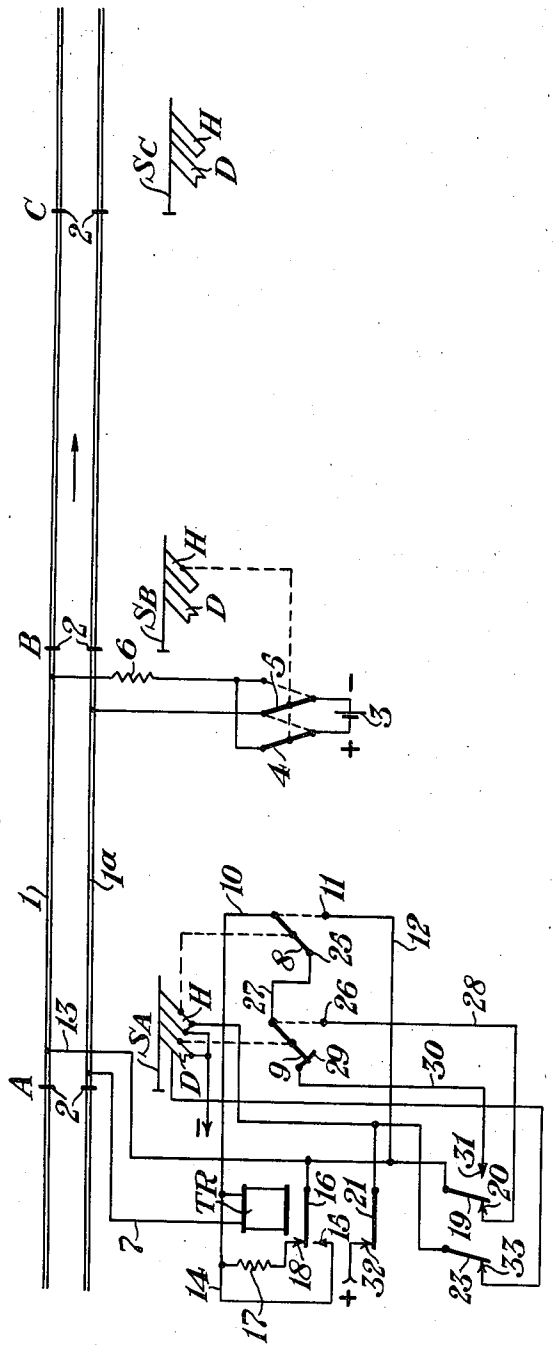
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RAILWAY TRACK CIRCUIT APPARATUS

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RAILWAY TRACK CIRCUIT APPARATUS

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My invention relates to railway track circuit apparatus, and has for an object the provision of apparatus for increasing the shunting sensitivity of the track circuit.

Track circuits of customary contemporary practice provide reliable shunting of a track relay in response to a train occupying the track section when the rolling stock is relatively heavy and the contact surfaces of the traffic rails are bright. Light weight high speed motor cars when operated over present day track circuits may not have a sufficiently low train shunt resistance to assure reliable shunting of the track relay, and the track relay may remain picked up or may be intermittently picked up for short intervals as the vehicle travels through the section with the result that the wayside signals may not indicate the occupancy of the section. A feature of my present invention is the provision of apparatus which may readily be superposed on the track circuits of existing signal systems and when so applied will materially increase the shunting sensitivity of the track circuit and avoid possible false operation of the associated signals. It will be understood, however, that I do not wish to limit my invention to existing track circuits, because apparatus embodying my invention is equally useful for newly installed systems.

In order to clarify the following description, the shunting sensitivity of a track circuit is to be taken as meaning the maximum resistance of a shunt which may be connected across the rails and cause the relay to release its armature. That is, if it requires a relatively low resistance path or shunt across the traffic rails to cause the track relay to release, the circuit possesses low shunting sensitivity; and if the track relay releases in response to a relatively high resistance shunt across the traffic rails, the track circuit possesses a high shunting sensitivity. Train shunt resistance is to be understood as being the resistance from one rail to the other through the paths comprising the wheels and axles of a car or train. Inasmuch as the safe operation of the wayside signals depends upon the release of the track relay in response to a vehicle occupying the section, it is clear that a track circuit possessing a high shunting sensitivity, within limits of course, is essential. I accomplish an increase in the shunting sensitivity of the track circuit by inserting a resistor between the relay and the track after the relay has been energized so that a higher resistance train shunt across the traffic rails will drop the relay than if the resistor were not interposed in series with the relay.

