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RAILWAY TRAFFIC CONTROLLING APPARATUS

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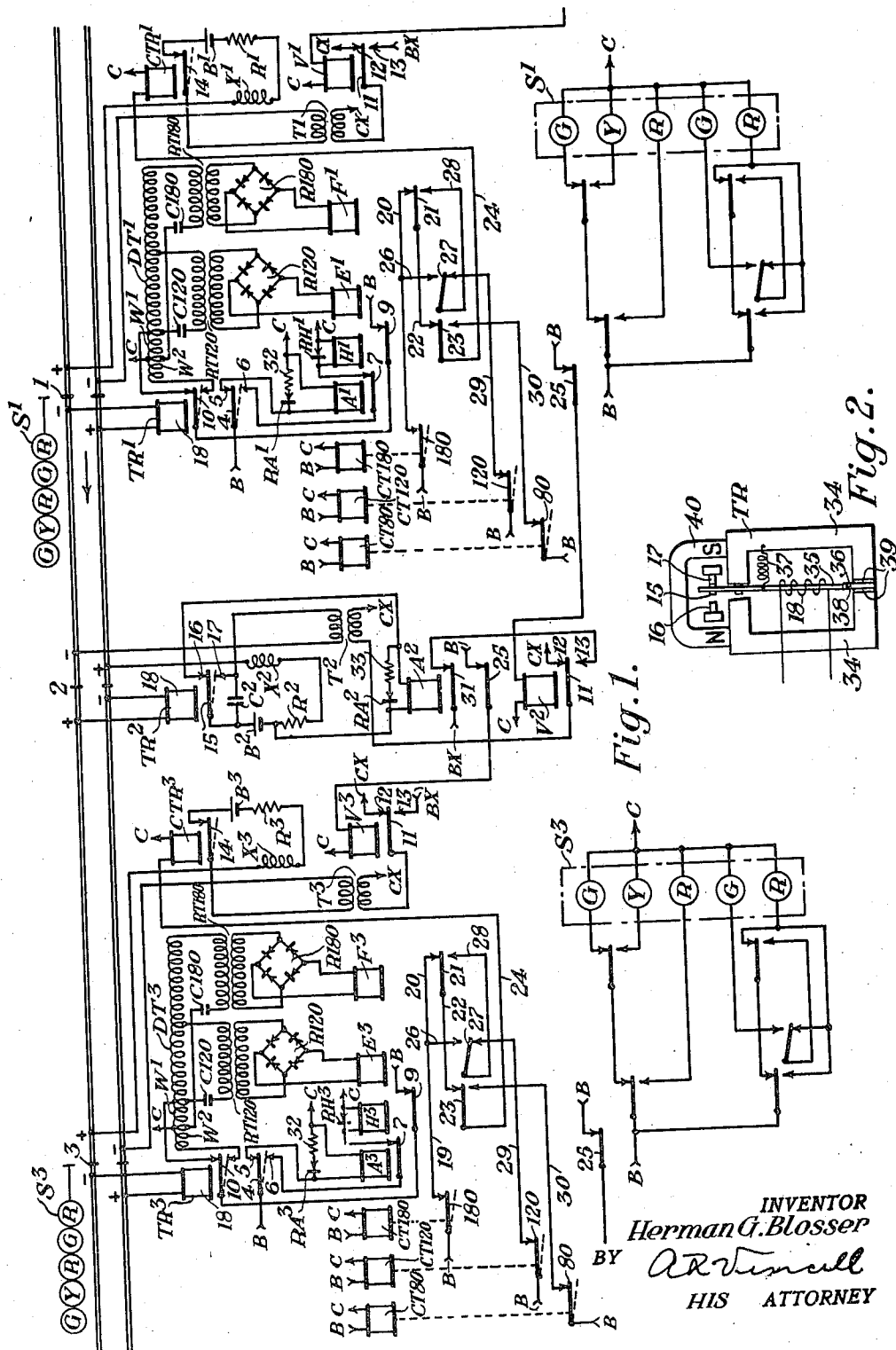


Fig. 1.

