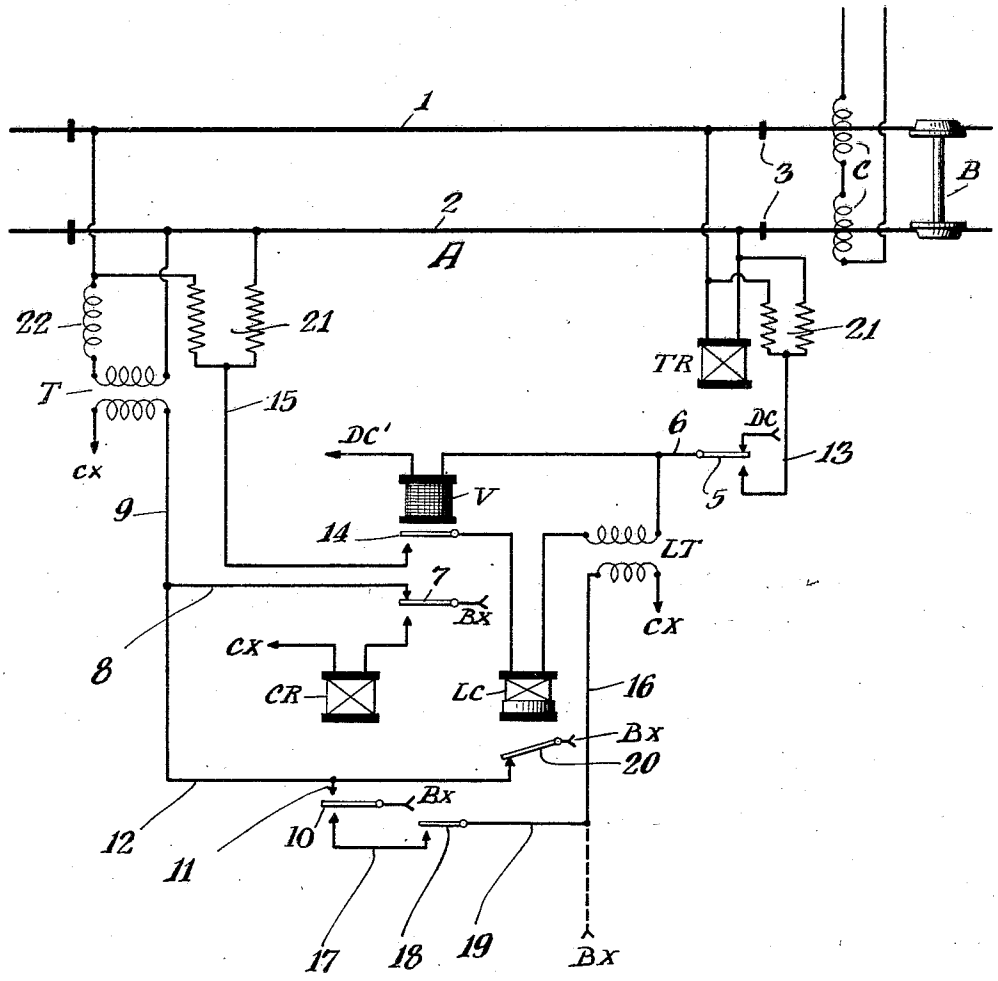
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METHOD OF AND MEANS FOR CONTROLLING TRAINS

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METHOD OF AND MEANS FOR CONTROLLING TRAINS

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This invention relates to an improvement in methods of and means for controlling trains, and has or its main object and feature the detection, by train-carried means, of a broken rail in a track section.

In the accompanying drawing the invention is disclosed in a concrete and preferred form, said drawing showing the trackway equipment more or less in detail and the train-carried means diagrammatically.

1 and 2 indicate the running or traffic rails of a track section A, separated from other rails in adjacent sections by insulation 3 or otherwise. A train is indicated at B and carries coils C in an inductive relation to the traffic rails, and these coils control a traffic-controlling device, that is, signals or brakes or both as the case may be in a well understood manner. The general operation of the system here disclosed is that when no train is in a section a track circuit including a relay is completed through the traffic rails, but that when a train enters the section the track relay is shunted, the normal track circuit is disestablished and a train-control current is applied to the rails in series, to which train-control current the means on the train is responsive. The train-control current is here of the character known as periodically varying interrupted or coded current.

