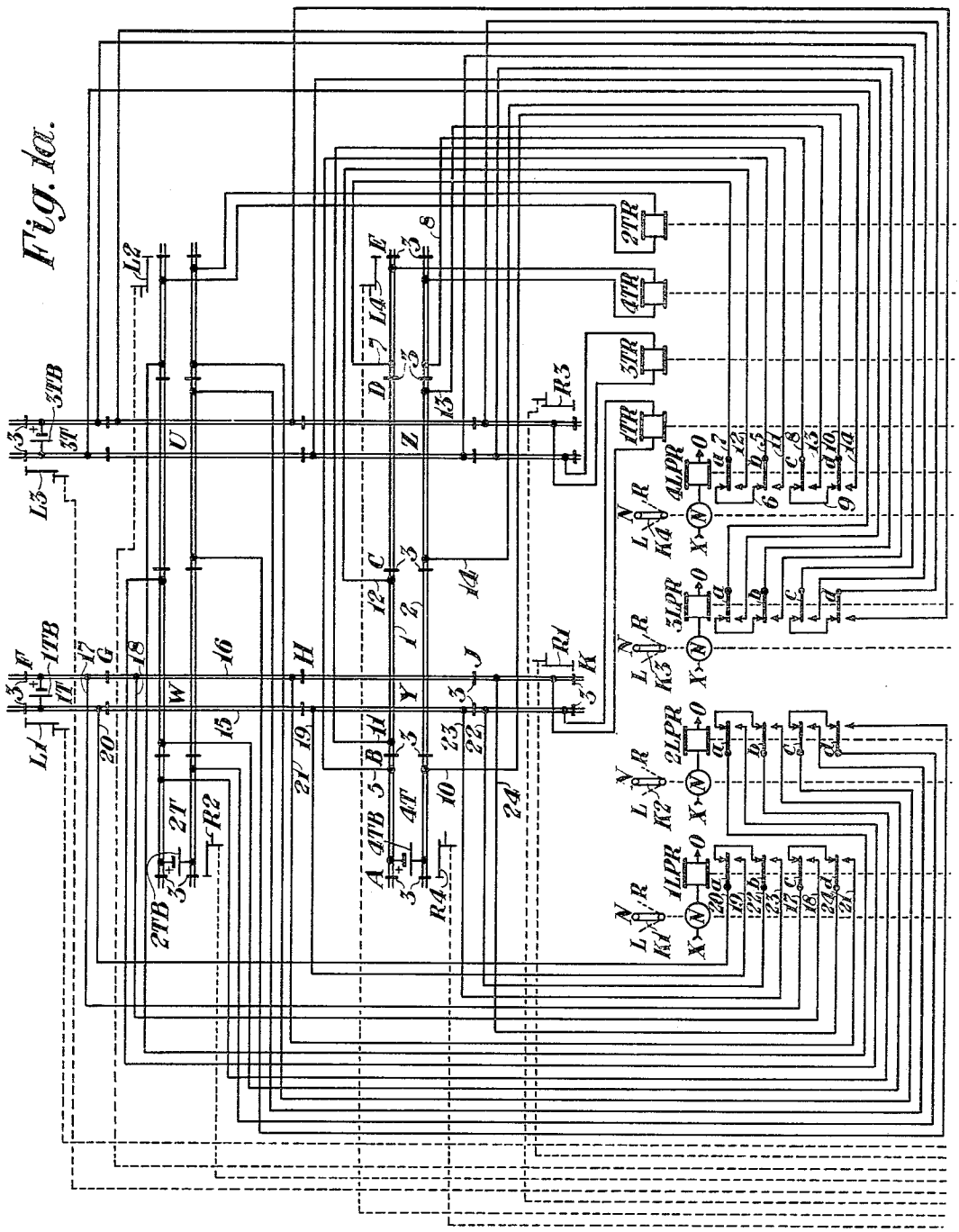
May 15, 1956 W. T. DERR ET AL 2,745,951

TRACK CIRCUIT SYSTEM FOR MULTIPLE TRACK RAILWAY GRADE CROSSINGS

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Fig. 1a.



