June 28, 1938. M. HORMATS 2,122,373

SIGNALING SYSTEM FOR RAILROADS

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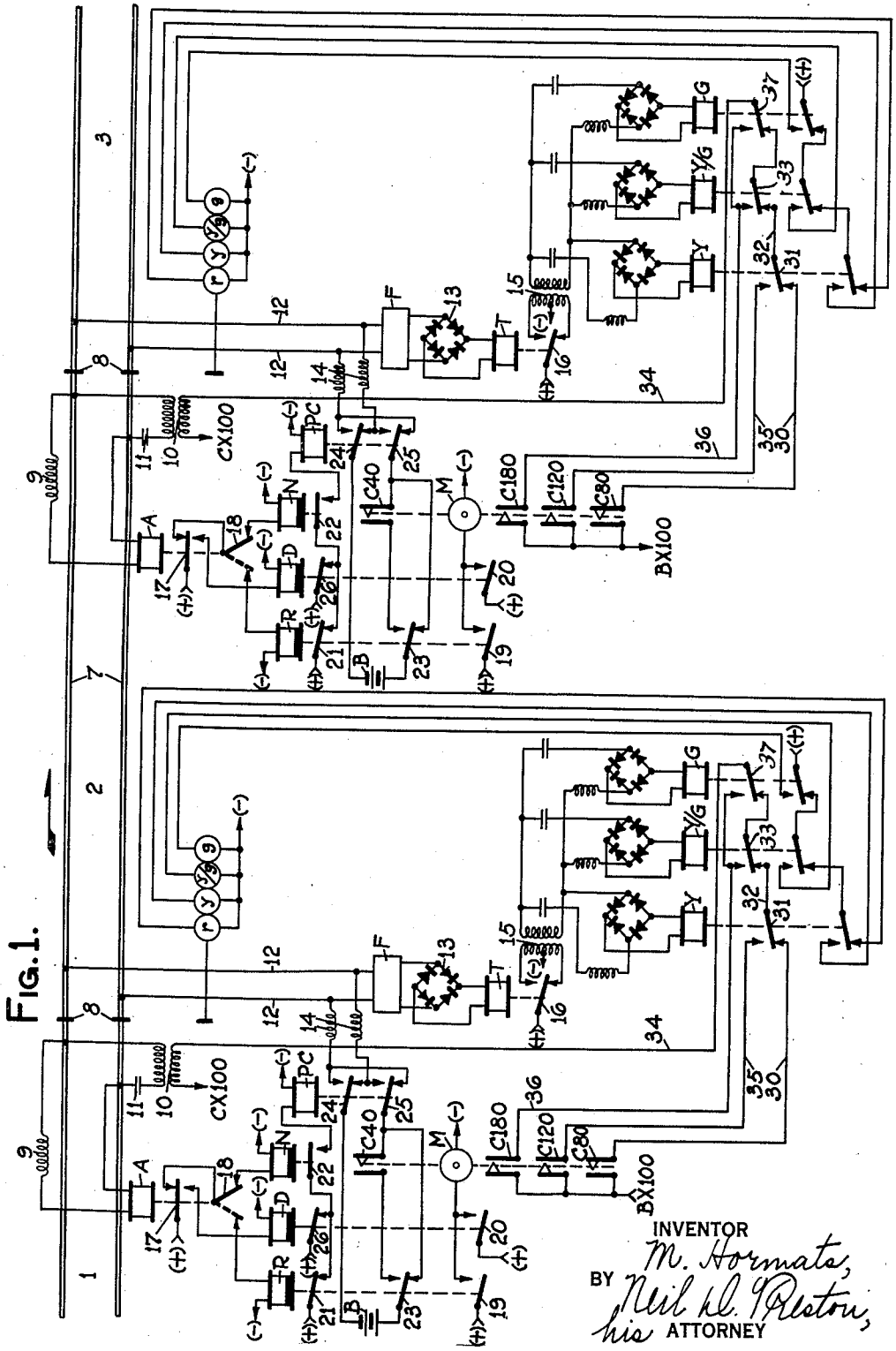


FIG. 1.

