Sept. 5, 1939. H. A. THOMPSON 2,171,771

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed June 23, 1938 2 Sheets-Sheet 1

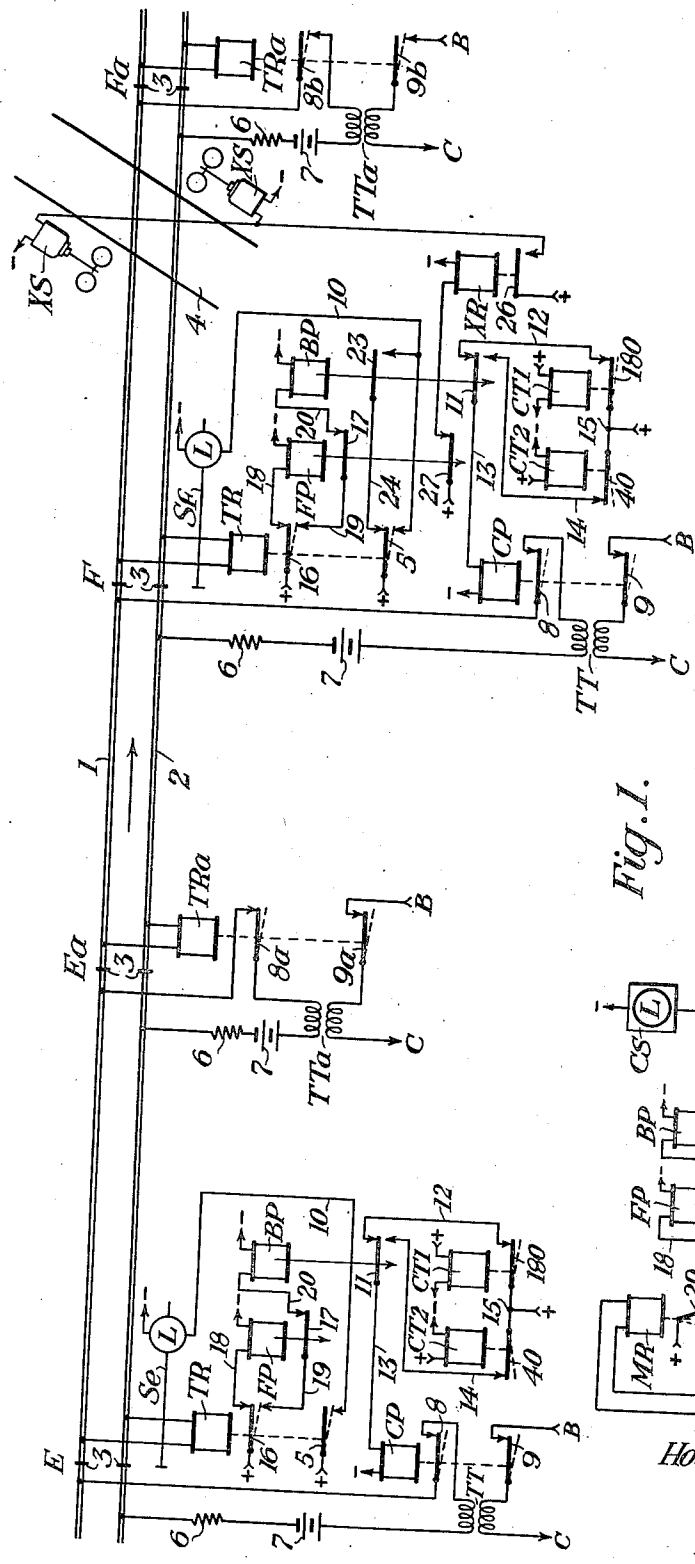


Fig. 1.

Code	Signal Lamp Illumination	Indication
None	———	Stop
Low Speed	— — —	Approach
High Speed	— — — —	Clear
	Time ⟶	

Fig. 2.

Fig. 3.

INVENTOR
Howard A. Thompson.
BY
HIS ATTORNEY

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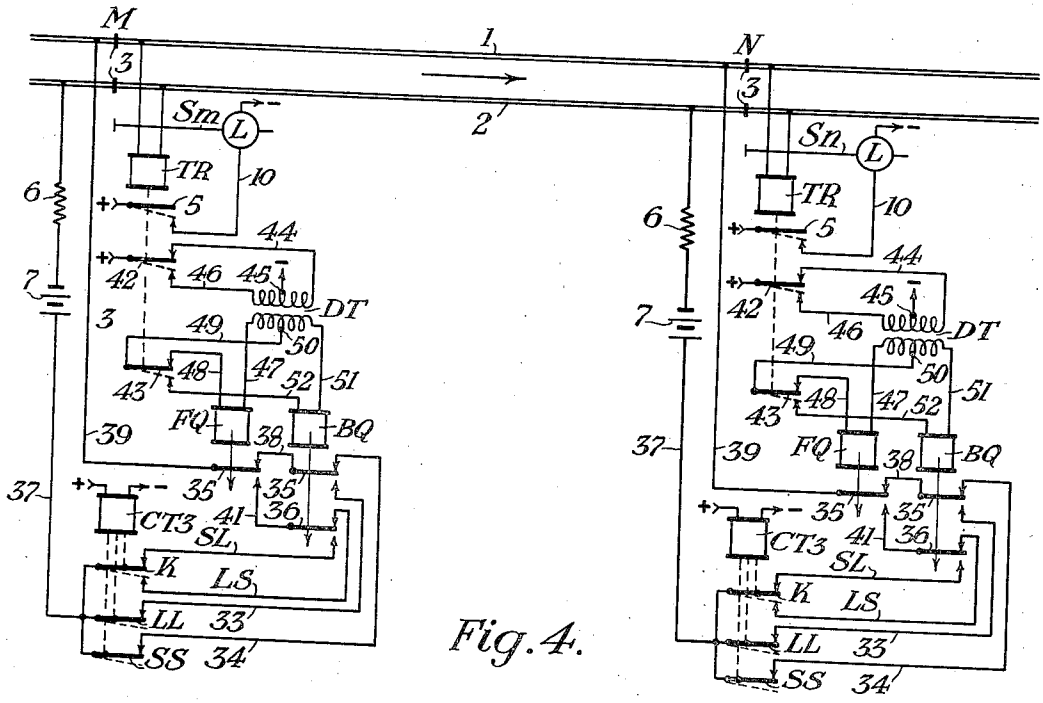


Fig. 4.

CODE	SIGNAL LAMP ILLUMINATION	INDICATION
NONE		STOP
SHORT-LONG		APPROACH
LONG-SHORT		APP. MED.
LONG-LONG		APP. REST.
SHORT-SHORT		CLEAR
	TIME →	

Fig. 6.

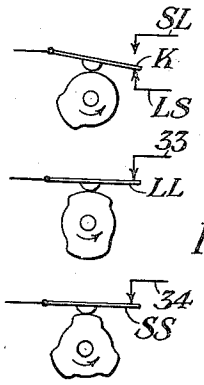


Fig. 5.

