

June 9, 1936.

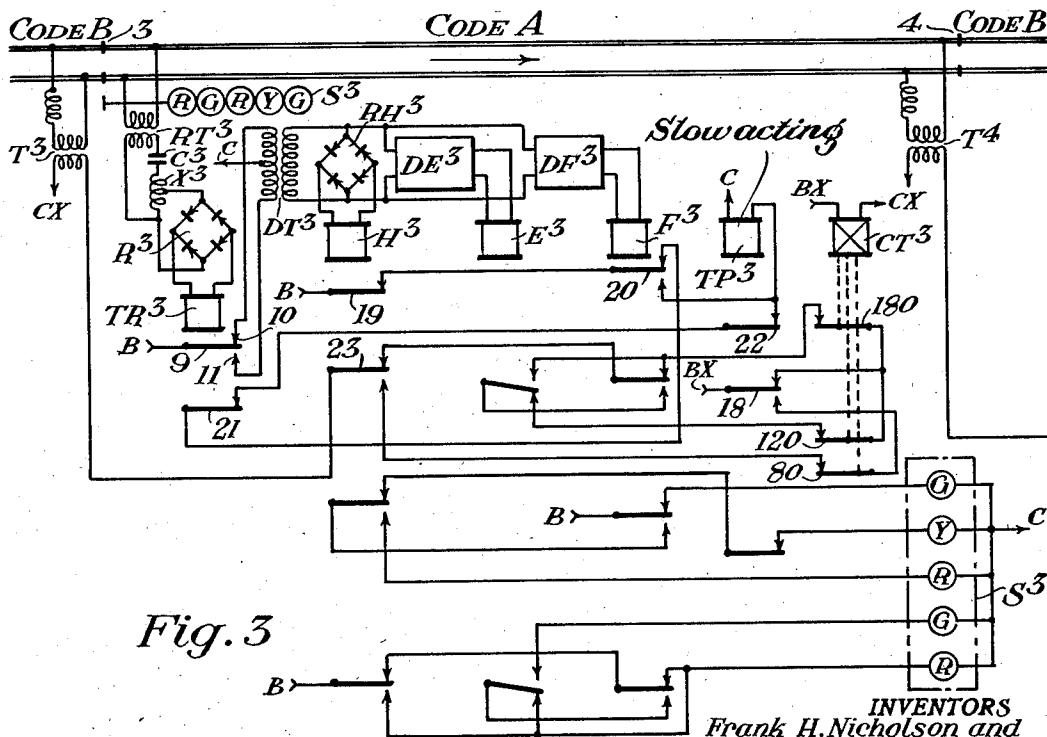
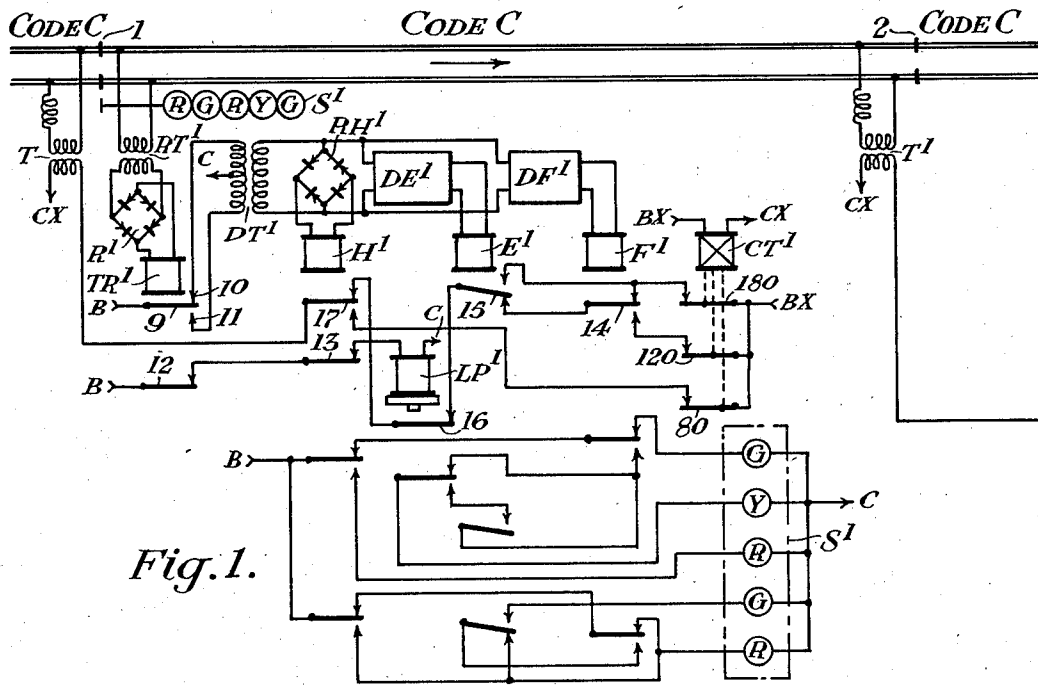
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2,043,768

