Aug. 13, 1935. W. M. PERRY 2,011,416

RAIL FLAW DETECTOR CAR

Filed April 16, 1934 2 Sheets-Sheet 1

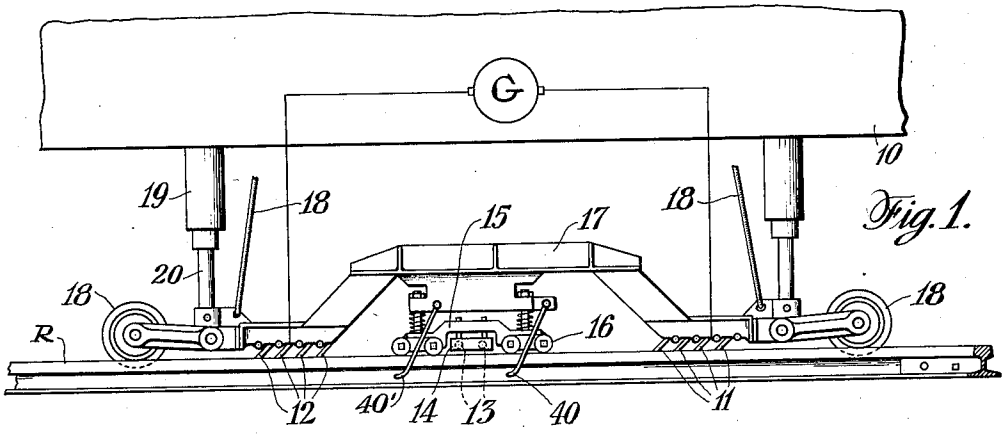


Fig. 1.

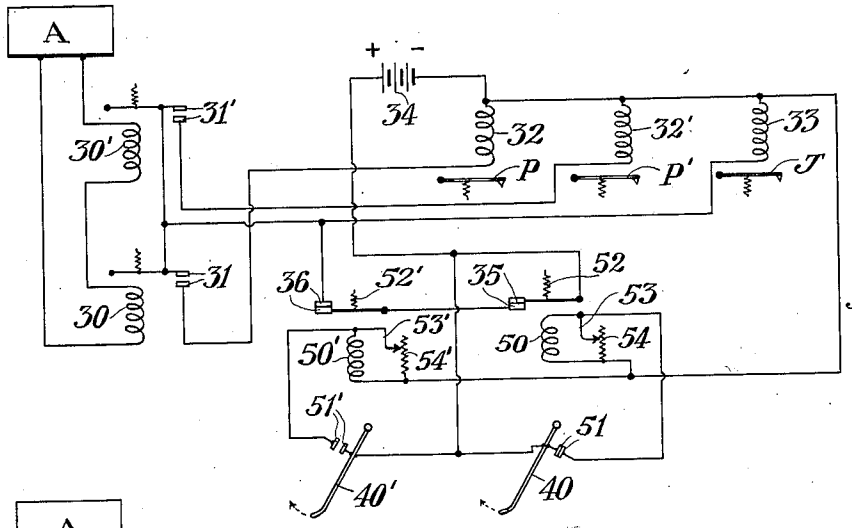


Fig. 2.