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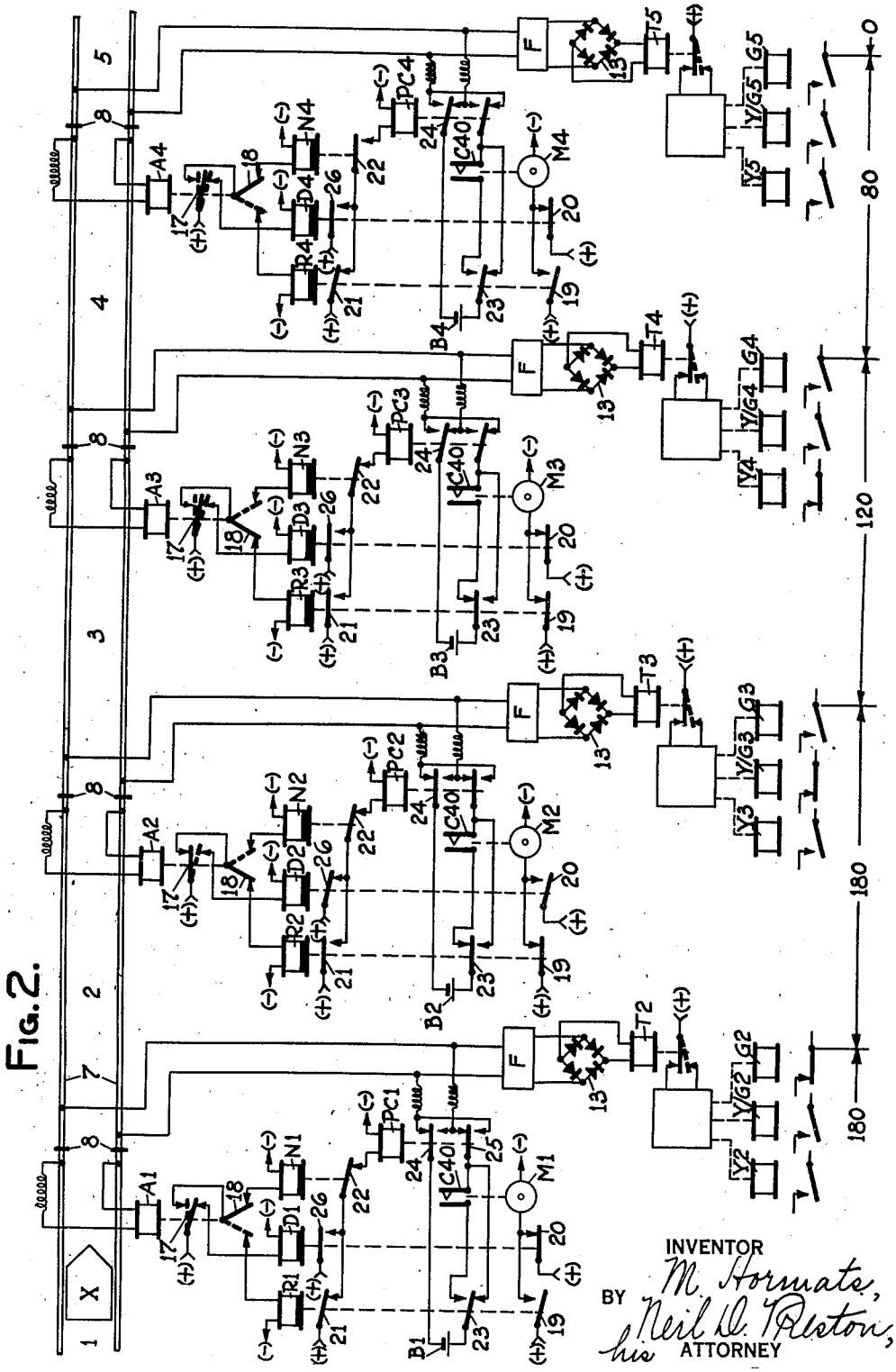


FIG. 2.