I will describe one form of apparatus embodying my invention, and will then point out the novel features thereof in claims.

In the accompanying drawing, illustrating one form of apparatus embodying my invention, the reference characters 1 and 1ª designate the traffic rails of a stretch of railway over which traffic normally moves in the direction indicated by the arrow, and which are formed by insulated rail joints 2 into track sections A—B, B—C, etc.

Each section of the stretch is provided with a wayside signal designated by the reference character S with an exponent corresponding to the location. These wayside signals SA, SB and SC may take different forms, and in the form here shown are two-arm lower quadrant semaphore signals of the type in use on many of the railroads at the present time.

The operating circuits for the signals S may be in accordance with any of the well known systems in common use and as here shown are governed by a track relay of the associated section. For example, the mechanism for the top arm H of the signal SA is supplied with current over a simple circuit easily traced and which includes the front neutral contact 32—21 of a track relay TR to be referred to later, for the section A—B. The mechanism for the bottom arm D of signal SA is supplied with current over a simple circuit which includes the front neutral contact 32—21 of the relay TR and the normal contact 33—23 of this relay as will be readily understood by an inspection of the drawing. Each of the remaining signals is provided with operating circuits similar to those just described for the signal SA, and which are omitted from the drawing for the sake of simplicity as they form no part of my present invention. It follows that in accordance with the usual practice each signal indicates stop when the immediate section in advance is occupied, and the associated track relay is deenergized; caution when the immediate section in advance is unoccupied and the second section in advance is occupied, and the associated track relay is energized with current of reverse polarity; and clear when the two sections in advance are both unoccupied, and the associated track relay is energized with current of normal polarity.

The track circuit provided for each track section comprises as its essential elements the traffic rails bonded in the usual manner, a source of current connected across the traffic rails at one end of the section and a track relay connect-

ed across the traffic rails at the opposite end of the section. In the form here shown the track circuit includes a battery reversibly connected across the traffic rails at the outgoing end of the section and a direct current polarized relay connected across the traffic rails at the entrance of the section. Referring to the track circuit for the section A—B, the track battery 3 is reversibly connected with the traffic rails 1 and 1ª over pole-changing contacts 4 and 5 operatively connected, as indicated by a dotted line, with the mechanism for the top arm H of signal SB. The arrangement is such that when the arm H of signal SB is operated to the position 60° below the horizontal, the pole-changing contacts 4 and 5 occupy the position illustrated in the drawing by the heavy lines, and when the arm H is moved to its biased horizontal position, the contacts 4 and 5 occupy the position illustrated by the dotted lines. It will be understood by an inspection of the drawing that the positive terminal of battery 3 is connected with the rail 1 over pole-changing contact 4 and a current-limiting resistor 6, and the negative terminal of battery 3 is connected with the rail 1ª over pole-changing contact 5 as long as the arm H of signal SB occupies the 60° position. When arm H is moved to the horizontal position, the pole-changing contacts 4 and 5 are shifted and the positive terminal of battery 3 is connected with rail 1ª and the negative terminal with the rail 1. In other words, when the track section B—C is unoccupied and the top arm H of signal SB is operated to its 60° position, the battery 3 supplies current of one polarity to the traffic rails of the section A—B and which polarity I shall call normal polarity. When the section B—C is occupied, and the semaphore arm H of signal SB is moved to its biased horizontal position, the battery 3 supplies current of the opposite polarity to the traffic rails of section A—B and which polarity I shall call reverse polarity.

The track relay TR is preferably a direct current polarized relay of the type commonly provided for direct current polarized track circuits. The manner of selectively connecting the winding of the track relay TR with the traffic rails of the section A—B and the operation of the apparatus embodying my invention can best be described simultaneously.

