

March 24, 1942.

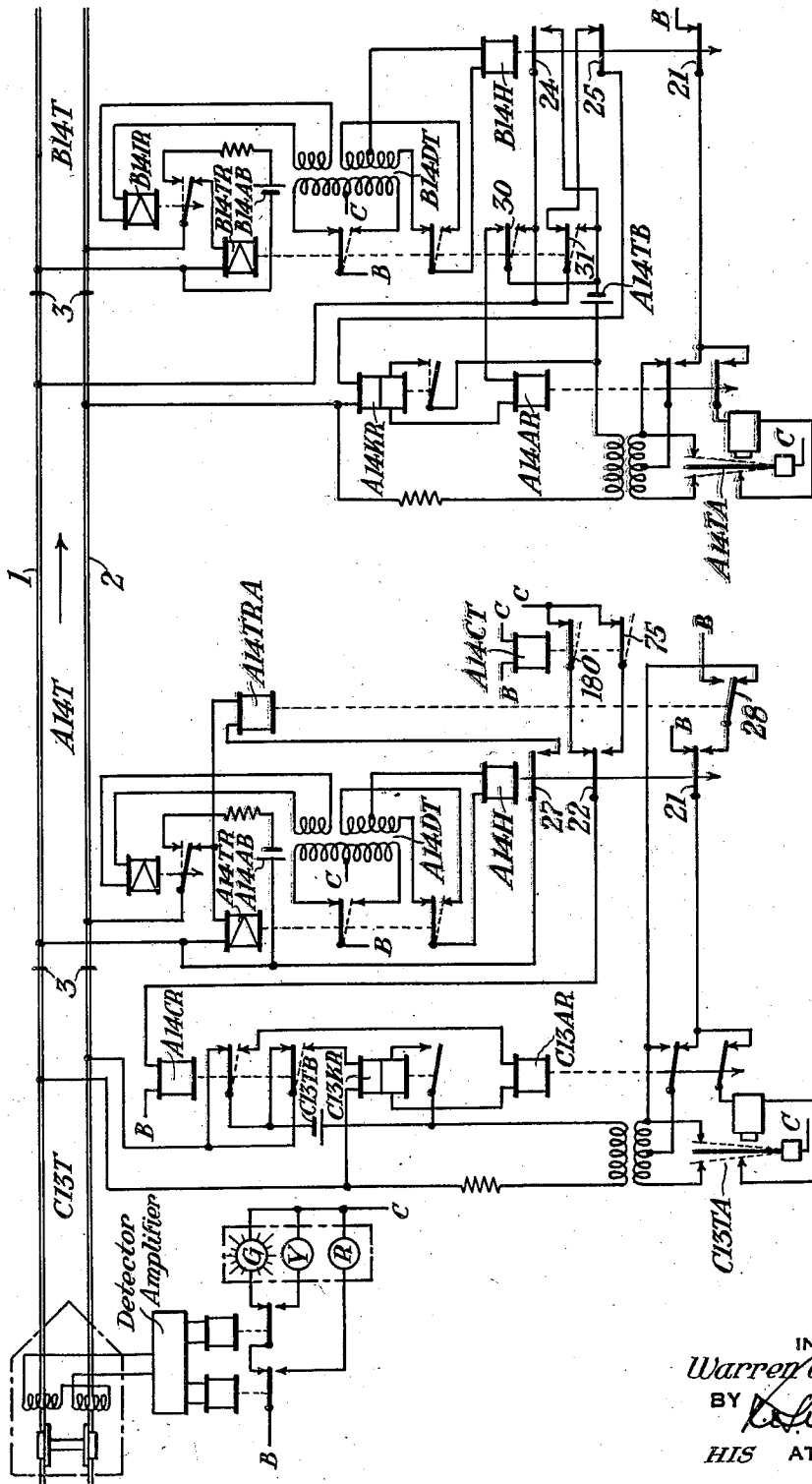
W. W. SEITZ

2,277,459

RAILWAY SIGNALING SYSTEM

Filed Aug. 20, 1940

3 Sheets-Sheet 1



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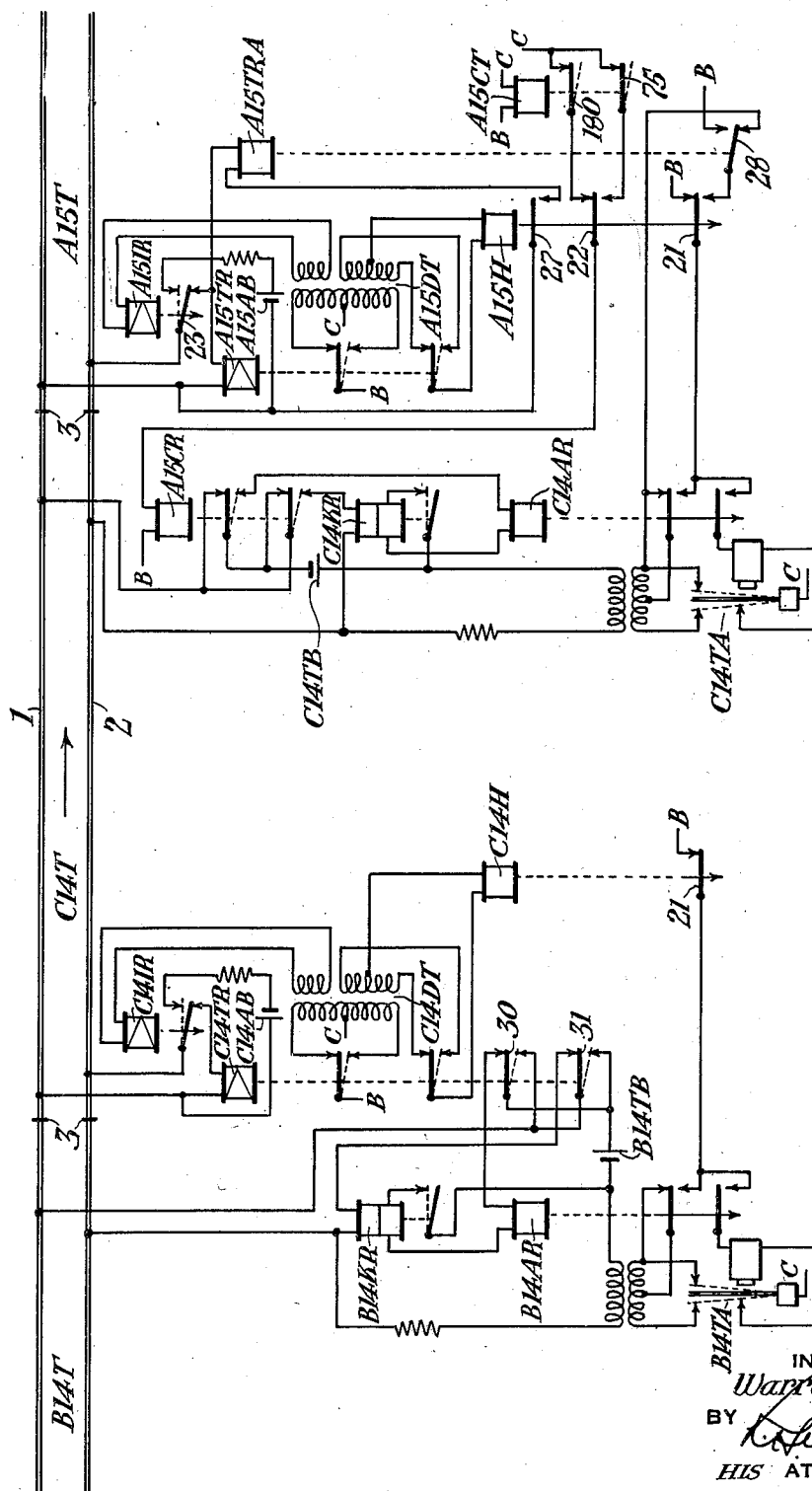
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3 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,277,459

RAILWAY SIGNALING SYSTEM

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vale, Pa., a corporation of Pennsylvania

Application August 20, 1940, Serial No. 353,354

15 Claims. (Cl. 246—63)

My invention relates to a coded railway signaling system and particularly to an improvement in the system shown in application Serial No. 330,122 of Howard A. Thompson, filed April 17, 1940, for Railway signaling system.

In the system shown in the application identified above each track section is divided into two subsections and the control of the signals is overlapped in such manner that there is always at least one unoccupied subsection in advance of the point in the track stretch at which a train receives the most restrictive indication. Because of this arrangement, the system is especially well suited for use in track stretches which are without wayside signals and employ cab signals only, although the system is not limited to use in such installations.

In the system shown in that application coded alternating current energy is supplied substantially continuously to the various track sections and is employed to actuate both the track relays and the cab signal apparatus on locomotives traversing the track stretch. This arrangement is satisfactory where alternating current energy is available from a commercial source of current. However, where the alternating current energy supplied to the track circuits is derived from tuned reed alternators or equivalent devices, it is preferable to employ coded direct current to operate the track relays and to arrange the circuit so that coded alternating current to actuate the locomotive cab signal apparatus is supplied to each track section only when a train is present in that section. This reduces the period of operation of the alternators and correspondingly increases their life, while it reduces the current consumed thereby.