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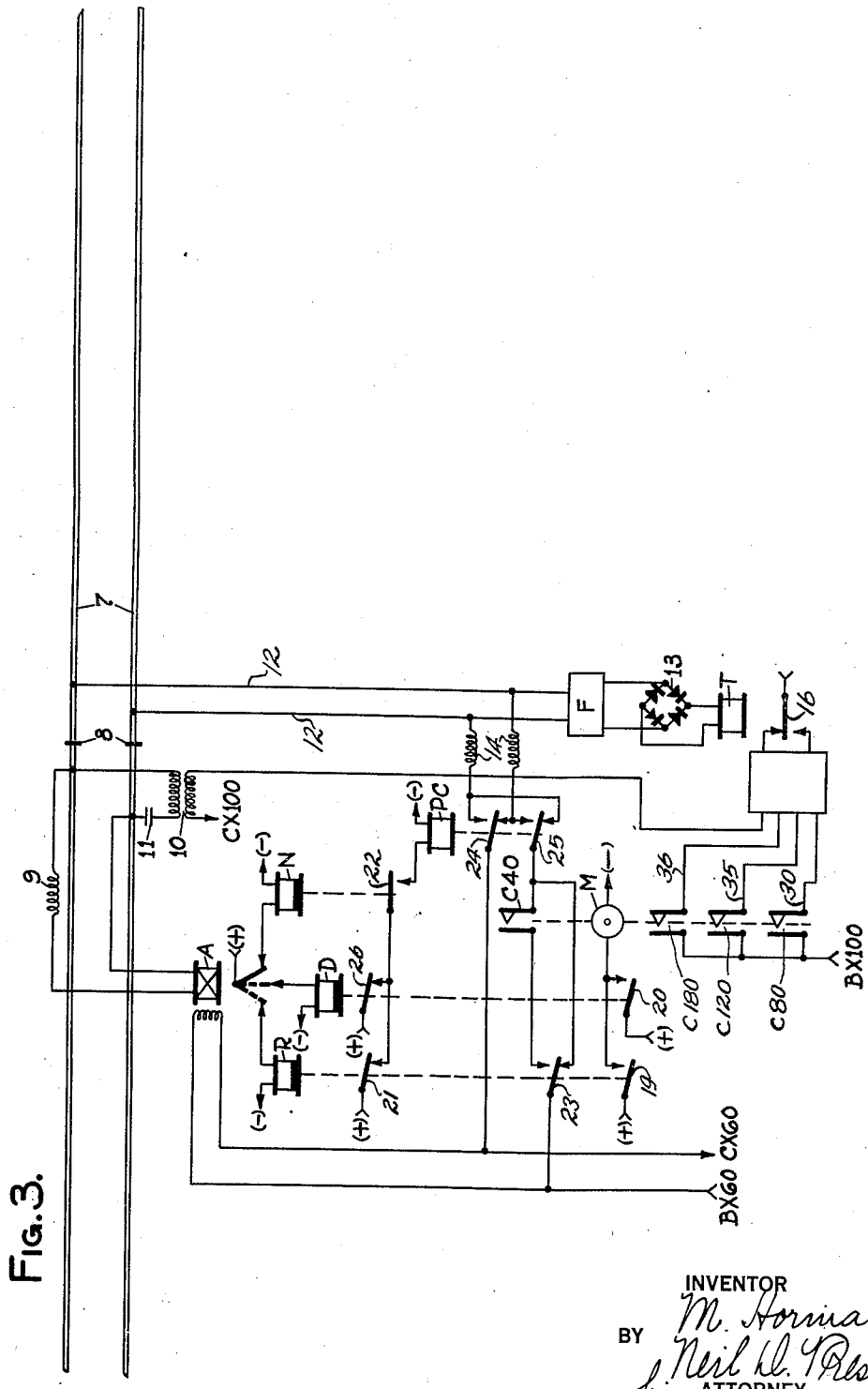


FIG. 3.

