper shunting of the track relay R^1, this relay will be automatically operated to the deenergized condition, putting to stop the signal controlled thereby, or otherwise manifesting by adverse control that the track circuit is out of order. In short, broken down joint protection is obtained by deenergizing the track relay. The point in the deterioration of the insulation of the joints, at which the track relay opens its contacts, depends upon a number of factors, but this point is well on the safe side.

In the specific arrangement shown, the rectifiers 7 and 8 for the track relays in the adjacent track section are disposed in the same polarity sense so that with the reversal

of the rectifiers 13 in the track circuit feed, these track relays normally develop torque in opposite directions; but, if desired, as will be evident, these rectifiers 7 and 8 for adjacent track relays may be disposed in an opposite polarity sense, so that the normal operating torque is in the same direction, the same protection against broken-down joints being attained in the same way in both arrangements.

Various other adaptations and modifications of the particular arrangement and construction of circuits and devices shown may be developed accordingly from the invention.

What I claim is:—

1. In a track circuit system for railroads, a plurality of track circuit sections, means for supplying uni-directional pulsating currents to each of said sections, said current for adjacent sections being of opposite polarity and electro-responsive means for each section closing its contacts when energized by the current supplied to that section and open its contacts when energized by current from an adjacent section.

2. In a track circuit system, a plurality of track circuit sections, means for supplying said track sections with uni-directional pulsating current, said current for adjacent track sections being of opposite polarity, and a two-element alternating current relay connected to each section and closing its contacts in response to current of the polarity with which the corresponding section is supplied and opening its contacts in response to current of the opposite polarity.

3. In a system of the character described, the combination with bonded track rails divided by insulated joints into a plurality of track sections, a source of alternating current and rectifying means for supplying uni-directional pulsating current to the track rails of each section, said current for adjacent sections being of opposite polarity, and a two-element alternating current relay connected across the track rails of each section, in series with rectifying means, said relay for each section closing its contacts only when energized with current of the polarity supplied to that track section.

4. In a signalling system for railroads, a plurality of insulated track sections, a source of alternating current connected across the track rails of each section in series with a rectifier, said rectifiers of adjacent track sections being disposed in an opposite polarity sense and a two-element alternating current relay for each section having its two windings connected across the track rails at the other end of that section in series with rectifiers disposed in an opposite polarity sense.

5. An alternating current track circuit comprising, a two-element alternating current relay of the induction type having two windings, and means including rectifiers disposed in an opposite polarity sense and connecting said windings across the track rails.

6. An alternating current track circuit comprising, a two-element alternating current relay connected across the track rails closing its contacts in response to a uni-directional pulsating current of a given polarity, and opening its contacts in response to such current of opposite polarity.

7. In a system of alternating current track circuits, the combination with a plurality of track sections, a source of alternating current and rectifying means for supplying current to each track section, said rectifying means for adjacent track sections being disposed in an opposite polarity sense.

8. A track circuit system comprising, a plurality of insulated track sections, sources of alternating current and a track relay for each section and means associated with each track relay for causing it to open its contacts when energized from the source connected to the adjacent track section.

9. A single phase alternating current track circuit system comprising, two-element alternating current relays for each section having both windings connected across the track rails of that section.

10. A single phase alternating current track circuit system comprising, sources of alternating current and rectifying means supplying uni-directional pulsating current to each track section, adjacent track sections being supplied only with pulsating currents of different polarities.

In testimony whereof I affix my signature.

AINSLIE T. CARTER.