

March 17, 1942.

H. A. WALLACE

2,276,634

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Feb. 7, 1941

2 Sheets-Sheet 1

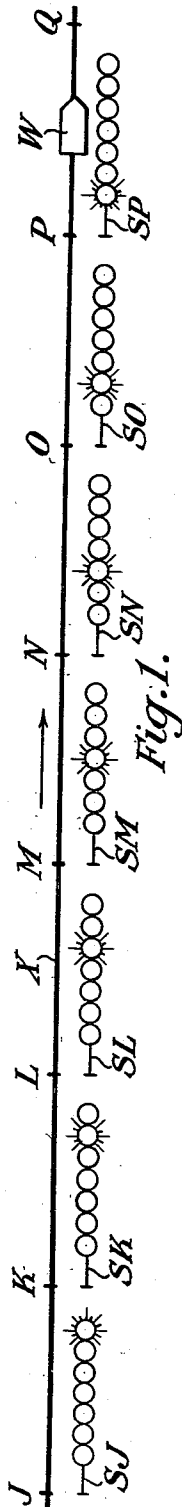


Fig. 1.

TABLE OF OPERATION

a	b	c	d	e	f	g	h	i	j	k
SIGNAL	Signal Unit Displayed	Indication Blocks Clear	Trackway Current Received Freq. ~ Code	Trackway Current Transmitted Freq. ~ Code	TH1	TR2	HI	H2	BJ	AJ
SP	L7	None	None	200 ~ 75	—	—	—	—	—	—
SO	L6	One	200 ~ 75	200 ~ 120	—	—	—	—	—	—
SN	L5	Two	200 ~ 120	200 ~ 180	—	—	—	—	—	—
SM	L4	Three	200 ~ 180	100 ~ 75	—	—	—	—	—	—
SL	L3	Four	100 ~ 75	100 ~ 120	—	—	—	—	—	—
SK	L2	Five	100 ~ 120	100 ~ 180	—	—	—	—	—	—
SJ	L1	Six	100 ~ 180	100 ~ 180	—	—	—	—	—	—

Fig. 3.

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March 17, 1942.

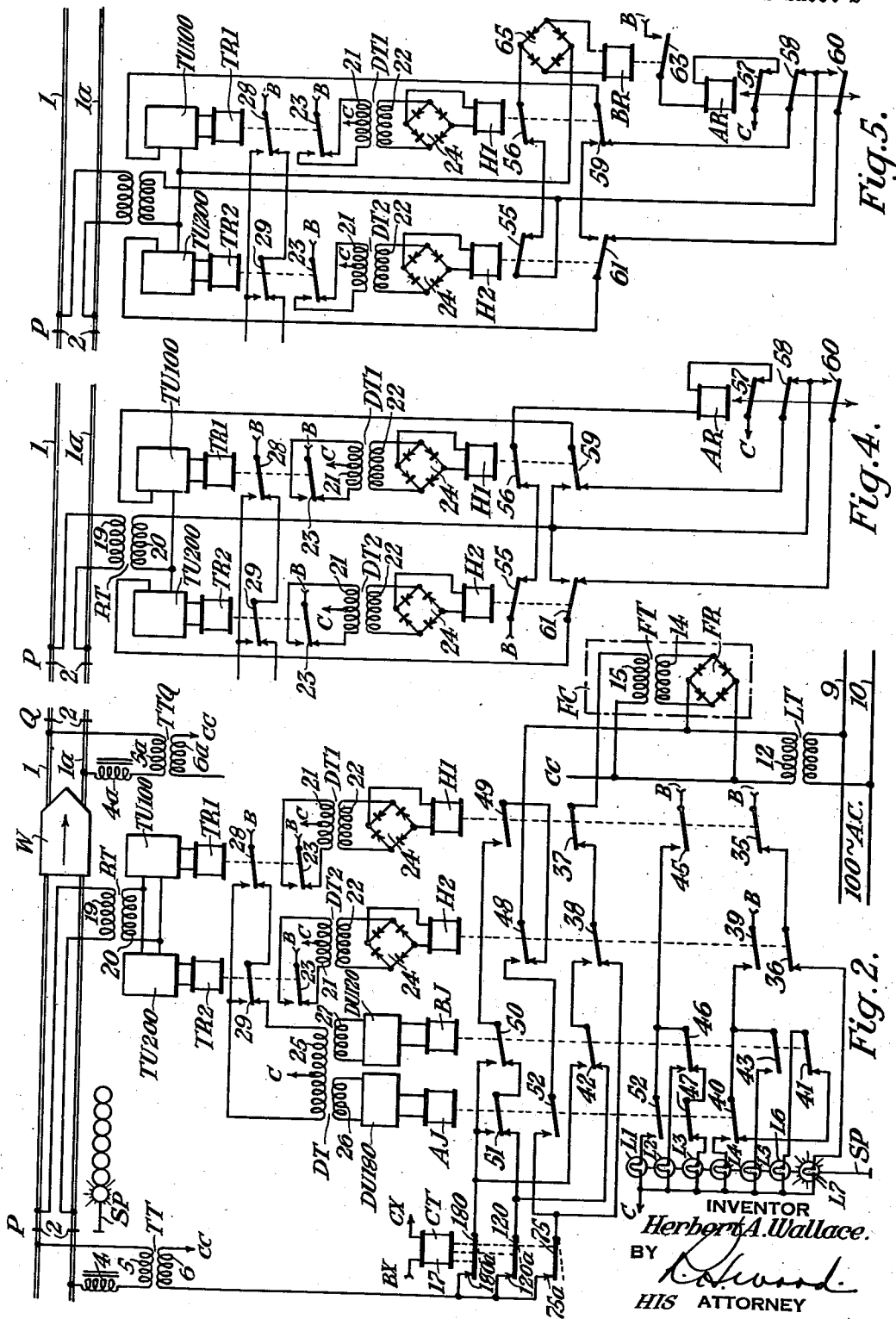
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2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