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Patented June 28, 1938 2,122,373

UNITED STATES PATENT OFFICE

2,122,373

SIGNALING SYSTEM FOR RAILROADS

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Application April 10, 1935, Serial No. 15,646

18 Claims. (Cl. 246—34)

This invention relates to signaling systems for railroads of the so-called coded track circuit type, and more particularly to a system of this type in which the code equipment is normally inactive and is automatically set into operation upon the approach of a train.

In a coded track circuit system, it is desirable to avoid the continuous operation of relay contacts and other moving parts unless a train is present; and in accordance with this invention, generally speaking, it is proposed to provide means for initiating operation of the coding and decoding equipment upon the approach of a train by control over the track rails and without the use of line wires.

Various characteristic features, adaptations, and advantages of the invention will be in part apparent and in part pointed out as the description progresses.

In the accompanying drawings, Fig. 1 shows in a simplified and diagrammatic manner one specific embodiment of the invention; Fig. 2 is an explanatory diagram showing the parts of the same apparatus for a number of blocks in the operated position when a train approaches; and Fig. 3 is a fragmentary diagram illustrating a modified arrangement employing three-position alternating current relays instead of direct current neutral polar relays.

Referring to Fig. 1, and considering first briefly the organization of parts associated with each block in accordance with this invention, it is contemplated that the track rails 7 will be bonded and divided by insulated joints 8 into track sections or blocks in the usual way. The normal direction of traffic is from left to right as indicated by the arrow. At the exit end of each block, a direct current neutral polar relay A of the usual construction, conveniently termed an approach control relay, is connected across the track rails in series with a suitable reactance or choke coil 9. Also connected across the track rails at the exit end of each block is a secondary of a transformer 10 in series with a condenser 11. The primary of this transformer 10 is supplied with the coded track rail current, preferably at a relatively high frequency such as 100 cycles, for operating the code following track relay of the corresponding block, and also controlling the cab signal or train control equipment of a locomotive in that block. The inherent impedance of the approach control relay A, together with the reactance 9, renders this relay immune to the 100 cycle rail current; and the condenser 11 blocks direct current from the secondary of the transformer 10.

At the entrance end of each block a 100 cycle filter F of the usual construction is connected across the track rails by wires 12 and supplies current through a double-wave rectifier 13 of the usual construction to a code following track relay T; and a battery B, or other source of direct current, supplies current in multiple with the filter F through contacts of a pole-changing relay PC and through reactances or choke coils 14 to the wires 12 leading to the track rails.

The code following track relay T controls the operation of decoder relays, designated Y, Y/G and G by a transformer and rectifier organization similar to that shown and described in the patent to W. D. Hailes, No. 1,852,409, April 5, 1932 for a locomotive equipment. In this decoding arrangement, the operation of the code following track relay T energizes the two halves of the primary of a transformer 15 with direct current of opposite polarity, by engagement of the contact finger 16 of said track relay with front and back contacts, in a manner readily apparent. The secondary of the transformer 15 is thus energized with pulses or current surges corresponding with the rate at which the code following track relay is operated; and this secondary supplies current to the input circuits of double-wave rectifiers, said circuits being tuned by condensers and reactances such that the decoder relays respectively receive sufficient energizing current when the code following track relay is operated at the corresponding code rate.

The decoder relays Y, Y/G and G control the indications of the wayside block signal at the entrance to the corresponding block, and also the code rate of the rail current supplied to the next block in the rear. The wayside signals are assumed to be a simple form of color light signal with lamps lighted to display the desired indications, these circuits being readily traced in the drawings.

Associated with each block is a modulator or coder of suitable construction, arranged to intermittently close contacts at the different code rates. In the simple arrangement shown, it is assumed that this coder comprises a suitable motor M having constant speed characteristics, which operates by cams or the like contacts designated C40, C80, C120, and C180, corresponding with typical code rates of 80, 120, and 180 times per minute. The coding contacts C40 are arranged to control the supply of direct current to the entering end of each block under certain con-

ditions hereinafter explained; and the coding contacts C80, C120 and C180 control the supply of rail current to the block in the rear dependent upon the condition of the decoder relays of the corresponding block.