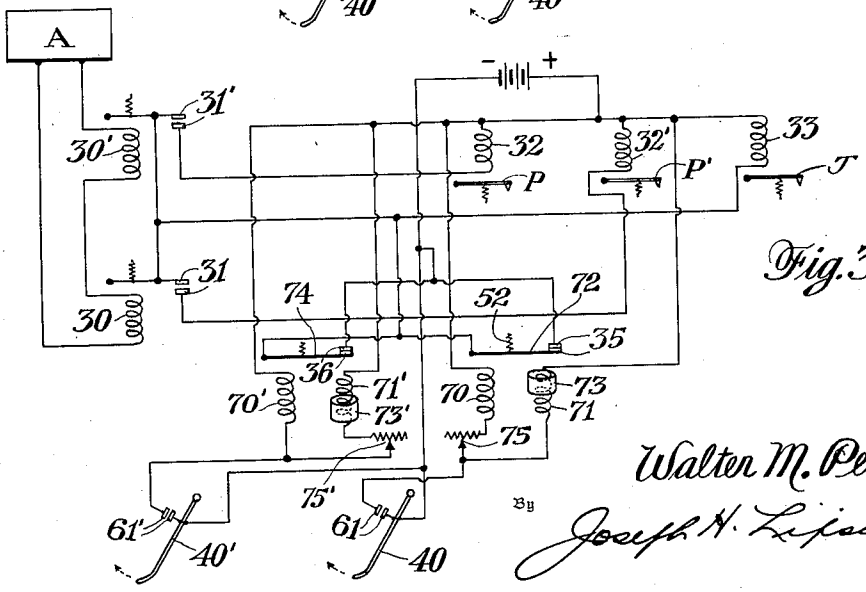


Fig. 3.

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RAIL FLAW DETECTOR CAR

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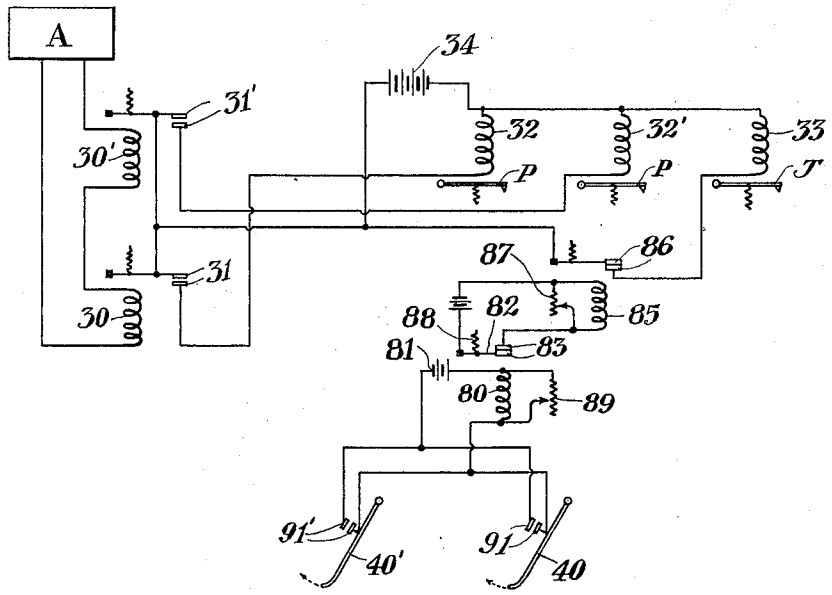


Fig. 4.

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Patented Aug. 13, 1935 2,011,416

UNITED STATES PATENT OFFICE

2,011,416

RAIL FLAW DETECTOR CAR

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Application April 16, 1934, Serial No. 720,821

17 Claims. (Cl. 175—183)

This invention relates to rail flaw detector cars and particularly to the Sperry rail flaw detector car. The construction of the latter car is now well known and consists of a generator which supplies current to the rail between spaced points to establish an electromagnetic field surrounding the rail. This field will be uniform, except in the region of a flaw where it will be distorted. Such variations in the electromagnetic field are detected by means comprising a pair of induction coils arranged in tandem along the rail and oppositely connected. These coils are supported at a constant distance above the rail so that normally they cut a constant number of lines of force, so that normally no E. M. F. is induced therein. Upon entering a region of flaw, however, first one coil and then the other coil will cut a different number of lines of force to generate a differential E. M. F. Said E. M. F. may be amplified and caused to operate any suitable indicator, such as a recorder.

It will be understood that at each rail joint, the electro-magnetic field is distorted by reason of the rail joint construction and such distortion would be picked up by the detector mechanism in the same manner as a flaw. In order to avoid picking up the rail joint by the detector mechanism, the Sperry rail flaw detector car employs a pair of joint cut-out fingers in advance and to the rear of the detector mechanism so that while said fingers engage the joint, the flaw indicating mechanism is rendered ineffective.