It is an object of this invention to provide an improved signaling system of the type described employing coded direct current to operate the track relays, and having approach controlled alternating current supply devices for supplying coded alternating current cab signal control energy to the various track sections.

A further object of the invention is to provide an improved signaling system of the type described and which is arranged so that there is always at least one track section in the rear of an occupied section to which no coded alternating current cab signal control energy is supplied to thereby insure that the cab signal equipment on a locomotive traversing the track stretch will operate to provide its most restrictive indication before the locomotive enters the oc-

cupied section and thus warn the engineman that he is approaching an occupied section.

Another object of the invention is to provide an improved coded railway signaling system.

5 Other objects of the invention and features of novelty will be apparent from the following description taken in connection with the accompanying drawings.

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

10 In the drawings Figs. 1A and 1B when placed together form a diagram of a stretch of railway track equipped with signaling apparatus embodying my invention, and

15 Fig. 2 is a diagram showing the types of energy supplied to the various track sections in a track stretch under different conditions of track occupancy.

20 Referring to Figs. 1A and 1B there is shown therein a stretch of railway track having track rails 1 and 2 over which traffic normally moves in the direction indicated by the arrow, that is, from left to right.

25 The rails of the track stretch have insulated joints 3 therein to divide the track stretch into block sections, while the rails of each block section are further divided by insulated joints into three subdivisions or track sections. There is shown in the drawings one complete block section and portions of the equipment for the ad-
30 joining sections in advance and in the rear.

The block section shown in Fig. 1 of the drawings includes track sections A14T, B14T and C14T, while the track section of the adjacent block section in advance is designated A15T, and the track section of the adjacent block section in the rear is designated C13T.

The system shown in this application is of the
40 three indication variety and employs coded direct current track circuit energy of two code frequencies which may consist of 75 and 180 energy impulses per minute which are separated by periods of equal duration in which no energy is supplied. These code impulses may be provided by code transmitters CT having contacts
45 75 and 180 which are continuously actuated by a motor or other means.

In the system provided by this invention the control codes originate at the exit end of each block section, while the track relays of the forward and intermediate track sections in each block section serve to relay the coded energy to the adjacent sections in the rear. In addition,
50 these track relays serve, at times, to supply

steady uncoded direct current energy to the adjacent sections in the rear.

The system provided by this invention employs coded alternating current of a suitable frequency, such as 100 cycles per second, in the track circuits to actuate cab signal equipment on the locomotives traversing the track stretch. The alternating current employed in the system is provided by tuned reed alternators, while these alternators are normally idle and are approach controlled so as to operate only when a train is present in the section to which current is supplied from the device. The alternators are also controlled by traffic conditions in advance so as to be prevented from operating when the adjacent section in advance is occupied, or in some instances when the second section in advance is occupied.

In order to effect the desired approach control of the tuned alternators the system provided by this invention makes use of the coded approach control equipment shown in United States Patent No. 2,174,255, issued September 26, 1939, to H. G. Blosser. The details of construction and operation of this part of the system are not a part of this invention. Similarly, the invention is not limited to use with this approach control means and any form of approach control equipment well known in the art may be employed to perform this function.

Each of the track relays has associated therewith a source of direct current, such as a storage battery, not shown, the terminals of which are designated B and C.

The locomotives which are operated in the territory equipped with the signaling system provided by this invention are equipped with cab signaling apparatus responsive to the presence of coded alternating current in the track rails. The cab signaling equipment is shown diagrammatically in the drawings and may be of any construction well known in the art. One system which may be employed is shown in United States Patent No. 1,986,679, issued January 1, 1935, to L. V. Lewis. The cab signal apparatus responds to alternating current energy of 180 code frequency to provide a green or clear indication, while it responds to alternating current energy of 75 code frequency to provide a yellow or caution indication. In addition, the cab signal apparatus operates when no coded alternating current energy is present to provide its red or most restrictive indication. This may be considered a stop indication or it may be regarded as a slow speed indication.

The equipment is shown in the condition which it assumes when a train is present in section C13T and when the track stretch is otherwise vacant. At this time direct current energy of 180 code frequency is supplied to the rails of section A15T and as the track relay A15TR is responding to coded energy, current is supplied through the decoding transformer A15DT to the relay A15H. As relay A15H is picked up its contact 22 establishes the circuit including contact 180 of code transmitter A15CT for energizing the coding relay A15CR. The relay A15CR, therefore, operates to supply "master" code energy of 180 code frequency from the track battery C14TB to the rails of section C14T, while during the "off" periods in the "master" code "feed back" energy is supplied from the section rails to the detector relay C14KR.