2,276,634

RAILWAY TRAFFIC CONTROLLING
APPARATUS

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Application February 7, 1941, Serial No. 377,815

12 Claims. (Cl. 246—34)

My invention relates to railway traffic controlling apparatus, and it has particular reference to the organization of such apparatus into railway signal systems of the class wherein coded track circuit current is utilized to control either or both wayside signals and train-carried apparatus such as cab signals or automatic train control devices.

An object of my present invention is to provide novel and improved signal systems of the class described.

Another object is to provide novel and improved railway signal systems of the class wherein traffic controlling devices such as wayside or cab signals are controlled by coded alternating trackway current of one or another of a plurality of distinctive frequencies.

Another object is to provide novel and improved decoding apparatus of the type adapted to be utilized in railway signal systems of the class wherein traffic governing devices are selectively controlled by coded alternating trackway current of one or another of a plurality of distinctive frequencies.

Another object is to provide novel and improved decoding apparatus of the type adapted to be employed in railway signal systems of the class disclosed in United States Letters Patent No. 2,194,371 granted to me on March 19, 1940, for Railway traffic controlling apparatus.

Another object is the provision in railway signal systems utilizing coded trackway current of one or another of a plurality of frequencies and having relays selectively responsive one to each of such frequencies, of novel and improved means for individually conditioning such relays to respond to the applied trackway current.

Another object is to incorporate into railway signal systems of the above described class, means for sequentially conditioning the frequency responsive relays one at a time to respond to the applied trackway current, and to maintain conditioned the relay responsive to the frequency of the applied trackway current.

The above-mentioned and other important objects and characteristic features of my invention which will become readily apparent from the following description, are attained in accordance with my invention by incorporating into railway signal systems of the class disclosed in my aforesaid Letters Patent No. 2,194,371, novel and improved decoding apparatus arranged to respond both to the code rate and to the frequency of the applied alternating trackway current. Such decoding apparatus may be incorporated into train-

carried systems for controlling either or both train-carried cab signals and train-controlled devices, or may be incorporated into wayside systems for controlling wayside signals as well as the code rate and the frequency of the alternating trackway current applied to the track rails. In addition, such decoding apparatus may include means for selectively and sequentially conditioning each of the frequency responsive relays one at a time to be energized by trackway current, and the decoding apparatus incorporates means effective upon energization of one of the frequency responsive relays for maintaining such relay conditioned to be energized by trackway current.

Other novel features and advantages of my invention reside in the provision and organization of railway traffic controlling apparatus into railway signal systems, and after describing in detail three preferred forms of apparatus embodying my invention, I shall point out the novel features thereof in claims.

In the accompanying drawings, Fig. 1 is a line diagram illustrating a stretch of railway track and the manner in which wayside signals associated with such stretch may be controlled by apparatus embodying my invention.

Fig. 2 is a diagrammatic view illustrating one form of apparatus embodying my invention represented provided for a typical one of the sections shown in Fig. 1.

Fig. 3 is a chart showing the conditions assumed by each decoding relay of the group shown in Fig. 2 under the several code rate and frequency conditions of the applied trackway current; the aspects and indications displayed by the signals represented in Fig. 1 for each condition of code rate and current frequency; and also the manner in which a six-block, seven indication signal system embodying my invention is provided by distributing the code rates and current frequencies in the rails of a number of sections to the rear of an occupied section.

Figs. 4 and 5 are diagrammatic views illustrating modified forms, each embodying my invention, of a portion of the apparatus represented in Fig. 2.

Similar reference characters have been employed to designate corresponding parts in each of the several views.

Referring first to Fig. 1, the reference character X designates a stretch of railway track over which traffic normally moves in the direction indicated by an arrow, or from left to right as viewed in the drawings. The stretch of track X

is divided by means of the usual insulated rail joints, into a plurality of successive adjoining track sections of which seven sections in all are illustrated. Each of the sections represented in Fig. 1 is provided adjacent its entrance end with a multiple indication railway traffic controlling signal, designated by the reference character S plus a suffix corresponding to its location. These signals are illustrated in Fig. 1 displaying the various distinguishing indications to which they are respectively controlled in response to the presence of a train W in the extreme right-hand section P—Q of the stretch, by apparatus embodying my invention and presently to be described in detail.

The track sections of stretch X are each provided with trackway apparatus of the type required for a combined wayside and cab signal system of the frequency code type, but I shall describe in detail only the trackway apparatus provided for a typical one of such sections since it is assumed that each of the sections is provided with apparatus substantially similar to that shown in Fig. 2 provided for the typical section P—Q. For convenience also, the same reference characters will be used throughout the description of the apparatus to designate those parts of the apparatus associated with other sections that correspond to the parts shown in Fig. 2 associated with section P—Q.