There are various occasions when it is desired to vary the time that elapses between the engagement of the joint cut-out finger with the joint bar and the time that the flaw indicating mechanism is rendered ineffective. Thus, for instance, certain joint bars have different shapes from certain other joint bars, which cause the joint cut-out finger to engage and leave said bars sooner or later than would otherwise be the case. Unless some provision were made to take care of such a situation, the indicating mechanism would be cut out or let in at greater or lesser distances from the joint bar than it would normally. Similarly, there are times when the cutting out of the indicating means should be accelerated or delayed for some reason such as the different method of connecting the bond wires to the rails, higher or lower speeds of the car than normal, or because it is desired to test closer to or further from the rail joint.

It is, therefore, the principal object of my invention to provide means whereby the time that elapses between the engagement of the joint finger with the joint bar and the rendering of the indicating means ineffective, as well as the time that elapses between disengagement of the joint finger with the joint bar and the rendering of the indicating means effective may be varied at will.

Further objects and advantages of this invention will become apparent in the following detailed description thereof.

In the accompanying drawings,

Fig. 1 is a side elevation showing a portion of a Sperry rail flaw detector car to which my invention is adapted to be applied.

Fig. 2 is a view consisting mainly of a wiring diagram illustrating one form of my invention.

Fig. 3 is a view similar to Fig. 2 disclosing another form of my invention.

Fig. 4 is a view similar to Figures 2 and 3 disclosing still another form of my invention.

Referring to Figure 1 of the diagrams, I have shown a portion of the car body 10 of a Sperry rail flaw detector car. Within said body there is mounted a generator G for supplying current to the rail R by way of current brushes 11 and 12 for establishing an electromagnetic field surrounding said rail. Any irregularity in said field caused by the presence of a flaw may be detected by means of a pair of induction coils 13 of equal inductance and oppositely wound. Said coils may be supported in a housing 14 carried by a detector carriage 15 adapted to be supported on the rail R by means such as wheels 16. Said detector carriage 15 is loosely mounted on current brush carriage 17 on which are supported the current brushes 11 and 12, said current brush carriage being supported on the rail by means such as flanged wheels 18. The said carriages are normally held in elevated position by means of springs (not shown) and cables 18. When it is desired to lower said carriages to effective position in engagement with the rail, fluid pressure is supplied to cylinders 19 to depress pistons 20 which are connected to said carriage 17. As the car moves along the rails, the coils 13 will each cut a constant number of lines of force so long as no flaws are present. Variations in the supply of current from generator G which would normally tend to vary the flux, have no effect on the coils 13 which are of equal inductance and oppositely wound. When, however, a region of flaw is encountered, first one and then the other of said coils will cut a different number of lines of force to generate a differential E. M. F. Said E. M. F. may be amplified by an amplifier A the output of which may energize either one or both of relays 30 and 30' which are of different strengths, depending upon the strength of the output, to close sets of contacts 31 and 31', which control the circuits through pen relays 32 and 32' to operate pens P and P' which may be in engagement with a traveling chart.

Also operating on said chart is a pen J which is normally held in attracted position by a relay 33 connected to a battery 34, and the circuit through which is normally closed by means of contacts 35 and 36. The pen J will normally trace a straight

line on said chart, and only when the circuit therethrough is open will the pen J be released by magnet 33 to cause a jog to be made in the line.

The pen J is adapted to be released when a rail joint is encountered. For this purpose the Sperry rail flaw detector car is provided with a joint finger 40 in advance of the detector coils 13 and in engagement with the gauge side of the rail so as a joint is approached said finger 40 will engage the joint bar of the joint and will render the circuits through 32 and 32' inoperative so that said pens P and P' cannot be accentuated and will break the circuit through joint pen relay 33 to release joint pen J so that said pen will indicate on the chart the presence of a joint. For this purpose it will be seen that the circuit through said relays 32, 32' and 33 lies through contacts 35 and 36, and if either or both of said set of contacts 35 and 36 are open, the pen magnets 32, 32' and 33 will be rendered inoperative.