INVENTOR
Howard A. Thompson.
BY
HIS ATTORNEY

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UNITED STATES PATENT OFFICE

2,171,771

RAILWAY TRAFFIC CONTROLLING APPARATUS

Howard A. Thompson, Edgewood, Pa., assignor to The Union Switch & Signal Company, Swissvale, Pa., a corporation of Pennsylvania

Application June 23, 1938, Serial No. 215,435

18 Claims. (Cl. 246—34)

My invention relates to railway traffic controlling apparatus and it has special reference to the organization of such apparatus into systems wherein either or both wayside signals and train carried cab signals are controlled by energy coded in accordance with advance conditions and transmitted through the track rails.

One object of my invention is to provide a new and improved form of such organization.

Another object is to simplify the code-distinguishing apparatus which is utilized by traffic governing systems of the class named.

An additional object is to lower the cost and power requirements of the controlled signals, both wayside and train carried.

A further object is to increase the permissible tolerance in the speed at which the energy pulses of each of the train control codes may be delivered to the trackway.

A still further object is to provide a signalling system which is immune to phantom proceed indications and which does not require approach energization control in ordinary installations.

A still additional object is to accomplish the above without dispensing with any of the desirable features of continuously coded track circuit control.

In practicing my invention I attain the above and other objects and advantages by employing the code as transmitted through the track circuit directly for signal energizing control without first converting it through decoding equipment. In my improved form of organization, each signal consists of a single lamp which flashes in step with the pulses of received code energy and thus displays a distinctive visual aspect which simulates the pattern of each of the different train control codes used.

I shall describe several forms of railway traffic controlling apparatus embodying my invention and shall then point out the novel features thereof in claims. These illustrative embodiments are disclosed in the accompanying drawings, in which:

Fig. 1 is a diagrammatic representation of a stretch of railway track equipped with traffic controlling apparatus embodying my invention and arranged to provide three signal indications;

Fig. 2 is a table showing the relation among the codes, lamp flashes and signal indications for the apparatus of Fig. 1;

Fig. 3 is a diagrammatic view of train carried apparatus organized into a three indication cab signaling system suitable for cooperation with and control by the trackway apparatus of Fig. 1;

Fig. 4 is a diagrammatic view of trackway apparatus organized in accordance with my invention into a five indication system of automatic block signaling;

Fig. 5 is a series of views indicating one manner in which the three contacts of each of the coding devices employed in the system of Fig. 4 may be arranged and actuated; and

Fig. 6 is a tabular representation of the relation among trackway codes, wayside lamp flashes and signal indications for the apparatus of Fig. 4.

Referring first to Figs. 1, 2 and 3 of the drawings, the improvements of my invention are there disclosed as being incorporated in a combined automatic block and cab signalling system for a track 1—2 over which traffic moves in the single direction designated by the arrow, or from left to right in the diagram of Fig. 1. Insulated joints 3 divide the rails of the protected stretch of this track into the customary successive track circuit sections only three of which, E—E*a*, E*a*—F and F—F*a*, are completely shown.

Locations E and F mark points of main signal block division while locations E*a* and F*a* represent subdivisions of two of the main signal blocks. The subdivision E*a* is representative of cut sections which are occasioned by excessive signal block lengths only while the subdivision F*a* is shown as being occasioned by a highway 4 which intersects the track and with which the usual crossing protecting devices XS are asssociated.

Positioned at the entrance of each of the main signal blocks is a wayside signal S which is adapted to indicate to an appproaching train the nature of the traffic conditions in the blocks immediately ahead. As signal S*e* protects the entire block E—F no wayside signal is provided at the subdividing location E*a* within the confines of that block. Likewise, as signal S*f* protects the complete length of the main block of which location F marks the entrance no wayside signal is provided at the subdividing location F*a*.

The wayside signals S shown by way of illustration at the locations E and F each consist of a single lamp L which is backed by the usual searchlight type of reflector (not shown) and which is arranged when lighted to direct rays of light into the range of vision of the engineman of an approaching train. These light rays may be either colored or uncolored as conditions make desirable. If white light is chosen, as it satisfactorily may be in the present application, a very low wattage lamp requiring but a small amount of power will be found adequate.

The lamp L of each of these wayside signals

is controlled by a track relay TR through the medium of a back contact 5 thereof. As long as this contact is released, as when the relay is deenergized, it connects the lamp with a suitable source of lighting current supply, designated by the terminals "plus" and "minus". In that event the lamp is energized over a circuit which extends from the positive supply terminal, through back contact 5, a conductor 10 and the lamp L back to the negative supply terminal. When, however, the contact is picked up, as when the relay winding is energized, it interrupts the lighting circuit and causes the lamp to remain dark.

Energy for operating each of the track relays TR is transmitted thereto through the rails of the track section which the controlled wayside signal S guards. These rails, together with the relay winding which is directly connected thereto, constitute the usual track circuit to which "coded" or periodically interrupted energy is supplied by facilities at the opposite or exit end of the section.

Relay TR is of the code-following type and is designed, in the particular system represented, to respond to direct current. As long as the winding thereof is deenergized, the relay contacts are released and the signal lamp L then is continuously lighted. When, however, the track rails transmit coded energy to the relay, its response to the individual pulses thereof causes contact 5 to break the lighting circuit upon the occasion and for the continuance of each of these pulses. In consequence, the signal lamp then displays a flashing indication which simulates the pattern of the particular code which is being received.

In the illustrative automatic block signalling system of Fig. 1, the arrangement is such that the controlled wayside signals S selectively display the three different aspects which are represented in Fig. 2. From this figure it will be seen that the "clear" indication consists of short and closely spaced light flashes, the "approach" indication of long and widely spaced flashes, and the "stop" indication of a continuous illumination of the lamp L.

The controlled signal S is caused to display the just described "clear" indication when the relay TR receives trackway energy of a "high-speed" code pattern which is produced by a coding device CT1 at the exit end of the guarded block; it displays the "approach" indication when the received energy is of a "low-speed" code which originates in a companion coding device CT2; and the signal shows the "stop" indication when the rails of the guarded section fail to transmit coded energy to the track relay at the entrance end of the section.

In the illustrative form shown in Fig. 1, the facilities for supplying the trackway with the just referred to coded energy include the mentioned coding devices CT1 and CT2, a source of track circuit energy, a circuit for connecting the rails of the associated section to this source, and means for periodically interrupting this connection under the control of one or the other of the two coding devices.

Included in each of the represented rail supply circuits is the usual current limiting resistor 6, a source of direct current energy in the form of a battery 7, the secondary winding of a track transformer TT and the contact 8 of a code repeating relay. In operation of this circuit, each time that it is closed at contact 8 the battery 7 impresses between the rails a unidirectional voltage which is effective to produce a response on the part of the track relay TR at the entrance end of the section. At the same time, the primary of the track transformer TT is connected, by a companion contact 9, with an alternating current source B—C to cause the rails also to be supplied with alternating current energy which is effective to control train carried cab signals of the general character represented in Fig. 3.

At each of the wayside signal locations E, F, etc., these rail energy controlling contacts 8 and 9 are carried by a relay CP which is selectively controlled by one or the other of the coding devices CT1 and CT2. To remove from contact 8 the duty of making and breaking the supply of alternating current energy, preferably it is arranged to close before contact 9 during the pick-up operation of the relay and to open after contact 9 when the relay releases.

