

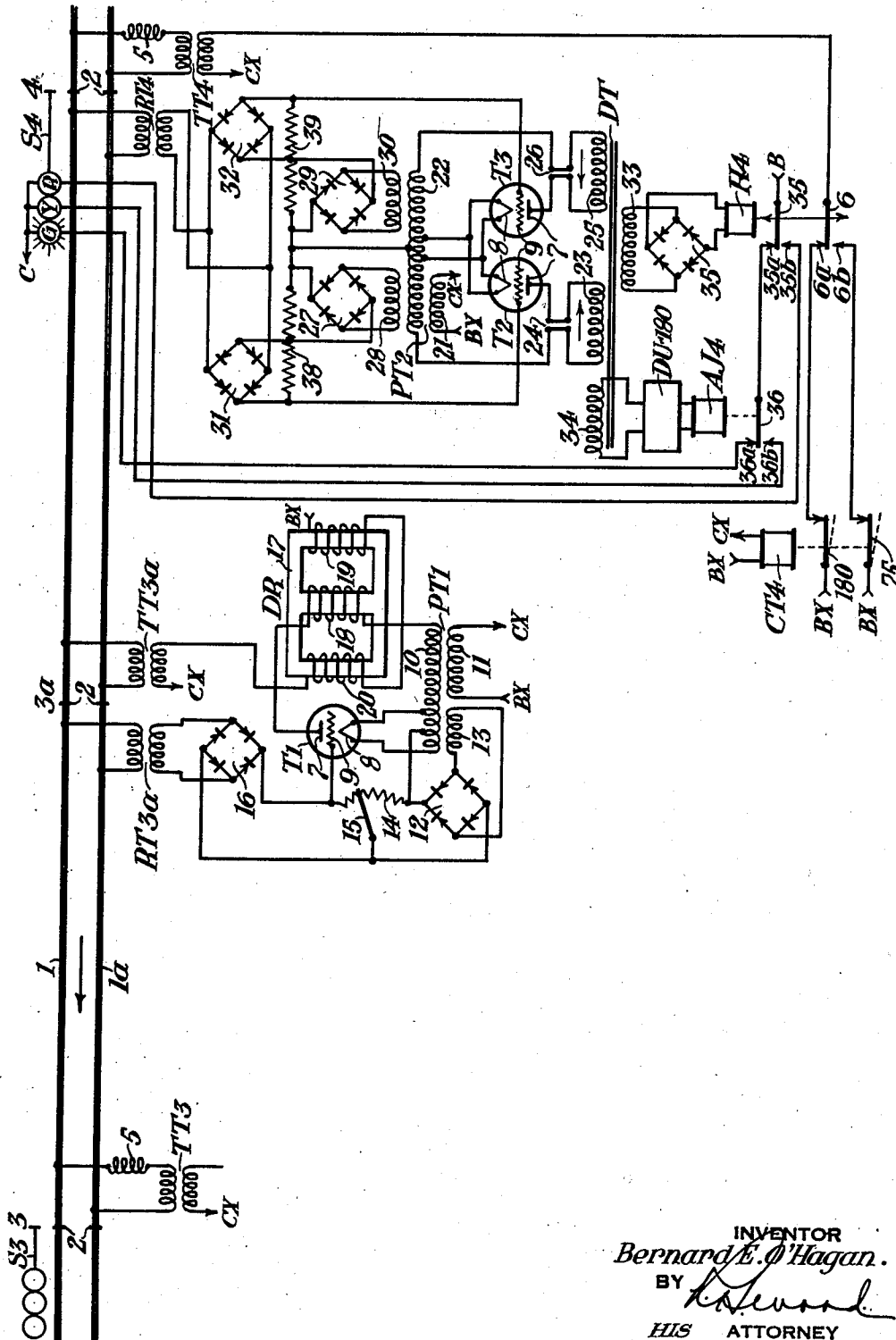
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RAILWAY SIGNALING APPARATUS

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RAILWAY SIGNALING APPARATUS

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My invention relates to railway signaling apparatus, and has particular reference to apparatus of the type employed in railway signaling systems in which coded trackway energy is utilized to control either or both wayside signals and train carried cab signals.