Contacts 35 are normally held closed by a relay 50, the circuit through which includes a pair of contacts 51, one of which is carried by joint cut-out finger 40. When said finger engages the joint bar it opens the contact 51 to deenergize relay 50, and this permits spring 52 to break contacts 35 and render the circuit through pen magnets 32 and 32' inoperative and to break the circuit through magnet 33.

Ordinarily the action of joint cut-out finger 40 upon the said circuits would be instantaneous. In order, however, to introduce a control and time lag between the opening of contacts 51 and rendering the magnets 32, 32' and 33 inoperative, I provide in the circuit of relay 50 a by-pass including a conductor 53 and variable resistance 54. There is thus formed an inductive circuit so that when the contacts 51 are open, relay 50 remains more or less energized by reason of the inductance in the said inductive circuit so that contacts 35 are delayed in opening. The degree of such delay may be determined by the amount of resistance 54 included in said inductive circuit. Thus by adjusting said resistance, the operator can vary the amount of lag between the time that contacts 51 are opened and the time that contacts 35 are opened.

A second joint cut-out finger 40' is provided to the rear of detector coils 13, said second cut-out finger being positioned so as to engage the joint bar before the first cut-out finger 40 has left the same. The purpose of this construction is to prevent rendering magnets 32, 32' and 33 effective again before the detector coils 13 have passed beyond the joint bar. In this case the second joint cut-out finger 40' is designed to close a set of contacts 51' to close the circuit through the relay 50' and open contacts 36 which are in series with contacts 35, against the action of a spring 52'. When the second finger 40' has passed beyond the joint bar, it is certain that the detector coils 13 have passed beyond said joint bar and therefore contacts 51' are permitted to open by reason of finger 40' leaving the joint bar, and this deenergizes magnet 50' to permit spring 52' to close contacts 36. Contacts 35 having previously been closed by reason of finger 40' having previously left the joint bar, the circuits through 32, 32' and 33 would ordinarily be again rendered effective. However, as previously described, it may be desired to introduce a certain time lag between the time that contacts 51' are opened and the time that the circuits through magnets 32, 32' and 33 are rendered effective. For this purpose I place in circuit with magnet 50' a lead 53' and variable resistance 54', forming an inductive circuit so that when contacts 51' open, magnet 50' is not immediately deenergized because of the induction in the inductance circuit comprising magnet 50', lead 53' and variable resistance 54'. The amount of inductance remaining in said circuit and hence the time lag that is introduced will depend upon the amount of resistance 54' in said inductive circuit. Thus the operator by adjusting the resistance 54' can vary the lag between the opening of contacts 51' and the closing of contacts 36.

In Figure 3, I have disclosed a modified form of my invention. All of the parts bearing the same numerals as in Figure 2 represent the same devices. Sets of contacts 35 and 36 again control the circuits through pen magnets 32 and 32' and joint magnet 33. In order to obtain a controlled delay of opening of contacts 35 and 36, the following device is employed. Joint finger 40 carries one contact of a set of contacts 61 which are normally open but are designed to be closed when said joint finger engages the joint bar at a joint. Closing of contact 61 serves to engage two relays 70 and 71, which together control the breaking of contacts 35. Both said relays 70 and 71 act upon a common armature 72 against the action of spring 52 which normally holds contacts 35 closed. Relay 71 is a slow acting relay by reason of the copper winding 73 surrounding the same near the armature end and forming an inductance which opposes building up of the current in coil 71. It would thus ordinarily take magnet 71 a definite time to open contacts 35. In order to vary this time, the additional magnet 70 is provided. Said magnet is of the type in which the full current builds up almost instantly but the pull of said magnet is insufficient in and of itself to attract armature 72 and open contacts 35. Since the building up of the current and hence the pull in magnet 71 is dependent upon the interval of time it will be seen that the time necessary to attract armature 72 is shortened to the extent of the pull exerted by magnet 70. Therefore, by varying the current through magnet 70, the time delay in opening contacts 35 may be varied. For this purpose I have provided in the circuit of magnet 70 a variable rheostat 75.