One terminal of the winding of the relay TR is permanently connected with the traffic rail 1ª by a wire 7, and the second terminal of the winding of relay TR is connected with the rail 1 over a plurality of selective circuits to be shortly pointed out in detail.

Circuit controller contacts 8 and 9 are operatively connected, as indicated by dotted lines, with the semaphore arms H and D of signal SA, respectively. The arrangement is such that each of the controller contacts 8 and 9 occupies the position illustrated by the heavy line when its respective semaphore arm occupies the 60° position, and is operated to the position illustrated by the dotted line when the respective semaphore arm is moved to the 0° position. It follows that contacts 8 and 9 constitute a circuit controller adapted to assume a distinctive position for each of the three indications of the associated signal.

I shall first assume that the two track sections A—B and B—C are both unoccupied and that the track relay TR is picked up. Under these conditions the right-hand terminal of the winding of relay TR is connected with the rail 1 over a holding circuit which includes wire 14, a resistor 17, front neutral contact 18—16, and wire 13. Hence, it is clear, that the current supplied to the traffic rails by the battery 3 normally flows through the winding of the relay TR and the resistor 17 in series. The parts are so proportioned and adjusted that the flow of current in the winding of relay TR is sufficient to retain the front neutral contacts closed; and that the corresponding normal polarity of the current is such as to cause the polar contacts to occupy their left-hand positions, that is, the positions illustrated in the drawing. The resistor 17 consumes a portion of the energy received from the traffic rails, and hence under the normal condition a train shunt of relatively high resistance will be effective to release the neutral armature of the relay TR. That is, the shunting sensitivity of the track circuit will be higher than would be possible were resistor 17 not interposed in the connection of the winding of relay TR with the traffic rails.

A vehicle travelling in the normal direction of traffic and entering the section A—B will shunt the track relay TR and the two semaphore arms H and D of signal SA will be moved under the biasing force of gravity to their respective 0° positions. The above-traced holding circuit by which the winding of the relay TR is connected across the traffic rails will now be open at the front contact 18—16, but a pickup circuit shunting around the resistor 17 and the front contact 18—16 will be available, and this circuit extends from the right-hand terminal of the winding of relay TR over wire 10, controller contact 8—11, and wires 12 and 13 to the rail 1, the left-hand terminal of the winding being permanently connected with the rail 1 by the wire 7 as pointed out above. A second pickup circuit shunting around the resistor 17 will also be completed when the relay TR is released and which circuit includes the wire 14 extending from the right-hand terminal of relay TR, back contact 15—16, wire 13 to the rail 1 across to rail 1ª and thence by wire 7 to the left-hand terminal of relay TR. This second pickup circuit, however, serves no useful function at this time and will be referred to later on in the description. It follows that when the relay TR is down, the normal holding circuit which includes the resistor 17 will be disconnected and the winding of the relay TR will be connected across the traffic rails by a pickup circuit which is governed by the stop position of the signal and which circuit shunts around the resistor 17. Thus, the track circuit for the section A—B is normally characterized by high shunting sensitivity, and quick release of the relay when a vehicle enters the section will be assured. With the track relay released and the associated signal set at the stop position, the winding of the relay is connected directly across the traffic rails and full energy of the track circuit will be available to pick up the relay.

In the event a poor train shunt occurs while the vehicle occupies any part of the section A—B and the relay TR receives sufficient energy over the pickup circuit to close its front neutral contacts, the closing of the front contact 32—21 will cause the semaphore arm H to start to clear. The picking up of the relay TR at once opens the pickup circuit which includes back contact 15—16, and also closes at the front contact 18—16 the holding circuit through the resistor 17. As soon as the semaphore arm H starts to clear, the contact 8—11 will be operated to open the above-

traced pickup circuit therethrough, and the relay TR will then receive current over the holding circuit only, with the result that the flow of current will be materially reduced due to the resistor 17. The current flowing in the winding of relay TR as the result of the poor train shunt will be so reduced when the resistor 17 is inserted in the connection that ordinarily the value of the current will not be sufficient to retain the neutral armature picked up and so it will be released. Poor train shunt resistances are usually intermittent but should a poor train shunt be prolonged, the operation of picking up and then releasing the track relay TR will be continuously repeated and the semaphore arm H will not be moved far enough away from its 0° position at any time to establish a false indication.