The code responsive apparatus heretofore proposed for use in railway signaling systems of the above described class usually requires that an appreciable amount of energy be supplied to the apparatus from the track rails of the section to effect proper operation of such apparatus. Such systems accordingly require that a relatively large amount of trackway energy be supplied the rails of a section in order to obtain the proper energy level across the track rails necessary to properly operate the associated code responsive apparatus. An object of my present invention is the provision of novel and improved code responsive apparatus which is highly sensitive to relatively small amounts of trackway energy, whereby more efficient operation of the code responsive apparatus is effected by supplying the track rails of a section with relatively small amounts of trackway energy, thereby reducing the power requirement necessary to effect operation of the code responsive apparatus.

Another object is to provide sensitive code responsive apparatus having no moving parts, and which is capable of following much higher code rates than is possible with code following apparatus having moving mechanical members.

A further object is to provide novel and improved code responsive apparatus having no moving parts, which reproduces coded energy without distortion of the characteristics of the control code.

An additional object is the provision of novel and improved cut section facilities to cascade trackway energy from one subsection to the next, and which apparatus is responsive to relatively small amounts of trackway energy.

A further object is to provide novel and improved means for controlling a saturation type relay to cause coded energy to be supplied from the saturation relay without distortion of the reproduced coded energy.

Other objects and advantages of my invention will appear as the description progresses.

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

The accompanying drawing is a diagrammatic view of a preferred form of apparatus embodying my invention.

Referring to the drawing, the reference characters 1 and 1a designate the track rails of a stretch of railway track over which traffic normally moves in the single direction indicated in the drawing by an arrow, and which I shall assume to be the westbound direction. The track rails of the stretch are divided by means of the usual insulated rail joints 2 into a plurality of successive adjoining track sections, of which only one section, 3—4, is shown complete in the drawing. Section 3—4 further is divided into a plurality of adjoining subsections, which are formed by interposing insulated joints 2 in the rails of section 3—4 at so-called "cut section" locations, and as shown, section 3—4 is divided by joints 2 located at cut section location 3a into an advance subsection 3—3a and a rear subsection 3a—4.

Each track section is provided with a signal, designated by the reference character S with a distinguishing suffix, located adjacent the entrance end of the section for governing traffic operating thereover. Signals S may take any one of several suitable forms but in the form herein shown are three-indication signals of the color light type, and each signal comprises a red lamp R, a yellow lamp Y and a green lamp G, which lamps when illuminated indicate "stop," "approach" and "clear," respectively.

Each section is further provided with means, located at the exit end of the section, for supplying to the rails of the associated section coded trackway energy, the code frequency or rate of which is controlled by traffic conditions in advance. These means are herein shown in the usual form and comprise a track transformer, designated by the reference character TT with a distinguishing suffix, the secondary winding of which is constantly connected with the rails of the associated section in series with the usual current limiting impedance 5. The primary winding of transformer TT is connected with the terminals BX and CX of a suitable source of alternating current (such as a generator not shown in the drawing) over one contact 180 or over another contact 75 of a coding device, designated by the reference character CT plus a distinguishing suffix, according as a front contact 6—5a or a back contact 6—5b of a relay, designated by the reference character H with a distinguishing suffix and which is associated with the section next in advance, is closed. Each coding device CT is constantly supplied with current from a suitable source of current, the terminals of which are indicated by the reference characters BX

and CX and each device periodically opens and closes its contact 180 at the rate of 180 times per minute, and also opens and closes its contact 75 at the rate of 75 times per minute. It is readily apparent, therefore, that when the relay H of a section is picked up so that its front contact 6—6a is closed, the rails of the section next in the rear are supplied with alternating trackway energy which is periodically interrupted or coded at the rate of 180 times per minute, but that, when the relay H of a section is released so that its back contact 6—6b is closed, the rails of the section next in the rear then is supplied with alternating trackway energy which is periodically interrupted or coded at the rate of 75 times per minute. The 180 code is used to provide a "clear" indication and the 75 code is used to provide an "approach" indication for the signal of the associated section, in a manner which will be made clear as the description proceeds. Each relay H is controlled by traffic conditions in the associated section in a manner which also will be made clear as the description proceeds. It is to be understood, of course, that while only the apparatus (which comprises coding device CT4 and relay H4) which controls the supply of energy to the primary winding of track transformer TT4 is shown in the drawing, similar apparatus is provided to control the supply of energy to the primary winding of track transformer TT3, this latter apparatus being omitted from the drawing since it would be but a duplication of the apparatus shown associated with track transformer TT4.

