June 9, 1942. H. G. BLOSSER 2,285,891

RAILWAY SIGNAL CONTROL CIRCUIT

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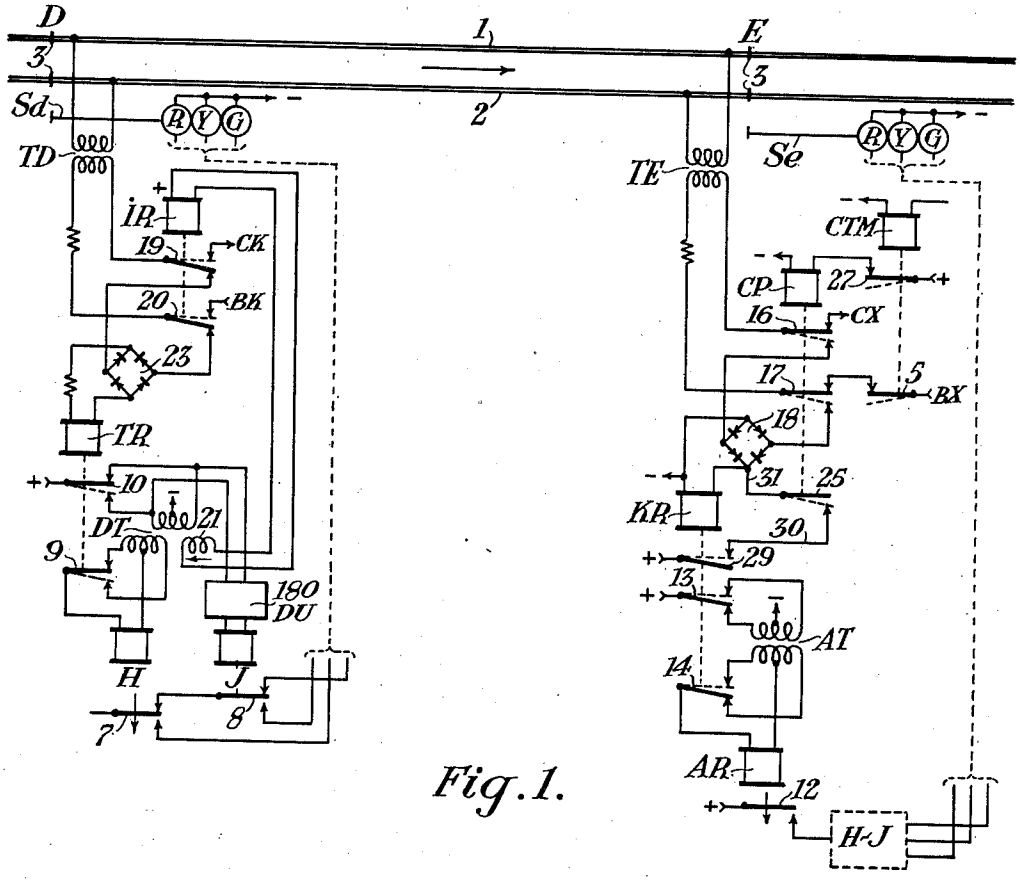


Fig. 1.

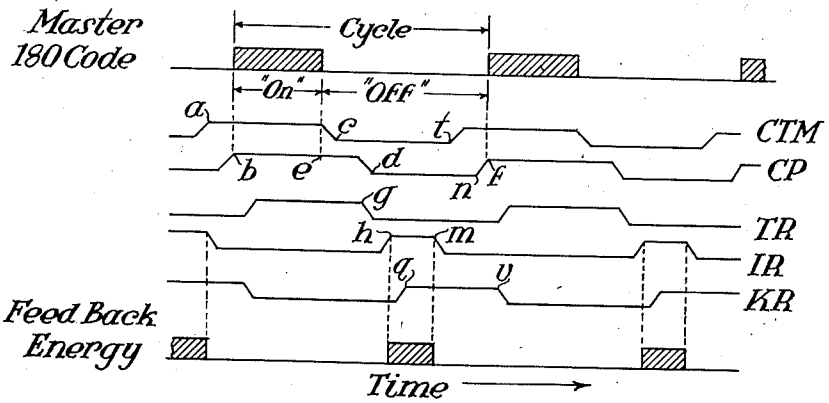


Fig. 2.