Referring now to Fig. 2, the rails 1 and 1a of the stretch as shown are divided by means of the usual insulated rail joints 2 to form a track section P—Q and this section is provided with a track circuit, the rails of which are supplied with trackway energy through the medium of a track transformer TTQ which has a secondary winding 5a connected across such rails adjacent the exit end Q of the section. The primary winding 6a of transformer TTQ is connected with trackway code transmitting means (not shown) located at location Q, whereby as will be pointed out presently in detail, the rails of the section are supplied with alternating trackway current having one or another of a plurality of frequencies and which is coded at one or another of a plurality of code rates. For the purposes of this description, I shall assume that the track rails of the section are supplied with alternating track circuit current of either one or another of two distinctive frequencies, and shall select 100 and 200 cycles per second as such two distinctive frequencies. I shall also assume that the track circuit current is coded at any one of the code rates customarily employed in coded railway signal systems, that is, at the code rate of 75, 120 or 180 times per minute. As will be made clear presently, the trackway code transmitting means located at signal location Q for supplying energy to primary winding 6a of transformer TTQ is controlled by traffic conditions in advance of section P—Q, and since this apparatus is substantially similar to the trackway code transmitting apparatus located at signal location P for supplying trackway energy to the rails of the section located next in the rear of the section illustrated in Fig. 2, only the transmitting apparatus located at signal location P is shown in the drawings.

The trackway code transmitting apparatus located adjacent signal location P (and in like manner the similar apparatus located at signal location Q) comprises a plurality of suitable sources of alternating current each having a distinctive frequency; a coding device or trans-

mitter CT having a plurality of continuously operating contact members; and a plurality of circuits controlled by decoding apparatus associated with section P—Q and later to be described in detail, and by means of which circuits energy from the sources is supplied to the track rails of the section located in the rear of section P—Q.

The sources of alternating current provided adjacent signal location P may comprise a plurality of line wire circuits one for each distinctive frequency of current employed and each supplied with alternating current of the associated frequency; may comprise a suitable source or sources of unidirectional current provided with means, such as vibrators, for converting such unidirectional current into alternating current having one or another of a plurality of distinctive frequencies; or as shown may comprise a single line wire circuit comprising line wires 9 and 10 supplied with current having one of the distinctive frequencies employed, and a frequency changer FC converting such current into current of another frequency employed. The line wires 9 and 10 are preferably connected to a suitable source of alternating current of the lowest frequency employed, such as a generator, not shown, generating 100 cycle alternating current, and as shown the frequency changer FC comprises a rectifier FR having its input terminals connected through a line transformer LT across the line wires 9 and 10, and supplying current from its output terminals to a primary winding 14 of a transformer FT. As is readily apparent, rectifier FR when energized by 100 cycle current supplies to winding 14 of transformer FT two pulses of unidirectional current in each cycle of alternating current, hence there is induced in secondary winding 15 of transformer FT by these double frequency pulses of unidirectional current in winding 14, an alternating electromotive force having a frequency which is double the frequency of the 100 cycle current supplied to rectifier FR. Secondary winding 15 of transformer FT thus may be regarded as a source of alternating current having a frequency of 200 cycles per second, or a frequency distinctively different from the frequency of the 100 cycle current in line wires 9 and 10.

The code transmitter CT is represented diagrammatically in the drawings since it may take any one of several well-known forms. As here shown, coder CT comprises a constantly energized winding 17 and a plurality of contact members 75, 120 and 180 each operated by the coder at different code rates. Contact 75 is operated by coder CT to close and open alternately a contact 75—75a at a rate of 75 times a minute, contact 120 is operated to close and open alternately a contact 120—120a at a rate of 120 times a minute, while contact member 180 is operated alternately to close and open a contact 180—180a at a rate of 180 times a minute. It follows, therefore, that when contact 75, 120 or 180 is interposed in a circuit supplied with current, such current is periodically interrupted or coded at a rate of 75, 120 or 180 times per minute, respectively.

The track circuit of section P—Q further includes receiving means for receiving trackway current from the rails of the section; a plurality of tuning or filtering units one for each of the different frequencies of alternating trackway current supplied to the rails of the section; and a plurality of code responsive relays one

for each filter unit. The receiving means as shown comprises a transformer RT having a primary winding 19 connected across the track rails adjacent signal location P and having a secondary winding 20 by means of which energy is inductively received from section P—Q. The filter or tuning units, represented conventionally in the drawings, are designated by the reference characters TU with suitably distinguishing suffixes corresponding to the frequency of current passed by such units. Such units may comprise a reactor condenser tuning unit tuned to resonance at the frequency corresponding to the frequency such filter is designed to transmit, and if it is desired to energize direct current relays from such units, they may include also a rectifier for rectifying the received alternating current into unidirectional current. Two code responsive track relays, designated by the reference character TR with suitably distinguishing suffixes, are provided one for each of the two assumed frequencies of alternating current employed. Each code responsive relay is represented as a direct current relay and is connected to receive unidirectional current from its associated filter unit when and only when the rails of section P—Q are supplied with current of the frequency passed by the associated filter.

The decoding means previously referred to as being provided at signal location P (see Fig. 2) comprises two decoding relays AJ and BJ, two decoding units DU180 and DU120 associated with relays AJ and BJ, respectively, a decoding transformer DT, other decoding relays, designated by the reference character H with suitably distinguishing suffixes, one for each code responsive relay TR, and other decoding transformers, designated by the reference character DT with suitably distinguishing suffixes, one for each of the code responsive relays TR.