Fig. 2.

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UNITED STATES PATENT OFFICE

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RAILWAY TRAFFIC CONTROLLING
APPARATUS

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23 Claims. (Cl. 246—34)

My invention relates to railway traffic controlling apparatus, and specifically to apparatus for controlling wayside and/or cab signals by means of coded trackway energy.

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

In the accompanying drawing, Fig. 1 is a diagrammatic view showing one form of apparatus embodying my invention. Fig. 2 is a diagrammatic view showing a portion of the apparatus illustrated in Fig. 1, in greater detail.

Referring to the drawing, I have shown a stretch of railway track divided by insulated rail joints into track sections 1—2 and 2—3, in which traffic normally moves from right to left, in the direction of the arrow. Each track section is provided with a code-following direct current track relay designated by the reference character TR with an exponent corresponding to the location. Each section is also provided with a battery B which supplies track circuit current for operating the associated track relay, and also a track transformer T which supplies alternating rail current of any suitable frequency such for example as 60 or 100 cycles per second for controlling cab signaling apparatus. Since both alternating and direct current may flow simultaneously in the rails of a section, as explained hereinbelow, the track circuits of the section represent combined alternating and direct current loads and may be conveniently so termed.

Considering the apparatus at location 3, which is representative of the apparatus at other wayside signal locations, the relay TR³ in following code, alternately closes front contact 4—5 and back contact 4—6. Each time that contact 4—5 closes, an impulse of current is received by relay A³ from a source having the terminals B—C, which causes relay A³ to pick up and to close front contact 7. Relay A³ is of the usual quick-pickup, quick-release type, but due to the presence of the rectifier RA³ which is poled in a direction such as to provide a low resistance path for the current induced by the flux decay in the relay core, relay A³ is capable of bridging the "off" periods in the code, and is therefore maintained energized at all times as long as relay TR³ is following code. Because of the prominent negative resistance-temperature characteristic of the copper oxide rectifier RA³, a resistor 32 is connected in series therewith, for the purpose of masking or compensating for the resistance changes of the rectifier, in order to preserve a substantially uniform release time for relay A³,

in spite of wide temperature variations. By constructing resistor 32 of material having a positive resistance-temperature coefficient, complete compensation for resistance changes with temperature in rectifier RA³ and the winding of relay A³ can be obtained.

Each time that contact 4—6 of relay TR³ closes, relay H³ receives an impulse of current, over front contact 7—8 of relay A³, and relay H³ is maintained energized during the "off" code intervals by virtue of the rectifier RH³ which is poled in such manner as to make relay H³ slow releasing. No compensating resistor is required in series with rectifier RH³ because a greater variation in pick-up and release time is permissible in the case of relay H³, than in the case of relay A³. If it be assumed for purposes of illustration that the codes used comprise rail current which is periodically interrupted at the rate of 180, 120, or 80 times per minute, each of the two relays A³ and H³ must be sufficiently slow releasing to bridge the "off" intervals of the 80 code, and at the same time, sufficiently quick acting to pick up promptly and hold up on short impulses of the 180 code.

When relay H³ is energized and relay TR³ is 25 operating, direct current is supplied over front contact 9 of relay H³, and the front and the back points of contact 10 of relay TR³, to the decoding transformer DT³, which in the form shown is of the auto-transformer type. As will be apparent 30 from an inspection of the drawing, when relay TR³ is operating, direct current will first flow through portion W¹ of the auto-transformer winding in a given direction, and at the next moment will flow through portion W² of the 35 winding in the opposite direction, thus causing a periodic reversal of the flux in the core of transformer DT³, whereby an alternating voltage of the code frequency will be induced in the auto-transformer winding.

Decoding relay F³ is energized from a portion of the auto-transformer winding, through condenser C180, reactive transformer RT180, and rectifier R180, and is selectively responsive to 180 code operation of the relay TR³ because of the electrical 45 tuning of the circuit of reactive transformer RT180 by means of the condenser C180. Similarly, relay E³ is energized from another portion of the auto-transformer winding and is selectively responsive to 120 code operation of relay TR³ 50 by virtue of the tuned circuit which includes reactive transformer RT120 and condenser C120.