INVENTOR
Herman G. Blosser.
BY
HIS ATTORNEY

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RAILWAY SIGNAL CONTROL CIRCUIT

Herman G. Blosser, Pittsburgh, Pa., assignor to The Union Switch & Signal Company, Swissvale, Pa., a corporation of Pennsylvania

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11 Claims. (Cl. 246—38)

My invention relates to circuits for controlling railway signals and it has special reference to the utilization by such circuits of the "coded feed back" operating principle that first was disclosed by Frank H. Nicholson Patent No. 2,021,944 (issued November 26, 1935) and that also is shown by numerous later patents and applications of common ownership herewith.

Generally stated, the object of my invention is to increase the utility and broaden the range of application of "coded feed back" control circuits of both the track and the line type.

A more specific object is to prevent the "off" period energized detector relays of such circuits from being falsely picked up by "storage" potential when the circuit conductors are by-passed and have only the "on" period pulses of master code energy impressed thereupon.

Another object is to provide improved means for prolonging each period of detector relay pick-up for the full duration of the master code "off" period within which the pick-up occurs.

A further object is to improve the organization of the apparatus by which the master "on" period energy pulses and the feed back "off" period energy pulses are supplied to and received from the circuit conductors.

In practicing my invention, I attain the above and other objects and advantages by: (1) supplementing the master coding device by a repeater relay which introduces a short delay between the end of each master code "on" period and the subsequent "off" period connection of the feed back energized detector relay with the circuit conductors; and (2) including a back contact of this repeater relay in the hold-up prolonging circuit for the detector relay.

I shall describe one form of "coded feed back" control circuit which embodies my invention, and shall then point out the novel features thereof in claims. This illustrative embodiment is disclosed in the accompanying drawing, in which:

Fig. 1 is a diagrammatic representation of a track type of control circuit that is equipped with the improved apparatus of my invention and that is organized to form part of an automatic block signaling system having "coded feed back" approach lighting control; and

Fig. 2 shows "master" and "feed back" codes for the circuit of Fig. 1, and indicates the manner in which those codes are produced by joint relay operation.

In the several views of the drawing, like reference characters designate corresponding parts.

Referring first to Fig. 1, the improved control circuit organization of my invention is there disclosed in association with a coded track circuit system of automatic block signaling for a railway track 1—2 over which it will be assumed that traffic moves in the single direction indicated by the arrow, or from left to right in the diagram. The protected stretch of this track is divided into the customary successive sections by insulated rail joints 3 and the rails of each section form part of a track type of control circuit which normally is capable of transmitting energy between its two ends but which at times is rendered incapable of such transmission.

In this view of Fig. 1, reference characters D and E respectively designate the entrance and the exit ends of one of these track sections (which illustratively is shown as being a full signal block in length); character TR designates a code following track relay which is installed at the entrance end of the section and operated by energy received from the rails thereof; characters BX—CX the terminals of an alternating current "master" energy source that is provided at the section exit for the purpose of supplying these rails with the relay operating energy just referred to; character CTM a coding device having a contact 5 which codes this energy by periodically interrupting the rail supply circuit; and character S the usual wayside signal which guards the entrance of each of the track blocks and which is controlled by the associated track relay TR through the medium of decoding apparatus H—J.

An automatic block signaling system of the referred to coded track circuit type operates without the aid of line wires and in the representative form disclosed it includes all of the elements above named. Such a system further comprises the customary facilities (not shown in Fig. 1) for continuously operating each of the exit end relays CTM at one or another of the usual plurality of distinctive code rates. Selection among these rates (which in a typical three-indication system may consist of 75 and 180 energy pulses per minute) is made in accordance with advance traffic conditions by the decoding apparatus H—J functioning in customary manner.

This decoding apparatus is controlled in the usual fashion by the associated track relay TR and it performs the further function of selectively setting up a lighting circuit for one or another of the signal lamps (G, Y and R in the typical three-indication system above referred to) of the wayside signal S at the same location,

Typically, such setting up is effected by contacts 7 and 8 of "home" and "distant" relays H and J that (as shown at location D) are energized through rectifying elements 9 and 180DU from a decoding transformer DT to which exciting current is supplied over the usual pole changing contact 10 of the code following relay TR.