The two coding devices represented at CT1 and CT2 are provided with the usual circuit making and breaking contacts, respectively shown at 180 and 40, which are continuously actuated (each by a motor or other suitable mechanism not shown in detail) at such rates that contact 180 provides the before mentioned "high-speed" code and contact 40 provides the previously referred to "low-speed" code. To facilitate explanation it will be assumed that this high-speed code consists of 180 energy pulses per minute and that the low-speed code consists of 40 energy pulses per minute.

Selection of which of the coding contacts 40 or 180 is included in the control circuit of the repeater relay CP is made by a contact 11 of a code-detecting relay BP. As shown, the referred to control circuit is connected with an energy source designated by the terminals "plus" and "minus". When contact 11 is picked up the winding of relay CP is periodically energized over a circuit extending from the positive supply terminal, through coding contact 180, conductor 12, front contact 11, conductor 13 and the relay winding back to the negative supply terminal. Under this condition repeater relay CP so operates its contacts 8 and 9 that they code the trackway energy at the high-speed or 180 pulse per minute rate.

When, however, contact 11 of relay BP is released, the winding of relay CP receives slower recurring current pulses over a circuit which extends from the positive supply terminal, through coding contact 40, conductor 14, back contact 11, conductor 13 and the relay winding back to the negative supply terminal. Under this condition, relay CP so operates its contacts 8 and 9 that they code the trackway energy at the low-speed or 40 pulse per minute rate.

It will be apparent that the code repeating relay CP may be dispensed with in applications in which a larger number of relay contacts in the main rail supply circuit is not objectionable and in which an increased duty may be imposed upon the contacts 11, 40 and 180 of the coding circuit. In that situation, the two connections which are now made with the contact 8 would respectively be transferred to conductors 13 and 15 and the primary winding of transformer TT would be continuously connected to source B—C.

It is also to be noted that the track relays shown at TR in the wayside equipment of Fig. 1 may also be operated by alternating current energy from source B—C instead of by the direct current energy which the batteries 7 supply. In that event, of course, these batteries could be omitted from the rail supply circuits and the

track relays TR either could be provided with alternating current windings or rectifiers could be included in the supply circuits for these relays. Such an arrangement lends itself very readily to the above suggested omission of the code repeater relay CP inasmuch as the coding circuit contacts 11, 40 and 180 are readily capable of controlling the supply of current to each associated track transformer TT and hence might be included directly in the primary winding circuit thereof.

For distinguishing code following operation on the part of the track relay TR and for selecting in accordance with the presence or absence of such operation the coding of the energy which is supplied to the rails of the track section to the rear, use is made at each wayside signal location of the previously referred to relay BP and of a cooperating or companion relay FP. These two devices respectively are back contact and front contact repeaters for the track relay TR. Both are sufficiently slow releasing that they keep their contacts continuously picked up between adjacent pulses of received trackway energy as long as that energy is coded by either of the devices CT1 and CT2.

Included in the energizing circuit (which is supplied from a source again designated by the terminals "plus" and "minus") of each is a contact 16 of the track relay and further included in that of relay BP is a contact 17 of the relay FP. Each time that contact 16 of the track relay picks up in response to a pulse of trackway energy the circuit of relay FP is completed over conductor 18. Moreover, each time that the track relay is deenergized and relay FP continues to hold its contact 17 in the picked up position the energizing circuit of relay BP is completed over conductors 19 and 20.

Consequently, as long as the track relay TR is not following a code and is continuously deenergized, both of the repeater relays FP and CP likewise are continuously deenergized and their contacts occupy the released positions. When, however, the track relay follows either of the two codes produced by the devices CT1 and CT2, relay FP is continuously picked up, its contact 17 sets up the circuit for relay BP, contact 16 of relay TR completes that circuit each time that it occupies its released position, and relay BP thus also is picked up continuously. Should, moreover, the track relay receive steady energy and thus hold its contacts continuously picked up, relay FP becomes continuously energized and relay BP becomes continuously deenergized.

In this manner the two relays FP and BP serve to distinguish whether coded trackway energy is received by the track relay TR. If such energy is received, relay BP holds its contacts picked up and thus causes the energy which is supplied to the rails of the track section to the rear to be of the "high-speed" coding, while if coded energy is not received, relay BP releases its contacts and causes the supplied trackway energy to be of the "low-speed" coding.

From the earlier given description of the manner in which the lamp L of each wayside signal S is controlled by contact 5 of the associated track relay TR, it has been seen that in the absence of energy received from the trackway, the signal lamp remains continuously lighted while during the reception of coded energy by the track relay TR it is lighted during each "off" period of the received code and is dark during each "on" period thereof. In order that the lamp may also be lighted continuously in the event that steady energy is received from the trackway, the basic control circuit which is represented at location E in Fig. 1 may be supplemented in the manner shown at location F. Such a supplement takes the form of a contact 23 of the repeater relay BP provided with a back point which is joined with the lamp energizing conductor 10 and which is adapted to connect it through a conductor 24 with a front engaged point of the track relay contact 5.

When now, steady or uncoded energy is received by the track relay TR, the resulting continuous energization of repeater relay FP causes repeater relay BP to be continuously deenergized and to allow its contacts to remain released. Under these conditions, the signal lamp L receives energizing current over a circuit which extends from the positive supply terminal through front contact 5, conductor 24, back contact 23, conductor 10 and the lamp L back to the negative supply terminal.

In the case of the usual signal blocks which contain only one section of track (such single section blocks are not shown in Fig. 1), the rails 1 and 2 thereof constitute track circuit conductors which are continuous throughout the entire block length and which, therefore, are effective directly to transmit the coded energy from the exit end of the block to the track relay TR at the entrance end thereof. However, in instances in which the signal block length of track includes, as does that shown at E—F, a cut section of the block length reducing character defined by location E*a*, provision must be made for repeating the trackway code around the insulated joints 3 which define the cut location.

As shown at location E*a* such code repeating provision may take the form of a circuit for supplying energy to the rails of the rear section and a relay TR*a* connected with the rails of the forward section and arranged to control this circuit. The rail supply circuit illustrated includes a direct current source 7, which is a duplicate of the battery of the same designation at each of the wayside signal locations, and a track transformer TT*a* through which alternating current source B—C at proper times also transmits energy to the rails. The primary circuit for this transformer is controlled by a contact 9*a* of the code following relay TR*a*, while the main circuit including battery 7 is controlled by a contact 8*a* of the same relay.

Relay TR*a* has the same response characteristics as does the track relay TR previously described. Each time that the rails of the forward section E*a*—F transmit energy to this relay it closes its contacts 8*a* and 9*a* and thereby causes the rails of the rear section E—E*a* simultaneously to receive direct and alternating current energy from sources 7 and B—C. When, however, the rails of the forward section transmit no energy the relay contacts are opened and the supply of energy to the rear section rails is discontinued. In this manner the coded energy which is received from the rails ahead of location E*a* is at all times repeated into the rails to the rear of that location.