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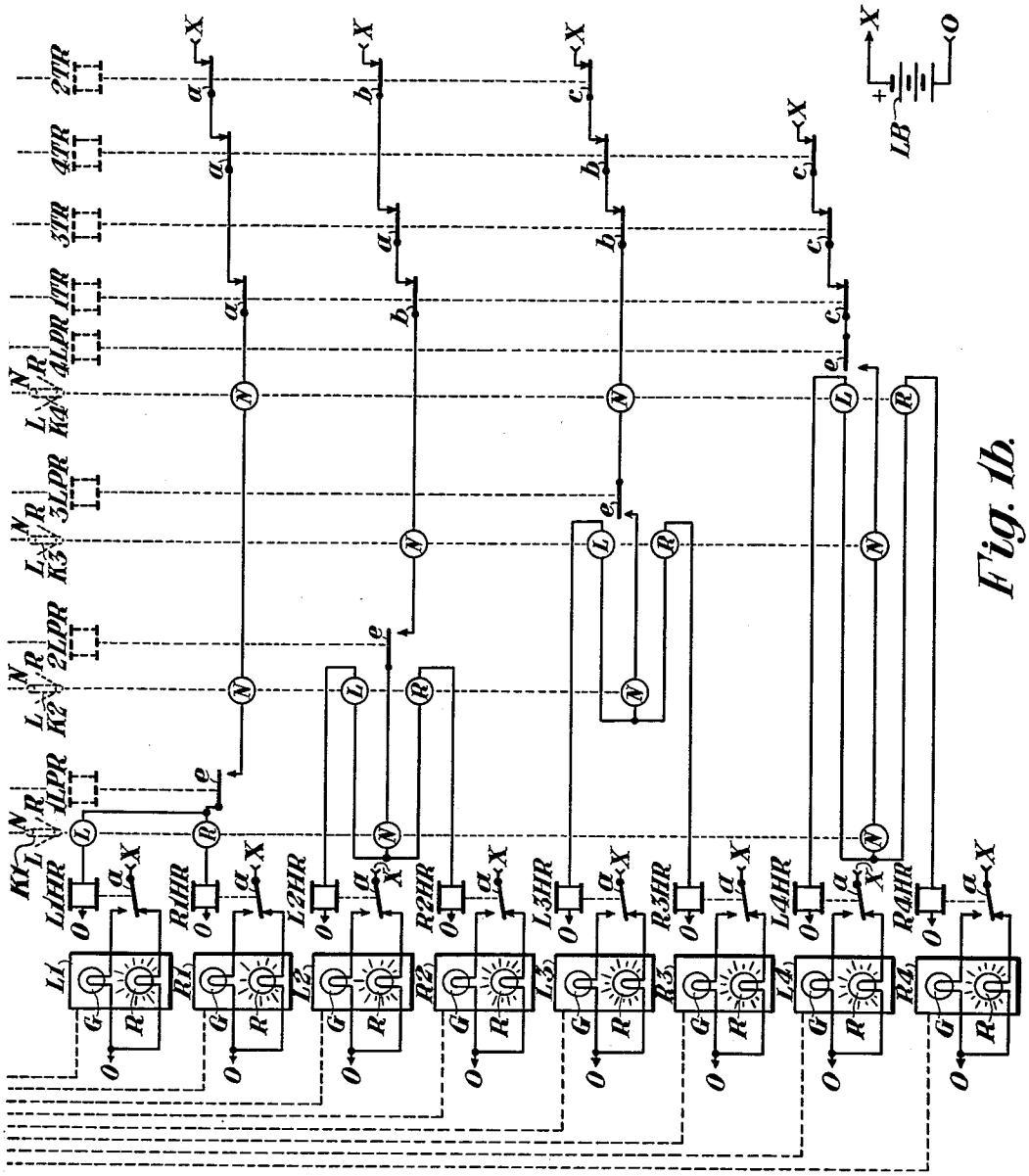


Fig. 1b.

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2,745,951

TRACK CIRCUIT SYSTEM FOR MULTIPLE TRACK RAILWAY GRADE CROSSINGS

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Application December 16, 1952, Serial No. 326,307

7 Claims. (Cl. 246—114)

Our invention relates to railway track circuits, and particularly to an improved railway track circuit providing continuous control of railway signaling by a train on a stretch of track which forms part of a railway grade crossing.

The present invention is an improvement on the circuits shown in an application for Letters Patent of the United States, Serial No. 197,057, filed on November 22, 1950, by Richard R. McGuire, for Railway Track Circuit for Track Sections Including Non-Insulated Portions of Track, which application is of common ownership with the present application.

At railway grade crossings, in order to provide sufficient rigidity and strength, the crossing frog assembly is usually constructed in such a manner as to render the insulation of one rail from the other very difficult. It has heretofore been proposed to insulate such an assembly completely from the track on either side of the crossing and to provide track circuits on either side of the crossing, which track circuits may comprise two individual track circuits with separate track batteries and relays, or may comprise a track section on one side of the crossing connected to a track battery, and a section on the other side of the crossing connected to a track relay, together with jumper wires to carry the track circuit energy around the "dead" section.

If, however, the length of the "dead" section is longer than the wheel base dimensions of the shortest locomotive or other vehicle which moves over the crossing, such as, for example, where one railway intersects another railway having relatively closely spaced multiple tracks, it is possible for a short vehicle to occupy the "dead" section without shunting the adjacent track circuits. Where such track circuits enter into the control of signals governing train movements over the crossing, it is thus possible that a signal might falsely indicate that the crossing is clear when it is actually occupied by a car or locomotive.