When the train advances to the right and enters the section B—C, the semaphore arms D and H of the signal SB will be moved to their horizontal positions and the pole-changing contacts 4 and 5 will be shifted to the dotted line positions. When the rear of the train vacates the section A—B, the current supplied by the battery 3 to the traffic rails of the section A—B will be of reverse polarity, and the winding of relay TR will at first receive current over the pickup circuit including the controller contact 8—11. This pickup circuit will remain effective until the front neutral armature contacts close and the semaphore arm H starts to clear as the result of the closing of the front contact 32—21. The controller contact 8—11 will now be opened and the relay TR will then be retained energized through the resistor 17 and the front contact 18—16.

When the train advances to the right and vacates the section B—C, the top arm H of the signal SB will be cleared in the usual manner and the track circuit for the section A—B will be pole-changed, the shifting of the contacts 4 and 5 changing the polarity of the current from reverse to normal. The track relay TR will now be deenergized and then reenergized in the normal direction and its neutral armature will drop as the magnetic field passes through zero. The opening of contact 18—16 will open the holding circuit through resistor 17 and will close the pick-up circuit which includes the back contact 15—16. As the magnetic field builds up in the normal direction, the polar armature will be shifted to the left-hand position before the magnetic field has reached a value sufficient to attract the neutral armature. The semaphore arm D of signal SA being in the 0° position, the shifting of the polar armature to the left-hand position will make available another pickup circuit which extends from the right-hand terminal of the winding of relay TR over wire 10, contact 8—25 (as arm H of signal SA was cleared when section A—B was vacated) wire 27, contact 9—26, wire 28, left-hand contact 19—20, and wire 13 to the rail 1. This last pickup circuit remains complete until the track relay TR is fully picked up and its holding circuit is closed. With relay TR picked up in its normal position, the arm D of signal SA will be cleared and the pickup circuit just traced will be open at the controller contact 9—26, leaving relay TR held energized through the resistor 17. Consequently, during the pole-changing period of the track circuit in response to a train vacating the section B—C, the pickup circuit including the back contact 15—16 will be effective long enough to shift the polar armature, and then another pick-up circuit will be rendered effective until the track relay is fully picked up and the corresponding signal is cleared. The clearing of the signal leaves the track relay energized over its holding circuit. In other words, a low shunting sensitivity is established for the track circuit to assure reliable picking up of the relay, and once the relay is picked up a high shunting sensitivity is established for the track circuit.

If a train moving against traffic enters the section B—C, the arm H of signal SB will be set at the 0° position and the polarity of the current supplied to the track circuit for the section A—B will be shifted from that of normal polarity to that of reverse polarity. Track relay TR will be deenergized and then reenergized in the reverse direction, the neutral armature dropping as the magnetic field passes through zero. With the back neutral contact 16—15 closed, the relay TR will receive current over this pickup circuit and as the magnetic field builds up in the reverse direction, the polar armature contact finger 19 will be shifted into engagement with the right-hand contact point 31 before the field is sufficiently strong to open back neutral contact 16—15. The slow release feature provided in accordance with common practice for the signal mechanism of the semaphore arm H of signal SA to bridge pole-changing periods will hold the controller contact 8—25 closed for an interval after the relay TR is deenergized. The contact 29 is made of sufficient length to assure engagement with the controller 9 during a major portion of the movement of the arm D from the 60° position to the 0° position, and hence the shifting of the polar armature contact finger 19 into engagement with the right-hand contact point 31 will complete a pickup circuit for the relay TR which extends from the right-hand terminal of the winding of relay TR over wire 10, contact 8—25, wire 27, contact 9—29, wire 30, right-hand contact 31, polar contact 19—31, and wire 13 to the rail 1. This pickup circuit will remain closed long enough to effect the closing of front contact 18—16 and so to close the holding circuit through resistor 17. When the semaphore arm D of signal SA is moved to its full 0° position, the contact 9—29 will be broken, leaving the relay TR retained energized over its holding circuit only. That is to say, when a train moving against traffic enters the section in advance and the track circuit is pole-changed, the pickup circuit including the back contact 16—15 will be effective long enough to shift the polar armature, and then another pickup circuit will be effective to fully pick up the track relay and complete its holding circuit, the relay being retained energized over the holding circuit only as soon as the signal assumes the corresponding position. In other words, a low shunting sensitivity will be established to assure reliable picking up of the relay during the pole-changing period and then the high shunting sensitivity for the track circuit will be re-established.