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Dec. 28, 1933

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

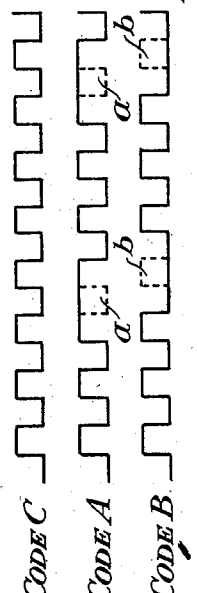
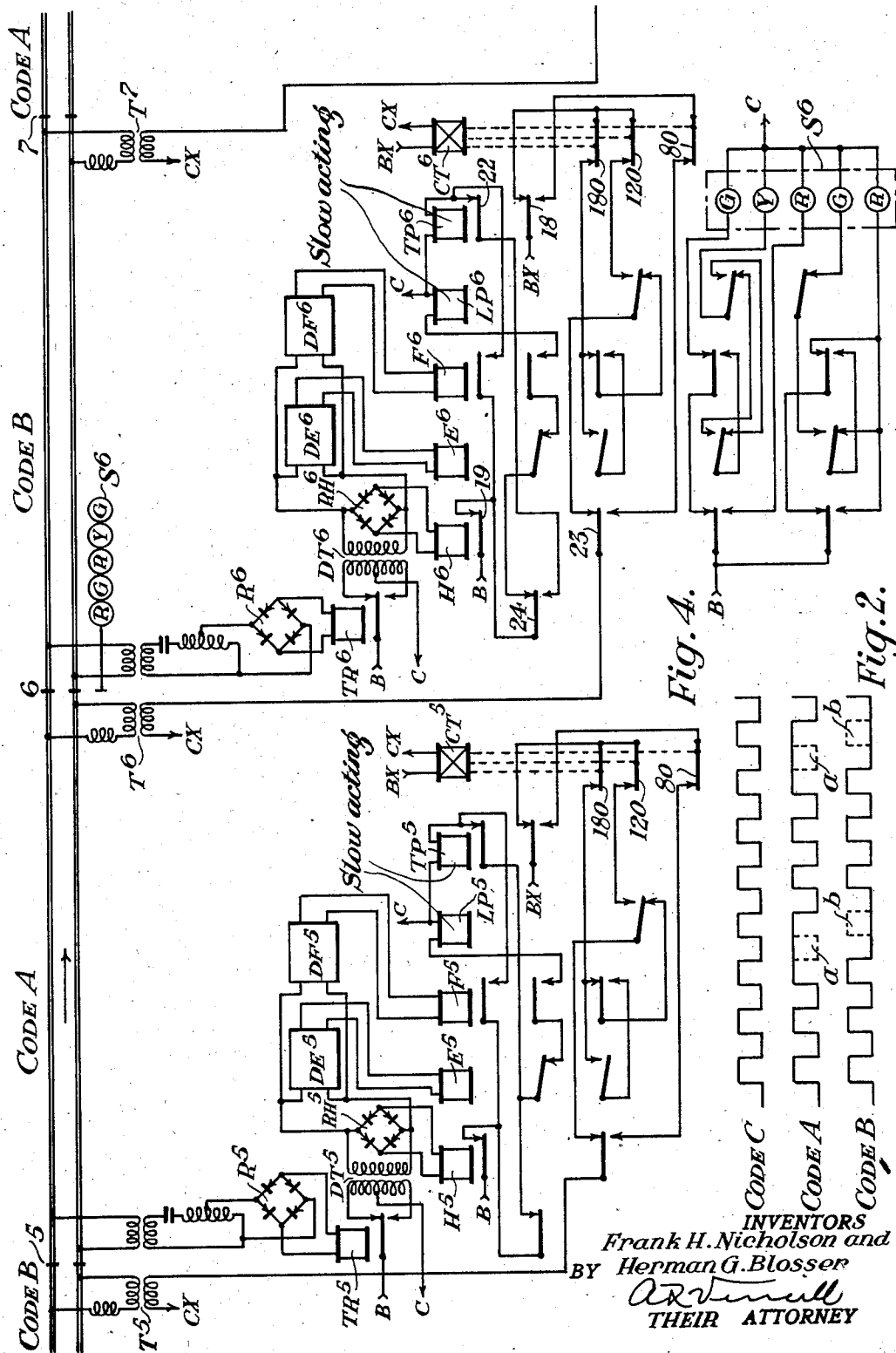


Fig. 2.