In order that each of the wayside signals S may be kept deenergized as long as the section to the inmediate rear thereof remains vacant and lighted only when a train places a shunt across the rails of that rear section, the lamp lighting circuits therefor are carried over a back contact 12 of an approach relay AR that is installed at each of the signal locations D, E, etc. Each of these relays AR is slow releasing and as long as the winding thereof is recurrently energized at code speed rate, contact 12 occupies the illustrated picked up position wherein the signal circuits are disconnected from their lighting supply source.

Controlling the energization of each of these approach relays AR is a detector relay KR installed at the section exit in the manner shown at location E and operating contacts 13—14 in the exciting and output circuits of a transformer AT through which pick-up current is at proper times supplied to the approach relay. This arrangement of devices KR—AT—AR embodies principles that are disclosed and claimed in a copending application Serial No. 210,744, filed May 28, 1938 by Frank H. Nicholson et al., now U. S. Patent 2,237,788, granted Apr. 8, 1941, and it results in relay AR holding contact 12 picked up as long as relay KR follows code and in releasing contact 12 whenever relay KR ceases to follow code.

The pick-up winding of the detector relay KR is connected with the section rails during and only during the "master" code "off" periods. This connection is established at the back points of contacts 16 and 17 of a relay CP which (as will be more completely described later) repeats the operations of coding device CTM; it includes a full wave rectifier 18; and over it "off" period pulses of "feed back" energy are impressed upon the detector relay as long as the section remains vacant. These pulses recurrently pick up contacts 13—14 and thereby cause the approach relay AR to keep signal Se deenergized.

These detector relay energizing pulses of feed back energy are supplied to the section rails by apparatus that is installed at the entrance location D. This apparatus comprises: (1) a source of "feed back" energy designated by the alternating current supply terminals BK—CK; (2) an impulse relay IR having contacts 19 and 20 for transferring the connection of the section rails 1—2 from the track relay TR to source BK—CK during each "off" period of the received "master" code; and (3) a circuit supplied from a winding 21 of the main decoding transformer DT over which a short pulse of pick-up current is impressed upon the impulse relay IR at the beginning of each of the named "off" code periods.

The just named impulse relay IR may be of the same polarized type as that shown and described by Patent No. 2,174,255 which issued to me on September 26, 1939, and which now is the subject of a reissue application Serial No. 358,319, filed September 25, 1940, now U. S. Reissue Patent 21,783, granted April 29, 1941. As long as the winding of this impulse relay remains deenergized or receives "reverse" polarity energy, contacts 19—20 stay released and bridge the operating winding of track relay TR across the section rails by way of a connection that includes a full wave rectifier 23 and a track transformer TD.

This connection is completed during each "on" period of the received master code. During each "off" period of the received master code, however, the decoding transformer winding 21 supplies the impulse relay IR with a short pulse of "given" polarity energy. Each of these pulses picks up contacts 19—20 and by transferring the rail connection from the relay TR to the feed back source BK—CK causes energy from that source then to be supplied to the section rails.

The "coded feed back" control circuit combination of Fig. 1 has illustratively been shown as utilizing alternating current energy for the operation thereof. As has now become apparent, this operating energy is supplied from the "master" and "feed back" sources BX—CX and BK—CK at the circuit exit and entrance ends E and D.

Interposed between the master source and the section rails is a track transformer TE which during the "on" periods of the supplied master code functions as a step-down device, and which during the "off" code periods steps up the potential of the received feed back energy to a value suitable for operating the detector relay KR. The earlier named transformer TD at the section entrance performs similar functions. During the "off" periods of the received master code it steps down the potential of the rail supplied feed back energy from source BK—CK and during the "on" periods of that code it steps up the received master energy to a potential suitable for operating the track relay TR.

The improvements of my invention reside in: (1) the interposition of the repeater relay CP between the master coding device CTM and the rail-to-detector relay connection for the purpose of introducing a short delay between the end of each master "on" period and the subsequent "off" connection of the detector relay with the section rails; and (2) an inclusion of a contact 25 of this repeater relay in the hold-up prolonging or "stick" circuit (later to be described) for the detector relay KR.

The improvements which the repeater relay CP effects will first be considered. In the prior art organizations which the "coded feed back" control circuits of my Patent 2,174,255 typify, the master coding contact 5 is directly used to connect the feed back energized detector relay KR with the section rails 1—2 during the master code "off" periods. With that arrangement, the detector relay connection is completed almost simultaneously with the end of each master code "on" period.