Decoding transformers DT1 and DT2 are similar and each comprises a primary winding 21 connected through a mid terminal tap to one terminal C of a suitable source of unidirectional current, such as a battery not shown, and having one or the other end of the winding connected to the other terminal B of the source according as a movable contact member 23 of the associated code responsive relay TR is in its picked-up or released position to close respectively its front or back contact. Each transformer DT1 and DT2 further comprises a secondary winding 22 connected through a rectifier 24 to the associated H relay, whereby to energize the associated H relay by unidirectional current supplied from rectifier 24 in response to the supply thereof of alternating current caused to be induced in winding 22 when contact member 23 of the associated code responsive relay TR is periodically picked up and released to alternately energize the two portions of winding 21 at a rate corresponding to the code rate of operation of the associated code responsive relay TR by current received from the rails of section P—Q. The relays H are proportioned so as to be effectively energized and picked up in response to operation of the associated code responsive relay TR at the 75, 120 or 180 code rate. Relays H therefore function as code detecting relays to detect a code operation of the associated code responsive relay TR.

Decoding transformer DT comprises a center tapped primary winding 25 and two secondary windings 26 and 27 connected to relays AJ and BJ through decoding units DU180 and DU120, re-

spectively. Winding 25 is constantly connected through a mid terminal tap to terminal C of the source of unidirectional current and whenever either relay TR1 or TR2 responds to coded current received from the rails of the associated section, the two portions of this winding are alternately energized. When relay TR1 responds to code and relay TR2 is released, one portion of winding 25 at times becomes energized over a circuit extending from terminal B through front contact 28 of relay TR1 and the left-hand portion, as viewed in the drawings, of winding 25 to terminal C, while the other portion at other times is energized over a circuit extending from terminal B through back contact 28 of relay TR1, back contact 29 of relay TR2, and the other or right-hand portion of winding 25 to terminal C. When relay TR2 follows code and relay TR1 is released, the left-hand portion of winding 25 is energized at times over a circuit passing from terminal B through back contact 28 of relay TR1, front contact 29 of relay TR2 and the left-hand portion of winding 25 to terminal C, and the right-hand portion of winding 25 at other times is energized over a circuit which may be traced from terminal B through back contact 28 of relay TR1, back contact 29 of relay TR2 and the right-hand portion of winding 25 to terminal C. It is to be noted that when relay TR1 is released and relay TR2 follows code, both portions of winding 25 are energized over circuits which include in series contact members 28 and 29 operated by relays TR1 and TR2, respectively; and that when relay TR1 follows code and relay TR2 is released, the two contact members 28 and 29 are likewise interposed in series in the energizing circuit of the right-hand portion of winding 25.

The details of construction of the decoding units DU180 and DU120 are not shown in the drawings but each usually comprises a reactor condenser tuning unit tuned to resonance at a frequency corresponding to the 180 and 120 code rates, respectively, whereby relay AJ is effectively energized and picked up when and only when transformed DT is supplied with current pulses due to either relay TR1 or TR2 operating in response to current coded at the 180 code rate received from the associated section, while relay BJ is effectively energized and picked up when and only when either relay TR1 or TR2 operates at the 120 code rate to supply transformer DT with current pulses.

The decoding apparatus above described functions to selectively control, in a manner to be pointed out in detail presently, the wayside signal provided for the associated track section. Such signal may take any one of many well-known forms of railway signal devices, but is shown in Fig. 2 (see signal SP) for the sake of illustration as comprising a light signal having seven individual light units disposed one above the other on the associated signal mast and designated by the reference character L with a distinguishing suffix corresponding to the position of the unit on the signal mast with unit L1 located at the top of the mast.

The decoding apparatus further cooperates with its associated code transmitter CT to selectively control in accordance with traffic conditions, the supply of trackway energy to the track rails of the section next in the rear. The manner in which the control of the associated signal and the supply of trackway energy to the rails of a section next in the rear are affected by apparatus embodying my invention will best be un-

derstood from the following description of the operation of the apparatus as a whole. In such description, the apparatus represented in Fig. 2 will be assumed to correspond to the similar apparatus provided for each of the sections represented in Fig. 1, and the operation of the apparatus as a whole will be described by tracing in Fig. 2 the various circuits that are set up by such or corresponding apparatus in response to each of the different code conditions of the plurality of distinctive frequencies of alternating current utilized as trackway current. To facilitate this description, reference will also be made to Fig. 3 wherein is set forth in chart form the various code rates and frequencies of the alternating current received and transmitted (columns *d* and *e*, respectively, of Fig. 3) by the wayside apparatus at each signal location; the positions assumed by each of the various relays comprising the decoding apparatus located at the several signal locations (columns *f* to *k*, inclusive); and the signal units controlled and the indications displayed by each of the several signals (columns *b* and *c*, respectively).

As can be seen in Fig. 1, section P—Q is occupied by a train W so that trackway energy is shunted away from the track relays of such section. From columns *f* and *g* of Fig. 3, it can be seen that the code responsive track relays TR1 and TR2 at signal SP are inactive, the inactive and active positions of the code responsive relays being indicated in Fig. 3 by representing the armatures associated with such relays in a dropped-away or code-following position, respectively. All decoding relays at signal location SP are similarly released, as indicated in Fig. 3 by showing the armatures associated with such relays in their released positions. Also, unit L7 of signal SP is illuminated to indicate that the associated section is occupied (see columns *b* and *c* of Fig. 3), and column *e* of Fig. 3 indicates that 200 cycle alternating current coded at the 75 code rate is supplied to the section next in the rear.

Referring now to Fig. 2, the wayside apparatus there illustrated is shown in the condition responsive to a train W occupying its associated section. In this condition of the apparatus, relays TR1 and TR2 are inactive and all of the decoding relays are released as shown in Fig. 2 and as set forth in the table of Fig. 3.