When the train moving against traffic enters the section A—B from the right, the high shunting sensitivity will be in effect and a quick release of the track relay TR will be assured for setting the semaphore arm H of the signal SA at the 0° position.

If a train should enter section A—B by way of a switch when signal SA is clear, it will be noted that the pickup circuit around the resistor 17 which includes the left-hand polar contact 19—20 would not be closed until the arm D reaches its 0° position, but by that time the top

arm H would have moved out of its 60° position and thus this pick up circuit will not be completed. Consequently, the low shunting sensitivity for the track circuit will not be established until arm H of signal SA has moved to its 0° position.

Each track section of the signal system will be provided with a track circuit similar in all respects to that described for the section A—B.

Although I have herein shown and described only one form 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 with a section of railway track and a source of current connected across the traffic rails of the section, a track relay, a resistor, a holding circuit for connecting the winding of said relay across the traffic rails of the section including a front contact of the relay and said resistor, a circuit controller having a closed position and an open position, means responsive to traffic conditions of the section for operating said controller and effective to close said controller only when said section is occupied, and a pickup circuit for connecting the winding of the relay across the traffic rails of the section around said front contact and resistor and including said circuit controller.

2. In combination with a section of railway track and a source of current connected across the traffic rails of the section, a signal having an operated position and a biased position for governing traffic through the section, a circuit controller contact governed by said signal and closed only when said signal occupies its biased position, a track relay, means governed by said relay when energized effective to move the signal to the operated position, a pickup circuit for connecting the winding of said relay across the traffic rails of the section including said circuit controller contact, a resistor, and a holding circuit for connecting the winding of said relay across the traffic rails including a front contact of the relay and said resistor.

3. In combination with a section of railway track, a source of current, means for reversibly connecting said source across the traffic rails of the section in accordance with traffic conditions in advance, a polarized track relay, a resistor, circuit means for connecting the winding of said relay and said resistor in series across the traffic rails of the section, signaling means having different positions for governing traffic through the section, means controlled by said relay effective to operate the signaling means to the different positions in accordance with the polarity of the current supplied by said source, a circuit controller governed by said signaling means, and other circuit means for at times connecting the winding of the relay across the traffic rails around the resistor and including a polar armature of said relay and said circuit controller.

4. In combination with a section of railway track, a source of current, means for reversibly connecting said source across the traffic rails of the section in accordance with traffic conditions in advance, a signal for governing traffic through the section and having an operated position and a biased position, a circuit controller operated by said signal and closed when said signal occupies the operated position, a polarized track relay, means controlled by said relay when energized with current of a given polarity effective to operate the signal to the operated position, a pickup circuit for connecting the winding of said relay across the traffic rails of the section including a polar contact of said relay and said circuit controller in series, a resistor, and a holding circuit for connecting the winding of the relay across the traffic rails including a front neutral contact of the relay and said resistor in series, whereby full energy received from the traffic rails is available to pick up the neutral armature of the relay when the circuit is pole-changed and the relay is retained energized in series with said resistor.

5. In combination with a section of railway track, a source of current, means for at times connecting said source across the traffic rails of the section to supply current of normal polarity, a polarized track relay, a resistor, circuit means for connecting the winding of said relay across the traffic rails of the section including said resistor, a signal to govern traffic through the section, means effective when said relay is energized with current of normal polarity to operate the signal to a given position, a circuit controller closed only when said signal is in said given position, means for at times reversing the connection of said source to supply current of reverse polarity, and other circuit means including a reverse contact of the polar armature of said relay and said circuit controller for shunting around said resistor.