The means to supply current to the rails here takes the form of a transformer T, the secondary of which is bridged across the rails at the outgoing end of the track section, and the track relay is indicated at TR and is bridged across the rails at the ingoing end of the block. Controlled by relay TR is a repeater relay V which latter is held energized as long as track relay TR is energized, the circuit for V being from point DC connected to a suitable source of current, armature 5 of relay TR, conductor 6, relay V and point DC' connected to the other side of the source of current. Relay V controls the energization of transformer T by means of armature 7 connected to a source of alternating current BX, so that when said relay V is energized armature 7 engages its front contact and the circuit from thence leads over conductor 8 to conductor 9, primary of transformer T and back to source at CX. Thus under normal conditions, transformer T and relays TR and V are energized. Upon entry of a train into the section, relay TR is shunted and deenergized thereby dropping armature 5, opening the circuit to relay V and causing the latter to become deenergized. Armature 7 of relay V therefore drops and disestablishes the normal circuit from BX to transformer T and point CX. When armature 7 drops, it engages its back contact and thereby establishes a circuit from source BX, and armature 7, coder relay CR and back to source at CX. The establishing of this circuit causes armature 10 of coder relay CR to vibrate to thereby engage and disengage contact 11, and interrupted or coded current is now supplied to primary of transformer T from source BX, armature 10, contact 11, conductors 12 and 9 to primary of transformer T and back to source at point CX. A coded current is thereby impressed on the rails of the track section, said rails being in series, and this current is picked up by the train-carried means which latter is responsive to the influence of this current. When the train leaves the section, the train-control current picks up relay TR in a well understood manner.

If a rail of the track section be broken it may happen that the traffic-controlling means of a train occupying the section will still be responsive to the coded current. This is of course objectionable because under such conditions an adverse indication should be given on the train and its speed should be reduced either automatically or manually. In order to assure the giving of an adverse indication on the train, there is provided a loop circuit which is established when the coded current is applied to the rails, such loop circuit being connected with the rails in parallel. It will be understood that current flowing down both rails in parallel will not have any effect upon train-carried means that is responsive to current flowing in series through the rails, so that when both rails are unbroken said train-carried means is not responsive to the current flowing down the rails in parallel. If, however, one rail be broken

current will flow in the other rail from the loop circuit and the voltage thereby induced in the train-carried means will render said means less responsive to the train-control current and so an adverse indication will be effected on the train. The means for establishing the loop circuit may vary, but are here as follows: When armature 5 of relay TR drops, it engages its back contact which latter is connected through conductor 13 to both rails at the relay end of the section. Relay V when deenergized drops an armature 14 that engages a back contact connected to conductor 15, which latter is connected to both rails at the transformer end of the section. When relays TR and V are deenergized, a loop circuit between both rails at both ends of the section is therefore established through conductor 13, armature 5, conductor 6, secondary of loop circuit transformer LT, relay LC, armature 14 and conductor 15. Current may of course be supplied to this loop circuit in various ways. Source BX that supplies current to the track transformer can be connected, as indicated at the broken line at the bottom of the figure, to conductor 16 that leads to the primary of loop transformer LT, in which event a steady alternating current will be applied to the track section. If desired, however, an interrupted or coded alternating current, similar to the one supplied by the track transformer, can be impressed upon the rails in parallel. This may be done by arranging a back contact in connection with armature 10 of the coder relay, said back contact connected by wire 17 to back contact of armature 18 controlled by relay V, said armature 18 being connected by wire 19 to wire 16. It will be seen that, by this construction, loop circuit transformer LT receives coded current similar to that received by the track transformer by way of source BX, armature 10 of the coder, back contact of said armature 10, wire 17, back contact of armature 18, wires 19 and 16, and primary of transformer LT back to source at CX. The function of relay LC is to check the operativeness of the loop circuit. If, for instance, V becomes deenergized and drops armature 7 thereby starting coder CR, and the loop circuit is not complete, relay LC will not pick up its armature 20 and hence source BX, connected to said armature 20, will supply steady alternating current to the track transformer by way of back contact of armature 20 and wires 12 and 9. Relay LC is here made a slow-release relay so as to hold up armature 20, between interruptions, if the current used in the loop circuit is coded.

The train-control current supplied to the rails in series may be of any suitable frequency. Tests have demonstrated that, if current of the same frequency as the train-control current is applied to the rails during the off-periods of the coded current, the train-carried means will be rendered less responsive to said train-control current; that is to say, the amount of coded current required to energize the master relay will be much greater than when the second current is absent. Under normal conditions (no rail broken), the loop circuit current flowing in parallel in the two rails will be equal so that no voltage will be induced by said loop circuit current in the train-carried means. As a consequence the train-carried means are fully responsive to the train-control current flowing in series in the rails. Under the condition when one rail is broken, the loop circuit current travels down the other rail, thereby inducing a voltage in the train-carried means and so rendering said train-carried means less responsive to the train-control coded current. The result will be an adverse indication on the train.

If the loop circuit current is a steady alternating current, and not a coded current, it is preferred to have a phase-displacement of about ninety degrees between the train-control current and the loop circuit current, as tests have shown that a better detection is thus obtained. This difference in phase can be obtained by inserting resisters 21 in the loop circuit, and a reactor 22 in the circuit leading from the secondary of transformer T to the rails.