With the decoding relays located at signal location P all released, unit L7 of signal SP is provided with an energizing circuit which may be traced from terminal B through back contact 35 of relay H1, back contact 36 of relay H2 and the filament of unit L7 of signal SP to terminal C, and unit L7 of signal SP is therefore illuminated to indicate that the associated section P—Q is occupied by a train.

Also, a circuit is completed for supplying 200 cycle alternating current coded at the 75 code rate to the rails of the section next in the rear of section P—Q, that is, section O—P. This circuit may be traced from one terminal of winding 15 of transformer FT of frequency changer FC through back contact 37 of relay H1, back contact 38 of relay H2, contact 75—75a of coder CT, primary winding 6 of transformer TT and common connection, indicated by the reference character CC, to the other terminal of winding 15 of transformer FT.

When 200 cycle alternating current coded at the 75 code rate is supplied to the rails of section O—P and the section is unoccupied, the current

is transmitted through the rails and causes relay TR2 associated with that section to be active and operate at the 75 code rate to energize relay H2 (see columns *g* and *j* of Fig. 3), but all other decoding relays are released and relay TR1 is inactive. The energization of relay H2 associated with section O—P establishes a circuit for unit L6 of signal SO, which circuit may be traced from terminal B through front contact 39 of relay H2, back contact 40 of relay AJ, back contact 41 of relay BJ, the filament of unit L6 of signal SO to terminal C, and signal unit L6 of signal SO is illuminated (see column *b* of Fig. 3) to indicate that one clear block intervenes between the signal and the next occupied block. In addition, with relay H2 picked up, 200 cycle alternating current coded at the 120 code rate is supplied to the section next in the rear, that is, section N—O, over a circuit which may be traced from one terminal of winding 15 of transformer FT of frequency changer FC through back contact 37 of relay H1, front contact 38 of relay H2, back contact 42 of relay BJ, contact 120—120a of coder CT, secondary winding 6 of transformer TT and common connection to the other terminal of winding 15 of transformer FT.

The 200 cycle alternating current coded at the 120 code rate supplied to section N—O causes relay TR2 associated with that section to be active and relays H2 and BJ to be picked up in response to the operation of the associated code responsive relay TR2 at the 120 code. With relays H2 and BJ associated with section N—O picked up, a circuit is established for unit L5 of signal SN, which circuit may be traced from terminal B through front contact 39 of relay H2, front contact 43 of relay BJ and the filament of unit L5 to terminal C, and signal SN accordingly is caused to illuminate unit L5 to indicate that two clear blocks intervene between the signal and the next occupied section. Also, with relays H2 and BJ associated with section N—O picked up, section M—N is supplied with 200 cycle alternating current coded at the 180 code rate, which current is supplied over a circuit which extends from one terminal of winding 15 of transformer FT of frequency changer FC through back contact 37 of relay H1, front contact 38 of relay H2, front contact 42 of relay BJ, contact 180—180a of coder CT, and secondary winding 6 of transformer TT through common connection CC to the other terminal of winding 15 of transformer FT.

In response to the 200 cycle alternating current coded at the 180 code rate supplied to section M—N, relay TR2 associated with that section is active and operates at the 180 code rate to energize relays H2 and AJ, whereupon there is established for unit L4 of signal SM a circuit extending from terminal B through front contact 39 of the relay H2, front contact 40 of relay BJ and the filament of lamp L4 to terminal C, so that unit L4 of signal SM is illuminated to indicate that three clear sections intervene between that signal and the next occupied section. In addition, the decoding apparatus located at signal SM causes 100 cycle alternating current coded at the 75 code rate to be supplied to the rails of section L—M, this current being supplied over a circuit extending from one terminal of secondary winding 12 of line transformer LT through front contact 48 of relay H2, front contact 52 of relay AJ, contact 75—75a of coder CT, and secondary winding 6 of transformer TT

through common connection CC to the other terminal of winding 12 of line transformer LT.

This 100 cycle alternating current coded at the 75 code rate in the rails of section L—M causes relay TR1 associated with that section to become active and pick up relay H1, thereby completing for unit L3 of signal SL a circuit extending from terminal B through front contact 45 of relay H1, back contact 46 of relay BJ, back contact 47 of relay AJ and the filament of lamp L3 to terminal C, whereupon unit L3 of signal SL becomes lighted to indicate that four clear blocks intervene between that signal and the next occupied section. In addition, the rails of section K—L are supplied with 100 cycle alternating current coded at the 120 code rate and supplied over a circuit which extends from one terminal of secondary winding 12 of line transformer LT through back contact 48 of relay H2, front contact 49 of relay H1, back contact 50 of relay BJ, back contact 51 of relay AJ, contact 120—120a of coder CT and secondary winding 6 of transformer TT through common connection CC to the other terminal of winding 12 of transformer LT.

Code responsive relay TR1 associated with section K—L is caused to be active by the supply to the rails of that section of 100 cycle current, and it operates at the 120 code rate to cause the associated decoding relays H1 and BJ to be picked up, thereby establishing for unit L2 of signal SK an energizing circuit which extends from terminal B through front contact 45 of relay H1, front contact 46 of relay BJ and the filament of unit L2 to terminal C. Under such assumed conditions, the rails of section J—K are supplied with 100 cycle alternating current coded at the 180 code rate and supplied over a circuit which may be traced from one terminal of winding 12 of transformer LT through back contact 48 of relay H2, front contact 49 of relay H1, front contact 50 of relay BJ, contact 180—180a of coder CT, and secondary winding 6 of transformer TT through common connection CC to the other terminal of winding 12 of transformer LT.