When, as shown at location F*a*, the cut section is occasioned by a highway intersection with which crossing protective devices XS are associated, code repeating provisions are again made. In such an application, however, these are modified in such manner that they supply steady or

uncoded energy to the rails of the rear section whenever a train occupies the forward section. As in the case of cut sections of the character shown at Ea, the code repeating apparatus at location Fa makes use of a code following relay TRa connected to the forward track circuit, a direct current supply source 7 and a track transformer TTa. The arrangement differs, however, in that the energy control contacts 8b and 9b of the code following relay TRa are arranged to complete the supply circuits when the relay is deenergized and to interrupt them under conditions of relay energization.

In operation of the equipment at location Fa, relay TRa responds to each pulse of energy transmitted thereto by the forward track circuit and interrupts the supply of energy to the rear track circuit. During, however, each "off" period of the code, the relay releases its contacts which then complete the circuit through which the rails of the rear section are supplied simultaneously with direct and alternating current energy. In this manner the coded energy which is received from the rails ahead of location Fa is at all times repeated into the rails to the rear of that location; moreover, when the forward rails fail to transmit energy the rear rails receive steady energy.

In the particular scheme of control which is shown for the highway crossing signals XS associated with the cut section Fa, a single relay XR is utilized to govern the completion of the signal operating circuits. This relay is provided with a contact 26 through which energy may be supplied to the signal operating mechanisms (not shown in detail). Normally, the winding of this relay receives current over a front contact 27 of repeater relay FP at location F and thus holds the contact 26 in the picked up position represented. Under such conditions, the crossing signals XS do not operate. When, however, the relay XR is deenergized it releases contact 26 and thereby brings the crossing signals XS into operation. This happens whenever the track relay TR at location F ceases to follow a trackway code and deenergizes repeater relay FP, as when the track section F—Fa is occupied by a train.

The various component parts of the three indication automatic block signalling system of Fig. 1 having been described, attention will now be directed to the manner in which that complete wayside system operates.

As long as all sections of the protected track 1—2 are vacant each of the track relays TR follows the pulses of coded energy received from the forward track section, the controlled signal S displays the high-speed flashing or "clear" indication (which signifies that at least two blocks ahead of the signal are unoccupied), the contacts of both of the repeater relays FP and BP are picked up, coding device CT1 supplies the winding of code repeater relay CP with 180 energizing pulses per minute and under the control of relay CP the rails of the track section to the rear of the signal location receive energy of the 180 or high-speed code.

In the event, now, that a train advances through the otherwise unoccupied stretch of the track 1—2, the track relay TR associated with each occupied section is deenergized, the wayside signal S controlled thereby is continuously lighted to show the indication of "stop", the contacts of both of the repeater relays FP and BP are released, the low-speed code transmitter CT2 supplies energizing pulses to the winding of repeater relay CP and the rails of the rear track section receive energy of the low-speed or 40 pulse per minute code.

At the first location to the rear of the occupied track section the track relay TR follows this low-speed code, the signal S displays the low-speed flashing or "approach" indication (which signifies that the track block protected by the signal is vacant but that the next block ahead is occupied), the contacts of both repeater relays FP and BP are picked up, the code repeating relay CP follows the coding of the high-speed transmitting device CT1, and the rails of the track section to the rear of the signal location receive energy of the 180 pulse per minute code.

At the second wayside signal location behind the occupied track section the track relay TR follows the high-speed code, the controlled signal S displays the high-speed flashing or "clear" indication (which signifies that at least two blocks ahead of the signal are clear), the contacts of both of the relays FP and BP are picked up, code repeating relay CP follows the coding of the high-speed device CT1 and the rails of the track section to the rear receive energy of the 180 pulse per minute code.

The effect of the train upon signalling equipment associated with signal blocks containing cut sections of the type shown at Fa as being occasioned by highway crossings and the like will now be considered. Normally, as has been pointed out, the crossing protecting signals SX are maintained inactive over the front contact 27 of repeater relay FP at the entrance end of the main signal block.

When, however, the train comes into section F—Fa, the track relay TR at location F releases its contacts as do also repeater relays FP and BP, control relay XR releases contact 26 and the crossing protective signals SX are by it placed in operation. Simultaneously, of course, the controlled wayside signal Sf is continuously lighted to show the indication of "stop". As the front end of the train advances beyond location Fa, code following relay TRa at that location becomes continuously deenergized and its contacts 8b and 9b now complete circuits through which the rails of section F—Fa are supplied with steady energy.

As soon as the rear end of the forward moving train clears the location Fa, these rails transmit this steady energy to relay TR at location F. It accordingly picks up its contacts, continuously energizes relay FP, continuously deenergizes relay BP, and contact 23 of the latter now supplies the lamp L of the wayside signal Sf with steady energizing current which causes it to continue to display "stop". Contact 27 of relay FP now completes the energizing circuit for relay XR and thus discontinues operation of the highway crossing signals XS.

Through the now released contact 11 of relay BP, low-speed coding device CT2 still controls relay CP and until the train clears the end of the track section of which location Fa marks the beginning the track section to the rear of location F continues to receive energy of the 40 code. When this clearing takes place, relay BP picks up its contacts and the coding of the supplied energy then is changed from the low-speed to the high-speed variety.

The operation of the wayside signalling system shown in Fig. 1 having been described, attention will next be directed to the cab-signalling equipment shown in Fig. 3. This equipment also

incorporates the improvements of my invention and is arranged to cooperate with the trackway apparatus of Fig. 1 in a manner which causes a cab signal CS to repeat on board the train the indications which the signals S of Fig. 1 display along the wayside.

This signal CS takes the form of a single lamp, again designated by the character L, supplied with energizing current over a circuit which is controlled by train carried apparatus including a master or code following relay MR and a pair of repeater relays FP and BP. These repeater relays are duplicates of those shown and described in connection with the apparatus of Fig. 1 and the master relay MR corresponds to the track relay TR.

This master relay is of the direct current polarized type and is provided with a pair of contacts **29** and **30** which are respectively included in the circuits of the repeater relays FP and BP and of the cab signal lamp L. The relay receives operating current from an amplifier of any suitable well known character which, in turn, is controlled by the output voltage of a pair of windings **31** which, together with a laminated iron bar **32** upon which they are mounted, constitute the usual receiver mounted ahead of the advance truck of the equipment carrying vehicle just above and spanning the two rails. When alternating current of the character supplied from source B—C flows in the rails voltages are induced in and additively combined by these windings.

Like relay TR in the system of Fig. 1, the train carried master relay MR shown in Fig. 3 follows the coding of the energy transmitted thereto from the track rails **1** and **2** through the receiver windings **31** and the amplifier. Both of its contacts **29** and **30** shift from one position to the other when the polarity of the relay energization changes and when the relay is deenergized these contacts stay in the position to which they were biased by the last energization of the relay. Thus, at the beginning of each pulse of trackway energy the contacts are moved to the right-hand position (shown heavy) and at the end of each energy pulse they are returned to the left-hand position (shown dotted) where they remain until another pulse of energy appears in the trackway.

The operation of the cab signalling apparatus shown in Fig. 3 is basically similar to that of the wayside signalling equipment previously explained in connection with locations E and F of Fig. 1. When the receiver **31—32** picks up no energy or uncoded steady energy from the rails **1** and **2**, the contacts of master relay MR are at rest and the lamp L of the cab signal CS is then steadily energized to display the indication of "stop". When the received energy is of the low-speed or **40** pulse per minute code, the lamp displays the low-speed flashing indication of "approach". Finally, when energy of the high-speed or **180** code is received the lamp displays the high-speed flashing indication of "clear".