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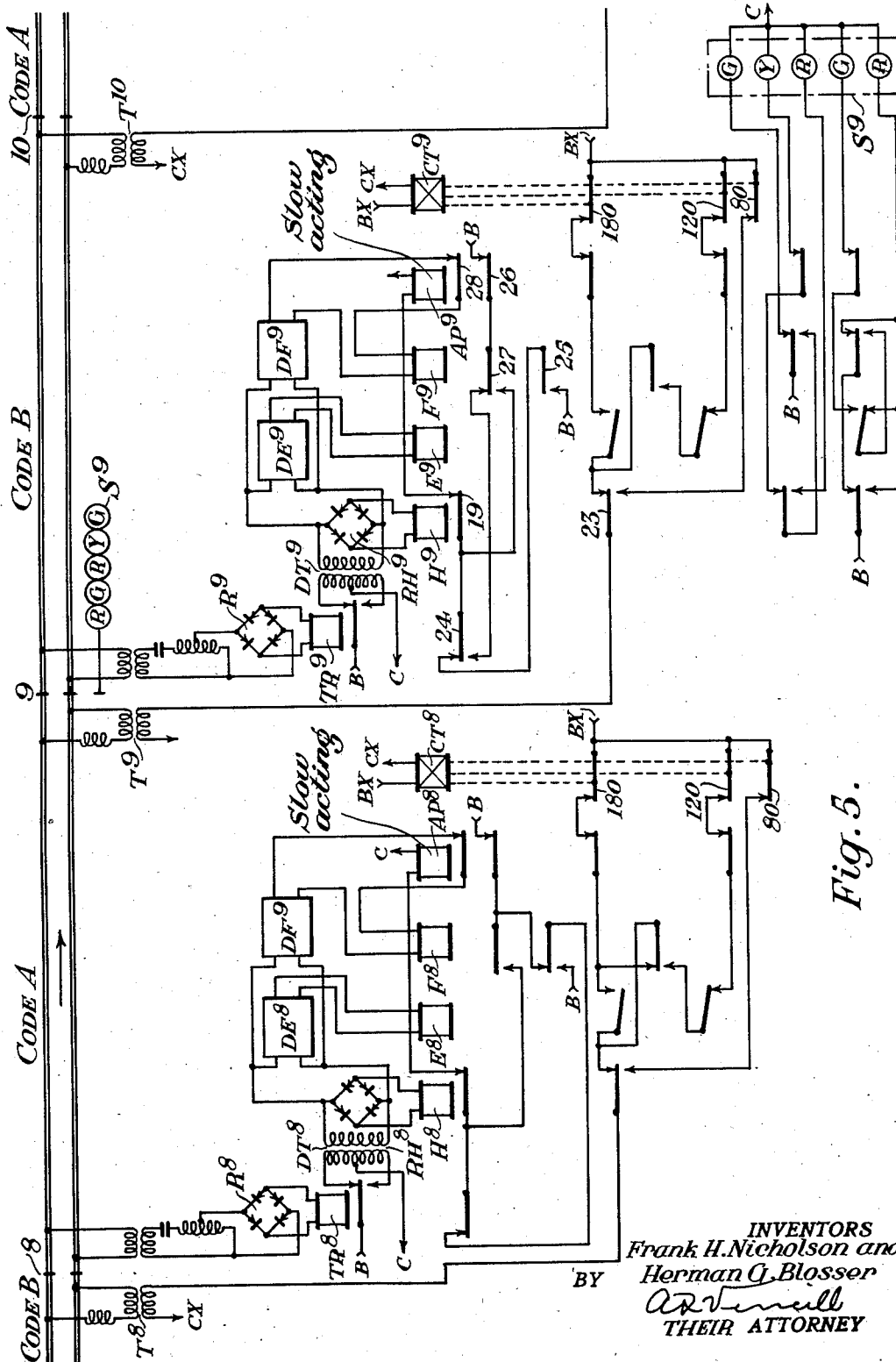


Fig. 5.

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RAILWAY TRAFFIC CONTROLLING
APPARATUS

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Our invention relates to railway traffic controlling apparatus, and more specifically to apparatus for providing broken down insulated rail joint protection in traffic governing systems which utilize coded rail current for controlling wayside and/or cab signals.

We will describe four forms of railway traffic controlling apparatus embodying our invention, and will then point out the novel features thereof in claims.

Fig. 1 of the accompanying drawings is a diagrammatic view showing one form of apparatus embodying our invention. Fig. 2 is a diagrammatic view illustrating some codes which may be used with apparatus embodying our invention. Figs. 3, 4 and 5 are diagrammatic views showing modified forms of apparatus also embodying our invention.

Similar reference characters refer to similar parts in each of the several views.

For reasons of economy, it is desirable that a signaling system have a minimum number of line wires. Therefore, other factors being equal, a system employing the single element type of track relay is to be preferred to one in which a two-element relay with its attendant line wires is used. However, in signaling systems using a single element track relay, broken down insulated rail joints may result in current from one track circuit flowing to the track relay of an occupied track circuit in advance, thereby creating a potential false clear condition unless some protective means are provided. Since broken down rail joint protection is but one phase of the coded wayside and cab signaling problem, there being numerous other factors and operating conditions which require that protective features be incorporated in any system which can be accepted as being safe and practicable, it is highly desirable that the solution for the broken down rail joint problem be of a type which can be readily assimilated into existing systems without necessitating extensive and costly changes.

Referring to Fig. 1, the apparatus shown therein can be used for providing protection to traffic moving from left to right, in the direction of the arrow. Section 1—2, as well as sections to the right and to the left thereof are supplied with coded rail current of what is known as the usual or unmodified frequency code, shown diagrammatically as code C of Fig. 2. This code comprises carrier current which may be either direct or alternating in character, upon which are impressed regular periodic variations recurring at any one of several code frequencies determined in accord-

ance with traffic conditions in advance. Code frequencies of 180, 120 and 80 impulses per minute will be assumed for purposes of illustration.

The code current for section 1—2 is supplied from a track transformer T^1 , energized from a suitable code transmitter and code-selecting apparatus which are not shown, but which are similar to the corresponding apparatus located at the entering end of section 1—2. Track relay TR^1 , which is energized through the relay transformer RT^1 and rectifier R^1 , is designed to follow the impulses of the code, alternately closing contacts 9—10 and 9—11. These contacts periodically reverse the flow of direct current from a source B—C, in the primary of decoding transformer DT^1 , thereby inducing an alternating voltage of the same code frequency in the secondary of this transformer. Decoding relay H^1 , which is energized through the rectifier RH^1 , is non-selective as to the various codes and will therefore be energized by current of any one of the three code frequencies which have been assumed. Relay E^1 , energized through the decoding unit DE^1 , is selective to 120 code; and relay F^1 , energized through the decoding unit DF^1 , is selective to 180 code. Units DE^1 and DF^1 are the usual code-tuning units and comprise a rectifier energized from a reactor and condenser circuit tuned to the desired code frequency. Relay H^1 , being non-tuned, will ordinarily pick up much more rapidly than either of the tuned relays E^1 or F^1 . The apparatus described thus far is well known in coded wayside and cab signaling circuits and requires no further detailed description.