In response to the supply of 100 cycle alternating current coded at the 180 code rate to the rails of section J—K, the associated code responsive relay TR1 is active and operates at the 180 code rate to energize the associated decoding relays H1 and AJ to establish for unit L1 of signal SJ an energizing circuit which extends from terminal B through front contact 45 of relay H1, front contact 52 of relay AJ and the filament of unit L1 to terminal C. In addition, the rails of the section next in the rear of section J—K are supplied with 100 cycle alternating current coded at the 180 code rate and supplied over a circuit which extends from one terminal of winding 12 of transformer LT through back contact 48 of relay H2, front contact 49 of relay H1, back contact 50 of relay BJ, front contact 51 of relay AJ, contact 180—180a of coder CT, and primary winding 6 of transformer TT through common connection CC to the other terminal of winding 12.

A modified arrangement of the apparatus represented in Fig. 2 is shown in Fig. 4, wherein means are provided for individually conditioning the two code responsive relays TR one at a time to respond to the trackway current in the associated section, and for maintaining conditioned the relay responsive to the frequency of the applied alternating current. Referring now to

Fig. 4, the reference character AR designates a slow acting auxiliary relay having slow pick-up and slow release characteristics. Relay AR is provided with an energizing circuit extending from terminal B through back contact 55 of relay H2, back contact 56 of relay H1, the winding of relay AR and back contact 57 of relay AR to terminal C, and it follows that when both relays H2 and H1 are released (as when a train occupies the associated section to shunt both code responsive relays TR), relay AR is caused alternately to pick up over its energizing circuit, and then to release due to the interruption of its energizing circuit at its own back contact, and this cyclic operation of relay AR continues as long as relays H2 and H1 remain released. When relay AR is released, relay TR1 is conditioned to respond to track circuit current in the associated section due to the associated tuning unit TU—100 being connected to secondary winding 20 of receiving transformer RT over a circuit which extends from one terminal of winding 20 through back contact 58 of relay AR, back contact 59 of relay H1, and tuning unit TU—100 to the other terminal of winding 20. When relay AR picks up, tuning unit TU—100 is disconnected from winding 20 and the other tuning unit TU—200 is connected to winding 20 over a circuit passing from one terminal of winding 20 through front contact 60 of relay AR, back contact 61 of relay H2 and tuning unit TU—200 to the other terminal of winding 20. It follows that when both code responsive relays TR are inactive and the associated decoding relays H are released, the code responsive relays TR of Fig. 4 are alternately conditioned one at a time to respond to current in the track rails.

When transformer RT of Fig. 4 first receives energy from the rails of the associated section, as when the section becomes vacated, relay TR1 or TR2 will respond to the received energy according as the frequency of current in the track rails is 100 cycles or 200 cycles. That is to say, when 100 cycle current is available in winding 20 of transformer RT, the code responsive apparatus remains unaffected by such current unless auxiliary relay AR is released or until it releases to close its back contact 58 and condition relay TR1 to respond by connecting winding 20 to tuning unit TU—100. Relay TR1 thereupon is caused to operate by the 100 cycle current in winding 20 of transformer RT, and the operation of relay TR1 causes relay H1 to pick up, thereby opening at its back contact 56 the previously traced energizing circuit of relay AR and terminating the cyclic operation of that relay. Relay H1 also closes its front contact 59 to complete an obvious circuit including that contact whereby winding 20 of transformer RT is connected to tuning unit TU—100 and relay TR1 is maintained conditioned to respond to the applied 100 cycle current in the associated section.

If, however, 200 cycle current is available in winding 20 of transformer RT, then the code responsive apparatus remains unaffected by this current unless and until relay AR picks up to close its front contact 60 and connect tuning unit TU—200 to winding 20. Relay TR2 thereupon is conditioned to respond and picks up relay H2 to interrupt the energizing circuit and terminate the cyclic operation of relay AR, and relay H2 also closes its front contact 61 to complete an obvious circuit connecting winding 20 to tuning unit TU—200 whereby relay TR2 is main-

tained conditioned to respond to 200 cycle current in the trackway.

With the exceptions pointed out heretofore, the decoding, signal control and trackway energy current control apparatus of Fig. 4 substantially corresponds in structure and arrangement to the decoding, signal control and trackway energy current control apparatus previously described in connection with Fig. 2, hence such apparatus has been omitted in order to avoid unduly complicating the drawings.

The apparatus shown in Fig. 4 for at times alternately conditioning the two code responsive relays to respond one at a time to the applied alternating current, is modified in Fig. 5 to be active only after trackway energy becomes available to energize the code responsive relay TR. Referring now to Fig. 5, the reference character BR designates a second auxiliary relay connected across the output terminals of a rectifier 65 which in turn has its input terminals provided with an energizing circuit extending from one terminal of winding 20 of transformer RT through back contact 55 of relay H2, back contact 56 of relay H1 to one input terminal of rectifier 65, and extending from the other terminal of winding 20 to the other input terminal of rectifier 65. Relay BR completes for relay AR an obvious energizing circuit including front contact 63 of relay BR and back contact 57 of relay AR, and it follows that when relay BR is effectively energized and picked up, relay AR is caused cyclically to pick up and release. Relay AR of Fig. 5 alternately conditions relays TR1 and TR2 to respond to the applied trackway current in substantially the same manner as that pointed out in detail heretofore in connection with the apparatus of Fig. 4.