Before finger, 40, has left the joint bar, finger 40' has engaged the same to close a set of contacts 61' and energize a similar pair of magnets 70' and 71', arranged in parallel and co-acting with the armature 74 carrying one contact of the set of contacts 36. The magnet 71' by reason of having the copper winding 73' at the binding-post end thereof is of the type that energizes rapidly and deenergizes slowly. Thus when finger 40' has left the joint bar and contacts 61' have opened, magnet 70' will deenergize quickly but magnet 71' will deenergize slowly and thus introduce a time lag into the relays of armature 74 and closing of contacts 36 to render magnets 32, 32' and 33 effective. The said lag may be varied by means of rheostat 75' in the circuit of magnet 71'.

In Fig. 4 I have shown still another form of my invention. In this form of my invention the contacts 91 and 91' are both normally open and are connected in parallel to a relay coil 80 supplied with current from a battery 81. Said coil will be energized immediately upon contacts 91 closing, to cause an armature 82 to be attracted and break contacts 83 to de-energize a coil 85. Said coil normally holds contacts 36 closed to energize the coil 33 and actuate joint pen J. The con-

tacts 86 are also in the circuit of the flaw pens 32 and 32' to render said circuit normally effective so that said relays may be energized when contacts 31 and 31' are closed. The coil 85 is not immediately de-energized when contacts 83 open by reason of the inductance by-path established by the resistance 87, so that the current can keep flowing in this inductance circuit for a predetermined interval of time after contacts 83 have opened, said interval of time depending upon the adjustment of resistance 87. Therefore, a predetermined time lag in the opening of contacts 86 rendering pen relays 32, 32' ineffective is obtained. The contacts 91' are closed before contacts 91 are opened by reason of the fact that joint cutout finger 40' engages the joint bar before finger 40 leaves the same. When finger 40' leaves the joint bar, contacts 91' open to de-energize coil 80 which would ordinarily permit spring 88 to close contacts 83 to energize relay 85 and close contacts 86 to render the pen coils 32, 32' effective again. However, coil 80 is not immediately de-energized by reason of the inductive circuit established by variable resistance 89, so that the current flows in said inductive circuit for a predetermined interval of time after contacts 91' have been opened, said interval of time depending upon the adjustment of resistance 89. Therefore, a predetermined time lag may be introduced by adjustment of resistance 89 between the disengagement of joint finger 40' with the joint bar and the rendering of pen coils 32, 32' again effective.

In accordance with the provisions of the patent statutes, I have herein described the principle and operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other means. Also, while it is designed to use the various features and elements in the combination and relations described, some of these may be altered and others omitted without interfering with the more general results outlined, and the invention extends to such use.

Having described my invention, what I claim and desire to secure by Letters Patent is:

1. The combination of a rail flaw detector car having means for energizing the rail, flaw-responsive means for detecting variations in energization of said rail caused by flaws, an indicator adapted to be actuated by said responsive means, means adapted to cooperate with the rail joints and means adapted to be rendered effective by said cooperative means when the latter is in cooperative relation to a rail joint for rendering said indicator ineffective, with means for delaying the action of said means for rendering said indicator ineffective.

2. The combination of a rail flaw detector car having means for energizing the rail, flaw-responsive means for detecting variations in energization of said rail caused by flaws, an indicator adapted to be actuated by said responsive means, means adapted to cooperate with the rail joints and means adapted to be rendered effective by said cooperative means when the latter is in cooperative relation to a rail joint for rendering said indicator ineffective, with means also adapted to be rendered effective by said cooperating means when in cooperative relation to a rail joint for delaying the action of said means for rendering said indicator ineffective.