The operation of relay LP^1 which provides the broken down rail joint protection will become apparent from the description which follows. It should be noted that relay LP^1 receives energy over a front point of contact 12 of relay TR^1 and a front point of contact 13 of relay H^1 . Relay LP^1 is sufficiently slow releasing to bridge the open interval of contact 12 when relay TR^1 is following the lowest code frequency, assumed to be 80. Relay LP^1 is also slightly slow to pick up for reasons which will become clear as the description progresses. The indications of signal S^1 are selectively controlled by the group of relays H^1 , LP^1 , E^1 and F^1 , in a manner which will be obvious from the drawings, and it is deemed unnecessary to trace the signal control circuits in detail.

In normal operation, if current of 180 code is supplied to section 1—2, 180 code will also be supplied to the rear section over a circuit which includes the following: terminal BX of a suitable

source, contact 180 of code transmitter CT¹, front point of contact 14 of relay F¹, back point of contact 15 of relay E¹, front contact 16 of relay LP¹, and front point of contact 17 of relay H¹, and the winding of track transformer T for the rear section. If the code is 120, the rear section will again receive 180 code over the same circuit as above, with the exception that the circuit from terminal BX and contact 180 of the code transmitter will pass directly over the front point of contact 15 of relay E¹, without including contact 14 of relay F¹.

If 80 code is supplied to section 1—2, 120 code will be supplied to the rear section over a circuit which includes terminal BX, contact 120 of transmitter CT¹, back point of contact 14 of relay F¹, and back point of contact 15 of relay E¹, the remainder of the circuit being the same as previously traced. If a train is occupying section 1—2, relay H¹ will be deenergized, and 80 code will be supplied to the rear section from terminal BX, contact 80 of transmitter CT¹, and back point of contact 17 of relay H¹, to the track transformer T.

From the foregoing description, it will be observed that relay LP¹ must be energized before a code higher than 80 can be supplied to transformer T of the rear section. The slow pick up feature of relay LP¹ aids in delaying the application of the 120 and 180 codes to the rear section when changes in traffic conditions in advance sections warrant the application of these codes.

Without relay LP¹, if the rail joints at location 1 should be broken down at the same time that a train occupies the right-hand end of section 1—2, relay TR¹ might follow 80 code from transformer T, energizing relay H¹, and causing 120 code to be supplied to transformer T. The 120 code might cause relay E¹ to become energized causing 180 code to be supplied to transformer T, with the possibility of relay F¹ becoming falsely energized. In this manner, by successive stages, a false proceed indication might finally be displayed by signal S¹ in the occupied section 1—2. Relay LP¹ provides the required protection by preventing the occurrence of the first step in the sequence of operations just described, that is, it prevents the stepping up of the code in the rear section from 80 to 120 when section 1—2 is occupied.

If the rail joints at location 1 are broken down at the same time that a train occupies the right-hand end of section 1—2, and relay TR¹ begins to follow 80 code from the rear section, relay H¹ may become temporarily energized, but as soon as relay H¹ picks up, all energy will be disconnected from transformer T at the back point of contact 17, whereupon relay TR¹ will immediately release, releasing relay H¹, in turn, to repeat the above cycle periodically. Relay LP¹ is so designed that the short time interval during which front contacts 12 and 13 of relays TR¹ and H¹ respectively are closed simultaneously is insufficient for pickup of relay LP¹. Therefore, neither 120 nor 180 code can be fed to transformer T under the above condition, as a result of which it will be impossible for signal S¹ to display a permissive indication. Furthermore, since relay H¹ will pick up and release alternately, the restrictive indication displayed by signal S¹ will be flashing in character, thus providing an indication of the defective rail joint condition.

The circuit of Fig. 1 is sufficient to provide protection to a train moving in the normal traffic direction, as indicated. However, under certain traffic conditions, this circuit may prove inadequate. For example, should the joints at loca-

tion 1 break down while signal S¹ is displaying a permissive indication and a train should back into section 1—2 or enter this section from a siding, it will be apparent that under this condition the 180 code from the rear section may energize relay TR¹, and may result in a false clear indication at signal S¹ in the rear of the train. That is to say, if a train enters section 1—2 in the normal traffic direction, and the rail joints break down, section 1—2 will not receive 120 or 180 code over the joints because relay LP¹ will not pick up, as explained above. However, if section 1—2 is already receiving code prior to the time that the joints break down, then since relay LP¹ is energized, there is nothing further to prevent the application of the 120 or 180 code. Therefore, a train backing into section 1—2 or entering the section from a siding without effectively shunting the track might fail to cancel the permissive indication of signal S¹.

The circuits of Figs. 3, 4 and 5 provide against conditions such as the one just described, and represent modified forms of the circuit of Fig. 1. These circuits are adapted to use codes such as A and B of Fig. 2 in alternate track sections. Codes A and B are essentially the same as code C in that the same wayside and cab signal response is obtainable therewith as with code C, but these codes are modified by interposing a relatively long "on" interval periodically in code A, and a relatively long "off" interval periodically in code B. These long intervals can be readily obtained with a code transmitter of standard form by mutilating a portion of the cam which operates to close the proper code contacts, thus cancelling the "off" intervals *a* and the "on" intervals *b* shown dotted in Fig. 2. For reasons which will become clear as the description of Figs. 3, 4 and 5 progresses, it is not necessary that the long "on" or long "off" intervals be present in each of the 180, 120 and 80 code frequencies of codes A and B, as it is sufficient merely to modify the 180 code for preventing a false clear signal, the 120 and 80 codes remaining unmodified and being therefore similar to code C of Fig. 2.