Section 3—4 also is provided with cut section facilities for cascading trackway energy from one subsection into the next. The cut section facilities shown in the drawing positioned at the cut section location 3a of section 3—4, includes an electronic tube, designated by the reference character T1, controlled by the trackway energy of the advance subsection for supplying the rails of the rear subsection with trackway energy coded at a rate corresponding to the code rate of the trackway energy of the advance subsection.

The electronic tube T1 as shown comprises two spaced electrodes, an anode or plate 7 and an electrically heated cathode or filament 8, and a control grid 9. Heating current for the cathode is supplied from a portion of secondary winding 10 of a transformer PT1, which transformer has its primary winding 11 connected across the source of alternating current designated by the reference characters BX and CX. The above tube elements are enclosed in a sealed envelope, and preferably this envelope is filled with a medium, such as neon gas, which forms a conducting path between the two tube electrodes when and only when the potential between the electrodes exceeds a value which depends upon the relative potential of the grid with respect to one of these electrodes. As the description proceeds, however, it will be apparent that tube T1 may be of any other type which is adapted to pass current when a suitable potential is applied to its grid, and which is adapted to remain non-conducting at all other times.

The particular type of the tube shown, however, is characterized by the fact that for a given plate potential, the tube is rendered conducting only when its anode is positive with respect to its cathode; and further that once the relative potential of the grid and the cathode is such that the medium has formed its conducting path, the tube remains conducting irrespective of the grid

potential until such time as the plate potential is removed or reversed, and in which latter event the tube becomes non-conducting and remains so until the anode is again positive with respect to the cathode and the proper grid potential is applied to break down the tube medium.

The tube T1 is arranged with its two electrodes forming a part of a circuit which includes secondary winding 10 of transformer PT1, and the potential which transformer PT1 normally impresses across the two electrodes is chosen to be somewhat less than the critical or breakdown value under conditions of a predetermined negative grid potential. Negative grid potential normally is established on the tube by means of a resistor 14 and a rectifier 12, and which rectifier has its input terminals connected across another secondary winding 13 of transformer PT1. The positive output terminal of rectifier 12 is connected to one terminal of grid resistor 14 and also to filament 8 of tube T1, and the negative output terminal of rectifier 12 is connected to grid resistor 14 through the medium of an adjustable contact finger 15, the other terminal of resistor 14 being connected with grid 9 of the tube. The resistance across the output terminals of rectifier 12 is adjusted by means of contact finger 15 to cause rectifier 12 to apply the predetermined negative grid potential to tube T1, with the result that tube T1 normally is non-conducting. If, however, there is applied to the grid in opposition to the negative biasing potential of rectifier 12 as determined by the position of contact 15 on resistor 14, a control potential having the proper magnitude and phase relation, the relative potential of the grid with respect to the cathode is then made such that the critical breakdown potential of the tube under these conditions is less than the potential impressed across the anode and cathode of the tube by secondary winding 10 of transformer PT1, and as a result the medium of the tube breaks down to render the tube conducting. By virtue of the fact that secondary winding 10 of transformer PT1 supplies the plate circuit of the tube T1 with alternating current, the relative polarity of the anode and cathode of the tube is reversed twice during each cycle, and as a result rectified current having half wave form is permitted to flow in the plate circuit each time that the anode is positive with respect to the cathode, provided that the grid voltage is such as to make the tube conducting. The alternation of potential of the plate circuit, therefore, renders the tube self-restoring when the grid control potential is removed, since the interruption and reversal of the plate potential will restore the tube to its non-conducting condition upon the negative biasing grid potential again becoming effective.