In certain track circuit installations wherein that arrangement is used, difficulty has been experienced in keeping the detector relay KR continuously released during occupied section conditions. This difficulty has its foundation in the accumulation between the section rails of a "storage" potential during each master code "on" period and the persistence of this accumulated potential into the early portion of each succeeding "off" code period.

When the detector relay KR was connected with the rails immediately after the "on" period end, it received and in certain instances was falsely picked up by the remaining voltage of this storage energy. Even with a train in the track section, the detector relay KR was in this manner continued in code following operation. In a system of the type shown in Fig. 1, such a continu-

ance is obviously objectionable in that entry of a train into section D—E, for example, is by it prevented from releasing approach relay AR and lighting signal Se in the intended manner.

To overcome this difficulty, I have supplemented the conventional exit end organization of track circuit apparatus by the repeater relay CP and have arranged that this relay delay the connection of the detector relay KR until such a point in each master code "off" period as the track storage potential has died down to a value that is ineffective for operating relay KR.

In the illustrative organization which Fig. 1 shows at location E, this repeater relay CP is energized from any suitable local source, such as is designated by the terminals "plus" and "minus", over a pick-up circuit which includes a front contact 27 of the master coding device CTM. The contacts of relay CP thus repeat all pick-up and releasing operations of coding device 27. That is, repeater contacts 16—17—25 are picked up when contacts 5—27 of device CTM are picked up and released when contacts 5—27 are released.

On each action, however, there is a delay on the part of the repeating contacts. Referring to Fig. 2, if the coding device contacts reach their picked up position at point *a*, then the repeater relay contacts will reach their picked up position at a slightly later point designated as *b*. Likewise, if the coding device contacts reach their released position at point *c*, the repeater relay contacts will reach their released position at the later point *d*.

Examining in greater detail the circuits of which contacts 16—17 of relay CP form a part, it will be seen that when these contacts are picked up they complete the circuit over which master source BX—CX supplies the section rails with "on" period pulses of master code energy, and that in releasing these same contacts transfer the rail connection from the master source to the pick-up circuit of the detector relay KR. This transfer is, however, delayed by the time *c*—*d* of Fig. 2. During this delay, the "storage" potential present in the track rails at the end of the "on" code period has a chance to die down or entirely disappear and, in consequence, the detector relay KR cannot falsely be picked up thereby.

The operation of my extended exit end facilities will have become more or less apparent from the foregoing description of the structure comprised thereby. Under both vacant and occupied conditions of track section D—E, the master coding relay CTM picks up and releases in the regularly recurring manner which the diagram of Fig. 2 represents, and the repeater relay CP picks up and releases in delayed synchronism with the master coding device, as points *b* and *d* of Fig. 2 show.

When the track section is vacant and devices CTM and CP are both picked up, as shown at *b*—*e* in Fig. 2, the exit end source BX—CX energizes and picks up the entrance end track relay TR over a circuit that includes front contact 5 of device CTM, front contacts 16—17 of device CP, the track transformer TE, the section rails 1—2, the track transformer TD, back contact 19—20 of device IR, rectifier 23 and the winding of relay TR. Upon, however, the release of either of the devices CTM or CP, as during the time period *e*—*f* of Fig. 2, the master code supply circuit is interrupted and at a later point, designated at *g* in Fig. 2 and determined by the relay characteristics, the entrance end track relay TR releases.

Each such release causes decoding transformer DT to induce in winding 21 a pulse of energy which picks up the impulse relay IR at some point such as shown at *h* in Fig. 2. Contacts 19—20 now transfer the rail connection from relay TR to feed back source BK—CK. While this connection is completed, or for time *h*—*m* of Fig. 2, that entrance end source energizes and picks up the exit end detector relay KR over a circuit that includes front contacts 19—20 of device IR, transformer TD, the track rails 1—2, transformer TE, back contacts 16—17 of relay CP, rectifier 18 and the winding of relay KR.

The impulse relay IR is timed to release before the master coding device CTM picks up repeater relay CP to start, as at point *f* of Fig. 2, another master code "on" period. Because of this release timing, the pulse of feed back energy is terminated, as at point *m* of Fig. 2, and the track relay TR is reconnected with the section rails well in advance of that succeeding "on" period.

In the manner just explained the code producing movements of contact 5 of master coding device CTM are reproduced by the entrance end relay TR and the "off" period pick-ups of the impulse relay IR are reproduced by the exit end detector relay KR. These reproducing actions take place, quite obviously, only as long as the section D—E remains vacant and the rails 1—2 thereof are left free to transmit energy between the two circuit ends.