It is readily apparent that when no energy is available in transformer RT and relays TR1 and TR2 are both inactive to cause relays H1 and H2 to be released, relay BR also is released so that relay AR is similarly released. When, however, energy becomes available in transformer RT, relay TR1 is conditioned, with relay AR released to close its back contact 58, to respond to such current and relay TR1 accordingly will respond to such current if it is 100 cycle alternating current. In the event, however, that the current available has a frequency of 200 cycles and relay AR is released, both relays TR are non-responsive and relay BR picks up to energize relay AR. When relay AR picks up at the end of its slow pick-up period, its front contact 60 closes to condition relay TR2 to respond to the energy available in transformer RT. Whenever relay TR1 or TR2 picks up in response to energy in transformer RT, the associated H relay is picked up to maintain such code responsive relay conditioned to respond to the applied trackway current, and also to interrupt the energizing circuit of auxiliary relay BR, thereby releasing that relay and opening the circuit of relay AR.

It is, of course, to be understood that while apparatus embodying my invention has been illustrated and described as applied to a wayside signal system, such apparatus may if desired be incorporated as well into a train-carried signal control system by using the usual train-carried receiving coils as the secondary winding 20 of transformer RT. In such event, the primary winding of transformer RT will of course be replaced by the two track rails, and the decoding apparatus will control a train-carried cab signal

and/or train-control apparatus, but such train-carried decoding apparatus would not, of course, control the frequency of the alternating current or the code rate at which such current is supplied to the track rails.

From the foregoing description of the operation of the apparatus embodying my invention, it is readily apparent that I have provided a six-block, seven indication railway signal system incorporating novel and improved decoding apparatus involving a plurality of code responsive relays one for each of a plurality of distinctive frequencies of alternating current employed. It is further apparent that my apparatus provides means for individually conditioning such relays one at a time to respond to the applied trackway current.

Although I have herein shown and described only three forms of railway traffic controlling 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 with a stretch of railway track divided into two adjoining track sections each having the rails thereof supplied with alternating current of one frequency or another coded at one or another of a plurality of code rates, two track relays receiving current from the rails of one of said sections and selectively responsive one relay to current of one of said frequencies and the other relay to current of the other frequency, two code detecting relays one for each track relay, means responsive to a code operation of a track relay for energizing the associated code detecting relay, a plurality of code selecting relays each selectively responsive to a different one of said plurality of code rates, means governed by each of said track relays for energizing said code selecting relays, means selectively controlled by said detecting and selecting relays for governing traffic in said one section, and means also controlled by said code detecting relays for controlling the frequency of current supplied to the rails of the other of said sections.

2. In combination with a stretch of railway track divided into two adjoining track sections each having the rails thereof supplied with alternating current of one frequency or another coded at one or another of a plurality of code rates, two track relays receiving current from the rails of one of said sections and selectively responsive one relay to current of one of said frequencies and the other relay to current of the other frequency, two code detecting relays one for each track relay, means responsive to a code operation of a track relay for energizing the associated code detecting relay, a plurality of code selecting relays each selectively responsive to a different one of said plurality of code rates, means governed by each of said track relays for energizing said code selecting relays, means selectively controlled by said code detecting and selecting relays for governing traffic in said one section, and means also controlled by said code selecting relays for governing the code rate of the current supplied to the rails of the other of said sections.

3. In combination with a stretch of railway track divided into two adjoining track sections each having the rails thereof supplied with alternating current of one frequency or another

coded at one or another of a plurality of code rates, two track relays receiving current from the rails of one of said sections and selectively responsive one relay to current of one of said frequencies and the other relay to current of the other frequency, two code detecting relays one for each track relay, means responsive to a code operation of a track relay for energizing the associated code detecting relay, a plurality of code selecting relays each selectively responsive to a different one of said plurality of code rates, means governed by each of said track relays for energizing said code selecting relays, means selectively controlled by said code detecting and selecting relays for governing traffic in said one section, and means also controlled by said code selecting and detecting relays for governing the code rate and frequency of current supplied to the rails of the other of said sections.

4. In combination with a stretch of railway track divided into two adjoining track sections each having the rails thereof supplied with alternating current of one frequency or another coded at one or another of a plurality of code rates, two track relays receiving current from the rails of one of said sections and selectively responsive one relay to current of one of said frequencies and the other relay to current of the other frequency, two code detecting relays one for each track relay, means responsive to a code operation of a track relay for energizing the associated code detecting relay, a plurality of code selecting relays each selectively responsive to a different one of said plurality of code rates, means governed by each of said track relays for energizing said code selecting relays, and means jointly governed by said code selecting and detecting relays for governing the code rate and frequency of current supplied to the other of said sections.

5. Decoding apparatus for use with a stretch of trackway which has its track rails supplied with alternating current of one frequency or another coded at one or another of a plurality of code rates, comprising the combination with two track relays receiving energy from the track rails and selectively responsive one relay to current of one of said frequencies and the other relay to current of the other frequency, two code detecting relays one for each of said track relays, and means controlled by a code operation of a track relay for energizing the associated code detecting relay; of a plurality of code selecting relays each selectively responsive to a different one of said code rates, a decoding transformer having a secondary winding connected to said code selecting relays and a primary winding, a circuit including in series contacts operated by each of said track relays for energizing said primary winding with pulses of current corresponding to the code operation of either of said track relays, and railway traffic governing apparatus selectively controlled by said code detecting and code selecting relays.