To prevent such a possibility, it has heretofore been proposed to provide special arrangements of circuits known in the art as "trap" circuits to insure that a train or vehicle, which commences a movement over the crossing, must complete the movement before the signals can be cleared for another train movement over the crossing. These arrangements are subject to failure, however, in the case where the last car of the train becomes disconnected and remains in the "dead" section while the remainder of the train continues its movement away from the crossing.

Accordingly, it is an object of our invention to provide an improved railway track circuit arranged to energize certain portions of a plurality of track structures, insulated one from the other, so that the energy is effectively shunted by the metallic structure of a car spanning one or more of the track structures.

Another object of our invention is to provide an improved railway track circuit arranged to energize the track structure of multiple track crossings with the track

circuit energy in such manner that adjacent crossing structures are energized with opposite polarities, so that a car spanning two of the crossings will shunt the track circuit energy through the metallic structure of the car.

A further object of our invention is to provide an improved railway track circuit arranged to provide supplemental shunting of the track circuit energy through the frame of a car occupying the track circuit in the portion or portions of the track circuit where the usual wheel-to-wheel shunting is ineffective.

Still a further object of our invention is to provide an improved railway track circuit arranged to provide for the selective shunting of a track circuit in a stretch of track forming part of a railway grade crossing in which all of the track stretches in the crossing are provided with track circuits.

Still another object of our invention is to provide a track circuit of the type described suitable for use at a crossing where two tracks cross two other tracks.

According to our invention, we provide suitable connections for connecting two or more adjacent "dead" sections of track to a selected conventional track circuit adjacent the "dead" sections by selectively operating a circuit controller interposed in the connection. This circuit controller preferably includes contacts of a selected one of the relays governing signals located at the crossing. When the connections are so closed, the "dead" sections are energized by the track circuit energy of the selected adjacent track circuit in such a manner that the adjacent "dead" sections are energized with energy of opposite polarities. Accordingly, when a vehicle spans two of the "dead" sections, and the connections are completed through the contacts of the properly selected circuit controller, the track circuit energy of the selected adjacent track circuit is shunted, through the metallic body or undercarriage of the vehicle, to release the associated track relay.

Other objects of our invention will appear hereinafter from the following description, taken in connection with the accompanying drawings.

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

In the accompanying drawings Figs. 1*a* and 1*b* when placed with Fig. 1*a* above Fig. 1*b* comprise a diagrammatic view showing a double track railway intersected by another double track railway at grade, in which each of the stretches of track is provided with a track circuit embodying our invention.

Because of the symmetry of the circuit arrangement, we shall describe the components and circuits of one track section in detail and shall then describe the operation of several of the track circuits under various conditions.

The track layout here shown consists of two parallel track sections 1T and 3T which intersect two other parallel track sections 2T and 4T. Track sections 1T and 3T are here shown running vertically and it will be assumed that a train traveling on one of these track sections in a downward direction is traveling south. Track sections 2T and 4T are here shown running in a horizontal direction, and it will be assumed that a train traveling from left to right in one of these track sections is traveling east. Sections 1T and 3T intersect sections 2T and 4T at points W, U, Y and Z. At each of these intersections, due to the crossing frog arrangement, the opposite rails of each intersecting stretch of track are metallically connected to one another. Each of the track sections forms a part of a separate track circuit which track circuits are energized by track batteries 1TB, 2TB, 3TB and 4TB, respectively, and which are provided with track relays 1TR, 2TR, 3TR and 4TR, respectively.

Each of the track sections is provided with a way-

side signal at each end to control traffic movements over the section. These signals, which are designated as R1 to R4 and L1 to L4, may be of any suitable type, and are here shown as being of the well-known color light type. It will be assumed, purely for the purpose of explanation, that these wayside signals are in part controlled by manually operated levers K1 to K4 associated with sections 1T to 4T, respectively. It is to be understood that other means of controlling these signals could be employed in practicing our invention.