Inasmuch as the repeater relay and signal control circuits shown in Fig. 3 are duplicates of those previously explained in connection with Fig. 1, with the exception of the fact that contacts **29** and **30** of master relay MR are substituted for contacts **16** and **5** respectively of track relay TR, no further detailed explanation of these circuits is here required. In lieu thereof it will be sufficient to point out that the train carried relay MR controls these circuits in exactly the same manner as does the wayside track relay TR.

That is, during each "on" period of the received code, contacts **29** and **30** occupy their right-hand positions. Under this condition, the winding of repeater relay FP is energized. During each "off" period of the trackway code the contacts occupy the left-hand position. Under this condition, the energizing circuit for repeater relay BP is completed and the energizing circuit for the lamp of cab signal CS is also completed. If the contacts occupy the left position continuously, as when no energy is being received from the trackway, both of the repeater relays are deenergized and released while if these contacts occupy the right position continuously, as when steady or uncoded energy is being received, relay FP is picked up, relay BP is dropped out and the signal lamp then also receives steady energy over contact **23** of relay BP.

As a train equipped with the cab signalling apparatus of Fig. 3 proceeds through the stretch of track **1—2** represented in Fig. 1, it receives from the rails thereof energy of one or another of the characters just described, depending upon the nature of the traffic conditions ahead. As long as two or more signal blocks ahead of the train are vacant, the received energy will be of the high-speed code. Master relay MR then follows the alternating current component of the code energy pulses, the contacts of relays FP and BP are both picked up and cab signal CS displays the high-speed flashing or "clear" indication.

If the train closes in on another train ahead the received energy changes to that of the low-speed code when the following train comes into the first section behind the advance train. In following these lower speed pulses relay MR then causes the signal CS to display the low-speed flashing or "approach" indication. As the following train comes into the same section as the advance train no energy is received and the cab signal accordingly is continuously lighted to show the indication "stop". Finally, should the following train enter a cut section, such as F—F*a*, at a time when steady energy is supplied to the rails thereof the cab signal CS will still show the "stop" indication by virtue of the lamp circuit then being completed over back contact **23** of relay BP.

Regarding the choice of the two different rates of light flashing which are employed by the three indication wayside and cab signaling system of Figs. 1 and 3, this choice is based upon a finding that under ordinary conditions the average engineman is able to distinguish between the described aspects of 40 and 180 light flashes per minute as readily as he can distinguish between the colors of yellow and green. If desired, however, it is, of course, possible further to increase the spread in rates of flashing from the ratio of four and one-half to one (represented by the 180 and 40 codes) to as much greater a value as may be necessary to avoid all possibility of confusing the "clear" and "approach" indications.

For example, the slow speed code may be reduced to say 20 pulses per minute in which case the ratio of flashing speeds will be raised to nine to one. Likewise, to obtain a comparable effect the high-speed code may be increased above the 180 pulse per minute value. Ordinarily, however, it will be preferred to retain the 180 rate for the high-speed code inasmuch as trackway

apparatus of the improved character shown in Fig. 1 will then also be effective for controlling cab signalling apparatus which employs frequency selective decoding equipment in which the full or authorized speed indication is given when energy pulses of the 180 code frequency are received from the trackway.

Moreover, since the 80 code or approach indication controlling portions of such prior art locomotive equipments ordinarily are non-tuned, any code pulse rate which is lower than that represented by the 80 code is effective to operate it. Hence, employment by the apparatus of Fig. 1 of a low-speed code of any value less than 80 energy pulses per minute allows train carried frequency selective decoders to cause cab signals which they control to give the approach indication on the train when that low-speed code is received from the running rails.

It will have been noted from the chart of Fig. 2 that in each of the codes of which use is made by the equipment of Figs. 1 and 3 the "on" and the "off" periods of repeated cycles are of substantially equal length, each of these periods having a duration of three-fourths of a second in the case of the 40 code and of one-sixth second in the case of the 180 code. With this arrangement, distinction between different aspects is, of course, based only on the difference in the rate at which the signal lamp L is flashed.

From an inspection of the table of Fig. 6 it will be seen that distinction between flashing signal aspects may also be based upon differences in the lengths of the lighted and the dark periods of the signal lamp. This, of course, makes possible a further extension in the number of different indications which may be given by a flashing light signal. In providing the five different indications which are represented in Fig. 6, the automatic block signalling system of Fig. 4 makes use of the additional basis of aspect distinction referred to above.

In the diagram of Fig. 4, as in that of Fig. 1, reference characters **1** and **2** designate the rails of a track over which it will be assumed that traffic moves in the single direction indicated by the arrow. Insulated joints **3** divide these rails into a plurality of successive track sections M—N, etc., and at the entrance of each of these sections a wayside signal S is installed to advise approaching trains of the traffic conditions ahead. Each of these signals S*m*, S*n*, etc., is a duplicate of the corresponding devices shown in Fig. 1 and its single lamp L is energized over the back contact **5** of the track relay TR which is connected to the rails of the guarded section.

Whereas the system of Fig. 1 includes provision for supplying both direct and alternating current energy to the track rails at the exit end of each section, the wayside equipment represented in Fig. 4 is shown, for purposes of simplicity, as including only the direct current source **7**. By a coding device **CT3** the current which this source supplies to the trackway is coded in one or another of four distinctive manners, each of which flashes the signal lamp L to produce a different "proceed" indication.

Referring to Fig. 6, it will be seen that the "clear" indication consists of short and closely spaced flashes, the "approach restricting" indication of long and widely spaced flashes, the "approach medium" indication of short and widely spaced flashes, the "approach" indication of long and closely spaced flashes, and the "stop" indication of a continuous lighting of the signal lamp L. The "clear" and "approach restricting" indications thus correspond to the flashing aspects previously explained in connection with Fig. 2 as resulting from the high-speed and the low-speed codes which are produced by the apparatus of Fig. 1. In the system of Fig. 4, however, the corresponding codes used will be designated by the terms "short-short" and "long-long" respectively. In each of these two codes, the "on" and the "off" periods are represented as being of the same duration.

The codes which respectively produce the "approach medium" and the "approach" indications will be designated by the terms "long-short" and "short-long" respectively. In the case of the first named code, the energy-on periods are approximately four times as long as the energy-off periods and in the case of the second named code the energy-off periods are approximately four times the length of the energy-on periods. Because, however, of the fact that the signal lamp L is controlled over a back rather than a front contact of the track relay TR, the "long-short" code produces the short and widely spaced flashes while the "short-long" code produces the long and closely spaced flashes.

For producing the four different codes just discussed the transmitting device represented at **CT3** makes use of three contacts designated by the characters SS, LL and K. One form of code transmitter mechanism for actuating these contacts in the special way indicated is shown in Fig. 5. There each of the coding contacts is represented as being associated with a constantly rotating cam shown immediately therebeneath and the periphery of which is provided with properly spaced raised portions and depressions. As shown, the SS-contact cam has three such raised portions or lobes and three depressions, the LL-contact cam has two lobes and two depressions and the K-contact cam has but a single protrusion or lobe which is coextensive with approximately one-fifth of its total circumference.