The above-mentioned control grid potential is applied to the tube T1 from a rectifier 16 receiving energy from the track rails of advance subsection 3—3a through the medium of a receiving transformer RT3a, which transformer has its primary winding connected across the track rails of subsection 3—3a and has its secondary winding connected to the input terminals of rectifier 16. The positive output terminal of rectifier 16 is connected to grid 9 of tube T1, and the negative output terminal of the rectifier is connected to cathode 8 of tube T1 over a circuit which includes contact finger 15 and a portion of grid resistor 14. It is apparent, therefore, that rectifier 16 applies across the grid and cathode of tube T1 a positive grid potential which opposes

the negative biasing grid potential of rectifier 12. The electromotive forces of rectifiers 12 and 16 are so proportioned and designed that whenever both rectifiers are supplying energy to the grid circuit of tube T1, the resultant electromotive force is sufficient to cause the tube medium to break down and become conducting in response to the plate circuit potential established by winding 10 of transformer PT1.

Trackway energy is supplied to the rails of subsection 3a—4 through the medium of a track transformer TT3a, which has its secondary winding constantly connected across the rails of subsection 3a—4 and has the supply of energy to its primary winding controlled by tube T1. The primary winding of transformer TT3a may be connected directly across the electrodes of tube T1 in series with secondary winding 10 of transformer PT1, and under these conditions, the rectified current of half wave form passed by tube T1 during its conducting period will be supplied to transformer TT3a and as a result the track rails of the rear subsection will be supplied with trackway energy having alternating current characteristics and also a code rate corresponding to the code rate of the trackway energy supplied to the rails of the advance subsection. However, it is preferred that tube T1 control means for supplying the transformer TT3a with alternating current. In the particular embodiment of my invention shown in the drawing, the particular means chosen to supply transformer TT3a with alternating current is a saturation relay, designated by the reference character DR.

Saturation relay DR may be of any suitable type, but as here shown is of the type shown in United States Letters Patent No. 1,936,705 granted to H. D. Abernethy on November 28, 1933. This relay comprises a three-legged magnetizable core 17 having a control winding 18 mounted on the middle leg of the core and connected in series with secondary winding 10 of transformer PT1 over a circuit which includes the anode 7 and cathode 8 of tube T1. The relay further comprises two main or impedance windings 19 and 20 connected in series and disposed one on each of the two outer legs of the core, the windings 19 and 20 being connected in series and so arranged that when supplied with alternating current, the windings send flux in opposite directions through the middle leg of the core so that no current will be induced in control winding 18. The main windings of the relay DR are connected across the source of alternating current in series with the primary winding of transformer TT3a. If now, control winding 18 of relay DR is deenergized, as, for example, during the non-conducting period of the tube T1, the main windings 19 and 20 of the relay represent a high impedance in series with the primary winding of transformer TT3a so that this transformer receives practically no energy. When, however, control winding 18 is supplied with energy during the conducting period of the tube T1, the rectified current flowing in winding 18 supplies a unidirectional flux to the relay core which varies the permeability of the core to the alternating flux created by windings 19 and 20, and as a result the impedance of windings 19 and 20 is decreased and alternating current is permitted to flow in the primary winding of transformer TT3a. Transformer TT3a, therefore, will be energized during the interval and for the period tube T1 is con-

ducting, and as a result the track rails of subsection 3a—4 will be supplied with impulses of alternating trackway energy coded at a rate corresponding to the rate at which the trackway energy of subsection 3—3a is coded. The trackway energy of subsection 3—3a is therefore cascaded around cut section location 3a of section 3—4 from the advance subsection into the rear subsection.

An advantage of the cut section facilitates embodying my invention and described above is that such apparatus is highly sensitive; requires but a relatively small amount of trackway current for operation; and prevents distortion of the trackway energy supplied to the rear subsection in that the opening of the circuit for the control winding of the saturation relay due to the restoration of the tube to its non-conducting condition during the "off" period of the code, causes a very rapid decay of the saturating flux in the relay core whereby a sharp cut off is effected in the energy supplied to the track transformer TT3a and to the rear subsection.