The track relay C14TR repeats the supply of master code energy to the rails of section B14T,

while the relay B14TR in turn repeats the supply of master code energy to the rails of section A14T. As each track relay is responding to coded energy the impulse relay IR associated with that track relay operates to supply feed back energy from a battery AB during the "off" intervals in the master code to the detector relay at the exit end of the section. As the detector relays for sections A14T, B14T and C14T are supplied with feed back energy the associated approach relays AR are energized and maintain the tuned alternators TA for these sections inactive.

As track relay A14TR is responding to coded energy relay A14H is picked up and energy of 180 code frequency is supplied to the coding relay A14CR so that master code energy of 180 code frequency is supplied to section C13T. Since the track section C13T is assumed to be occupied feed back energy is not supplied to the detector relay C14KR and the approach relay C14AR is released and establishes the circuits of the operating winding of the alternator C14TA and of the primary winding of the associated transformer so that energy is induced in the transformer secondary winding. The secondary winding of this transformer is included in series with the circuit controlled by the coding relay A16CR for supplying direct current master code energy from the battery C13TB to the rails of section C13T so alternating current energy of 180 code frequency is supplied to the rails of section C13T.

The alternating current energy of 180 code frequency supplied to the rails of section C13T causes the locomotive cab signal apparatus to display its green or clear indication.

If the train in section C13T advances into section A14T it will shunt the track relay A14TR and cut off the supply of feed back energy to the detector relay A14KR, and this relay will no longer establish the circuit of approach relay A14AR. Accordingly relay A14AR will release and supply energy to the alternator A14TA so that coded alternating current will be supplied to the rails of section A14T to operate the locomotive cab signal apparatus and this equipment will continue to operate to provide its green or clear indication.

As the train continues through the track stretch, as it enters each successive track section the approach relay for that section becomes released and effects operation of the tuned alternator which it controls so that alternating current is supplied to operate the locomotive cab signal apparatus.

When the train under consideration enters section A14T and shunts the track relay A14TR, relay A14H releases and its contact 21 interrupts the supply of energy to the alternator C14TR and this device ceases to operate. In addition, on release of relay A14H contact 22 interrupts the circuit of the 180 contact and establishes the circuit including the 75 code contact of code transmitter A14CT for energizing the coding relay A14CR. Accordingly the coding relay A14CR operates to supply master code energy of 75 code frequency to the rails of section C13T, while when the train vacates section C13T feed back energy is supplied over the section rails to the detector relay C13KR and this relay establishes the circuit of the approach relay C13AR.

If while the first train is present in section A14T a second or following train should enter section C13T the supply of feed back energy to

the detector relay C13KR will be cut off and the approach relay C13AR will become released. However, release of the approach relay C13AR at this time will not effect operation of the alternator C13TA as the circuit of this device is interrupted by contact 21 of relay A14H. Accordingly, no alternating current is supplied to the rails of section C13T and the cab signal equipment on the locomotive of the second or following train will function to provide its red or stop indication, that is, its most restrictive indication.

When the first train advances into section B14T the track relay B14TR is shunted and relay B14H releases and its contact 21 cuts off operation of the alternator A14TA. In addition, on release of relay B14H its contact 24 establishes a circuit to supply steady uncoded energy from the track battery A14TB to the rails of section A14T. Another circuit for supplying steady uncoded energy to the rails of section A14T is established at this time by back contacts 30 and 31 of the track relay B14TR.

In addition, on release of relay B14H contact 25 interrupts the circuit of the pick-up winding of the detector relay A14KR, to thereby prevent energy supplied to the rails of section B14H feeding to the relay A14KR and picking up the contacts of this relay.

When the first train vacates section A14T the steady energy supplied to the rails of section A14T picks up the track relay A14TR and also picks up the auxiliary track relay A14TRA. The auxiliary track relay A14TRA is connected in multiple with the track relay A14TR at this time as contact 27 of relay A14H is released, while relay A14H is released since energy is not supplied thereto through the decoding transformer A14DT when the track relay A14TR is steadily picked up.

When contact 28 of relay A14TRA is picked up and contact 21 of relay A14H is released a circuit is established to permit energy to be supplied to the alternator C13TA if a train enters section C13T and releases the approach relay C13AR. Accordingly, if while the first train is present in section B14T, but has vacated section A14T, a second or following train should enter section C13T, the alternator C13TA will operate so that alternating current energy will be supplied to the rails of section C13T, while this energy will be coded at the 75 code frequency so that the locomotive cab signal apparatus will provide its yellow or caution indication.