We shall describe track section 4T in detail and trace its associated track circuit. The positive terminal of track battery 4TB is connected to a rail 1 and the rail 1 is connected to lead 5 just to the left of an insulated joint 3 at location B. The lead 5 is connected to a lead 6 over a front contact *b* of a lever repeater relay 4LPR and lead 6 is connected to a lead 7 over a front contact *a* of relay 4LPR. Lead 7 is in turn connected to rail 1 to the right of insulated joint 3 at a location D. The rail 1 is connected to one terminal of the winding of track relay 4TR at a location E and the other terminal of the winding is connected to rail 2 at the same location. Just to the right of insulated joint 3 at location D, rail 2 is connected to lead 8 which is in turn connected to lead 9 over a front contact *c* of the relay 4LPR. Lead 9 is connected to a lead 10 over a front contact *d* of the relay 4LPR and lead 10 is connected in turn to rail 2 to the left of insulated joint 3 at location B. Rail 2 is connected to the negative terminal of track battery 4TB to the right of an insulated joint 3 at location A. With the track circuit so arranged, it is apparent that leads 5, 6 and 7 and front contacts *b* and *a* of relay 4LPR and leads 8, 9 and 10 and front contacts *d* and *c* of relay 4LPR comprise jumpers which by-pass the portions of rails 1 and 2 from locations B to D, heretofore referred to as "dead" sections, leaving these portions deenergized. Levers K1 to K4, which are three-position levers, each have several contacts here shown as circles with the lever position in which the contact is closed indicated by the same reference characters within the circle as the reference character which designates the line position. The lever repeater relay 4LPR is energized by a circuit which may be traced from the positive terminal X of a suitable source of current, here shown as a battery LB, through a normal contact N of lever K4, and winding of relay 4LPR to negative terminal 0 of the battery LB. The lever K4 has two other positions, left or L and right or R, in each of which the energizing circuit for relay 4LPR is opened and relay 4LPR is released. When relay 4LPR is released, the previously traced track circuit is interrupted and a new circuit path associated with track section 4T is established, as follows.

The positive terminal of track battery 4TB is connected to rail 1 to the right of the insulated joint 3 at location A. Lead 5 is connected at one end to rail 1 to the left of insulated joint 3 at location B and at its other end lead 5 is connected, over back contact *b* of the lever repeater relay 4LPR, to lead 11 which in turn is connected to rail 1 to the right of insulated joint 3 at location B. Rail 1 is connected to lead 12 just to the left of insulated joint 3 located at location C and lead 12 is connected to lead 7 over back contact *a* of the relay 4LPR. Lead 7 is in turn connected to rail 1 to the right of insulated joint 3 at location D, and rail 1 is connected to a terminal of the winding of track relay 4TR at a point located to the left of insulated joint 3 at location E. The other terminal of the winding of relay 4TR is connected to rail 2 to the left of insulated joint 3 at location E and rail 2 is connected to lead 8 to the right of insulated joint 3 at location D. Lead 8 is connected to a lead 13 over back contact *c* of the relay 4LPR and lead 13, in turn, is connected to rail 2 to the left of insulated joint 3 at location D. To the right of insulated joint 3 at location C, rail 2 is connected to lead 14 which is connected to lead 10 over back contact *d* of the relay 4LPR. Lead 10 is connected to rail 2 at a point to the left of insulated joint 3 at location B and rail 2 is connected to the negative terminal of track battery 4TB to the right of insulated joint 3 at location A.

It should be clear from the above tracing of the track circuit of track section 4T, that with the relay 4LPR released, rails 1 and 2 are both energized with energy of positive polarity at intersection Y from location B to location C and they are both energized with energy of negative polarity at intersection Z from location C to location D. It should also be apparent that rail 1 is energized with energy of positive polarity from locations A to B and D to E and rail 2 is energized with energy of negative polarity from locations A to B and D to E. The reasons and utility for this will become clear as the description proceeds.

If the track circuits shown were arranged as it has been proposed in the past, the rails of track section 4T would not be energized from location B to location D, jumpers being used to by-pass these portions. The other track circuits shown, that is those associated with sections 1T, 2T and 3T would also be similarly provided with jumpers so that the entire crossing would be electrically isolated and deenergized. If a train or vehicle were to enter track section 4T, its wheels and axles would shunt track relay 4TR causing it to release. This would make it possible for restrictive signals to be displayed at signals R4 and L4 and possibly elsewhere. However, if the train is shorter than the distance from location B to location D, then when the train occupies the portion of the section 4T between locations B and D, the track relay 4TR will pick up thus making it possible for a clear signal to be shown for an occupied section. It is this condition which our novel track circuit is designed to eliminate.

In operation, all wayside signals R1 to R4 and L1 to L4 normally display a red aspect. This is accomplished by keeping levers K1 to K4 in their normal position in which the lever repeater relays 1LPR to 4LPR are picked up by obvious circuits. With these relays picked up, all the *e* contacts of the lever repeater relays are open, thus opening all the energizing circuits for the signal control relays L1HR to L4HR and R1HR to R4HR, which causes these relays to be released and all their back contacts to be closed, thus causing all the red lamps of the signals to be energized.