Each section also is provided with code following and decoding apparatus positioned adjacent the entrance end of the section to control the associated wayside signal and the supply of trackway energy to the section next in the rear. The code following and decoding apparatus shown in the drawing located at signal location 4 comprises two tubes T2 and T3 (which preferably are similar to tube T1 hereinbefore described) controlled by energy derived from subsection 3a—4 and supplying energy to a decoding transformer DT from a source of alternating current here shown as a transformer PT2. Transformer PT2 has its primary winding 21 connected to the terminals BX and CX of the source of alternating current, and a portion of its secondary winding 22 constantly supplies heating energy to the cathodes 8 of tubes T2 and T3. The left-hand portion (as viewed in the drawing) of secondary winding 22 of transformer PT2 is connected across the electrodes 7 and 8 of tube T2 over a plate circuit which includes primary winding 23 of decoding transformer DT. A four-lead condenser 24 also is connected across the primary winding 23 of transformer DT for a purpose later to be explained, and has its plates connected in series in the plate circuit of tube T2 on opposite sides of winding 23. The right-hand portion of secondary winding 22 of transformer PT2 is connected across the two electrodes 7 and 8 of tube T3 over a plate circuit which includes another primary winding 25 of decoding transformer DT, and this primary winding 25 also has a condenser 26 connected across its terminals with the plates of such condenser connected in series in the plate circuit of tube T3.

Tube T2 normally is caused to be non-conducting by virtue of a negative grid biasing potential which is applied over an obvious circuit across the grid and filament of tube T2 by a resistor 38 and a biasing rectifier 27, which rectifier receives energy from a secondary winding 28 of transformer PT2. Tube T3 normally is caused to be conducting by virtue of a positive grid biasing potential which is applied over an obvious circuit across the grid and filament of tube T3 by a resistor 39 and a biasing rectifier 29, which rectifier constantly receives energy from a secondary winding 30 of transformer PT2. It is apparent, therefore, that with tube T2 normally non-conducting, primary winding 23 of decoding transformer DT

is normally deenergized. Primary winding 25 of decoding transformer DT, however, normally is energized by the rectified half wave current passed by tube T2 (which is normally conducting), which current sets up in primary winding 25 a unidirectional flux having a polarity indicated by an arrow in the drawing.

A receiving transformer RT4 also is provided for section 3-4 adjacent its entrance end 4, and which transformer has its primary winding constantly connected across the rails of subsection 3a-4. The secondary winding of transformer RT4 is connected across the input terminals of two rectifiers 31 and 32 for supplying energy to such rectifiers from the rails of subsection 3a-4. Rectifier 31 is connected across the grid 9 and filament 8 of tube T2 over an obvious circuit including resistor 33 in such manner as to apply a control potential, opposing the biasing potential of rectifier 27, whereby when rectifier 31 is receiving energy from the rails of subsection 3a-4, tube T2 is caused to become conducting. Tube T2 under the above condition, therefore, supplies rectified half wave current to primary winding 23 of decoding transformer DT, which current sets up in the winding a unidirectional flux having a polarity indicated in the drawing by an arrow. Rectifier 32 is connected across the grid 9 and cathode 8 of tube T3 over an obvious circuit including resistor 39 in such manner as to apply a control potential which opposes the biasing potential of rectifier 29, whereby when rectifier 32 is receiving energy from the rails of subsection 3a-4, tube T3 then is caused to become non-conducting. Under the above condition, therefore, primary winding 25 of transformer DT will be deenergized. It can be seen from the foregoing that primary winding 25 of decoding transformer DT is supplied with unidirectional flux of one polarity when tube T3 is caused to be conducting during the interval energy is not present in the track rails of subsection 3a-4 (as for example during "off" periods of the coded trackway energy supplied to sections 3-4), and that primary winding 23 of decoding transformer DT is supplied with unidirectional flux of the other polarity when tube T2 is caused to be conducting during the interval that energy is present in the track rails of subsection 3a-4 (as for example during the "on" period of the coded trackway energy). It follows, therefore, that whenever coded trackway energy is received by the receiving transformer from the rails of subsection 3a-4, the primary windings 23 and 25 of transformer DT are alternately supplied with impulses of rectified current, and that such impulses will have a code rate which depends upon the code rate of the trackway energy present in the rails of section 3-4. The impulses of rectified current which are supplied to the primary windings 23 and 25 by tubes T2 and T3 set up opposing fluxes in the core of the transformer whereby the transformer action of alternating current of relatively low frequency equal to the code rate is simulated.