Referring now to Fig. 3, adjoining track sections of this figure have "staggered" codes, that is, section 3—4 is supplied with code A having a long "on" interval, and the adjoining section to the left as well as the section to the right thereof are supplied with code B having a long "off" interval, it being understood that codes of additional adjoining sections, which are not shown, will be alternated or staggered in a similar manner throughout the stretch. The stagger will be present in the 180 code only, the 120 and 80 codes of adjoining sections being unmodified, that is, identical for all sections of the stretch.

The normal operation of the system of Fig. 3 is identical with that of the system of Fig. 1, in that the decoding relay H³ will remain energized on any one of the three code frequencies, and the tuned decoding relays E³ or F³ will be energized on 120 or 180 code, respectively. The circuits for signal S³ are not shown extended to the signal location in order to simplify the drawings. The manner in which the decoding relays control the indications of signal S³ under normal conditions, being well known, will not be described in detail.

Relay TP³ is the protective relay in Fig. 3, and performs a function analogous to that of the LP¹ relay of Fig. 1. It will be noted that the front contact 18 of relay TP³ is included in the circuits which feed 180 and 120 code to track transformer T³. Therefore, it is necessary that relay TP³ be

energized before any code higher than 80 can be fed to the rear section. If 80 or 120 code is applied to section 3—4, relay TP³ will be energized over front contact 19 of relay H³ and the back point of contact 20 of relay F³. If relay TR³ is following 180 code having the long "on" interval, the energizing circuit for relay TP³ will include front contact 19 of relay H³, front point of contact 20 of relay F³, front contact 21 of relay TR³ and front contact 22 of relay TP³. Relay TP³ is quick to pick up but is sufficiently slow releasing to bridge the normal periodic opening of front contact 21 of relay TR³ on 180 code such as is provided by code A of 180 code frequency.

We shall now assume that while code B of 180 code frequency is being fed to the rear section and the rail joints at location 3 are broken down, a train enters section 3—4 from a siding, or a switch is thrown in the section, thus cutting off the normal supply of current to section 3—4. Should relay TR³ operate on current of code B entering over the rail joints, relays F³ and H³ will be held energized momentarily, but the first long "off" interval of the code B of 180 code frequency will cause relay TP³ to release, by virtue of the prolonged open circuit time of front contact 21. Thereupon, all code will be disconnected temporarily from the rear section, causing a release of the decoding relays F³ and H³, and causing signal S³ to display its most restrictive indication.

Upon the release of relay H³, 80 code will be fed to the rear section over the back points of contacts 18 and 23 of relays TP³ and H³. If the 80 code passes over the joints, relay H³ will become energized, picking up relay TP³ which will step up the code for the rear section to 120, over the front point of contact 18. If the 120 code causes response of relay E³, this relay will connect the modified 180 code with the long "off" interval to the rear section, thus releasing relay TP³ again, only to cause a periodic repetition of the above cycle of operation.

It will be apparent from the foregoing that whenever conditions are such that a false clear signal might be displayed by leakage of the 180 code from an adjoining section, the TP relay becomes deenergized and deenergizes the decoding apparatus, thus preventing a clear signal. With the apparatus of Fig. 3, if the rail joints break down, the signal indications will be stepped up in repeated and rapid succession from the indication corresponding to no code, through the indications corresponding to the 80 and 120 codes up to, but not including, the sustained clear indication which corresponds to 180 code. The flashing aspect of the signal may be used to provide a distinctive indication of the particular type of failure which has occurred.

The decoding apparatus for the rear section adjoining section 3—4 has not been shown since it is identical with the apparatus of section 3—4 with the exception that, since the TP relay for the rear section must release during a long "on" interval, this relay will be controlled over a back contact of the code-following track relay, corresponding to the front contact 21 of relay TR³. It is understood that if desired, the 120 and 80 code frequencies can also be modified in the manner of the 180 code, whereupon the momentary signal indication will not be stepped up beyond the indication corresponding to 80 code.

Referring to Fig. 4, the circuit of this figure combines some of the protective features of the LP relay circuit of Fig. 1 with the protective fea-

tures of the TP relay circuit of Fig. 3. The LP relay of Fig. 1 insures that once the signal is caused to indicate danger as a result of defective rail joints, the danger indication will be maintained. However, should the dangerous condition arise while the signal is displaying a proceed indication, the LP relay will not provide the required protection. On the other hand, the TP relay of Fig. 3 will provide the desired protection against a false clear signal, but will not maintain a steady danger indication, which in most cases is to be desired. By incorporating both LP and TP relays in Fig. 4, a circuit is obtained in which, if the rail joints break down and the normal code supply is cut off from the track section for any reason, the TP relay will cause the associated signal to indicate danger, and the LP relay will cause this indication to be maintained until the defect is cured.