6. Decoding apparatus for use with a stretch of trackway which has its track rails supplied with alternating current of one frequency or another coded at one or another of a plurality of code rates, comprising the combination with two track relays receiving energy from the track rails and selectively responsive one relay to current of one of said frequencies and the other relay to current of the other frequency, two code detecting relays one for each of said track relays, and means controlled by a code operation of a track

relay for energizing the associated code detecting relay, of a plurality of code selecting relays each selectively responsive to a different one of said code rates, a decoding transformer having a secondary winding connected to said code selecting relays and a primary winding, a circuit including in series a contact operated by said one track relay and a contact operated by said other track relay for energizing said primary winding with pulses of current corresponding to the code operation of either of said track relays, and railway traffic governing apparatus selectively controlled by said code detecting and code selecting relays.

7. Decoding apparatus for use with a stretch of trackway which has its track rails supplied with alternating current of one frequency or another coded at one or another of a plurality of code rates, comprising the combination with two code responsive track relays receiving energy from the track rails and selectively responsive one relay to current of one of said frequencies and the other relay to current of the other frequency, two code detecting relays one for each of said track relays, and means controlled by a code operation of a track relay for energizing the associated code detecting relay, of a plurality of code selecting relays each selectively responsive to a different one of said code rates, a decoding transformer having a secondary winding connected to said code selecting relays and a primary winding divided into two portions, circuit means including in series a contact operated by said one track relay and a contact operated by said other track relay for alternately energizing said two portions of said primary winding with pulses of current corresponding to the code operation of either of said code responsive relays, and railway traffic governing apparatus selectively controlled by said code detecting and code selecting relays.

8. Decoding apparatus for use with a stretch of trackway which has its track rails supplied with alternating current of one frequency or another coded at one or another of a plurality of code rates, comprising the combination with two code responsive track relays receiving energy from the track rails and selectively responsive one relay to current of one of said frequencies and the other relay to current of the other frequency, two code detecting relays one for each of said code responsive relays, and means controlled by a code operation of a code responsive relay for energizing the associated code detecting relay, of a plurality of code selecting relays each selectively responsive to a different one of said code rates, a decoding transformer having a secondary winding connected to said code selecting relays and a primary winding divided into two portions, a circuit for one portion of said primary winding including two alternate paths one path of which includes a front contact of said one code responsive relay and the other path of which includes in series a back contact of said one code responsive relay and a front contact of said other code responsive relay, a circuit for the other portion of said primary winding including in series a back contact of each of said two code responsive relays, and railway traffic governing apparatus selectively controlled by said code detecting and selecting relays.

9. In combination, a section of railway track having the rails thereof supplied with alternating current of one frequency or another coded at one or another of a plurality of code rates,

two track relays one selectively responsive to current of said one frequency and the other relay selectively responsive to current of said other frequency, two code detecting relays one for each track relay, means responsive to a code operation of a track relay for energizing the associated code detecting relay, an auxiliary relay, means controlled by said code detecting relays when released for causing said auxiliary relay to be alternately picked up and released, circuit means controlled by said auxiliary relay for conditioning one or the other of said two track relays to be energized by current derived from said track rails according as said auxiliary relay is picked up or released, and means controlled by each code detecting relay when energized for maintaining said circuit means conditioned to energize the associated track relay.

10. In combination, a section of railway track having the rails thereof supplied with alternating current of one frequency or another coded at one or another of a plurality of code rates, two track relays one selectively responsive to current of said one frequency and the other relay selectively responsive to current of said other frequency, two code detecting relays one for each track relay, means responsive to a code operation of a track relay for energizing the associated code detecting relay, an auxiliary relay, means controlled by said code detecting relays when released for causing said auxiliary relay to be alternately picked up and released when said section is unoccupied, circuit means controlled by said auxiliary relay for conditioning one or the other of said two track relays to be energized by current derived from said track rails according as said auxiliary relay is picked up or released, and means controlled by each code detecting relay when energized for maintaining said circuit means conditioned to energize the associated track relay.

11. In combination, a section of railway track having the rails thereof supplied with alternating current of one frequency or another coded

at one or another of a plurality of code rates, two track relays one selectively responsive to current of said one frequency and the other relay selectively responsive to current of said other frequency, two code detecting relays one for each track relay, means responsive to a code operation of a track relay for energizing the associated code detecting relay, an auxiliary relay, means for momentarily picking up said auxiliary relay when said code detecting relays are both released and said section is unoccupied, circuit means controlled by said auxiliary relay for conditioning one or the other of said two track relays to be energized by current derived from said track rails according as said auxiliary relay is picked up or released, and means controlled by each code detecting relay when energized for maintaining said circuit means conditioned to energize the associated track relay.

12. In combination, a section of railway track having the rails thereof supplied with alternating current of one frequency or another coded at one or another of a plurality of code rates, two track relays one selectively responsive to current of said one frequency and the other relay selectively responsive to current of said other frequency, two code detecting relays one for each track relay, means responsive to a code operation of a track relay for energizing the associated code detecting relay, a slow pick-up, slow release auxiliary relay, means conditioned by back contacts of each of said code detecting relays for energizing said auxiliary relay over its own back contact, circuit means controlled by said auxiliary relay for conditioning one or the other of said two track relays to be energized by current derived from said track rails according as said auxiliary relay is picked up or released, and means controlled by each code detecting relay when energized for maintaining said circuit means conditioned to energize the associated track relay.

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