Upon entry of a train into section D—E, the resulting by-pass of rails 1—2 prevents master code energy from source BX—CX from reaching relay TR and also prevents feed back energy from source BK—CK from reaching detector relay KR. In consequence, both of these relays then are kept continuously released.

In the case of relay KR, this desired condition of continuous release persists even though the section rails 1—2 accumulate considerable "storage" potential during each "on" period of the master code energy that is supplied during occupied section conditions. The reason for this persistence is the before described delay, designated at *e*—*d* in Fig. 2, which the repeater relay CP introduces in each "off" period connection of the detector relay KR with the section rails.

The magnitude of this delay (*e*—*d* of Fig. 2) will, of course, vary with the track circuit characteristics and may be adjusted by changing the delay period of the repeater relay CP. For extreme cases of storage effect, a comparatively long period may be required. For other installations where the storage effect is less pronounced, a smaller delay will be found adequate.

The expedients of my invention by which the hold-up time of the detector relay KR is prolonged will next be considered. As Fig. 2 shows, each pulse of feed back energy which is supplied over the front points of contacts 19—20 of the impulse relay IR has the comparatively short length that is designated by *h*—*m*. Each of these feed back pulses picks up detector relay KR at a point therein such as is indicated at *q* in Fig. 2. In the absence of hold-up prolonging means, the period of each pick-up for the detector relay KR would obviously be exceedingly short in comparison to the total length of the master code "off" period during which that pick-up occurs.

Such extreme shortness of pick-up time is undesirable in that it means a greatly prolonged time of relay release. In the performance of

control functions such as involve the approach relay AR of Fig. 1, as close an approximation as possible to equal pick-up and release times is much to be desired.

To equalize the pick-up and release times of detector relay devices of the type which Fig. 1 shows at KR, it has been proposed to supplement the relay pick-up circuit by a "stick" circuit which is completed from the time of each pick-up of the relay until the end of the "on" code period during which that pick-up occurs. One form which such a stick circuit may take is disclosed and claimed by Patent No. 2,172,893 which issued to Edward U. Thomas on September 12, 1939.

As there shown, the detector relay stick circuit employs a front contact of the detector relay connected in series with a back contact of the associated master coding device. In the improved arrangement of my invention (see location E of Fig. 1) the corresponding stick circuit makes use of a front contact **29** of the detector relay KR that is connected in series with a back contact **25** of the repeater relay CP.

In this improved arrangement, cut-off of the stick circuit energization is extended beyond the pick-up time *t* (Fig. 2) of the master coding device CTM and does not occur until the time *n* (Fig. 2) that the repeater relay CP picks up. In consequence, the hold-up time of the detector relay KR is prolonged to the order indicated at *v* in Fig. 2.

The matter in which my improved detector relay stick circuit operates will now have become more or less apparent. During each master code "off" period, contact **25** of relay CP is released and it sets the circuit up. Upon pick-up of contact **29** of relay KR the circuit is completed. It extends from the positive terminal of a suitable supply source through front contact **29**, conductor **30**, back contact **25**, conductor **31** and the winding of relay KR back to the negative terminal of the supply source.

Once completed this stick circuit holds the detector relay continuously picked up until an interruption therein occurs. Such an interruption is made at contact **25** upon pick-up of relay CP at the "off" period end. This allows relay KR to release at the later time *v* of Fig. 2.

Although the several improvements of my invention have been shown and described as forming a part of a "coded feed back" control circuit of the track type, it will be obvious that these improvements are not restricted thereto but that they also have utility when applied to control circuit combinations of any other form wherein the conductors lose their normal energy transmitting capability under certain conditions only.

Thus, instead of being track rails as shown, the control circuit conductors **1—2** may also take the form of line wires which connect master energy supply and feed back repeating equipment (see devices CTM—CP—KR at location E in Fig. 1) at one end of the circuit with master energy receiving and feed back energy supply equipment (see devices TR—IR—TD at location D in Fig. 1) at the other end of the circuit.

When used with a control circuit of the line conductor type just described, each of the improvements herein disclosed will function in exactly the same manner as when used with the track type of control circuit that is herein illustrated. My invention is, therefore, one of broad utility and is not to be restricted to the specific form of application that I have shown by way of illustration.