The 180 code supplied to section 5—6 contains a periodic long "on" interval (Code A of Fig. 2), and the 180 code supplied to section 6—7 contains a periodic long "off" interval (Code B of Fig. 2), the 120 and 80 codes for both sections being unmodified, as in Fig. 3. If section 6—7 is deprived of code, that is, if a train enters this section from a siding for example at a time when the rail joints at location 6 are broken down and section 5—6 is being supplied with code A of 180 code frequency, relays H⁶ and F⁶ will be energized momentarily, but relay TP⁶ which was picked up following the pickup of relay H⁶ will release upon the occurrence of the first long "on" interval of code A, since it is controlled over the back point of contact 24 of relay TR⁶. This will occur because during the long "on" interval the back point of contact 24 will remain open, and the retardation of relay TP⁶ is insufficient to bridge this interval. During the release interval of relay TP⁶ and the subsequent release interval of relay H⁶, no code will be fed to section 5—6 because as soon as the front point of contact 18 of relay TP⁶ opens, the 120 or 180 code is disconnected, and until the back point of contact 18 and the back point of contact 23 of relay H⁶ are both closed, 80 code can not be supplied to the rear section.

As soon as the back point of contact 23 of relay H⁶ closes, 80 code will be supplied to section 5—6. The 80 code will operate relay TR⁶, causing relay H⁶ to pick up, again cutting off the 80 code at the back point of contact 23. Since relay LP⁶, which controls the application of 120 code to section 5—6, requires that front contacts 19 and 24 of relays H⁶ and TR⁶ be both closed for an appreciable time interval in order that relay LP⁶ may pick up, therefore, as previously described in connection with Fig. 1, relay LP⁶ will not pick up when 80 code enters from an adjoining section. Consequently, signal S⁶ will continue to indicate danger, as will be apparent from an inspection of the signal control circuits, which are self-explanatory. That is, the danger indication will be momentarily interrupted each time that relay H⁶ picks up, opening the back contacts which control the R lamps of signal S⁶, but no less restrictive indication will be given, even momentarily.

If 120 code flows from section 5—6 into section 6—7, this code will be stepped up to 180 by the decoding apparatus for section 6—7. However, as explained heretofore, once relay TP⁶ is released on code A, no code frequency higher than 80 can subsequently enter section 6—7 from 75

the rear section, with the result that after a momentary signal flash, the danger indication will be maintained even though this indication is periodically interrupted.

Referring to Fig. 5 which represents a simplification of the circuit of Fig. 4, it will be noted that the single relay AP replaces the two relays LP and TP of Fig. 4, and combines the protective features of each. Considering section 9-10, under normal conditions relay AP⁹ will remain energized on any of the codes supplied to the section by transformer T¹⁰. That is, if the code is 80, relay H⁹ will be energized, and relay AP⁹ will be picked up over a circuit which includes back contact 25 of relay F⁹, front point of contact 24 of relay TR⁹, and front contact 19 of relay H⁹. If the code is 120, no change in the above energizing circuit for relay AP⁹ will occur. If the code is 180, code B being understood, then the energizing circuit for relay AP⁹ will include front contact 26 of relay AP⁹, front point of contact 27 of relay F⁹, back point of contact 24 of relay TR⁹, and front contact 19 of relay H⁹.

With a train occupying the right-hand end of section 9-10, if 180 code A from the rear section passes over the joints and operates relay TR⁹, the long "on" interval of this code will hold the back point of contact 24 of relay TR⁹ open for a sufficient period to release relay AP⁹, which in opening its front contact 28 will release relay F⁹ immediately, thus shortening the duration of the signal flash and accelerating the display of the danger indication. The release of relay AP⁹ will cut off all code from section 8-9, causing relay H⁹ to release. When relay H⁹ releases, 80 code will be fed to section 8-9 over the back point of contact 23, picking up relay H⁹ momentarily, thus cutting off the code, as described previously. Relay AP⁹ is so designed that it will not pick up during the short interval that front contacts 19 and 24 of relays H⁹ and TR⁹ are simultaneously closed, in the above operation. Therefore, signal S⁹ will continue to indicate danger. If 120 code from section 8-9 operates relay TR⁹, relay E⁹ will pick up and will apply 180 code A to the rear section, which code will, in turn, release relay AP⁹.

From the above description it will be apparent that with apparatus embodying our invention, complete broken down rail joint protection is provided in a system which is comparatively simple and which requires no control line wires.

Although we have herein shown and described only four forms of apparatus embodying our 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 our invention.

Having thus described our invention, what we claim is:

1. In combination, two adjoining sections of railway track, a source of code current and a code-following track relay connected with the rails of one of said sections, a decoding relay responsive to code operation of said track relay, a protection relay controlled by both said track relay and said decoding relay, a signal governed by said protection relay, and means governed by said decoding relay for controlling the supply of rail current to the other of said two sections.

2. In combination, two adjoining sections of railway track, a source of code current and a code-following track relay connected with the

rails of one of said sections, a decoding relay responsive to code operation of said track relay, a protection relay controlled by both said track relay and said decoding relay, and means governed by said decoding relay and said protection relay for controlling the supply of rail current to the other of said two sections.

3. In combination, two adjoining sections of railway track, a source of code current and a code-following track relay connected with the rails of one of said sections, a decoding relay which becomes energized in response to code operation of said track relay, a protection relay, an energizing circuit for said protection relay including a front contact of said track relay and a front contact of said decoding relay, a signal governed by said protection relay, and means including a back contact of said decoding relay for supplying rail current to the other of said two sections.

4. In combination, two adjoining sections of railway track, a source of code current and a code-following track relay connected with the rails of one of said sections, a decoding relay which becomes energized in response to code operation of said track relay, a protection relay energized over a front contact of said track relay and a front contact of said decoding relay, and means including a front contact of said decoding relay and a front contact of said protection relay for controlling the supply of rail current to the other of said two sections.