I claim:

1. The method of detecting a broken rail in a track composed of traffic rails which consists in impressing on the rails in series a train control current to the influence of which a train-carried device is responsive, and in impressing on the rails in parallel a second current to the influence of which the train-carried device is not effectively responsive but which upon a break in one rail, renders the train-carried device less responsive to the train control current.

2. The method of detecting a broken rail in a track composed of traffic rails which consists in impressing on the track a periodically varying train-control current to the influence of which a train-carried device is responsive, and in impressing upon the track a second current to the influence of which the train-carried device is not effectively responsive but which upon a break in a rail energizes the train-carried device during the off period of the periodically varying train-control current to thereby render the train-carried device less responsive to the train-control current.

3. The method of detecting a broken rail in a track composed of traffic rails which consists in impressing on the rails in series a periodically varying train-control current to the influence of which the train-carried device is responsive, and in impressing on the rails in parallel a second current to the influence of which the train-carried device is

not effectively responsive but which upon a break in one rail, energizes the train-carried device during the off period of the periodically varying train-control current to thereby render the train-carried device less responsive to the train-control current.

4. A train-control system including: a track section composed of rails, a train, traffic-controlling means on the train, means to impress on the rails in series a train-control current to the influence of which the traffic-controlling means is responsive, and means to impress on the rails in parallel a second current to the influence of which the traffic-controlling means is not effectively responsive but to which it becomes responsive upon an increased flow of said second current in one of the rails.

5. A train-control system including: a track section composed of rails, a train, traffic-controlling means on the train, means to impress on the track a periodically varying train-control current to the influence of which the traffic-controlling means is responsive, and means to impress on the track a second current to the influence of which the traffic-controlling means is not effectively responsive but to which it becomes responsive upon a break in a rail.

6. A train-control system including: a track section composed of rails, a train, traffic-controlling means on the train, means to impress on the rails in series a periodically varying train-control current to the influence of which the traffic-controlling means is responsive, and means to impress upon the rails in parallel a second current to the influence of which the traffic-controlling means is not effectively responsive but to which it becomes responsive upon an increased flow of said second current in one of the rails.

7. A train control system including: a track section composed of rails, a train, traffic-controlling means on the train, means set in operation by the entry of a train into the section to impress on the rails in series a train-control current to the influence of which the traffic-controlling means is responsive, and means also set in operation by the entry of a train into the section to impress on the rails in parallel a second current to the influence of which the traffic-controlling means is not effectively responsive but to which it becomes responsive upon an increased flow of said second current in one of the rails.

8. A train-control system including: a track section composed of rails, a train, traffic-controlling means on the train, means set in operation by the entry of a train into the section to impress on the track a periodically varying train-control current to the influence of which the traffic-controlling means is responsive, and means also set in operation by the entry of a train into the section to impress on the track a second current to the influence of which the traffic-controlling means is not effectively responsive but to which it becomes responsive upon a break in a rail.

9. A train-control system including: a track section composed of rails, a train, traffic-controlling means on the train, means set in operation by the entry of a train into the section to impress on the rails in series a periodically varying train-control current to the influence of which the traffic-controlling means in responsive, and means also set in operation by the entry of a train into the section to impress on the rails in parallel a second current to the influence of which the traffic-controlling means is not effectively responsive but to which it becomes responsive upon an increased flow of said second current in one of the rails.

10. A track circuit system including: a track section composed of traffic rails, a normally closed track circuit supplying current to the rails in series, means governed by traffic conditions to take said current off the rails and to supply to said rails in series current of a character different from that normally supplied and also to supply current to the rails in parallel.

11. A track circuit system including: a track section composed of traffic rails, a normally closed track circuit including a track relay, and means, controlled by the deenergization of the track relay, to supply said track circuit with periodically varying current, and to establish a charged loop circuit connecting the rails in parallel.

12. A track circuit system including: a track section composed of traffic rails, a normally closed track circuit including a track relay, a repeater relay held energized as long as the track relay is energized, means to supply periodically varying current to the track circuit set in operation by the deenergization of the repeater relay, and a closed loop circuit connecting the rails in parallel established when the track relay is deenergized.

13. A track circuit system including: a track section composed of traffic rails, a normally closed track circuit including a track relay, a repeater relay held energized as long as the track relay is energized means to supply periodically varying current to the track circuit set in operaton by the deenergization of the repeater relay, and a closed loop circuit connecting the rails in parallel established when the track relay and the repeater relay are deenergized.

14. A track circuit system including: a track section composed of traffic rails, a normally closed track circuit including a track relay, means, controlled by the deenergization of the track relay, to supply said track circuit with periodically varying current, and to establish a charged loop circuit connect-

ing the rails in parallel, and a relay in the loop circuit to connect a source of steady current to the track circuit as long as said relay remains deenergized.

Signed at Swissvale, in the county of Allegheny, Commonwealth of Pennsylvania, this 26th day of June, 1931.

GEORGE W. BAUGHMAN.