From the foregoing description of Figs. 1 and 2, therefore, it will be seen that I have made important contributions to control circuit combinations of the "coded feed back" class. In particular, I have increased the utility and broadened the range of application of such circuits; I have prevented the "off" period energized detector relays from being falsely picked up by "storage" potential when the circuit conductors are by-passed and have only the "on" period pulses of master code energy impressed thereon; I have provided improved means for prolonging each period of detector relay pick-up for the full duration of the master code "off" period within which the pick-up occurs; and I have improved the organization of the apparatus by which the master code "on" period energy pulses and the feed back "off" period energy pulses are supplied to and received from the circuit conductors.

Although I have herein shown and described only one form 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, a control circuit comprising a pair of conductors which normally are capable of transmitting energy between given and opposite ends of said circuit but which at times are rendered incapable of such transmission, means including a coding device at the given end of said circuit for supplying said conductors with master code energy in the form of recurring "on" period pulses that are separated by "off" period intervals, means governed by the said pulses of master energy that are received at the opposite end of said circuit for there further supplying said conductors with feed back energy in the form of pulses that recur in step with said master code "off" periods, a detector relay at said given circuit end for distinguishing between said normal or energy transmitting conditions of said circuit conductors and non-transmitting conditions thereof, and means controlled by said coding device for (1) connecting said detector relay with said conductors during each of said master code "off" periods whereby under said energy transmitting conditions of those conductors the detector relay receives and responds to the said pulses of feed back energy which the conductors then transmit and (2) maintaining said detector relay disconnected from said conductors during each of said master code "on" periods plus the early portion of each following "off" period whereby at all times the detector relay is prevented from receiving either the master energy of said "on" period pulses or the master energy potential that under non-transmitting as well as transmitting conditions of said circuit may be stored in said conductors at the beginning of each of said "off" code periods.

2. In combination, a control circuit comprising a pair of conductors which normally are capable of transmitting energy between given and opposite ends of said circuit but which at times are rendered incapable of such transmission, means including a coding device at the given end of said circuit for supplying said conductors with master code energy in the form of recurring "on" period pulses that are separated by "off"

period intervals, means governed by the said pulses of master energy that are received at the opposite end of said circuit for there further supplying said conductors with feed back energy in the form of pulses that recur in step with said master code "off" periods, a detector relay at said given circuit end for distinguishing between said normal or energy transmitting condition of said circuit conductors and non-transmitting conditions thereof, a repeater relay controlled by said coding device and occupying a first position during each of said master code "on" periods but shifting after a short delay to a second position upon the occasion of each of said master code "off" periods, and means including a contact of said repeater relay that is closed in said second position and open in said first position for connecting said detector relay with said conductors during and only during the concluding portion of each of said master code "off" periods whereby under said energy transmitting conditions of those conductors the detector relay receives and responds to the said pulses of feed back energy which the conductors then transmit and whereby at all times the detector relay is prevented from receiving master energy storage potential that under non-transmitting as well as transmitting conditions of said circuit may be stored in said conductors at the beginning of each of said "off" code periods.

3. In combination, a control circuit comprising a pair of conductors which normally are capable of transmitting energy but which at times are rendered incapable of such transmission, a coding device having contacts which shift from a front to a back position and from said back to said front position repeatedly and in synchronous relation with respect to each other, a repeater relay energized over one of said coding device contacts and being picked up when that contact is in its front position but releasing after a short delay upon each transfer of that contact to its back position, a source of master energy for said circuit, a connection which is completed only when another of said coding device contacts is in its front position at a time when a contact of said repeater relay is picked up and over which said circuit conductors are supplied with master code energy that is derived from said master source and that is in the form of recurring "on" period pulses that are separated by "off" periods intervals, means governed by said "on" period pulses of master energy for further supplying said conductors with feed back energy in the form of pulses that recur in step with said master code "off" periods, a detector relay for distinguishing between said energy transmitting and said non-transmitting conditions of said circuit conductors, and a connection of said detector relay with said conductors which includes a back contact of said repeater relay and which is completed during and only during each of said master code "off" periods but not until after the initial portion thereof whereby under said circuit transmitting conditions the detector relay receives and responds to the said pulses of feed back energy which the circuit conductors then transmit and whereby at all times the detector relay is prevented from receiving master energy storage potential that under said non-transmitting as well as said transmitting conditions of said circuit may be present between said conductors during the early portion of each of said "off" code periods.