At each wayside signal location are three constantly operating code transmitters CT180, CT120, and CT80, which may be of any suitable 55

design, such for example as the oscillating pendulum type shown in United States Patent No. 1,858,876, granted on May 17, 1932, to Paul N. Bossart, for Coding apparatus. These code transmitters provide the 180, 120 and 80 codes by virtue of the operation of a code-following line relay CTR³, the energizing circuit of which is periodically interrupted over one or another of the contacts 180, 120, or 80 of the respective code transmitter. The particular code which relay CTR³ is following at any given time depends on the traffic conditions in advance of section 2—3, as reflected in the condition of the decoding relays H³, E³, and F³.

It will be noted that in the embodiment which is shown, direct current is supplied to the track circuits at all times, whereas alternating current is supplied to a particular track circuit during such time only as the given track circuit is occupied. That is, the track transformers which supply cab signaling energy become energized upon the approach of a train. At location 3, relay V³ is the approach relay which, upon becoming de-energized due to the entry of a train into section 2—3, closes back contact 11—13, thus connecting a source of alternating current having the terminals BX—CX, across the primary winding of transformer T³.

The secondary winding of transformer T³ and the track battery B³ are connected in series across the two rails of section 2—3. The track feed connections include a resistor R³ for limiting the flow of direct current, and a reactor X³ for limiting the flow of alternating current to the track circuit. Included in the track feed circuit is a front contact 14 of the code-following relay CTR³, which contact acts to code the direct current supplied to section 2—3, as well as to code the alternating current supplied from transformer T³ at such times as approach relay V³ is deenergized. Contact 14 will operate at the rate of 180, 120 or 80 times per minute, depending upon traffic conditions in advance, which conditions in turn determine which of the code transmitters CT180, CT120, or CT80 will be effective in operating relay CTR³.

The apparatus shown at location 3 is duplicated at location 1, as well as at any additional wayside signal locations along the stretch of track. Location 2 represents a cut section, and since the code which is effective in section 2—3 is relayed or repeated into section 1—2 over the contact 15—17 of the code-following track relay TR², no code transmitters and selective decoding equipment are required at location 2. Relay A² is energized from the track battery B² and remains energized as long as relay TR² is either following code, or is energized in a direction such that front contact 15—16 is closed. Rectifier RA² permits relay A² to bridge the "off" code intervals without at the same time materially affecting the quick pickup characteristic of the relay, and the resistor 33 provides for temperature compensation in the manner previously explained in connection with resistor 32. Condenser C² is provided for the purpose of decreasing the arcing on contact 15—17 of relay TR².

Fig. 2 shows a relay which is described and claimed in my copending application Serial Number 705,278 filed January 4, 1934, for Electrical relays. This relay is of the two-position, polarized type and comprises a field made up of two magnetizable portions 34, and a movable magnetizable armature 35, suitably pivoted at 36. The armature 35 carries a contact 15 which co-

operates, respectively, with fixed contact 16 or 17, according as the armature occupies one or the other extreme position. The armature 35 is biased by a spring 37 in such manner that contact 15—17 is maintained closed when the relay is deenergized. The armature support 38 is made of magnetizable material and is separated from the field members 34 by non-magnetizable spacers 39. A polarizing field is supplied by the permanent magnet 40. Obviously, the polarizing field may be supplied in numerous other suitable ways, such as by a winding, or by an electromagnet.

When winding 18 is supplied with direct current of the proper polarity, the upper portion of armature 35 will develop a south pole and therefore, due to the polarizing action of magnet 40, armature 35 will be moved to the left, and will close contact 15—16, against the bias of spring 37. As soon as current is removed from winding 18, the armature will be returned by spring 37 to the position illustrated. Should the current in winding 18 be reversed for any reason, contact 15—17 will be maintained closed, and the relay will be prevented from operating, by the combined effect of the pull of spring 37 and the magnetic torque of the relay.