The condensers 24 and 26 are connected across primary windings 23 and 25, as the case may be, of transformer DT to smooth out and prevent any transformer action of the pulsating or half wave current which comprises the code impulses of current supplied to the primary windings of the transformer. The condensers 24 and 26, therefore, prevent transformer action in the event that either tube T2 or tube T3 is controlled continuously to its conducting condition, and permit transformer action only in the event that code impulses of current are supplied to the primary

windings of transformer DT by tubes T2 and T3 in response to the coded trackway energy received from subsection 3a-4.

Decoding transformer DT is provided with two secondary windings 33 and 34, one for each of two signal control relays H4 and AJ4. Relay H4 is controlled by energy supplied from secondary winding 33 of transformer DT through the medium of a full wave rectifier 35, which converts the alternating current induced in winding 33 of transformer DT in response to the impulses of rectified current supplied to the primary windings of transformer DT, into unidirectional current which is supplied to relay H4. This relay is a slow-acting direct current relay proportioned to have slow pick-up characteristics and caused to be slow releasing by virtue of the short-circuiting action of rectifier 35 connected across its terminals, and is effectively energized and picked up whenever 75 or 180 code is applied to decoding transformer DT. Relay H4, therefore, functions as a code detecting relay since it is picked up on either of the two code frequencies, but is not picked up whenever half wave current is continuously supplied to one primary winding of transformer DT by one tube only, due to the previously described action of condensers 24 and 26 in dampening the transformer action of this rectified or half wave current.

Relay AJ4 is controlled by energy supplied from secondary winding 34 of transformer DT, through the medium of a decoding unit DU-180. The details of construction of this unit are not shown in the drawing, but this unit usually comprises a rectifier and a reactor condenser tuning unit tuned to resonance at a frequency corresponding to the 180 code, whereby relay AJ4 is effectively energized and is picked up when and only when impulses of 180 code are supplied to transformer DT. Relay AJ4, therefore, functions as a code selecting relay since it is picked up on 180 code but is released on 75 code.

The code selecting relay AJ4 and the code detecting relay H4 cooperates to selectively control the various aspects displayed by signal S4, in the following manner: When relays H4 and AJ4 are both picked up, signal S4 is caused to display its "clear" indication over a circuit which may be traced from terminal B through front contact 35-35a of relay H4, front contact 36-36a of relay AJ4, and the filament of lamp G of signal S4 to terminal C. When the code detecting relay H4 is picked up and the code selecting relay AJ4 is released, signal S4 then is caused to display its "approach" indication over a circuit passing from terminal B through front contact 35-35a of relay H4, back contact 36-36b of relay AJ4 and the filament of lamp Y of signal S4 to terminal C. When, however, both relays H4 and AJ4 are released, signal S4 then is caused to display its "stop" indication over a circuit passing from terminal B through back contact 35-35b of relay H4 and the filament of lamp R of signal S4 to terminal C.

The above selective control of signal S4 is effected by relays H4 and AJ4 in the following manner: Section 3-4 will be supplied with 180 code or 75 code according as the section next in advance is unoccupied or occupied. When section 3-4 is supplied with 180 code and the section is unoccupied, all parts of the apparatus will occupy the position in which they are shown in Fig. 1. Under the above condition, relays H4 and AJ4 are both picked up, the circuit for lamp G of signal S4 is completed whereby that signal is

caused to display its "clear" indication, and the circuit including front contact 6—6a of relay H4 and contact 180 of coding device CT4 is closed so that the section next in the rear of section 3—4 is supplied with the 180 code also.