The approach control relay A of each block is steadily or intermittently energized with direct current of one polarity or the other under different conditions as hereinafter explained, and controls slow releasing relay designated R, D, and N, for the purpose of controlling the pole changing relay PC, starting of coder motor M, and including or excluding the contacts C40 in the direct current circuit for the next block in advance.

The various circuits are shown conventionally, with symbols (+) and (—) indicating connections to opposite terminals of a battery or other suitable source of direct current, and the symbols BX100 and CX100 indicating connections to a suitable source of 100 cycle current, either from a local vibrator or generator or from a transmission line, all in a manner familiar to those skilled in the art. The details of the circuit connections are more conveniently considered in describing the operation.

Considering now the operation of the approach control means constituting the invention, the parts are shown in Fig. 1 in the normal condition when no trains are present. Each block is supplied with a steady direct current of one polarity, conveniently assumed to be positive, with the pole changer relays PC de-energized; and this current energizes the approach control relay A at the exit end of the corresponding block, picking up its neutral armature 17 and positioning the polar armature 18 to the right, so as to energize the relay N by a circuit readily traced on the drawings. Relays R and D for each block are de-energized and open their front contacts 19 and 20, so that the coder M is not supplied with current, and the coder is inactive.

As shown, it is assumed that, with the coder at rest, the contacts C80, C120, and C180 are all open, so that no 100 cycle rail current is supplied to any of the blocks, and consequently the code following track relay T is de-energized. If the coder should happen to stop with the contact C80 closed, steady rail current would be supplied and the code following track relay T energized. In either case, however, since the track relay is not operating, all of the decoder relays Y, Y/G and G are de-energized. This lights the lamp *r* of the wayside signal through the back contacts of these decoder relays, giving a stop indication for all of the blocks.

It will be noted that, when no trains are present under these normal conditions there are no constantly operating or moving parts, and hence none of the wear and deterioration of contacts, bearings, and the like which occurs when relays and devices are operated continuously some 180 times per minute.

Assume now that a train approaches, so that it becomes necessary to initiate operation of the coding equipment to provide the desired indications of the wayside signals and the cab signal or train control equipment. This condition is illustrated in Fig. 2, where a train X has entered the block 1. This train X shunts and de-energizes the approach relay A1, opening its neutral front contact and de-energizing relay N1, and closing its neutral back contact to relay D1. The energization of relay D1 closes at its front contact 20 a circuit for the coder motor M1, thereby starting this coder for the block 1. Relays R1 and N1 being de-energized, relay PC1 is energized over a circuit from (+), through back contact 21 of relay R1 and back contact 22 of relay N1. Under these conditions, steady direct current of the opposite or reverse polarity is supplied to the entering end of block 2 from the battery B1, through the back contact 23 of relay R1, and the front contacts 24 and 25 of relay PC1.

The approach control relay A2 at the end of block 2 is thus steadily energized with the reverse polarity, which shifts its polar contact 18 to the left so that relay R2 is energized, while relays D2 and N2 are de-energized. Relay R2 closes its front contact 19 and supplies current to the coder motor M2, thereby starting the coder for block 2. Relays D2 and N2 being de-energized establish a circuit for energizing relay PC2 through the back contacts 26 and 22 of said relays. This supplies direct current of the reverse polarity to block 3; but since relay R2 is also energized, the coder contacts C40 are included in the battery circuit through the front contact 23 of relay R2, so that this current of reverse polarity is interrupted or pulsed, instead of being steady.

Approach control relay A3 of block 3, therefore, is intermittently energized with current of the reverse polarity; and while its polar contact 18 moves and stays to the left, its neutral armature moves up and down, alternately energizing relays R3 and D3, which are made sufficiently slow releasing so that such intermittent energization will maintain their armatures in the attracted position. Relays R3 and D3 being thus energized, current is supplied to the coder motor M3 through both the front contacts 19 and 20 of these relays; but the energizing circuit for relay PC3 is broken at the back contacts 21 and 26 of these relays. Consequently, relay PC3 is de-energized and current of the normal polarity is supplied to the block 4; and relay R3 being energized, this current is pulsed or interrupted by the coder contacts C40.