With this illustrative arrangement, the K-contact connects conductor SL with one side of the supply battery **7** once during each cam rotation and conductor LS with the battery once also during each cam rotation but for a much longer portion thereof; the LL-contact connects conductor **33** two successive times with the supply battery **7** during each cam rotation; and the SS-contact connects conductor **34** three successive times with the supply battery during each rotation of its operating cam. Moreover, each rotation of the K-contact cam produces one complete cycle of each of the short-long and long-short codes, each rotation of the LL-contact cam produces two cycles of the long-long code and each rotation of the SS-contact cam produces three complete cycles of the short-short code.

Selection of which one of the four code energy supply conductors SL, LS, **33** and **34** is included with the battery **7** in the rail supply circuit for the rear track section is effected by contacts **35** and **36** of a pair of code-selector relays FQ and BQ which form a part of the equipment installed at each of the wayside signal locations M, N, etc. When the contacts of both of the relays FQ and BQ are picked up the rear section rails receive energy of the short-short code through a circuit which includes current limiting resistor **6**, the supply battery **7**, conductor **37**, coding contact SS, conductor **34**, front contact **35** of relay FQ, conductor **38**, front contact **35** of relay BQ and conductor **39**.

When the contacts of code selector relay FQ are picked up and those of relay BQ are released, the rear section rails receive energy of the long-long code over a circuit which includes the current limiting resistor 6, supply battery 7, coding contact LL, conductor 33, back contact 35 of relay BQ, conductor 38, front contact 35 of relay FQ and conductor 39.

When the contacts of code selector relay FQ are released and those of relay BQ are picked up, the rear section rails receive energy of the long-short code over a circuit which includes the current limiting resistor 6, supply battery 7, coding contact K, conductor LS, front contact 36 of relay BQ, conductor 41, back contact 35 of relay FQ and conductor 39.

Finally, when the contacts of both of the code selector relays FQ and BQ are released, the rear section rails receive energy of the short-long code over a circuit which includes the current limiting resistor 6, supply battery 7, coding contact K, conductor SL, back contact 36 of relay BQ, conductor 41, back contact 35 of relay FQ and conductor 39.

The manner in which the two code selector relays FQ and BQ are controlled will now be described. Each of these relays is of the direct current type and is energized from the secondary of a decoding transformer DT of which both the primary and the secondary windings are pole changed simultaneously by contacts 42 and 43 of the track relay TR whenever that relay follows a trackway code. From the diagram it will be seen that contact 42 operates in the primary circuit of the decoding transformer while contact 43 serves to rectify the resulting induced voltage which the secondary winding of the transformer supplies to the direct current windings of the relays FQ and BQ.

The code distinguishing apparatus represented in Fig. 4 is more completely described in a copending application Serial No. 215,203 of Crawford E. Staples, filed June 22, 1938, and also assigned to The Union Switch & Signal Company; moreover, certain features of the same decoding apparatus are further disclosed and claimed in a copending application Serial No. 210,744 of Frank H. Nicholson et al. filed May 28, 1938, and likewise assigned to The Union Switch & Signal Company. In operation of that apparatus, the track relay contact 42 pole changes the primary supply circuit for the decoding transformer DT in the customary manner. That is, each time that the contact is picked up direct current flows in one direction through one portion of the transformer primary (by way of a circuit which extends from the positive supply terminal through front contact 42, conductor 44, the right half of the transformer winding and mid-tap 45 back to the negative supply terminal) and each time that contact 42 is released current flows in the opposite direction through another portion of the winding (by way of a circuit which includes conductor 46 and the left winding half).

The resulting alternating current voltage of code pulse frequency which is induced in the secondary winding of transformer DT supplies the windings of relays FQ and BQ with operating currents which are rectified by the track relay contact 43. That is, each time that this contact is picked up the winding of relay FQ is connected with the left half of the secondary winding of transformer DT through a circuit which extends from the left terminal of that winding, through conductor 47, the winding of relay FQ, conductor 48, front contact 43 and conductor 49 back to the mid-tap 50 of the winding. In consequence, only the positive half cycles of induced transformer voltage are effective to circulate current through the winding of relay FQ.

Likewise, each time that the track relay contact 43 is released the winding of relay BQ is connected with the right half of the secondary of transformer DT through a circuit which may be traced from the right terminal of the transformer winding, through conductor 51, the winding of relay BQ, conductor 52, the back contact 43 and conductor 49 back to the mid-tap 50 of the transformer winding. In consequence, only the negative half cycles of induced transformer voltage are effective to produce current flow through the winding of relay BQ.

From the nature of their supply circuits it will be seen that the windings of these two transformer fed code selector relays FQ and BQ are deenergized as long as the contacts of the associated track relay TR occupy one position continuously and receive energizing current only when the track relay is following coded pulses of trackway energy. Moreover, both of these relays have slow release characteristics which are so coordinated with the four different codes produced by the transmitter CT3 at the exit end of the associated track section that once picked up by a particular one of these codes the relay will span the off periods thereof and hold its contacts continuously picked up as long as the track relay TR continues to receive that code.

In addition to having these special release delay characteristics, each of the two relays FQ and BQ is further designed to pick up its contacts only if the recurring pulses of current which its operating winding receives from transformer DT represent more than a critical portion of the length of the cycles of received trackway code which produces them. In the system shown, relay FQ is arranged to respond only if the track relay TR is coding on its front contact about half or more of the time. This means that the contacts of relay FQ are picked up only if a long "on"-short "off" or an equal on and off code is being received. Similarly, relay BQ is arranged to be sufficiently energized to pick up its contacts only if the track relay is coding on its back contact about half or more of the time. This means that that relay responds only to codes of the short "on"-long "off" or equal on and off variety.

Accordingly, when the track relay TR receives no code, the contacts of both of the relays FQ and BQ are released and the rails of the rear track section are supplied with energy of the short-long code over conductor SL; when energy of the short-long code is received by the track relay the contacts of relay BQ are picked up, those of relay FQ are released and the rails of the rear track section then receive energy of the long-short code over conductor LS; when energy of the long-short code is received, the contacts of relay FQ are picked up, those of relay BQ are released and the rails of the rear track section then receive energy of the long-long code over conductor 33; and finally, when either the long-long or the short-short code is received by the track relay, the contacts of both of the relays FQ and BQ are picked up and the rails of the rear track section then receive energy of the short-short code over conductor 34.

From the foregoing description of the appara-

tus which the system of Fig. 4 comprises, the manner in which this complete system operates to provide five different indications on the part of the wayside signals S will have become more or less apparent. As long as all of the protected sections of track are vacant the track relay TR at each of the signal locations follows the "short-short" code received from the rails of the section ahead, the lamp L of the signal S displays the high-speed flashing or "clear" indication, the contacts of both of the relays FQ and BQ are picked up and contact SS of the transmitting device CT3 supplies energy of the short-short code to the rails of the track section to the immediate rear.

As, now, a train advances through the protected stretch of this track, the track relay associated with each of the occupied sections is deenergized, the controlled wayside signal S is continuously lighted to show the "stop" indication, the contacts of relays FQ and BQ are released, and device CT3 supplies the rails of the rear section with energy of the short-long code.