When section 3—4 is supplied with 75 code and the section is unoccupied, relay H4 is picked up but relay AJ4 is released, thus causing signal S4 to display its "approach" indication since the circuit previously traced for lamp Y of signal S4 is now completed. The rails of the section next in the rear of the section 3—4, however, are still supplied with 180 code since front contact 6—6a of relay H4 is closed.

Whenever section 3—4 is occupied by a train, the coded trackway energy supplied to section 3—4 then is shunted away from the code following apparatus of that section. For example, whenever a train occupies rear subsection 3a—4, the wheels and axles of the train then shunt the trackway energy away from receiving transformer RT4 so that tube T2 is controlled constantly to its non-conducting condition and tube T3 is controlled constantly to its conducting condition. Under the above condition, winding 25 of decoding relay DT is constantly supplied with rectified current of half wave for, but as was pointed out heretofore, no transformer action is effected by this current so that both relays AJ4 and H4 are released and signal S4 is controlled to its "stop" indication over back contact 35—35b of relay H4. In like manner, when subsection 3—3a is occupied by the train, the trackway energy is shunted away from receiving transformer RT3a and as a result tube T1 of the cut section apparatus is constantly controlled to its non-conducting condition. With tube T1 in its non-conducting condition, saturation relay DR is controlled to limit the energy supplied to track transformer TT3a and to the rails of subsection 3a—4 to a relatively low value insufficient to effect the control of tubes T2 and T3 of the code following apparatus, and tube T3 is controlled by virtue of biasing rectifier 29 to its conducting condition to constantly energize winding 25 of decoding transformer DT with rectified half wave current. Since no transformer action is effected by this half wave current (due to the action of condenser 25), relays AJ4 and H4 are both released, and signal S4 is controlled to its "stop" indication. It is readily apparent from the foregoing, therefore, that the coded trackway energy is shunted away from the code following apparatus of the section whenever a train occupies either or both of the subsections comprising that section, and that the two subsections when taken together cooperate to provide a single track section which is responsive to traffic conditions in the section in the same manner as if the rails of the section were continuous conductors from one end of the section to the other.

An advantage of the code responsive apparatus hereinbefore described and embodying my invention is that such apparatus provides improved operation and efficiency of the decoding apparatus controlling the traffic controlling signals, and requires no rapidly moving or code following contacts for the code following apparatus. The code responsive apparatus accordingly is capable of following much higher code rates than is possible with code responsive apparatus having moving mechanical members, since there is no inertia of the mechanical members to be contended with. Improved operation and efficiency of the decoding apparatus is effected by virtue of

the sharp cut off in energy passed by the electronic tubes employed, whereby impulses are supplied to the decoding transformer having the same code characteristics as possessed by the coded trackway energy supplied to the track rails of the associated section. Furthermore, the control of the electronic tubes employed is established by virtue of the potentials applied to the control grids of the tubes, thereby requiring relatively small amounts of trackway energy for controlling the code responsive apparatus.

An additional advantage is obtained by employing an electronic tube in connection with the cut section facilities which cascades trackway energy from the advance subsection to the adjoining rear subsection, in that the trackway energy supplied to the rear subsection has substantially the same code characteristics as possessed by the trackway energy of the advance subsection, since a sharp cut off is effected in the high magnitude energy supplied through the saturation relay to the rear subsection due to the fact that the saturating flux of the saturation relay decays very rapidly upon interruption of the flow of energy through tube T1.

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, means for supplying coded trackway energy to the rails of said section, two tubes each comprising two spaced electrodes and a grid in a medium which forms a conducting path between said electrodes when and only when the potential between the electrodes exceeds a value which depends upon the relative potential of the grid with respect to one of said electrodes, an output circuit for each of said two tubes including the two spaced electrodes of the associated tube, means for impressing across the grid and said one electrode of one of said two tubes a biasing electromotive force which normally renders that tube conducting, means for impressing across the grid and said one electrode of the other of said two tubes a biasing electromotive force which normally renders that tube non-conducting, means receiving energy from the track rails for impressing across the grid and said one electrode of each of said two tubes an electromotive force which opposes the biasing electromotive force normally impressed thereon to render said one tube non-conducting and said other tube conducting for the interval in which energy is received from the track rails, and railway traffic controlling apparatus controlled by the output circuits of said two tubes.