The purpose in polarizing the track relays TR is to provide broken down insulated rail joint protection. It will be noted, with reference to the drawing, that the polarities of adjoining track circuits are staggered. Therefore, should a pair of rail joints break down, permitting current from the adjoining track circuit to energize the track relay, the back contacts of the relay will be held closed and the relay will be prevented from following code, thus providing a restrictive indication as a warning of the fault.

Having described certain elements of the system individually, I shall now describe the operation of the system as a whole. When at least three blocks in advance of location 3 are unoccupied, track relay TR³ will be following 180 code, as a result of which, relays A³, H³ and F³ will be energized. Relay CTR³ will be operating on 180 code, over a circuit which includes contact 180 of code transmitter CT180, wires 19 and 20, front point of contact 21 of relay F³, wire 22, front point of contact 23 of relay H³, and wire 24, to relay CTR³. Since section 2—3 is unoccupied, relay A² will be energized and front contact 25 of this relay will be closed. Therefore, relay V³ will be energized, and the terminal BX of the alternating current source will be disconnected from the primary winding of transformer T³, at back contact 11—13.

Alternating current will, therefore, not be supplied to the rails of section 2—3. Direct current of 180 code will, however, be supplied to section 2—3 from battery B³, over front contact 14 of relay CTR³. Since the secondary winding of transformer T³ is in series with the direct current source, a substantial flux tends to be set up in the transformer core each time that contact 14 closes, with the result that appreciable arcing tends to take place upon the opening of contact 14. To decrease the arcing, the primary winding of transformer T³ is short-circuited over front contact 11—12 of relay V³. The short-circuited winding acts to retard the rate at which flux may build up in the core of transformer T³, and since the "on" code periods are of relatively short duration, the value attained by the flux under the latter condition is substantially decreased, with a substantial improvement in the arcing condition. Obviously, it is not essential

that the primary winding, as such, be short circuited, as short circuiting any suitable winding on the transformer core will produce the result desired.

When relay TR³ is following 180 code as described above, section 2—3 will be supplied with direct current of 180 code, and signal S³, which is controlled by the decoding relays H³, E³ and F³ in the usual and well-known manner, will provide an indication corresponding to clear traffic conditions in three advance blocks. The manner in which signal S³ is controlled by the decoding relays H³, E³ and F³ will be obvious from the drawing, and it is believed unnecessary to trace the signal control circuits in detail.

If two blocks in advance of location 3 are unoccupied, and the third block in advance is occupied, relay TR³ will be following 120 code, and relays A³, H³ and E³ will be energized, relay F³ being deenergized under this condition. Relay CTR³ will again be operating on 180 code, the energizing circuit now including contact 180 of code transmitter CT180, wires 19 and 26, front point of contact 27 of relay E³, wire 28, back point of contact 21 of relay F³, wire 22, front point of contact 23 of relay H³, and wire 24, to relay CTR³. Signal S³ will display an indication corresponding to two clear blocks in advance.

If the block in advance of location 3 is unoccupied, and the second block in advance is occupied, relay TR³ will be following 80 code, and relays A³ and H³ will be energized, relays E³ and F³ being both deenergized under this condition. Relay CTR³ will now be operating on 120 code over a circuit which includes contact 120 of code transmitter CT120, wire 29, back point of contact 27 of relay E³, wire 28, back point of contact 21 of relay F³, wire 22, front point of contact 23 of relay H³, and wire 24 to relay CTR³.

If the block in advance of location 3 is occupied, relay TR³ will be deenergized, and relays A³, H³, E³ and F³ will all be deenergized. Due to the opening of front contact 9 of relay H³, all energy will be removed from the decoding transformer DT³, to economize current from the source B—C at such times as the decoding equipment is not functioning. Relay CTR³ will now be operating on 80 code, the energizing circuit including contact 80 of code transmitter CT80, wire 30, back point of contact 23 of relay H³, and wire 24 to relay CTR³.