5. In combination, two adjoining sections of railway track, a source of code current and a code-following track relay connected with the rails of one of said sections, a decoding relay which becomes energized in response to code operation of said track relay, a circuit including a back contact of said decoding relay for supplying rail current to the other of said two sections, and a protection relay energized over a front contact of said track relay as well as a front contact of said decoding relay and having a time interval sufficiently long for bridging the code operation of said track relay, said time interval being sufficiently short to permit said relay to release if said track relay becomes operated by current supplied to said other section, thereby providing an indication that rail current from said other section is flowing in said one section.

6. In combination, a first section of railway track, a second section of railway track adjoining therewith, means for supplying said first section with rail current varied according to a first code, a code-following track relay for said first section, a decoding relay responsive to code operation of said track relay, a source of current varied according to a second code, a protection relay controlled by said track relay and said decoding relay in such manner as to assume one condition when the track relay is following current varied according to said first code and another condition when the track relay is following current from said source varied according to said second code, and means controlled in accordance with the condition of said protection relay for supplying current from said source to the rails of said second section.

7. In combination, a first section of railway track, a second section of railway track adjoining therewith, means for supplying said first section with a first code having a periodically recurrent "on" interval of relatively long duration, means for supplying said second section with a second code having a periodically recur-

rent "off" interval of relatively long duration, a code-following track relay for said first section, a decoding relay responsive to code operation of said track relay, a protection relay controlled by said track relay and said decoding relay in such manner as to assume a first or a second condition according as said track relay is following said first or said second code respectively, and means effective when the protection relay occupies said second condition for preventing the supply of said second code to said second section.

8. In combination, a first section of railway track, a second section of railway track adjoining therewith, means for supplying said first section with a first code having a periodically recurrent "on" interval of relatively long duration, means for supplying said second section with a second code having a periodically recurrent "off" interval of relatively long duration, a code-following track relay for said first section, a decoding relay which maintains its energized condition in response to code operation of said track relay, a protection relay energized over a front contact of said decoding relay and having a release time insufficient to bridge the long "off" interval of said second code, and means effective when the protection relay is de-energized for preventing the supply of said second code to said second section.

9. In combination, a first section of railway track, a second section of railway track adjoining therewith, means for supplying rail current of a first and of a second code to said first and said second section respectively, a code-following track relay for said first section, a decoding relay which becomes energized in response to code operation of said track relay, a protection relay, a pickup circuit for said protection relay including a front contact of said decoding relay, a stick circuit for said protection relay including a front contact of said track relay and a front contact of said decoding relay, the release time of said protection relay with respect to the duration of impulses of said second code being such that said protection relay will release if said track relay is following said second code, and means controlled by said protection relay for governing the supply of said second code to said second section.

10. In combination, a first section of railway track, a second section of railway track adjoining therewith, means for supplying rail current of a first and of a second code to said first and said second section, respectively, a code-following track relay for said first section, a decoding relay which becomes energized in response to code operation of said track relay, a protection relay, a pickup circuit for said protection relay including a front contact of said decoding relay, a stick circuit for said protection relay including a front contact of said track relay and a front contact of said decoding relay, the release time of said protection relay with respect to the duration of impulses of said second code being such that said protection relay will release if said track relay is following said second code, and a signal controlled by said protection relay.

11. In combination, a first section of railway track, a second section of railway track adjoining therewith, means for supplying said first section with rail current of a first or of a second code in accordance with traffic conditions, means for supplying said second section with rail current of said first code or of a third code in accordance with traffic conditions, a code-following track relay for said first section; a first and a second decoding relay, said first relay being energized in response to operation of said track relay on either

said first section; a first and a second decoding relay, said first relay being energized in response to operation of said track relay on either said first or said second code, and said second relay being energized only in response to operation of said track relay on said second code; a first and a second protection relay; a pickup circuit for said first protection relay including a back contact of said second decoding relay, a front contact of said track relay, and a front contact of said first decoding relay; a pickup circuit for said second protection relay including a back contact of said second decoding relay and a front contact of said first decoding relay, a stick circuit for said second protection relay including a contact of said track relay and a front contact of said first decoding relay, said second protection relay having a release time sufficient to bridge the operation of said track relay on said first or said second code but not on said third code, means controlled by said second protection relay for governing the supply of said third code to said second section, means including a back contact of said first decoding relay for preventing the pickup of said first protection relay if said track relay is following rail current of said first code supplied to said second section, and a signal governed by said first protection relay.

12. In combination, a first section of railway track, a second section of railway track adjoining therewith, means for supplying rail current of a first and of a second code to said first and said second section respectively, a code-following track relay for said first section, a protection relay, a pickup circuit for said protection relay including a front contact of said track relay; a stick circuit for said protection relay including a back contact of said track relay, said protection relay having a release time sufficient to bridge the operation of said track relay on said first code but not on said second code; and means controlled by said protection relay for governing the supply of said second code to said second section.

13. In combination, a first section of railway track, a second section of railway track adjoining therewith, means for supplying rail current of a first and of a second code to said first and said second section respectively, a code-following track relay for said first section, a decoding relay energized in response to code operation of said track relay, a protection relay, a pickup circuit for said protection relay including a back contact of said decoding relay and a front contact of said track relay; a stick circuit for said protection relay including a front contact of said decoding relay and a contact of said track relay, said protection relay having a release time sufficient to bridge the operation of said track relay on said first code but not on said second code; and means including a front contact of said protection relay for governing the supply of said second code to said second section.