6. In combination with a section of railway track, a source of current, means for at times connecting said source across the traffic rails of the section to supply current of normal polarity, a polarized track relay, a resistor, a holding circuit for connecting the winding of said relay across the traffic rails of the section including a front neutral contact of said relay and the resistor, a traffic governing device controlled by said relay effectively operated to a given position in response to the energizing of the relay with current of normal polarity, a circuit controller operated by said device and closed when said device occupies said given position, means for at times reversing the connection of said source to supply to the traffic rails current of reverse polarity, and a pickup circuit for connecting the winding of said relay across the traffic rails around said front neutral contact and said resistor and including said circuit controller and a reverse contact of the polar armature of said relay.

7. In combination with a section of railway track, a source of current, means for at times connecting said source across the traffic rails of the section to supply current of normal polarity, a polarized track relay, a resistor, a holding circuit for connecting the winding of said relay across the traffic rails of the section including a front neutral contact of said relay and the resistor, a traffic governing device controlled by said relay effectively operated to a given position in response to the energizing of the relay with current of normal polarity, a circuit controller operated by said device and closed when said device occupies said given position, means for at times reversing the connection of said source to supply to the traffic rails current of reverse polarity, a first pickup circuit for connecting the winding of said relay across the traffic rails including a back contact of the neutral

armature of the relay, and a second pickup circuit for connecting the winding of the relay across the traffic rails including said circuit controller and a reverse contact of the polar armature of said relay.

8. In combination with a section of railway track, a source of current, means for reversibly connecting said source across the traffic rails of the section in accordance with traffic conditions in advance, a polarized track relay, a resistor, a holding circuit for connecting the winding of the relay across the traffic rails including said resistor, a signal for the section operated to a clear position or to a caution position in accordance with the relay energized with current of normal polarity or reverse polarity, a circuit controller operated by said signal and having a first position and a second position corresponding to the clear and caution positions, respectively, a first pickup circuit to shunt around the resistor including a back neutral contact of the relay, a second pickup circuit to shunt around the resistor including a normal contact of the polar armature of the relay and the controller in its second position, and a third pickup circuit for shunting around the resistor including a reverse contact of the polar armature and the circuit controller in its first position, whereby full energy received from the traffic rails is available to pick up the relay when the circuit is pole-changed and the relay is retained energized in series with the resistor.

9. In combination with a section of railway track, a source of current, means for reversibly connecting said source across the traffic rails of the section in accordance with traffic conditions in advance, a polarized track relay, a resistor, a holding circuit for connecting the winding of the relay across the traffic rails including said resistor, a signal for the section operated to a clear position or to a caution position according as the relay is energized with current of normal polarity or reverse polarity and said signal having a biased stop position; a circuit controller operated by said signal and having a first, a second and a third position corresponding to the clear, caution and stop positions, respectively; a first pickup circuit to shunt around the resistor including said controller in its third position, a second pickup circuit to shunt around the resistor including a back neutral contact of the relay, a third pickup circuit to shunt around said resistor including a normal contact of the polar armature of the relay and the circuit controller in its second position, and a fourth pickup circuit to shunt around the resistor including a reverse contact of the polar armature and the circuit controller in its first position, whereby full energy received from the traffic rails is available to pick up the relay or to reverse the polar armature of the relay and the relay is retained energized in series with the resistor.

10. In combination with a section of railway track and a source of current connected across the rails of the section, a track relay, an impedance, a pickup circuit for said relay including a back contact of the relay, a holding circuit for said relay including a front contact of the relay and said impedance, and means governed by traffic conditions for at times providing a shunt path around said back contact.

11. In combination with a section of railway track and a source of current connected across the rails of the section, a track relay, an impedance, a pickup circuit for said relay including a back contact of the relay, a holding circuit for said relay including a front contact of the relay and said impedance, and a circuit controller for closing a shunt path around said back contact when said section becomes occupied.

12. In combination with a section of railway track and a source of current connected across the rails of the section, a track relay, an impedance, a holding circuit for said relay including a front contact of the relay and said impedance, and a circuit controller effective when said section becomes occupied for closing a pickup circuit for said relay exclusive of said impedance.

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