Considering now the operations at location 2, if section 2—3 is unoccupied and is supplied with 180 code, relay TR² will follow this code, and will repeat the code over back contact 15—17, into the rear section 1—2. Similarly, relay TR² will follow and will repeat the 120 and 80 codes which may be supplied to section 2—3.

Let it now be assumed that a train which is moving from right to left enters section 1—2, the remaining sections which are shown being unoccupied. Track relay TR¹ will become deenergized, causing all of the decoding relays A¹, H¹, E¹ and F¹ to release. Relay CTR¹ will follow 80 code, and will cause this code to be supplied to the section in the rear of location 1. As soon as relay A¹ releases, approach relay V² will become deenergized due to the opening of front contact 25 of relay A¹. Therefore, back contact 11—13 of relay V² will close, and since relay A² is energized and its front contact 31 is closed when section 2—3 is unoccupied, the primary winding of transformer T² will be connected with

the alternating current source BX—CX, and coded cab signaling energy will be supplied ahead of the train, in section 1—2.

When the train enters section 2—3, relay TR³ will release, thus releasing relay A². As soon as front contact 31 of relay A² opens, cab signaling current will be removed from section 1—2. Also, the opening of front contact 25 of relay A² will cause approach relay V³ to release and to apply cab signaling energy to section 2—3, ahead of the train. As soon as the train vacates section 1—2, relay TR² remaining deenergized due to the continued presence of the train in section 2—3, steady direct current will be supplied to section 1—2, over the back contact 15—17 of relay TR². Relay TR¹ will, therefore, become steadily energized, and will pick up relay A¹, over front contact 4—5. Approach relay V² will now become energized over front contact 25 of relay A¹. The use of steady direct current in section 1—2, in the manner described above, permits the clearing out of highway crossing apparatus or other detecting equipment by means of relay V², should a highway crossing exist at a location such as 2.

As soon as the train vacates section 2—3, relay H³ being deenergized, relay CTR³ will be operated at 80 code over contact 80 of code transmitter CT80 and the back point of contact 23 of relay H³. Section 2—3 will therefore be supplied with 80 code, and this code will be repeated into section 1—2, in the manner previously explained. Relay TR¹ will follow the 80 code, causing relays A¹ and H¹ to pick up, whereupon signal S¹ will be operated to provide an indication that block 1—3 is unoccupied, but that the block in advance of location 3 is occupied. The remaining operations resulting from the passage of the train into other sections in advance of location 3 will be understood from the foregoing description without added explanation.

It will be noted that the code current which is supplied to section 2—3 passes over a front contact of relay CTR³, whereas the code current supplied to section 1—2 passes over a back contact of relay TR². The reason for alternating front and back contacts of code-following relays where cut sections are involved is to provide compensation for code distortion when the code is repeated over the contacts of a code-following relay, as for example, over contact 15—17 of relay TR². With changes in ballast resistance due to weather conditions, the ratio of the release time to the pickup time of a track relay is altered, since the ballast resistance has somewhat the effect of a snubbing resistor connected across the track relay terminals. The code-following line relays, as well as the track relays, are subject to changes in the pickup-release time ratio with changes in temperature, and changes in other factors affecting relay energization throughout the section. Should it be required to repeat the code over a number of cut sections in cascade, the use of front contacts or back contacts exclusively, for the code repetition, tends to result in code distortion which is cumulative with each additional repeating relay, being most pronounced in the last section of the group. By alternating front and back contacts, substantial compensation for code distortion can be obtained.

Obviously, where a number of cut sections are involved, particularly if some or all of the sections are relatively short, it is not essential that strict alternation of code-feeding contacts of relays in adjoining cut sections be followed, as a

substantially undistorted code may be obtained by alternating, for example, every third or every fourth section, or using any other combination of front and back contacts determined by the particular track circuit constants, which produces the least amount of code distortion. Since the code supplied to code-following relays such as CTR¹ and CTR³ at signal locations 1 and 3, is always substantially true, being produced by the code transmitters CT80, CT120, and CT180, and since relays CTR¹ and CTR³ produce very little distortion, being unaffected by ballast conditions, therefore, the code supplied to the track rails at locations such as 1 and 3, is practically undistorted. For this reason, it does not matter, from the standpoint of code distortion, whether a front or a back contact of the CTR relay starts the code repetition for a group of cut sections.