When the first train advances into section C14T the track relay C14TR is shunted and relay C14H releases. When relay C14TR is shunted the contacts 30 and 31 establish a circuit to supply steady uncoded energy from the track battery C14TB to the rails of section B14T, and when the train vacates section B14T this energy feeds to the track relay B14TR and picks up its contacts. When relay B14TR picks up contacts 30 and 31 interrupt the circuit which they established for supplying steady energy to the rails of section A14T. However, at this time the relay B14H remains released and its contact 24 maintains the circuit for supplying steady energy to the rails of section A14T so the auxiliary track relay A14TRA continues to be picked up and maintains the circuit for supplying energy to the alternator C13TA on release of the approach relay C13AR.

On picking up of the contacts of track relay B14TR steady energy supplied to the rails of section A14T does not energize the detector re-

lay A14KR since at this time the circuit of the pick-up winding of this relay is interrupted by contact 25 of relay B14H. Relay A14KR, therefore, remains released and relay A14AR is also released.

Accordingly, if while section C14T is occupied and sections B14T and A14T are vacant a second or following train should enter section C13T the alternator C13TA will operate and alternating current energy of 75 code frequency will be supplied to the rails of section C13T to cause the cab signal equipment to display its yellow or caution indication.

However, if while either section B14T or C14T is occupied a second or following train should advance into section A14T, no alternating current would be supplied to the section rails since the circuit of the alternator A14TA is interrupted by contact 21 of relay B14H and the locomotive cab signal apparatus will function to provide its most restrictive indication.

Similarly, if while section C14T is occupied a train should enter section B14T, no alternating current would be supplied to the section rails as the circuit of the alternator B14TA is interrupted by contact 21 of relay C14H and the locomotive cab signal equipment will function to provide its most restrictive indication.

When the train under consideration advances into section A15T the track relay A15TR is shunted and relay A15H releases. On release of relay A15H contact 22 changes the energy supplied to the coding relay A15CR from 180 to 75 code frequency, while contact 21 interrupts the circuit of the alternator C14TA.

When the train vacates section C14T the master code energy supplied by the coding relay A15CR feeds to the track relay C14TR and produces code following operation of this relay so that it relays the supply of master code energy of 75 code frequency to section B14T, while relay B14TR similarly relays the supply of master code energy to section A14T.

On the supply of master code energy to the relay C14TR the impulse relay C14TR operates to supply feed back energy to the section rails, and this energy operates the detector relay C14KR so that the approach relay C14AR picks up. In addition, when relay C14TR responds to coded energy the relay C14H picks up and its contact 21 establishes the circuit to permit energy to be supplied to the alternator B14TA when section B14T is occupied.

Similarly, on the supply of master code energy to section B14T, relay B14H is picked up, while feed back energy is supplied over the section rails and the approach relay B14AR picks up. When relay D14H picks up contact 24 interrupts the circuit for supplying steady energy to section A14T and thereafter coded energy is supplied to section A14T over the circuits controlled by contacts 30 and 31 of the track relay B14TR.

In addition, on picking up of relay B14H its contact 25 establishes the circuit of the pick-up winding of the detector relay A14KR so that this relay will respond to feed back energy supplied over the rails of section A14T.

When coded energy is supplied to the track relay A14TR, relay A14H picks up and interrupts the circuit of the auxiliary track relay A14TRA, while contact 21 of the relay establishes a circuit to permit energy to be supplied to the alternator C13TA on release of the approach relay C13AR, and contact 22 changes the energy sup-

plied to the coding relay A14CR from 75 to 180 code frequency. There is, therefore, a change in the frequency of the master code energy supplied to the block section 13T and a train in this section will receive a clear cab signal instead of a yellow or caution signal.

Similarly, the master code energy supplied to block section 14T continues to be of the 75 code frequency as long as a train is present in the block section in advance, but when the train vacates the block section in advance the master code energy supplied to block section 14T is changed to 180 code frequency, while energy of 180 code frequency continues to be supplied to section 13T.

The operation of the equipment may be more clearly understood by reference to Fig. 2 which is a diagram showing the types of energy supplied to the various track sections in a track stretch under different conditions of occupancy. In this diagram alternating current is shown as being supplied to certain of the track sections, but it should be understood that the supply of alternating current is governed by the approach control apparatus, and that this current is supplied to a track section only when that section is occupied. The supply of alternating current to the various track sections is shown in the diagram to make clear the sections to which such energy is supplied, and those to which this energy is not supplied.

Referring to Fig. 2 it will be seen that when a train occupies the rearward track section in a block section direct current master code energy of the 75 code frequency is supplied to the track sections of the adjacent block section in the rear, while master code energy of 180 code frequency is supplied to the track sections of the second block section in the rear. It will be seen also that alternating current energy of the appropriate code frequency is supplied to the various track sections except to the forward track section of the adjacent block section in the rear of the train. As a result when a train is present in section A15T a following train will receive a clear cab signal as long as it is in block section 13T, while the cab signal will change to caution when the train enters section 14T. The caution indication will be maintained while the train is in either track section A14T or B14T, but as soon as the train enters track section C14T the cab signal indication changes from yellow or caution to red or stop. The system operates at this time, therefore, to provide a caution indication at a point one full block section in the rear of the occupied section, and to provide the red or stop indication at a point one full track section in the rear of the occupied section.