The approach control relay A4 of block 4 is thus energized with a pulsating current of the normal polarity, which keeps the polar contact 18 to the right, and opens and closes the front and back contacts of the neutral armature to maintain relays D4 and N4 energized. Relay D4 being energized closes a circuit through its front contact 20 for the coder motor M4, thereby starting the coder at this location. Relay N4 is energized and opens its back contact 22 so that relay PC4 is de-energized to supply current of the normal polarity to the block 5. R4 is de-energized and its back contact 23 is closed, so that this current to the block 4 is a steady current. In short, the current supplied to the approach control relay for the block 5 (not shown) is the steady normal current, which leaves the parts in the normal inactive condition for that block the same as shown in Fig. 1.

In this way the coders are started at the ends of the blocks 1, 2, 3, and 4, with the train X in the block 1 as shown in Fig. 2. Since there is no coded rail current in the block 5 the decoder relays Y, Y/G and G for that block are all deenergized, and this establishes the circuit for supplying 100 cycle rail current to block 4 through contacts C80. Referring to Fig. 1, this circuit may be traced from BX100, through contacts C80, wire 30, back contact 31 of relay Y, wire 32, back contact 33 of relay Y/G, wire 34, primary of transformer 10, to CX100.

Assuming no trains present in the block 4, this rail current at the 80 code rate operates the code following track relay T4 to energize the decoder relay Y4; and with this relay energized, the circuit for supplying rail current to the block 3 includes the contacts C120, such circuit being traced by referring to Fig. 1 from BX100, contacts C120, wire 35, front contact 31 of relay Y, wire 32, back contact 33 of relay Y/G, wire 34, primary of transformer 10, to CX100, thereby displaying a *y* indication of the wayside signal.

The rail current for block 3 being at the 120 code rate, decoder relay Y/G at the entrance to block 3 is energized, displaying an indication of *y/g* for the wayside signal, and also including the contacts C180 in a circuit for supplying rail current to the block 2, said circuit being traced on Fig. 1 as including wire 36 and front contact of relay Y/G. Accordingly, rail current at the code rate of 180 is supplied to the block 2; and this energizes the decoder relay G for that block displaying the *g* indication for that block. This also supplies current at the 180 code rate through the front contact 37 of this relay G to the block 1 for controlling cab signal or train control equipment on the train X.

From the foregoing it can be seen that this invention provides an organization of coded track circuits in which the coding equipment is normally inactive, but is automatically set into operation by an approaching train by a current transmitted over the same track rails, and without the use of line wires.

Fig. 3 illustrates a modified arrangement in which the approach control relay A is in the form of a three-position polyphase alternating current relay of the usual rotor type which is energized with alternating current of a frequency, such as 60 cycles, distinctive from the frequency of the coded rail current. This 60 cycle current is assumed to be supplied from a transmission line in accordance with the usual practice, connections to which are indicated by the symbols BX60 and CX60. This 60 cycle current energizes the local winding of the relay A, and is connected to the contacts of the pole changing relay PC, so that the relative instantaneous polarity of the current supplied to the track rails at the entering end of a block may be changed and thereby cause the approach control relay A at the exit end of that block to assume corresponding positions, in much the same way as the neutral-polar direct current relay of Fig. 1. The general scheme of operation of this modification of Fig. 3 is the same as already explained.

The particular organization and arrangement of parts shown and described is merely typical or representative; and various adaptations, modifications, and additions may be made in the specific embodiment of the invention illustrated without departing from the invention.

What I claim is:—

1. In a coded track circuit system for railroads, the combination with coding equipment normally inactive while no train is present, of means responsive to the presence of a train and controlled over the track rails without line wires for causing operation of said coding equipment for a predetermined plurality of blocks in advance of such train.