4. In combination, a section of railway track, means including a coding device for supplying the rails of said section with master code energy in the form of recurring "on" period pulses that are separated by "off" period intervals, means effective under vacant conditions of said section and governed by said "on" period master energy pulses for further supplying said rails with feed back energy in the form of pulses that recur in step with said master code "off" periods, a detector relay for distinguishing between vacant and occupied conditions of said section, and means controlled by said coding device for connecting said detector relay with said rails during and only during the concluding portion of each of said master code "off" periods whereby under said vacant section conditions the detector relay receives and responds to the said pulses of feed back energy which those rails then transmit and whereby at all times the detector relay is prevented from receiving master energy storage potential that under occupied as well as vacant conditions of said section may be present between said rails during the early portion of each of said "off" code periods.

5. In combination, a section of railway track, means including a coding device for supplying the rails of said section with master code energy in the form of recurring "on" period pulses that are separated by "off" period intervals, means effective under vacant conditions of said section and governed by said "on" period master energy pulses for further supplying said rails with feed back energy in the form of pulses that recur in step with said master code "off" periods, a detector relay for distinguishing between vacant and occupied conditions of said section, and means controlled by said coding device for (1) connecting said detector relay with said rails during each of said master code "off" periods whereby under said vacant section conditions the detector relay receives and responds to the said pulses of feed back energy which those rails then transmit and (2) maintaining said detector relay disconnected from the section rails during each of said master code "on" periods plus the early portion of each following "off" period whereby at all times the detector relay is prevented from receiving either the master energy of said "on" period pulses or the master energy potential that under occupied as well as vacant conditions of said section may be stored in said rails at the beginning of each of said "off" code periods.

6. In combination, a section of railway track, means including a coding device for supplying the rails of said section with master code energy in the form of recurring "on" period pulses that are separated by "off" period intervals, means effective under vacant conditions of said section and governed by said "on" period master energy pulses for further supplying said rails with feed back energy in the form of pulses that recur in step with said master code "off" periods, a detector relay for distinguishing between vacant and occupied conditions of said section, a repeater relay controlled by said coding device and occupying a first position during each of said master code "on" periods but shifting after a short delay to a second position upon the occasion of each of said master code "off" periods, and means including a contact of said repeater relay that is closed in said second position and open in said first position for connecting said detector relay with said rails during and only during the concluding portion of each of said master code

"off" periods whereby under said vacant section conditions the detector relay receives and responds to the said pulses of feed back energy which those rails then transmit and whereby at all times the detector relay is prevented from receiving master energy storage potential that under occupied as well as vacant conditions of said section may be present between said rails during the early portion of each of said "off" code periods.

7. In combination, a section of railway track, a source of master control energy for said section, a detector relay for distinguishing between vacant and occupied conditions of said section, a coding device having contacts which repeatedly shift from a front to a back and from said back to said front position, a contact of said device which in a given one of said two positions connects the section rails with said source and thereby causes those rails to receive an "on" period pulse of master code energy and which in the other of said positions interrupts that connection and thereby produces a master code "off" period, means effective under vacant conditions of said section and governed by said "on" period master energy pulses for further supplying said rails with feed back energy in the form of pulses that recur in step with said master code "off" periods, a repeater relay controlled by said coding device and occupying a first position during each of said master code "on" periods but shifting after a short delay to a second position upon the occasion of each of said master code "off" periods, and means including a contact of said repeater relay that is closed in said second position and open in said first position for connecting said detector relay with said rails during and only during the concluding portion of each of said master code "off" periods whereby under said vacant section conditions the detector relay receives and responds to the said pulses of feed back energy which those rails then transmit and whereby at all times the detector relay is prevented from receiving master energy storage potential that under occupied as well as vacant conditions of said section may be present between said rails during the early portion of each of said "off" code periods.