2. In combination, a section of railway track, means for supplying coded trackway energy to the rails of said section, two tubes each comprising two spaced electrodes and a grid in a medium which forms a conducting path between said electrodes when and only when the potential between the electrodes exceeds a value which depends upon the relative potential of the grid with respect to one of said electrodes, a decoding transformer, a source of alternating current, a circuit including said two electrodes of one of said two tubes connected in series with said source for supplying from said source rectified current

of a given polarity to said decoding transformer, a circuit including said two electrodes of the other of said two tubes connected in series with said source for supplying from said source rectified current of the other polarity to said decoding transformer, circuit means for impressing across the grid and said one electrode of each of said two tubes a biasing electromotive force effective to render said one tube normally conducting and said other tube normally non-conducting, means receiving energy from the track rails for impressing across the grid and said one electrode of each of said two tubes an electromotive force which opposes said biasing electromotive force to render said one tube non-conducting and said other tube conducting for the interval that energy is received from the track rails, and traffic controlling apparatus controlled by energy supplied from said decoding transformer.

3. In combination with adjoining advance and rear subsections of railway track, means for supplying coded trackway energy to the track rails of said advance subsection, an electron tube comprising two spaced electrodes and a control grid in a medium which forms a conducting path between said electrodes when and only when the potential between the electrodes exceeds a value which depends upon the relative potential of the control grid with respect to one of said electrodes, means for impressing across the control grid and said one electrode of said tube a biasing electromotive force which normally renders said tube non-conducting, means receiving energy from the track rails of said advance subsection for impressing across the control grid and said one electrode of said tube an electromotive force opposing said biasing electromotive force whereby said tube is rendered conducting for the interval in which energy is received from the track rails of said advance subsection, a source of energy, a saturation relay having a magnetizable core provided with impedance windings connected in series with said source of energy and also provided with a control winding effective when energized to supply a saturating flux to said core whereby to vary the impedance of said impedance windings, means including a source of current connected across the two electrodes of said tube for energizing said control winding of said relay only when said tube is in its conducting condition, whereby there will be effected a sharp decay in the saturating flux supplied to the relay core, and means for connecting the im-

pedance windings of said relay across the track rails of said rear subsection whereby the track rails of said rear subsection are supplied with energy from said source of energy as controlled by the supply of energy to the control winding of said relay.

4. In combination with a section of railway track divided into an advance and a rear subsection and having means for supplying coded trackway energy to the rails of said advance subsection, an output winding mounted on a magnetizable core, a source of periodically varying current, means including said output winding for connecting said source to the rails of said rear subsection, a control winding also mounted on said core and effective when supplied with current to control the transfer of energy from said source to said rear subsection through said output winding in accordance with the magnetic flux created in such core due to current in said control winding, an electronic tube controlled by coded trackway energy received from the rails of said advance subsection, and means controlled by said electronic tube for supplying current to said control winding whereby the coded trackway energy of said advance subsection causes undistorted code to be supplied to the rails of said rear subsection due to the sharp cut-off in current passed by said tube.

5. In combination with a section of railway track divided into an advance and a rear subsection and having means for supplying coded trackway energy to the rails of said advance subsection, a saturable reactor having a main winding disposed on a magnetizable core, a source of alternating current, means for connecting said source to the rails of said rear subsection through said main reactor winding, a control winding for said reactor disposed on said core and effective to vary the impedance of said main reactor winding by varying the magnetic flux set up in said core due to current in said control winding, an electronic tube controlled by coded trackway energy received from the rails of said advance subsection, and means controlled by said electronic tube for supplying current to said control winding whereby the coded trackway energy of said advance subsection causes undistorted code to be supplied to the rails of said rear subsection due to the sharp cut-off in current passed by said tube.

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