2. In a coded track circuit system for railroads, a coding device associated with each track circuit section for controlling the supply of coded rail current at the exit end of that section, an approach control relay connected across the track rails at the exit end of each section and operable by a current distinctive from the coded rail current, means controlled by each of said control relays for controlling the supply of distinctive current to the track section next in advance, and means governed by each of said relays for controlling the operation of the associated coding device, whereby said coding devices are normally inactive while no train is present, and are automatically set into operation for a predetermined number of track sections ahead of a track section occupied by a train shunting the corresponding approach control relay.

3. A coded track circuit system for railroads comprising, a relay connected across the track rails at the exit end of each track section, means associated with each relay and responsive to the polarity and the steady or intermittent energization thereof for controlling the supply of current to the track rails of the track section next in advance, and thereby controlling the operation of such means associated with that track section, and a coding device associated with each track section and having its operation controlled by said means of that section, said coding devices being normally inactive and being automatically set into operation for a predetermined number of track sections ahead of a section occupied by a train shunting one of said relays.

4. In a system of the character described, the combination with a coding device and decoding means associated with each track section, an approach control means for initiating operation of said coding device and comprising, a relay connected across the track rails at the exit end of the section, and means controlled by each relay for supplying current of a distinctive character to the track rails at the entering end of the section next in advance to energize the relay of that section and thereby cause operation of the coding device, whereby said coding devices are automatically set into operation upon the approach of a train by current over the track rails and without line wires.

5. In a system of the character described, the combination with a normally inactive coding device for each track section, of approach control means for initiating operation of said coding devices and comprising, a relay connected across the track rails at the exit end of each section, and means responsive to the polarity and steady or intermittent energization of each relay for controlling the polarity and mode of energization of the relay for the next track section in advance.

6. In a system of the character described, the combination with a normally inactive coding device for each track section, of approach control means for initiating operation of said coding devices and comprising, a polarized approach control relay connected across the track rails at the exit end of each section, and slow acting relays selectively energized dependent upon the polarity and the steady or intermittent energization of said approach control relay, said slow-acting relays controlling the operation of the corresponding coding devices and also the polarity and mode of operation of the approach control relay for the track section next in advance.

7. In a system of the character described, the combination with a normally inactive coding device for each track section, of approach control

means for initiating operation of said coding devices and comprising, a neutral polar approach control relay connected across the track rails at the exit end of each section, and slow-acting relays selectively energized dependent upon the polarity and the steady or intermittent energization of said approach control relay, said slow-acting relays controlling the operation of the corresponding coding devices and also the polarity and mode of operation of the approach control relay for the track section next in advance.

8. In a system of the character described, the combination with a normally inactive coding device for each track section, of approach control means for initiating operation of said coding devices and comprising, a three position A. C. polar approach control relay connected across the track rails at the exit end of each section, and slow-acting relays selectively energized dependent upon the polarity and the steady or intermittent energization of said approach control relay, said slow-acting relays controlling the operation of the corresponding coding devices and also the polarity and mode of operation of the approach control relay for the track section next in advance.

9. In a coded track circuit system for railroads, in combination, a plurality of track circuit sections, a coding device for each section for supplying coded alternating current to the exit end of its section, a polar neutral approach control relay connected across the exit end of each section and operable by direct current, means governed by each approach relay for controlling the operation of the associated coding device, and means governed by each approach relay for controlling the supply of direct current to the track section next in advance, said means including a plurality of code relays distinctively responsive to the deenergization, and the polarity of energization, of the associated approach relay.

10. In a coded track circuit system for railroads, in combination, a plurality of track circuit sections, a coding device for each section for supplying coded alternating current to the exit end of its section, a polar neutral approach control relay connected across the exit end of each section and operable by direct current, means governed by each approach relay for controlling the operation of the associated coding device, means governed by each approach relay for controlling the supply of direct current to the track section next in advance, said means including a plurality of code relays distinctly responsive to the deenergization, and the polarity of energization, of the associated approach relay, and to whether the approach relay be steadily or intermittently energized, and a coder controlled by each approach relay through its code relays for at times coding the direct current supplied to the section next in advance.