As a train approaches the crossing from the left on the stretch of track including section 4T, the operator throws lever K4 from its normal or N position to its right or R position. This opens the circuit which normally energizes the lever repeater relay 4LPR thus causing it to release. When relay 4LPR releases, the previously described jumpers for section 4T are opened at front contacts *a*, *b*, *c* and *d* of relay 4LPR and relay 4LPR's back contacts are closed. This results in the energization of the portion of the section 4T from B to C with energy of positive polarity and the portion of section 4T from C to D with energy of negative polarity, as was explained earlier. The jumpers for the other track sections 1T, 2T and 3T, remain intact. Hence the only energy supplied to the intersections Y and Z is supplied from the track battery 4TB. When relay 4LPR releases, its back contact *e* will close, and with lever K4 in its R position, a circuit will be established for energizing relay R4HR causing it to pick up. This circuit may be traced from the positive terminal X of of battery LB, over front contact *c* of track relay 4TR, front contact *c* of track relay 3TR, front contact *c* of track relay 1TR, back contact *e* of lever repeater relay 4LPR, the N contact of lever K3, the N contact of lever K1, the R contact of lever K4, and the winding of signal control relay R4HR to the negative terminal 0 of battery LB. With relay R4HR energized, it will pick up causing its front contact *a* to close, thus energizing the green lamp G of wayside signal R4 over an

obvious circuit and deenergizing the red lamp R of the signal R4. This green signal will permit the train to enter section 4T.

As the train or vehicle crosses the insulated joints 3 at location A and enters section 4T, the wheels and axles of the train will shunt track relay 4TR, causing it to release. This opens front contact *c* of relay 4TR, thus opening the circuit which was energizing signal control relay R4HR and causing that relay to release. The release of relay R4HR will cause it to open its front contact *a* and close its back contact *a* thus causing signal R4 to now display a red aspect. If the train is longer than the portion of section 4T from location B to location D, the wheels and axles of the train or vehicle will shunt track relay 4TR throughout the entire time which the train or vehicle occupies section 4T. However, if the train or vehicle is shorter than portion B—D, the following will occur.

As the rear wheels of the train or vehicle pass over the insulated joints 3 at location B, the front wheels of the train or vehicle will have already passed over the insulated joints 3 at location C. Track relay 4TR will remain released because a new shunt path has been established as follows. Current will now flow from the positive terminal of track battery 4TB along rail 1 to lead 5, through back contact *b* of lever repeater relay 4LPR, rails 1 and 2 to the right of insulated joint 3 at location B, the wheels and trucks of the train which are in portion B—C, the metallic underframe and/or metallic body of the train or vehicle, the trucks and wheels of the train or vehicle which are in portion C—D, rails 1 and 2 to the right of insulated joint 3 at location C, lead 14, back contact *d* of the relay 4LPR, lead 10, rail 2 to the left of insulated joint 3 at location C, and then to the negative terminal of track battery 4TB. In other words, the metallic undercarriage or frame of the train or vehicle shunts track relay 4TR by being in both positive intersection Y and negative intersection Z simultaneously. When the train occupies portion D—E of section 4T, the track relay 4TR is, of course, directly shunted by the wheels and axles and remains released. When the train vacates track section 4T entirely, energy is once more supplied to the winding of track relay 4TR by the circuit previously traced thus causing relay 4TR to pick up and restablish the energizing circuit to signal control relay R4HR which will cause the green lamp G to be reenergized on wayside signal R4. The operator can now return lever K4 to its normal position thus reestablishing the initial condition causing signal R4 to show red. The apparatus will thus be restored to its normal condition, as shown.

In case a train were to approach the grade crossing on the track including section 1T from the north, for example, and the operator were to mistakenly attempt to give this second train a clear signal by throwing lever K1 to its L position while the first train was moving east on section 4T as previously described, signal L1 will continue to show red so long as the train or vehicle remains in section 4T. This is so because the circuit which energizes the signal control relay L1HR, even with back contact *e* of lever repeater relay 1LPR closed, will still be open at front contact *a* of track relay 4TR so long as the train is in section 4T. In addition, lever K4 will probably be in its L position rather than the N position necessary for a closed contact through lever K4 in the energizing circuit for the signal control relay L1HR. The same analysis holds for a train or vehicle approaching section 1T from the south or for a train or vehicle approaching section 3T from either direction while a train occupies section 4T.

However, with a train or vehicle moving in section 4T, traffic can be given a clear signal to move over section 2T since the controls in the track circuit of section 2T are independent of the track circuit of section 4T, and energizing intersections W and X with energy from the battery 2TB will not affect the track circuit of section 4T. It should be clear that traffic moving simultaneously on these two sections will not create a hazardous condition.

From the foregoing discussion it can be seen that if a train or vehicle shorter than portion B—D should be stopped in the portion B—D of track section 4T, track relay 4TR will continue to be shunted and only red signals can be displayed at signals L1, R1, and L3, R3 and L4 and R4 so long as this condition exists. Traffic could, however, be permitted to move over section 2T.