At the first signal location to the rear of the occupied track section the track relay TR follows this short-long code, the wayside signal S displays the "approach" indication of closely separated long flashes (which signifies that only one track section ahead is vacant), the contacts of relay BQ are picked up, those of relay FQ are released, and contact K of device CT3 supplies the rails of the rear track section with energy of the long-short code.

At the second wayside signal location to the rear of the occupied track section the track relay follows this long-short code, the signal S shows the "approach medium" indication of short flashes separated by long intervals (which signifies that only the two sections immediately ahead are vacant), the contacts of relay FQ are picked up and those of relay BQ are released, and the rails of the rear track section receive energy of the long-long code.

At the third signal location behind the occupied track section the track relay TR follows this long-long code, the wayside signal S shows the "approach restricting" indication of long flashes separated by long intervals (which signifies that only the three sections immediately ahead are vacant), the contacts of both of the relays FQ and BQ are picked up and the rails of the rear track section are supplied with energy of the short-short coding.

At the fourth signal location behind the train, the track relay TR follows the pulses of this short-short code, the wayside signal S shows the "clear" indication of short flashes separated by short intervals (which signifies that at least four sections immediately ahead are vacant), the contacts of both of the relays FQ and BQ are picked up and the rails of the rear track section again receive energy of the short-short coding. The particular conditions just described for this fourth location also obtain for all succeeding signal locations to the rear which are associated with unoccupied track sections.

From the foregoing it will be seen that the herein disclosed expedients of my invention substantially reduce the complexity, cost and power consumption of the control apparatus which is needed by railway signalling systems of the continuously coded class. For example, in my new flashing light aspect systems, only two relays (FP and BP in Figs. 1 and 3 and FQ and BQ in Fig. 4) perform the code distinguishing functions of the conventional complex and expensive decoding apparatus of comparable prior art systems; the circuit arrangements are extremely simple and only a few contacts are needed on each relay; and the signal controlling and code selecting equipment is operative by only a small amount of energy.

In addition, the expedients of my invention simplify the construction and reduce the power requirements of the signals themselves, both in wayside and in train carried installations. One factor in this connection is that a nonmoving part signal having but a single lamp L is all that is required. Another is that the conventional colored lenses, which cut down the illumination efficiency, are not needed since an uncolored or white light is as satisfactory as any other kind. For this reason a very low wattage bulb is adequate. A third factor is that the amount of power which the low-wattage signal lamp consumes is still further reduced by the intermittent nature of the lamp energization.

Moreover, my improved signalling systems have an unusually high inherent factor of safety since in using a steady indication for "stop" and flashing indications for "proceed" they are completely immune to phantom proceed indications. In addition, approach lighting may economically be dispensed with in most applications because of the fact that the signal power consumption is so small.

Another practical advantage of my new systems is that they increase the permissible tolerances in code speed and thus allow less expensive coders to be used. Whereas prior art systems employing frequency selective decoding apparatus are not capable of proper operation if a code speed variation of more than two or three cycles per minute is exceeded, the flashing light aspect systems of my invention are very uncritical in this respect and will function satisfactorily even though the speed of individual codes varies over a comparatively wide range.

Finally, all of the above advantages are attained without dispensing with any of the desirable features of continuously coded track circuits. In this connection it is to be noted that my improved systems require no line conductors between signal locations, that they have the same immunity to foreign track circuit currents as do other systems which use track and master relays of the code following type, and that they possess all other desirable features which are incident to signalling systems of the continuously coded class.

Although I have herein shown and described only a few 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 a railway signalling system, the combination of a section of track, means for supplying the rails of said section with recurring pulses of trackway energy which are spaced in accordance with one or another of a plurality of different code patterns, a traffic governing signal lamp, an energizing circuit therefor, and means controlled by said coded energy received from said rails for interrupting said circuit upon the occasion and for the duration of each pulse of that energy and

for completing said circuit at all other times whereby said signal lamp is caused intermittently to light in one or another of a plurality of distinctive manners which respectively simulate the patterns of said plurality of different trackway codes and each of which is identified with a different signal aspect.

2. In a traffic governing system for a stretch of railway track, the combination of means for supplying the rails of said stretch with recurring pulses of trackway energy which are spaced in accordance with one or another of a plurality of different code patterns, a signal lamp, a circuit through which lighting current may be transmitted to said lamp, and a code following relay operated by said coded energy received from said rails and arranged to complete said lamp lighting circuit during each energy off condition of the relay and to interrupt it during each energy on condition thereof whereby to cause said signal lamp intermittently to light in one or another of a plurality of distinctive manners which respectively simulate the patterns of said plurality of different trackway codes and each of which is identified with a different signal aspect.

3. A railway signalling system comprising a section of track, a circuit for supplying energy to the rails of said section, means controlled by advance traffic conditions for periodically interrupting said circuit in accordance with the pattern of one or another of a plurality of different trackway codes, means for receiving energy from said rails, a code following relay operated by said received energy, a signal lamp, a circuit for supplying lighting current to said lamp, and a contact carried by said relay and arranged to complete said circuit during each energy off condition of the relay and to interrupt said circuit during each energy on condition thereof whereby to cause said signal lamp intermittently to light in one or another of a plurality of distinctive manners which respectively simulate the patterns of said plurality of different trackway codes and each of which is identified with a different signal aspect.

4. In a railway signalling system, the combination with a section of track of means effective to supply the rails of said section with energy which is coded under certain conditions and steady under others, a code following relay operated by energy received from said rails, a signal lamp, a circuit through which lighting current may be supplied to said lamp, and means controlled by said code following relay for governing the completion of said circuit, said means being effective to maintain said circuit continuously completed when the relay either fails to receive energy or receives steady trackway energy and to interrupt said circuit in step with the pulses of coded trackway energy when such coded energy is received by the relay.

5. In combination with a section of railway track, means effective to supply the rails of said section with energy which is coded under certain conditions and steady under others, a code following relay operated by energy received from said rails, first and second slow release relays, a circuit over which said first slow release relay is energized when said code following relay is picked up, a circuit over which said second slow release relay is energized when said code following relay is released provided said first slow release relay is picked up, a signal lamp, and a circuit controlled by said code following relay and said second slow release relay for supplying said lamp with energizing current during each energy off condition of the code following relay and also whenever an energy-on condition thereof is prolonged for more than a given time.

6. In combination with a section of railway track, means effective to supply the rails of said section with energy which is coded under certain conditions and steady under others, a code following relay operated by energy received from said rails and having a front contact which closes during each energy-on condition of the relay and a back contact which closes during each energy-off condition thereof, a first repeater relay energized over said front contact of the code following relay and having a slow opening front contact, a second repeater relay energized over a serial connection of said back contact of the code following relay and said front contact of the first repeater relay and having a slow closing back contact, a signal lamp, and a circuit controlled by said code following relay and said second repeater relay for supplying said lamp with energizing current during each energy-off condition of the code following relay and also whenever an energy-on condition thereof is prolonged beyond the contact closing period of said second repeater relay.