In addition, it will be seen from Fig. 2 that when a train is present in the intermediate track section of a block section, a following train receives a clear cab signal until it enters the adjacent block section in the rear of the occupied block section, and that the following train will receive a caution cab signal indication throughout the block section next in the rear of the occupied block. As soon, however, as the following train enters the occupied block it will receive a red or stop cab signal indication, and that this indication is given to the following train at a point one full track section in the rear of the occupied section.

If a train is present in the forward track section of a block section the following train will

receive the stop cab signal indication at the entrance to the occupied block section, and this indication is given the following train two full track sections in the rear of the occupied track section.

As this system operates to give a following train a caution cab signal at least one block section in the rear of an occupied track section and to give the most restrictive cab signal indication at a point at least one track section in the rear of an occupied section, the engineer of the following train has ample warning of the fact that he is approaching an occupied section and he can stop his train before entering the occupied section.

In the system provided by this invention the alternating current energy employed to operate the cab signal equipment is provided by tuned reed alternators. Each of these alternators is approach controlled so as to operate only when the section to which it supplies energy is occupied. Each of these alternators is also controlled by traffic conditions in advance so that the alternator is maintained inoperative at times when alternating current is not required to be supplied to the track section.

It will be seen also that each approach relay when picked up not only interrupts the supply of energy to the associated alternator, but it also short circuits the primary winding of the transformer associated with the alternator. This reduces the impedance of the transformer secondary winding which is included in series with the circuit for supplying direct current master code energy to the section rails. As the impedance of this winding is at a minimum the winding offers the least resistance to flow of impulses of master code energy and the impulses of master code supplied to the section rails are of the maximum value, therefore, and insure positive operation of the track relay for the section.

When a track section is occupied and the approach relay is released the circuit shunting transformer primary winding is interrupted, but the impedance of the secondary winding and its effect on the impulses of master code energy is not objectionable at this time as the track relay is shunted.

The equipment at the control locations, that is, at the entrance to each block section, is arranged so that the primary winding of the alternator transformer is short circuited when the associated approach relay is released provided the associated code detecting relay and track relay are also released. This is the condition when a train enters the rearward track section in a block section, as for example, section A15T, and before the train vacates the adjacent section in the rear.

When a train is present in sections C14T and A15T the relays C14AR, A15H and A15TRA are released and the primary winding of the transformer associated with the alternator C14TA is short circuited by a circuit which includes a back contact of the approach relay C14AR, back contact 21 of relay A15H and back contact 28 of relay A15TRA.

At this time direct current master code energy of 75 code frequency is supplied to the rails of section C14T over the circuit which includes in series therewith the secondary winding of the alternator transformer. As the primary winding of this transformer is short circuited at this time the impulses of master code energy are of the maximum value, and when the train vacates sec-

tion C14T these impulses of master code feed to the track relay C14TR and cause it to follow code. As the master code impulses are of the maximum value they are certain to operate the track relay C14TR. As soon as the track relay C14TR responds to the master code, feed back energy is supplied over the rails of section C14T to the detector relay C14KR and the approach relay C14AR picks up and establishes another circuit to short circuit the primary winding of the alternator transformer.

Although I have herein shown and described only one form of railway signaling system 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 signaling system, in combination, a stretch of railway track over which are operated locomotives equipped with signaling apparatus responsive to the presence of coded alternating current energy in the track rails of the track stretch, the rails of said stretch being divided by insulated joints into successive block sections, the rails of each block section being divided by insulated joints into a plurality of track sections, the track section at the entrance end of each block section having means receiving energy over the rails of such section, said means being effective when deenergized to supply coded direct current of a first frequency to the rails of the adjacent track section in the rear and being effective when supplied with coded direct current of said first or a second frequency to supply coded direct current of said second frequency to the rails of the adjacent section in the rear, each track section except the track section at the entrance end of each block section having means operative on the supply of coded direct current thereto to supply coded direct current of the same code frequency to the rails of the adjacent track section in the rear, and means for each track section governed by traffic conditions in such section and operative when and only when the section is occupied to supply to the rails of such section alternating current energy coded at the same code frequency as the direct current energy supplied to the said section.