It will now be assumed that a train or vehicle shorter in length than the portion of track section 1T designated as portion G—J approaches the crossing from a northerly direction on the track including section 1T. As the train or vehicle approaches section 1T, all signals are displaying red for reasons already described in connection with track section 4T. When the operator becomes aware of the presence of the train or vehicle approaching section 1T, he will throw lever K1 to its L position, thus opening the obvious energizing circuit for lever repeater relay 1LPR causing it to release. This will cause the back contacts *a* to *d* of relay 1LPR to close, thus causing the portion G—H of both rails 15 and 16 of section 1T to be energized with energy of positive polarity and the portion H—J of both rails 15 and 16 of section 1T to be energized with energy of negative polarity in a manner substantially similar to that described in connection with track section 4T. That is, intersection W is energized with energy of positive polarity and intersection Y with energy of negative polarity by circuits obvious from the drawings. At this time, all of the other track circuits bypass the intersections through jumpers similar to those described in connection with section 4T. In addition, back contact *e* of lever repeater relay 1LPR will also close and, with the lever K1 in its L position, a circuit is established for energizing signal control relay L1HR, causing it to pick up. This circuit may be traced from the positive terminal of battery LB, over front contact *a* of track relay 2TR, front contact *a* of track relay 4TR, front contact *a* of track relay 1TR, contact N of lever K4, contact N of lever K2, back contact *e* of lever repeater relay 1LPR, contact L of lever K1, and through the winding of relay L1HR to the negative terminal of battery LB. With signal control relay L1HR picked up as just described, the green lamp of wayside signal L1 will be energized over an obvious circuit and the train or vehicle may now enter track section 1T. It is believed that the manner in which the connections to section 1T are switched by operation of the contacts of relay 1LPR is sufficiently obvious from the drawings and the previous description of connections for section 4T to render a detailed description unnecessary.

As the front wheels of the train or vehicle move past insulated joints 3 at location F, track relay 1TR releases because it is shunted by the wheels and axles of the train or vehicle. This interrupts the circuit energizing relay L1HR causing it to release and further causing a red aspect to be displayed at wayside signal L1. This shunting by the wheels and axles will continue until the rear wheels of the train or vehicle move over insulated joints 3 at location G. By this time, the front wheels of the train or vehicle will have passed over the insulated joints at location H. Therefore, a shunt path is still present and track relay 1TR remains released and the red aspect at signal L1 continues to be displayed. This second shunt path may be traced as follows: From the positive terminal of track battery 1TB to rail 16 below insulated joint 3 at location F down rail 16 to lead 17, through back contact *c* of lever repeater relay 1LPR, lead 18 to portion G—H of rails 15 and 16, the wheels and trucks of the train or vehicle in portion G—H, the metallic undercarriage and/or body of the train or vehicle, the trucks and wheels of the train or vehicle in portion

H—J, rails 15 and 16 in portion H—J, lead 19, back contact *a* of relay 1LPR, lead 20 and rail 15 to the negative terminal of track battery 1TB. By the time the rear wheels of the train or vehicle move over insulated joints 3 at location H, the front wheels have moved over the insulated joints 3 at location J and the wheels and axles once more shunt the track relay 1TR directly, causing it to remain released. This shunt path may be traced from the positive terminal of track battery 1TB, through rail 16 from location F to location G, lead 17, back contact *c* of relay 1LPR, lead 18, rail 16 from location G to location H, a lead 21, back contact *d* of relay 1LPR, a lead 24, rail 16 below location J, through wheels and axles contacting rails 15 and 16 below location J, through rail 15 and a lead 22, back contact *b* of relay 1LPR, a lead 23, rail 15 from location J to H, lead 19, back contact *a* of relay 1LPR, lead 20 and rail 15 to the negative terminal of track battery 1TB. This shunt path will be maintained until the train or vehicle leaves the track section 1T at which time the track relay 1TR will pick up and signal L1 will display a green aspect again. If, subsequent to this time, the operator restores lever K1 to its normal position, relay L1HR will be released, so that signal L1 will display its red aspect, and the circuit elements will be restored to their normal condition, as shown in the drawings.

In case a train were to approach section 2T from either direction while a train was moving south on section 1T, as previously described, and the operator mistakenly attempts to give the train approaching section 2T a clear signal by throwing lever K2 to its L or R positions, depending on the direction the train on track 2T was approaching from, signals L2 and R2 will continue to display a red aspect as long as the train or vehicle remained in section 1T. This is so because the circuit which energizes signal control relays L1HR and R1HR, even with back contact *e* of lever repeater relay 2LPR closed, will still be open at front contact *a* of track relay 1TR and probably at the contact controlled by lever K1 since the track relay 1TR will be released and lever K1 will probably be kept in its L position rather than the N position. The same analysis holds for a train or vehicle trying to enter section 4T from either direction while a train is moving through section 1T. However, with a train occupying section 1T, traffic can be given a clear signal on section 3T since the controls in the track circuit of section 3T are independent of the track circuit of section 1T. It should be clear that traffic moving simultaneously on these two sections does not create a hazardous condition.