3. The combination of a rail flaw detector car having means for energizing the rail, flaw-responsive means for detecting variations in energization of said rail caused by flaws, an indicator adapted to be actuated by said responsive means, means adapted to cooperate with the rail joints and means adapted to be rendered effective by said cooperating means when the latter reaches a rail joint for rendering said indicator ineffective, with means for delaying the action of said means for rendering said indicator ineffective, means adapted to be rendered effective by said cooperating means when the latter has passed a rail joint for rendering said indicator effective, and means for delaying the action of said means for rendering said indicator effective.

4. The combination of a rail flaw detector car having means for energizing the rail, flaw-responsive means for detecting variations in energization of said rail caused by flaws, an indicator adapted to be actuated by said responsive means, means adapted to cooperate with the rail joints and means adapted to be rendered effective by said cooperating means when the latter reaches a rail joint for rendering said indicator ineffective, with means also adapted to be rendered effective by said cooperating means when the latter reaches a rail joint for delaying the action of said means for rendering said indicator ineffective, means adapted to be rendered effective by said cooperating means when the latter has passed a rail joint for rendering said indicator effective, and means also adapted to be rendered effective by said cooperating means when the latter has passed a rail joint for delaying the action of said means for rendering said indicator effective.

5. In a rail flaw detector car having means for energizing the rail, flaw responsive means for detecting variations in energization of said rail caused by flaws, an indicator adapted to be actuated by said responsive means, and means adapted to cooperate with the rail joints, means adapted to be rendered effective by said cooperating means when in cooperative relation to a rail joint for rendering said indicator ineffective, said last-named means including delayed action means.

6. In a rail flaw detector car having means for energizing the rail, flaw responsive means for detecting variations in energization of said rail caused by flaws, an indicator adapted to be actuated by said responsive means, and means adapted to cooperate with the rail joints, means adapted to be rendered effective by said cooperating means when the latter reaches a rail joint for rendering said indicator ineffective, said preceding means including delayed action means.

7. In a rail flaw detector car having means for energizing the rail, flaw responsive means for detecting variations in energization of said rail caused by flaws, an indicator adapted to be actuated by said responsive means, and means adapted to cooperate with the rail joints, means adapted to be rendered effective by said cooperating means when the latter reaches a rail joint for rendering said indicator ineffective and means adapted to be rendered effective by said cooperating means when the latter has passed over a rail joint for rendering said indicator effective, each of said means for rendering said indicator effective and ineffective including delayed action means.

8. In a rail flaw detector car having means for energizing the rail, flaw-responsive means for detecting variations in energization of said rail

caused by flaws, an indicator adapted to be actuated by said responsive means and means adapted to cooperate with the rail joints, means including an electric circuit for rendering said indicator ineffective, an inductive circuit in parallel with said first circuit for delaying the action thereof, and means whereby said cooperating means when in cooperative relation to a rail joint controls said circuits for rendering said indicator ineffective.

9. In a rail flaw detector car having means for energizing the rail, flaw-responsive means for detecting variations in energization of said rail caused by flaws, an indicator adapted to be actuated by said responsive means and means adapted to cooperate with the rail joints, means including an electric circuit for rendering said indicator ineffective, an inductive circuit in parallel with said first circuit for delaying the action thereof, means whereby said cooperating means when in cooperative relation to a rail joint controls said circuits for rendering said indicator ineffective, and means for varying the inductance of said inductive circuit.

10. In a rail flaw detector car having means for energizing the rail, flaw-responsive means for detecting variations in energization of said rail caused by flaws, an indicator adapted to be actuated by said responsive means and means adapted to cooperate with the rail joints, means including an electric circuit for rendering said indicator ineffective, an inductive circuit in parallel with said first circuit for delaying action thereof, means whereby said cooperating means upon reaching a rail joint controls said circuits for rendering said indicator ineffective, a second electric circuit for rendering said indicator effective, a second inductive circuit for delaying the action thereof, and means whereby said cooperating means controls said second circuit when said cooperating means has passed over a rail joint for rendering said indicator effective.