14. In combination, a first section of railway track, a second section of railway track adjoining therewith, means for supplying said first section with rail current of a first or of a second code in accordance with traffic conditions, means for supplying said second section with rail current of said first code or of a third code in accordance with traffic conditions, a code-following track relay for said first section; a first and a second decoding relay, said first relay being energized in response to operation of said track relay on either

said first or said second code, and said second relay being energized only in response to operation of said track relay on said second code; a protection relay; a pickup circuit for said protection relay including a back contact of said second decoding relay, a front contact of said track relay, and a front contact of said first decoding relay; a stick circuit for said protection relay including a front contact of said second decoding relay, a contact of said track relay, and a front contact of said first decoding relay, said protection relay having a release time sufficient to bridge the operation of said track relay on said first or said second code but not on said third code; means including a back contact of said first decoding relay for interrupting the supply of said first code to said second section, said protection relay having a pickup interval sufficiently long to prevent pickup if said track relay is following said first code supplied to said second section; and means controlled by said protection relay for governing the supply of said third code to said second section.

15. In combination, a first section of railway track, a second section of railway track adjoining therewith, means for supplying said first section with rail current of a first code characterized by a periodically recurrent long "off" interval, means for supplying said second section with rail current of a second code characterized by a periodically recurrent long "on" interval, a code-following track relay for said first section, a protection relay, a pickup circuit for said protection relay including a front contact of said track relay; a stick circuit for said protection relay controlled by said track relay in such manner as to become interrupted due to release of said protection relay if said track relay follows said long "on" interval of said second code; and means controlled by said protection relay for governing the supply of said second code to said second section.

16. In combination, a stretch of railway track divided into a plurality of track sections alternate ones of which are supplied with rail current of a first code and intervening ones of which are supplied with rail current of a second code, a code-following track relay and a protection relay for each of said alternate sections and for each of said intervening sections, a pickup circuit for each of said protection relays including a front contact of the associated track relay, a stick circuit for each of said protection relays controlled by the associated track relay in such manner as to become interrupted due to release of the protection relay in the event that the associated track relay is following the code supplied to an adjoining track section, and means controlled by each of said protection relays for governing the supply of rail current to the rear section adjoining the section associated with the given protection relay.

17. In combination, a stretch of railway track divided into a plurality of track sections alternate ones of which are supplied with rail current of a first code characterized by a periodically recurrent long "off" interval and intervening ones of which are supplied with rail current of a second code characterized by a periodically recurrent long "on" interval, a code following track relay and a protection relay for each of said alternate sections and for each of said intervening sections, a pickup circuit for each of said protection relays including a front contact of the associated track relay; a stick circuit for each

of said protection relays controlled by the associated track relay in such manner as to become interrupted due to release of said protection relay if the associated track relay follows said long "on" interval of the second code or said long "off" interval of the first code, respectively, according as the protection relay is associated with an alternate or an intervening track section; and means controlled by each of said protection relays for governing the supply of rail current to the rear section adjoining the section associated with the given protection relay.

18. In combination, a first section of railway track, a second section of railway track adjoining therewith, means for supplying rail current of a first and of a second code to said first and said second section respectively, a code-following track relay for said first section, a protection relay, a decoding relay energized in response to code operation of said track relay over a front contact of said protection relay, means for controlling said protection relay by said track relay in such manner that the protection relay will remain energized if the track relay is following said first code but will release if said track relay is following said second code, means controlled by said protection relay for governing the supply of said second code to said second section, and a signal controlled by said decoding relay.

19. In combination, a first section of railway track, a second section of railway track adjoining therewith, means for supplying rail current of a first and of a second code to said first and said second section respectively, a code-following track relay for said first section, a protection relay, a pickup circuit for said protection relay effective when said track relay is following code, a stick circuit for said protection relay controlled by said track relay in such manner as to remain effective when said protection relay is following said first code but not said second code, and means controlled by said protection relay for governing the supply of said second code to said second section.

20. In combination, a first section of railway track, a second section of railway track adjoining therewith, means for supplying rail current of a first and of a second code to said first and said second section respectively, a code-following track relay for said first section, a decoding relay energized in response to code operation of said track relay, a protection relay, a pickup circuit for said protection relay including a front contact of said decoding relay, a stick circuit for said protection relay including a front contact of said decoding relay and a contact of said track relay, said protection relay having a release time sufficient to bridge the operation of said track relay on said first code but not on said second code, and means including a front contact of said protection relay for governing the supply of said second code to said second section.

21. In combination, two adjoining sections of railway track, a code-following track relay for the forward section, a decoding relay controlled by said track relay in such manner as to assume an operated condition when the track relay is following code, means for supplying current to the rear section over a contact of said decoding relay which contact becomes opened when the decoding relay assumes said operated condition thereby causing an interruption in the supply of current to said rear section if said track relay becomes operated by the current supplied to said

rear section, and a protection relay controlled by said decoding relay and said track relay in such manner that said protection relay will respond during said current interruption thereby providing an indication that rail current from said rear section is flowing in said forward section.

22. In combination, two adjoining sections of railway track, a code following track relay for the forward section, a decoding relay controlled to an energized condition by said track relay when the track relay is operated, means including a back contact of said decoding relay for

supplying rail current to the rear section, and a protection relay controlled by said track relay and over a circuit including a front contact of said decoding relay whereby said protection relay will release during the interruption of said circuit which follows when said track relay is operated by current supplied to said rear section thereby providing an indication that rail current from said rear section is flowing in said forward section.

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