Although I have herein shown and described only one form of apparatus embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In combination, a section of railway track, a track transformer for at times supplying alternating signaling current to the rails of said section, a source of direct current included in the circuit of the secondary winding of said transformer for supplying direct signaling current to the rails of said section, a coding device, a contact controlled by said device for periodically coding the current supplied to the rails of said section, an approach relay, means controlled by said approach relay for at times energizing the primary winding of said transformer, and other means controlled by said approach relay for at other times short circuiting said primary winding to decrease arcing at said contact of the coding device.

2. In combination, a combined alternating and direct current load, a transformer having its secondary winding connected across said load, a source of direct current connected between said secondary winding and said load, a contact for interrupting the circuit of said load, means for at times energizing the primary winding of said transformer, and means for at other times short-circuiting said primary winding to decrease arcing at said contact when the circuit of said load is interrupted.

3. In combination, a combined alternating and direct current load, a transformer for supplying alternating current to said load, a source of direct current connected in series with said load, a contact for interrupting the current of said load, means for at times energizing said transformer with alternating current to thereby energize said load, and means for at other times short circuiting a winding of said transformer to decrease arcing at said contact when the circuit of said load is interrupted.

4. In combination, a combined alternating and direct current load, a transformer for supplying alternating current to said load, a source of direct current connected in series with said load, a contact for interrupting the current of said load, means for at times energizing said transformer with alternating current to thereby energize said load, and means for at other times decreasing the rate of flux change in said transformer resulting from operation of said contact whereby arcing at said contact will be decreased.

5. In combination, a section of railway track, a track transformer connected across the two rails of said track for supplying alternating signaling current, a source of direct signaling current connected between said transformer and said track, a contact for interrupting the current supplied from said transformer and said direct current source to said track, means for at times supplying alternating current to said transformer to energize said track with alternating current, and means for at other times short circuiting a winding of said transformer to thereby decrease arcing at said contact.

6. In combination, a section of railway track, a track transformer connected across the two rails of said track, a source of direct current connected between said transformer and said track, a coding contact for interrupting the current from said transformer and said direct current source to said track, an approach relay, means including a back contact of said approach relay for energizing said transformer to supply alternating current to said track, and means including a front contact of said approach relay for short circuiting a winding of said transformer to decrease arcing at said coding contact.

7. In combination, a load, a first and a second source of current connected in series across said load, said first source having a high inductance characteristic, a contact for disconnecting said load from said two sources, means for rendering said first source effective to supply current at given times only, and means effective at times other than said given times for decreasing the inductance of said first source to decrease arcing at said contact when the current from said second source is being interrupted.

8. In combination, a source of direct current, an auto-transformer, means for periodically supplying direct current from said source to a portion of the winding of said auto-transformer whereby an alternating potential having a frequency determined by the rate at which said direct current is supplied will be induced in the auto-transformer winding, a tuned circuit comprising a reactive transformer and a condenser connected across a portion of said auto-transformer winding and tuned to resonance at a selected frequency of said induced potential, and control means governed by said tuned circuit in accordance with the frequency of said induced potential.

9. In combination, a source of direct current, an auto-transformer, means for periodically supplying direct current from said source to a portion of the winding of said auto-transformer whereby an alternating potential having a frequency determined by the rate at which said direct current is supplied will be induced in the auto-transformer winding, a tuned circuit comprising a reactive transformer and a condenser connected across a portion of said auto-transformer winding and tuned to resonance at a selected frequency of said induced potential, and a control relay connected so as to receive current from the output winding of said reactive transformer and capable of attaining its energized condition when the frequency of said induced potential corresponds to the resonant frequency of said tuned circuit.