11. In a rail flaw detector car having means for energizing the rail, flaw-responsive means for detecting variations in energization of said rail caused by flaws, an indicator adapted to be actuated by said responsive means and means adapted to cooperate with the rail joints, means including an electric circuit for rendering said indicator ineffective, an inductive circuit in parallel with said first circuit for delaying action thereof, means whereby said cooperating means upon reaching a rail joint controls said circuits for rendering said indicator ineffective, a second electric circuit for rendering said indicator effective, a second inductive circuit for delaying the action thereof, means whereby said cooperating means controls said second circuit when said cooperating means has passed over a rail joint for rendering said indicator effective, and means for varying the inductances of said circuits.

12. In a rail flaw detector car having means for energizing the rail, flaw-responsive means for detecting variations in energization of said rail caused by flaws, an indicator adapted to be actuated by said responsive means and means adapted to cooperate with the rail joints, means including an electric circuit for rendering said indicator ineffective, and means whereby said cooperating means when in cooperative relation to a rail joint controls said circuit for rendering said indicator ineffective, said last-named means including a delayed action relay.

13. In a rail flaw detector car having means for energizing the rail, flaw-responsive means for detecting variations in energization of said rail caused by flaws, an indicator adapted to be actuated by said responsive means and means adapted to cooperate with the rail joints, means including an electric circuit for rendering said indicator ineffective, and means whereby said cooperating means when in cooperative relation to a rail joint controls said circuit for rendering said indicator ineffective, said last named means including a two-part relay comprising a quick acting coil and a delayed action coil.

14. In a rail flaw detector car having means for energizing the rail, flaw-responsive means for detecting variations in energization of said rail caused by flaws, an indicator adapted to be actuated by said responsive means and means adapted to cooperate with the rail joints, means including an electric circuit for rendering said indicator ineffective, means including an electric circuit for rendering said indicator effective, and means whereby said cooperating means controls said circuits when reaching and passing beyond a rail joint, respectively, said last-named means including a delayed action relay in each circuit.

15. In a rail flaw detector car having means for energizing the rail, flaw-responsive means for detecting variations in energization of said rail caused by flaws, an indicator adapted to be actuated by said responsive means and means adapted to cooperate with the rail joints, means including an electric circuit for rendering said indicator ineffective, means including an electric circuit for rendering said indicator effective, and means whereby said cooperating means controls said circuits when reaching and passing beyond a rail joint, respectively, said last-named means including a two-part relay in each circuit, each relay comprising a quick acting coil and a delayed action coil.

16. In a rail flaw detector car having means for energizing the rail, flaw-responsive means for detecting variations in energization of said rail caused by flaws, an indicator adapted to be actuated by said responsive means and means adapted to cooperate with the rail joints, an electric circuit adapted to be rendered effective by said cooperative means when the latter is in cooperative relation to a rail joint, a second electric circuit adapted to be rendered ineffective when said first circuit is rendered effective, means whereby said indicator is rendered effective and ineffective when said second circuit is rendered effective and ineffective, and means for delaying rendering said second circuit ineffective.

17. In a rail flaw detector car having means for energizing the rail, flaw-responsive means for detecting variations in energization of said rail caused by flaws, an indicator adapted to be actuated by said responsive means and means adapted to cooperate with the rail joints, an electric circuit adapted to be rendered effective by said cooperative means when the latter is in cooperative relation to a rail joint, a second electric circuit adapted to be rendered ineffective when said first circuit is rendered effective, means whereby said indicator is rendered effective and ineffective when said second circuit is rendered effective and ineffective, means for delaying rendering said second circuit ineffective, said first circuit being adapted to be rendered ineffective when said cooperative means has passed a rail joint, and means for delaying rendering said first circuit ineffective.

WALTER M. PERRY.