2. In a railway signaling system, in combination, a stretch of railway track over which are operated locomotives equipped with signaling apparatus responsive to the presence of coded alternating current energy in the track rails of the track stretch, the rails of said stretch being divided by insulated joints into successive block sections, the rails of each block section being divided by insulated joints into a plurality of track sections, the track section at the entrance end of each block section having means receiving energy over the rails of such section, said means being effective when deenergized to supply coded direct current of a first frequency to the rails of the adjacent track section in the rear and being effective when supplied with coded direct current of said first or a second frequency to supply coded direct current of said second frequency to the rails of the adjacent section in the rear, each track section except the track section at the entrance end of each block section having means operative on the supply of coded direct current thereto to supply coded direct

current of the same code frequency to the rails of the adjacent track section in the rear, and means for each track section for supplying to the rails of such section alternating current energy coded at the same code frequency as the direct current energy supplied to such section, the means for each track section being governed by traffic conditions in that track section and also in the adjacent track section in advance and being operative to supply energy to the section when and only when the section is occupied and the adjacent section in advance is unoccupied.

3. In a railway signaling system, in combination, a stretch of railway track over which are operated locomotives equipped with signaling apparatus responsive to the presence of coded alternating current energy in the track rails of the track stretch, the rails of said track stretch being divided by insulated joints into successive block sections, the rails of each block section being divided by insulated joints into a forward, an intermediate and a rearward track section, means governed by traffic conditions in each block section and in the adjacent block section in advance for supplying coded direct current energy of a first or a second code frequency to the rails of the forward track section of the adjacent block section in the rear, the forward and intermediate track section of each block section having means operative on the supply of coded direct current thereto to supply coded direct current of the same code frequency to the rails of the adjacent track section in the rear, and means for each track section governed by traffic conditions in such section and operative when and only when the section is occupied to supply to the rails of such section alternating current energy coded at the same code frequency as the direct current energy supplied to said section.

4. In a railway signaling system, in combination, a stretch of railway track over which are operated locomotives equipped with signaling apparatus responsive to the presence of coded alternating current energy in the track rails of the track stretch, the rails of said track stretch being divided by insulated joints into successive block sections, the rails of each block section being divided by insulated joints into a forward, an intermediate and a rearward track section, means governed by traffic conditions in each block section and in the adjacent block section in advance for supplying coded direct current energy of a first or a second code frequency to the rails of the forward track section of the adjacent block section in the rear, the forward and intermediate track section of each block section having means operative on the supply of coded direct current thereto to supply coded direct current of the same code frequency to the rails of the adjacent track section in the rear, and means for each track section for supplying to the rails of such section alternating current energy coded at the same code frequency as the direct current energy supplied to such section, the means for each track section being governed by traffic conditions in that track section and also in the adjacent track section in advance and being operative to supply energy to the section when and only when the section is occupied and the adjacent section in advance is unoccupied.

5. In a railway signaling system, in combination, a stretch of railway track over which are operated locomotives equipped with signaling apparatus responsive to the presence of coded al-

ternating current energy in the track rails of the track stretch, the rails of said track stretch being divided by insulated joints into successive block sections, the rails of each block section being divided by insulated joints into a forward, an intermediate and a rearward track section, means governed by traffic conditions in each block section and in the adjacent blocks section in advance for supplying coded direct current energy of a first or a second code frequency to the rails of the forward track section of the adjacent block section in the rear, the forward and intermediate track section of each block section having means operative on the supply of coded direct current thereto to supply coded direct current of the same code frequency to the rails of the adjacent track section in the rear, and means for each track section for supplying to the rails of such section alternating current energy coded at the same code frequency as the direct current energy supplied to such section, the alternating current supply means for each track section being governed by traffic conditions in the adjacent track section in advance and being incapable of supplying energy to the associated track section when the adjacent track section in advance is occupied.

6. In a railway signaling system, in combination, a stretch of railway track over which are operated locomotives equipped with signaling apparatus responsive to the presence of coded alternating current energy in the track rails of the track stretch, the rails of said track stretch being divided by insulated joints into successive block sections, the rails of each block section being divided by insulated joints into a plurality of track sections, means governed by traffic conditions in each block section and in the adjacent block section in advance for supplying coded direct current energy of a first or a second code frequency to the rails of the forward track section of the adjacent block section in the rear, each track section except the track section at the entrance end of each block section having means operative on the supply of coded direct current thereto to supply coded direct current to the rails of the adjacent track section in the rear, and means for each track section for supplying to the rails of such section alternating current energy coded at the same code frequency as the direct current energy supplied to such section, the alternating current supply means for each track section being governed by traffic conditions in the adjacent track section in advance and being incapable of supplying energy to the associated track section when the adjacent track section in advance is occupied.