From the foregoing discussion it should be apparent that if a train or vehicle shorter than the portion G—J of section 1T should stop in the portion G—J, track relay 1TR will continue to be shunted, and only red signals will be displayed at signals L1, R1, L2, R2, L4 and R4. Traffic will, however, be permitted to move over section 3T.

It will be obvious from the symmetry of the circuit arrangement that the operation of the apparatus associated with sections 2T and 3T is similar to that previously described for sections 1T and 4T, and accordingly, a detailed description of those portions of the apparatus is deemed unnecessary.

As was pointed out earlier, the signal control circuits herein shown and described are used for illustrative purposes only and many other circuit arrangements could be employed. For example, the switching of the track circuit connections could be accomplished by contacts of the route selection relays used in well-known automatic interlocking arrangements.

Furthermore, our invention is not limited to two tracks crossing two tracks, but it can be advantageously employed at any grade crossing where two or more tracks cross two or more other tracks by arranging the circuits so that each track intersection will be energized with energy of opposite polarity to the energy supplied to the adjacent intersection. And lastly, our invention is not limited to steady energy direct current track circuits, but will clearly operate as well with alternating current or coded track circuits.

It is to be noted that the track circuit arrangement provided by our invention may be employed with so-called "trap" circuits usually employed at such locations, to further increase the safety provided by such "trap" circuits. For example, our arrangement may be employed with the "trap" circuit system shown and described in Letters Patent of the United States, No. 2,039,820, granted May 5, 1936, to Ronald A. McCann et al.

Although we have herein shown and described only one form of improved railway track circuits embodying our invention, it is to be 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 plurality of track stretches including frogs forming a multiple track crossing, the frogs being insulated from each other and from adjoining portions of the stretches, an insulated portion in each stretch at each side of the crossing, a source of energy associated with each stretch and connected to the rails of the insulated portions on one side of the crossing, a track relay associated with each stretch and connected to the rails of the insulated portion on the other side of the crossing, circuit controlling means associated with each stretch and having first and second conditions, a first circuit means associated with each stretch of track controlled by said associated circuit controlling means and effective only when said circuit controlling means is in said first condition for connecting the rails of the two insulated portions at opposite sides of the crossing together to form a track circuit to energize the associated track relay whereby said frogs will be by-passed and deenergized, a second circuit means associated with each stretch controlled by said associated circuit controlling means and effective only when said circuit controlling means is in said second condition and including the insulated frogs and so connected that adjacent frogs have opposite polarities for connecting the insulated portions on opposite sides of the crossing together to energize the associated track relay, said frogs being so arranged in said second circuit means that engagement of adjacent frogs simultaneously by the wheels of a vehicle having a metallic undercarriage will shunt energy away from the associated track relay and thereby deenergize it.

2. In combination, at least two stretches of railway track intersected by at least two other stretches of railway track so that each rail in each stretch of track is metallically connected to the other rail of the stretch at each intersection, each stretch of track being divided into insulated portions by insulated joints in each rail placed adjacent the two outermost rails which intersect said stretch and between each two track intersections so that each track intersection is insulated from all other intersections and from the non-intersected portions, the rails at one end of each stretch beyond the insulated joints being connected to an associated source of energy and the rails at the other end of each stretch beyond the insulated joints being connected with an associated track relay, each stretch having associated therewith a first set of contacts which open in synchronism and close in synchronism, each stretch being provided with a first circuit means for energizing the associated track relay by the associated source including the contacts of the associated first set of contacts and being so arranged that the insulated portions are normally by-passed and deenergized, each stretch of track also being provided with a second set of contacts which open in synchronism and close in synchronism but

which are open when said first set of contacts is closed and which are closed when said first set is open, each stretch being further provided with a second circuit means for energizing the associated track relay by the associated source including the contacts of the associated second set of contacts and the insulated portion of the stretch and being so arranged that adjacent insulated portions have opposite polarity, and means for selecting which associated set of contacts is closed.

3. In combination, at least two stretches of railway track being intersected by at least another two stretches of railway track so that each rail in each stretch of track is metallically connected to the other rail in the stretch at each intersection, each stretch of track being divided into insulated portions by insulated joints in each rail placed adjacent the two outermost rails which intersect said stretch and between each two track intersections so that each intersection is insulated from each other intersection and from the non-intersected portions, the rails at one end of each stretch beyond the insulated joints being connected to an associated source of energy and the rails at the other end of each stretch beyond the insulated joints being connected to an associated track relay, each stretch having associated therewith a first set of contacts which open in synchronism and close in synchronism, each stretch having associated therewith a first circuit means for energizing its associated track relay from its associated source including the associated first set of contacts and being so arranged that said insulated portions are normally by-passed and deenergized, each stretch of track having further associated therewith a second set of contacts which open in synchronism and close in synchronism but which are open when the first associated set of contacts is closed and which are closed when the first associated set is open, each stretch being provided with a second circuit means for energizing the associated track relay by the associated source including the associated second set of contacts and the insulated portions of the stretch and being so arranged that adjacent insulated portions have opposite polarity, means for selecting which associated set of contacts is closed, and wayside signals one associated with each of said stretches for controlling traffic movements over said stretches of track and governed in part by a contact of the associated first and second sets of contacts.