10. In a frequency code system of signaling, a source of direct current, an auto-transformer, means for periodically supplying direct current from said source to the winding of said auto-

transformer whereby an alternating potential having a frequency determined by the rate at which said direct current is supplied will be induced in said winding, a tuned circuit comprising a reactive transformer and a condenser connected across a portion of said winding and tuned to resonance at a selected frequency of said induced potential, and a signal control relay connected so as to receive current from said tuned circuit and capable of attaining its energized condition when the frequency of said induced potential corresponds to the resonant frequency of said tuned circuit.

11. In combination, a source of direct current, an auto-transformer, means for establishing an alternating flux in the core of said auto-transformer by periodically supplying current from said source to one portion of the auto-transformer winding in a given direction and alternately to another portion of the auto-transformer winding in the reverse direction whereby an alternating potential will be induced in said winding having a frequency determined by the rate at which said direct current is supplied, a tuned circuit comprising a reactive transformer and a condenser connected across a portion of said winding and tuned to resonance at a selected frequency of said alternating potential, a rectifier, and a direct current control relay connected to receive current from the output winding of said reactive transformer through said rectifier and capable of attaining its energized condition when the frequency of said induced potential corresponds to the resonant frequency of said tuned circuit.

12. In combination, a section of railway track, means for supplying said section with rail current of a first or a second code in accordance with traffic conditions in advance of said section, a code-following track relay for said section, a first relay having a release time capable of bridging the operation of said track relay on said first or said second code, means including a front contact of said track relay for energizing said first relay, a second relay having a release time capable of bridging the operation of said track relay on said first or said second code, means including a back contact of said track relay and a front contact of said first relay for energizing said second relay, a decoding relay controlled by said track relay in such manner as to become energized when and only when said track relay is following said second code, means controlled by said second relay for preventing the energization of said decoding relay, and traffic governing means controlled by said second relay and said decoding relay.

13. In combination, a section of railway track, means for supplying said section with rail current of a first or a second code in accordance with traffic conditions in advance of said section, a code-following track relay for said section, a first relay capable of bridging the code operation of said track relay on said first or said second code, means including a front contact of said track relay for energizing said first relay, a second relay capable of bridging the code operation of said track relay on said first or said second code, means including a back contact of said track relay and a front contact of said first relay for energizing said second relay, a decoding transformer which becomes energized in response to code operation of said track relay, a decoding relay receiving energy from said transformer and selectively responsive to code operation of said track relay on said second code,

means including a contact of said second relay for preventing the energization of said decoding transformer unless said second relay is energized, and traffic governing means controlled by said second relay and said decoding relay.

14. In combination, a section of railway track, means for at times supplying coded rail current to said section, a code-following track relay for said section, a decoding transformer, a source of direct current, a circuit including a contact of said track relay for periodically supplying direct current from said source to a winding of said decoding transformer, means effective for preventing the supply of direct current to said winding unless said track relay is following code, a decoding relay controlled by the potential induced in said transformer when said winding is periodically supplied with direct current, and traffic governing apparatus controlled by said decoding relay.

15. In combination, a section of railway track, means for supplying said section with rail current of a first or a second code in accordance with traffic conditions in advance of said section, a code-following track relay for said section, a first quick-pickup relay, a circuit including a front contact of said track relay for energizing said first relay, a rectifier connected across the winding of said first relay for rendering said first relay sufficiently slow-releasing to bridge code operation of said track relay on said first or said second code, means governed by said first relay for controlling the supply of train governing current to said section, a second quick-pickup relay, a circuit including a back contact of said track relay and a front contact of said first relay for energizing said second relay, a rectifier connected across the winding of said second relay for rendering said second relay sufficiently slow releasing to bridge code operation of said track relay on said first or said second code, a decoding relay controlled by said track relay in such manner as to become energized when and only when said track relay is following said second code, means controlled by said second relay for preventing the energization of said decoding relay if said second relay is deenergized, and traffic governing means controlled by said second relay and said decoding relay.