7. In combination, a section of railway track, means effective to supply the rails of said section with energy which is coded under certain conditions and which is steady under others, a code following relay operated by energy received from said rails, a first slow release relay energized when said code following relay is picked up, a second slow release relay energized when said code following relay is released provided said first slow release relay is picked up, a signal lamp, a circuit completed over a back contact of said code following relay for supplying lighting current to said lamp during each energy-off condition of that relay, and a circuit completed over a front contact of said code following relay and a back contact of said second slow release relay for also supplying said lamp with lighting current whenever an energy-on condition of the code following relay is prolonged for more than a given time.

8. Railway signalling apparatus comprising a section of track, means effective to supply the rails of said section with energy which is coded under certain conditions and which is steady under other conditions, a code following relay operated by energy received from said rails, a first slow release relay responsive to code following operation of said code following relay, a second slow release relay also responsive to said code following operation provided said first slow release relay is picked up, a signal lamp, and circuit means controlled by said code following relay and said second slow release relay for supplying lighting current to said lamp during each energy-off condition of the code following relay and also whenever an energy-on condition thereof is prolonged for more than the release period of either of said slow release relays.

9. In a railway signalling system, the combination with adjoining forward and rear sections of track of means for supplying coded energy to the rails of said forward section, a code following track relay operated by energy received from said forward section rails, a circuit for supplying energy to the rails of said rear section, a plurality of coding contacts which operate in distinctive manners, means controlled by said track relay for causing one or another of said coding contacts to control said rail supply circuit depending

upon whether said relay is or is not following a trackway code, and a flashing light signal positioned at the entrance of said forward track section and energized over a circuit which includes a contact of said track relay.

10. In a railway traffic controlling system, the combination with adjoining forward and rear sections of track of means for supplying coded energy to the rails of said forward section, a code following track relay operated by energy received from said forward section rails, a circuit for supplying energy to the rails of said rear section, coding contacts which operate at different rates, a first slow release relay responsive to code following operation of said track relay, a second slow release relay also responsive to said code following operation provided said first slow release relay is picked up, means including a contact of said second slow release relay for causing one of said coding contacts to control said rail supply circuit when that relay is picked up and another of said coding contacts to control the rail supply circuit when that relay is released, and a flashing light signal positioned at the entrance of said forward track section and energized over a circuit which includes a contact of said code following track relay.

11. In combination with a section of railway track, a circuit through which current may be supplied to the rails of said section, a source of direct current energy included in said circuit, a transformer having a secondary winding which also is included in said circuit and a primary winding, a code repeating relay, a first contact of said repeating relay connected in said rail supply circuit for controlling the completion thereof, a source of alternating current energy, and a second contact of said repeating relay arranged to control a connection of the primary winding of said transformer with said alternating current source.

12. In combination with a section of railway track, a circuit through which current may be supplied to the rails of said section, a source of direct current energy included in said circuit, a transformer having a secondary winding which also is included in said circuit and a primary winding, a code repeating relay, a first contact of said repeating relay connected in said rail supply circuit for controlling the completion thereof, a source of alternating current energy, and a second contact of said repeating relay arranged to control a connection of the primary winding of said transformer with said alternating current source, said contacts being so coordinated that the first closes before the second and the second opens before the first.

13. In a railway signalling system, the combination with a signal block length of track which is intersected by a highway and divided into a forward and a rear section, of means for supplying coded energy to the rails of said forward section, means effective to repeat said coded energy into the rails of said rear section and to supply steady energy to said rear section rails when no energy is received from said forward rails, a code following track relay operated by energy received from said rear rails, a flashing light signal positioned at the entrance of said rear section and energized over a circuit which includes a back contact of said track relay, a slow release relay responsive both to code following operation and to steady energy response on the part of said track relay, a highway crossing signal at the location of said intersection, and a control relay therefor which places the signal in operation only when said slow release relay is released.

14. In a cab signalling system for use with trackway apparatus which supplies coded energy to the running rails, the combination of: train carried apparatus comprising means for receiving energy from said rails; a code following master relay operated by said energy and having contacts which occupy one position under conditions of energy reception and a second position when no energy is received; a pair of slow release relays controlled by one of said contacts, the first being responsive to code following operation by that contact and the second also being responsive to said code following operation when such is combined with a picked up condition of the first slow release relay; and a cab signal lamp jointly controlled by another contact of said master relay and by said second slow release relay, said lamp lighting whenever said contact is in its energy-off position and also whenever the contact remains in its energy-on position for longer than the release period of said second slow release relay.

15. In a railway signalling system, the combination with a section of track of a circuit for supplying energy to the rails of said section, a coding contact which operates to produce recurring on and off periods of substantially equal lengths, a second coding contact which operates to produce on periods of one length and off periods of a substantially different length, means controlled by advance traffic conditions for causing one or the other of said coding contacts to control said rail supply circuit, a code following relay operated by energy received from said rails, a signal lamp, a circuit for supplying lighting current to said lamp, and a contact carried by said relay and arranged to complete said circuit during each energy-off condition of the relay and to interrupt said circuit during each energy-on condition thereof.

16. In a railway signalling system, the combination with forward and rear sections of track of means for supplying coded energy to the rails of said forward section, a circuit for energizing the rails of said rear section, a coding contact which operates to produce recurring on and off periods of substantially equal lengths, a second coding contact which operates to produce on periods of one length and off periods of a substantially different length, a code following track relay connected to receive operating energy from the rails of said forward section, a slow release relay controlled by said track relay and arranged to distinguish whether the track relay is or is not following a trackway code, means governed by said slow release relay for causing one or another of said coding contacts to control said rear section rail supply circuit, a second code following relay operated by energy received from the rails of said rear track section, and a flashing light signal controlled over a back contact of said second code following relay.

17. In a railway signalling system including a forward and a rear section of track, the combination of: means for supplying coded energy to the rails of said forward section, means selectively operable to supply the rails of said rear section with energy of one or another of three codings in which, respectively, the on and the off periods are of a similar length, the on periods are substantially longer than the off periods and the off periods are substantially longer than the on periods; a

code following track relay connected to receive operating energy from the rails of said forward section; a pair of transformer fed slow release relays controlled by said track relay and arranged to distinguish whether the track relay is following a trackway code and also whether the on and the off periods of that code are of similar or dissimilar lengths; means governed by said slow release relays for selecting which of the three codes named above is supplied to the rails of said rear track section; a second code following relay operated by energy received from the rails of said rear section; and a flashing light signal controlled over a back contact of said second code following relay.

18. In a railway signalling system, the combination with forward and rear sections of track of means for supplying coded energy to the rails of said forward section, a circuit for supplying energy to the rails of said rear section, a coding contact which operates to produce recurring on and off periods of substantially equal lengths, a second coding contact which operates to produce on periods of one length and off periods of a substantially different length, a code following track relay connected to receive operating energy from the rails of said forward section, a pair of slow response relays controlled by said track relay and arranged to distinguish whether the track relay is following a trackway code and also whether the on and the off periods of that code are of similar or dissimilar lengths, means governed by said slow response relays for causing one or another of said coding contacts to control said rear section rail supply circuit, a second code following relay operated by energy received from the rails of said rear track section, and a flashing light signal controlled over a back contact of said second code following relay.

HOWARD A. THOMPSON.