4. In combination, at least two stretches of railway track intersected by at least two other stretches of railway track so that the one rail of each track is metallically connected to the other rail of the track at each track intersection, each stretch of track being divided into insulated portions by insulated joints in each rail placed adjacent the two outermost rails which intersect said stretch and between each two track intersections so that the track intersections are insulated from each other and from the non-intersected portions, the rails of each stretch beyond the insulated joints at one end being connected to an associated source of energy and the rails of each stretch beyond the insulated joints at the other end being connected to an associated track relay, each stretch of track having associated therewith a circuit controlling means which may occupy either one of two positions, a separate set of contacts being closed in each position, each stretch of track being provided with a first circuit including the set of contacts of the associated circuit controlling means closed in the first of said positions for energizing its associated track relay by its associated energy source, said first circuit being so arranged that said insulated portions are normally by-passed and deenergized, each stretch of track being provided with a second circuit for energizing its associated track relay by its associated energy source including the set of contacts of the associated circuit controlling means closed in said second position and the insulated portions of the stretch, said second circuit being so arranged that adjacent insulated portions have opposite polarity, and means for selecting the position of the associated circuit controlling means.

5. In combination, a plurality of track stretches including frogs forming a multiple track crossing, the frogs being insulated from each other and from adjoining portions of the stretches, an insulated portion in each stretch at each side of the crossing, a source of energy associated with each stretch and connected to the rails of the insulated portion on one side of the crossing, a track relay associated with each stretch and connected to the rails of the insulated portion on the other side of the crossing, circuit controlling means having first and second positions and associated with each stretch, first and second sets of contacts associated with each circuit controlling means and closed when said circuit controlling means is in said first and second positions, respectively, means for selecting the position of said circuit controlling means, a first circuit associated with each stretch including said first set of contacts of the associated circuit controlling means for connecting the rails of the two insulated portions at opposite ends of the crossing together to form a track circuit for energizing the associated track relay whereby said frogs are by-passed and deenergized, a second circuit associated with each stretch for energizing the associated track relay by the associated energy source including said second set of contacts of the associated circuit controlling means and further including the insulated frogs connected so that adjacent frogs have opposite polarities, whereby when said second circuit is closed simultaneous engagement of adjacent frogs by the wheels of a train having a metallic undercarriage will shunt energy away from the associated track relay and deenergize it, and wayside signals, one associated with each of said stretches of track for controlling traffic movements over said stretches and governed in part by said associated circuit controlling means.

6. In combination, two stretches of railway track intersected by another two stretches of railway track so that the track rail of each stretch is metallically connected to the other rail of the stretch at each track intersection, each stretch of track being divided into insulated portions by insulated joints in each rail placed adjacent the two outermost rails which intersect said stretch and between the two track intersections so that each intersection is insulated from each other intersection and from the non-intersected portions, the rails of each stretch beyond the insulated joints at one end being connected to an associated source of energy and the rails of each stretch beyond the insulated joints at the other end being connected to an associated track relay, a control relay associated with each stretch of track, each stretch of track being provided with a first circuit for energizing its associated track relay from its associated source including a plurality of front contacts of the associated control relay, said first circuit being so arranged that said insulated portions in the stretch are by-passed and deenergized, each stretch of track being further provided with a second circuit for energizing the associated track relay by the associated source including a plurality of back contacts of the associated control relay on the insulated portions of the stretch, said second circuit being so arranged that adjacent insulated portions have opposite polarity, and circuit means for controlling the associated control relay.

7. In combination, two stretches of railway track intersected by another two stretches of railway track so that the track rail of each stretch is metallically connected to the other rail of the stretch at each track intersection, each stretch of track being divided into insulated portions by insulated joints in each rail placed adjacent the outermost rails which intersect the stretch and between the two track intersections so that each intersection is insulated from each other intersection and from the non-intersected portions, the rails of each stretch beyond the insulated joints at one end being con-

nected to an associated source of energy and the rails of each stretch beyond the insulated joints at the other end being connected to an associated track relay, a control relay associated with each stretch of track, each stretch of track being provided with a first circuit for energizing its associated track relay including a plurality of front contacts of the associated control relay, said first circuit being so arranged that the insulated portions are by-passed and deenergized, each stretch of track being further provided with a second circuit for energizing the associated track relay including a plurality of back contacts of the associated control relay and the insulated portions of the stretch, said second

circuit being so arranged that the insulated portions have opposite polarity, circuit means for controlling each control relay, and wayside signals at least one being associated with each of said stretches of track for controlling traffic movement over said stretches and governed in part by the associated control relay.

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