8. In combination, a section of railway track, a source of master control energy for said section, a detector relay for distinguishing between vacant and occupied conditions of said section, a coding device having contacts which shift from a front to a back and from said back to said front position repeatedly and in synchronous relation with respect to each other, a repeater relay energized over one of said coding device contacts and being picked up when that contact is in its front position but releasing after a short delay upon each transfer of that contact to its back position, a circuit which is completed only when another contact of said coding device is in its front position at a time when a contact of said repeater relay is picked up and over which the rails of said section are supplied with master code energy that is derived from said control source and that is in the form of recurring "on" period pulses that are separated by "off" period intervals, means effective under vacant conditions of said section and governed by said "on" period master energy pulses for further supplying said rails with feed back energy in the form of pulses that recur in step with said master code "off" periods, and a circuit completed only when a contact of said repeater relay is released for connecting said detector relay with said rails during each of said master code "off" periods but not until after the initial portion thereof whereby under said vacant section conditions the detector relay receives and responds to the said pulses of feed back energy which those rails then transmit and whereby at all times the detector relay is prevented from receiving master energy storage potential that under occupied as well as vacant conditions of said section may be present between said rails during the early portion of each of said "off" code periods.

9. In combination, a control circuit comprising a pair of conductors, means including a coding device for supplying said conductors with master code energy in the form of recurring "on" period pulses that are separated by "off" period intervals, means governed by said "on" period pulses of master energy for further supplying said conductors with feed back energy in the form of momentary pulses that recur in step with said master code "off" periods, a repeater relay controlled by said coding device and occupying a first position during each of said master code "off" periods but shifting to a second position upon the occasion of each of said master code "on" periods, a code following detector relay provided with a pick-up winding and with a stick circuit, means including a first contact of said repeater relay that is closed only in said first position for connecting said pick-up winding with said conductors during each of said master code "off" periods whereby the detector relay receives and is picked up by each of the said feed back energy pulses which those conductors transmit, means including a front contact of said detector relay and a second contact of said repeater relay that is closed only in said first position for completing said stick circuit from the time of each pick-up of the detector relay until the end of the off code period within which that pick-up occurs whereby to prolong the hold-up time of the detector relay for the full duration of each of those "off" code periods, and apparatus controlled by said detector relay and distinctively responsive according as that relay is or is not recurrently picking up and releasing.

10. In combination, a section of railway track, means including a coding device for supplying the section rails with master code energy in the form of recurring "on" period pulses that are separated by "off" period intervals, means effective under vacant conditions of said section and governed by said "on" period master energy pulses for further supplying said rails with feed back energy in the form of momentary pulses that recur in step with said master code "off" periods, a repeater relay controlled by said coding device and occupying a first position during each of said master code "off" periods but shifting to a second position upon the occasion of each of said master code "on" periods, a code following detector relay provided with a pick-up winding and with a stick circuit, means including a contact of said repeater relay that is closed only in said first position for connecting said pick-up winding with said rails during each of said master code "off" periods whereby the detector relay receives and is picked up by each of the said feed back energy pulses which those rails transmit, means including a front contact of said detector relay and a contact of said repeater relay that is closed only in said first position for completing said stick circuit from the time of each pick-up of the detector relay until the end of the

"off" code period within which that pick-up occurs whereby to prolong the hold-up time of the detector relay for the full duration of each of those "off" code periods, and traffic governing apparatus controlled by said detector relay and distinctively responsive according as that relay is or is not recurrently picking up and releasing.

11. In combination, a section of railway track, a source of master control energy for said section, a coding device having contacts which repeatedly shift from a front to a back and from said back to said front position, a repeater relay energized over a contact of said coding device and being released when that contact is in its back position but picking up after a short delay upon each transfer of that contact to its front position, a circuit which is completed only when a contact of said coding device is in its front position at a time when a contact of said repeater relay is picked up and over which the rails of said section are supplied with master code energy that is derived from said control source and that is in the form of recurring "on" period pulses that are separated by "off" period intervals, means effective under vacant conditions of said section and governed by said "on" period master energy pulses for further supplying said rails with feed back energy in the form of momentary pulses that recur in step with said master code "off" periods, a code following detector relay provided with a pick-up winding and with a stick circuit, means including a back contact of said repeater relay for connecting said pick-up winding with said rails during said recurrent "off" code periods whereby the detector relay receives and is picked up by each of the said feed back energy pulses which those rails transmit, means including a back contact of said repeater relay and a front contact of said coding device for completing said stick circuit from the time of each pick-up of the detector relay until the end of the "off" code period within which that pick-up occurs whereby to prolong the hold-up time of the detector relay for the full duration of each of those "off" code periods, and apparatus controlled by said detector relay and distinctively responsive according as that relay is or is not recurrently picking up and releasing.

HERMAN G. BLOSSER.