11. In a coded track circuit system, in combination, a plurality of track sections, a polar neutral control relay connected across the rails at the exit end of each section, a normally deenergized coding device and a source of energy for each control relay, and means governed by each control relay for connecting the source of energy to the section next in advance with one polarity or the other, and either coded or not by the coding device.

12. In a coded track circuit system, in combination, a plurality of track sections, a polar neutral control relay connected across the rails at the exit end of each section, a normally deenergized coding device and a source of energy for each control relay, and means governed by each control relay for connecting the source of energy to the section next in advance with one polarity or the other, and either coded or not by the coding device, said means including slow releasing normal, reverse, and deenergized relays, energized accordingly as their control relay is energized normal, or reverse, or is deenergized, and a pole changing relay energized only if the normal relay and either the reverse or the deenergized relay, are deenergized, the coding device being energized when either the reverse or deenergized relay is energized.

13. In a coded track circuit system, in combination, a plurality of track sections, a polar neutral approach control relay connected across the exit end of the rails of each section, a source of energy connected across the rails at the entrance end of each section, and governing means controlled by each approach relay for variously controlling the application of energy from said source to the entrance end of the section next in advance, and including, a pole changer, assuming one position when its approach relay is energized with one polarity of current, and assuming its other position when its approach relay is energized with the other polarity of current or is deenergized.

14. In a coded track circuit system, in combination, a plurality of track sections, a polar neutral approach control relay connected across the exit end of the rails of each section, a source of energy connected across the rails at the entrance end of each section, governing means controlled by each approach relay for variously controlling the application of energy from said source to the entrance end of the section next in advance, and including, a pole changer, assuming one position when its approach relay is energized with one polarity of current, and assuming its other position when its approach relay is energized with the other polarity of current or is deenergized, a normally deenergized coder having a coding contact, means for energizing the coder when the approach relay is energized with current of said other polarity or is intermittently energized or is deenergized, a conductor connected in multiple with the coding contact, and means connecting the coding contact or said conductor in series with the said source of energy dependent upon whether or not the approach relay is energized with said other polarity of current.

15. In coded track circuits, in combination, a plurality of isolated track sections, a polar neutral relay connected across the exit end of each section, a source of energy connected across the entrance end of each section, a code motor having a coding contact in series with the source, and means for placing coded or uncoded current of one or the other polarity, on the track section next in advance, said means including, three slow release relays energized respectively upon normal energization, reverse energization, and deenergization, of the associated polar relay, a pole changing relay energized when the normal slow release relay is deenergized and either of the other slow release relays is deenergized, the code motor being energized when either of the reverse or deenergized slow release relays is energized, a branch circuit in multiple with the coding contact, the branch circuit or the coding

contact being connected to the source according as the reverse slow release relay is deenergized or energized.

16. In a coded track circuit system for railroads, a coding device associated with each track circuit section for controlling the supply of coded rail current to the exit end of that section, an approach control relay connected to a track rail at the exit end of each section so as to release upon occupancy of its section, means controlled by each of said control relays for controlling the supply of current to the control relay for the track section next in advance, and means governed by each of said relays for controlling the operation of the associated coding device, whereby said coding devices are normally inactive while no train is present, and are automatically set into operation for a predetermined number of track sections ahead of a track section occupied by a train.

17. A coded track circuit system for railroads, comprising, a relay connected to a track rail at the exit end of each track section so as to release upon occupancy of its section, means associated with each relay and responsive to the polarity and the steady or intermittent energization thereof for controlling the supply of current for controlling the operation of the means for the track section next in advance, and a coding device associated with each track section and having its operation controlled by said means of that section, said coding devices being normally inactive and being automatically set into operation for a predetermined number of track sections ahead of a section occupied by a train.

18. In a system of the character described, the combination with a coding device and decoding means associated with each track section, an approach control means for initiating operation of said coding device and comprising, a relay connected to a track rail at the exit end of the section and effective to release upon occupancy of its section, and means controlled by each relay for supplying current of a distinctive character to the relay of the section next in advance and thereby cause operation of the coding device, whereby said coding devices are automatically set into operation upon the approach of a train.

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