16. In combination with a stretch of railway track divided into track circuit sections, a source of direct current for each of said sections and connected with the rails of each section in such manner as to provide staggered polarities in adjoining sections of said stretch, means for coding the rail current supplied to said sections; a code following two position polarized track relay for each of said sections, said relay being biased to assume its reverse energized position at such times as current of normal relative polarity is not supplied to said relay, the track connections of said relay being reversed in adjoining track sections whereby the relay will follow coded current supplied from said source to the respective section but will be prevented from operating by being held in its reverse energized position should rail current of the reverse relative polarity enter from an adjoining section into said relay; and traffic governing means controlled by said relay.

17. In combination with a stretch of railway track divided into track circuit sections, a source of direct current for each of said sections and connected with the rails of each section in such manner as to provide staggered polarities in adjoining sections of said stretch, means for coding

the rail current supplied to said sections; a direct current code following track relay of the two-position polarized type for each of said sections and connected with the rails in such manner as to follow the code supplied to its associated section, said relay being mechanically biased to assume its reverse energized position in the absence of rail current of normal relative polarity and being electrically biased to assume its reverse energized position under the condition of rail current from an adjoining section entering said relay; and traffic governing means controlled by said relay.

18. In a coded wayside system of signaling, a stretch of track divided into track circuit sections, means for supplying coded direct current to each of said sections the polarity of the current being staggered in adjoining sections; and a code-following two-position polarized track relay for each of said sections, said relay being mechanically biased to its reverse energized position and having its track connections so arranged as to be capable of attaining its energized position only when receiving rail current from its associated section, whereby said relay will be caused to assume its reverse energized position should rail current from an adjoining section enter said relay.

19. In combination, a first and a second section of railway track, means for supplying track current to each of said sections, a code-following line relay and a code-following track relay for said first section, means including a front contact of said code-following line relay for coding the current supplied to said first section, means including a back contact of said code-following track relay for coding the current supplied to said second section, and traffic governing apparatus controlled by the code current supplied to said second section.

20. In a code system of signaling for a stretch of railway track divided into a plurality of cut sections, a code-following relay associated with each of said sections, and means for repeating the code supplied to a given cut section into the cut sections of said stretch in the rear of said given section, said means including alternate front and back code-repeating contacts of consecutive code-following relays to decrease code distortion resulting from changes in the pickup-release time ratio of said code-following relays.

21. In a code system of signaling for a stretch of railway track divided into a plurality of cut sections, a code-following relay associated with each of said sections, and means for repeating

the code supplied to a given cut section into the cut sections of said stretch in the rear of said given section, said means including front contacts of code-following relays associated with the respective sections except that a back contact is substituted for a front contact in the case of a given relay of the code repeating chain to compensate for code distortion resulting from changes in the pickup-release time ratio of said code-following relays, the particular code-following relay at which the substitution is made being determined with reference to the amount of code distortion which is permissible in said system.

22. In a code system of signalling for a stretch of railway track divided into a plurality of cut sections, a code following relay associated with each of said sections, and means for repeating the code supplied to a given cut section into the cut sections of said stretch in the rear of said given section over a contact chain which includes front and back contacts of consecutive code-following relays associated with the respective sections, the selection of said front and back contacts forming consecutive elements of said chain being made in such manner as to substantially offset the code distortion resulting from changes in the pickup-release time ratio of said code-following relays.

23. In combination with a stretch of railway track divided into track circuit sections; means for supplying coded direct current of a first or a second code to each of said sections in accordance with traffic conditions in advance, the polarity of said current being staggered in adjoining sections; a two-position polarized code-following track relay for each of said sections having its track connections so arranged as to follow the code supplied to its respective section, a repeating relay which becomes energized when said track relay is following said first or said second code, an auto-transformer, means including a contact of said track relay for periodically supplying direct current to said auto-transformer to induce an alternating potential in a winding thereof, a circuit including a reactive transformer and a condenser energized from said winding and tuned for response at the frequency of said second code, a decoding relay energized from said tuned circuit, means including a contact of said repeating relay for preventing the supply of direct current to said auto-transformer, and traffic governing apparatus controlled by said repeating relay and said decoding relay.

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