7. In a coded railway signaling system, in combination, a stretch of railway track over which are operated locomotives equipped with signaling apparatus responsive to the presence of coded alternating current energy in the track rails of the track stretch, the rails of said track stretch being divided by insulated joints into successive block sections, the rails of each block section being divided by insulated joints into a forward, an intermediate and a rearward track section, each track section in the track stretch having at the entrance end thereof a code following track relay responsive to coded direct current and receiving energy over the section rails, each track relay having associated therewith an auxiliary relay which is picked up when and only when said track relay is responding to coded energy, the auxiliary relay for the rearward track section in

each block section being operative when released to effect the supply of coded direct current of a first code frequency and when picked up to effect the supply of coded direct current of a second code frequency to the rails of the forward track section of the adjacent block section in the rear, the track relays of the forward and intermediate track section of each block section each being operative when responding to coded energy to supply coded direct current energy to the rails of the adjacent track section in the rear, each track section having at the exit end thereof alternating current supply means for supplying to the rails of such section alternating current energy coded at the same code frequency as the direct current energy supplied to the section rails, the alternating current supply means for each track section being governed by the auxiliary relay of the adjacent track section in advance and being operative to supply energy only when said auxiliary relay is picked up.

8. In a coded railway signaling system, in combination, a stretch of railway track over which are operated locomotives equipped with signaling apparatus responsive to the presence of coded alternating current energy in the track rails of the track stretch, the rails of said track stretch being divided by insulated joints into successive block sections, the rails of each block section being divided by insulated joints into a forward, an intermediate and a rearward track section, each track section in the track stretch having at the entrance end thereof a code following track relay responsive to coded direct current and receiving energy over the section rails, each track relay having associated therewith an auxiliary relay which is picked up when and only when said track relay is responding to coded energy, the auxiliary relay for the rearward track section in each block section being operative when released to effect the supply of coded direct current of a first code frequency and when picked up to effect the supply of coded direct current of a second code frequency to the rails of the forward track section of the adjacent block section in the rear, the track relays of the forward and intermediate track section of each block section each being operative when responding to coded energy to supply coded direct current energy to the rails of the adjacent track section in the rear, each track section having at the exit end thereof alternating current supply means for supplying to the rails of such section alternating current energy coded at the same code frequency as the direct current energy supplied to the section rails, the alternating current supply means for each track section being controlled by the auxiliary relay of the adjacent track section in advance and also by traffic conditions in the track section to which energy is supplied by said means and being operable to supply energy to such track section when and only when said auxiliary relay is picked up and the track section to which the energy is supplied is occupied.

9. In a coded railway signaling system, in combination, a stretch of railway track over which are operated locomotives equipped with signaling apparatus responsive to the presence of coded alternating current energy in the track rails of the track stretch, the rails of said track stretch being divided by insulated joints into successive block sections, the rails of each block section being divided by insulated joints into a forward, an intermediate and a rearward track section, each track section in the track stretch having at the

entrance end thereof a code following track relay responsive to coded direct current and receiving energy over the section rails, each track relay having associated therewith an auxiliary relay which is picked up when and only when said track relay is responding to coded energy, the auxiliary relay for the rearward track section in each block section being operative when released to effect the supply of coded direct current of a first code frequency and when picked up to effect the supply of coded direct current of a second code frequency to the rails of the forward track section of the adjacent block section in the rear, the track relays of the forward and intermediate track section of each block section each being operative when responding to coded energy to supply coded direct current energy to the rails of the adjacent track section in the rear, each track section having at the exit end thereof an alternating current supply device operative on the supply of direct current thereto to supply to such track section alternating current energy coded at the same code frequency as the direct current energy which is supplied to said track section, the auxiliary relay for each track section controlling the supply of direct current to the supply device of the adjacent track section in the rear and being operative only when picked up to establish a circuit to permit direct current energy to be supplied to such supply device.

10. In a coded railway signaling system, in combination, a stretch of railway track over which are operated locomotives equipped with signaling apparatus responsive to the presence of coded alternating current energy in the track rails of the track stretch, the rails of said track stretch being divided by insulated joints into successive block sections, the rails of each block section being divided by insulated joints into a forward, an intermediate and a rearward track section, each track section in the track stretch having at the entrance end thereof a code following track relay responsive to coded direct current and receiving energy over the section rails, each track relay having associated therewith an auxiliary relay which is picked up when and only when said track relay is responding to coded energy, the auxiliary relay for the rearward track section in each block section being operative when released to effect the supply of coded direct current of a first code frequency and when picked up to effect the supply of coded direct current of a second code frequency to the rails of the forward track section of the adjacent block section in the rear, the track relays of the forward and intermediate track section of each block section each being operative when responding to coded energy to supply coded direct current energy to the rails of the adjacent track section in the rear, each track section having at the exit end thereof an alternating current supply device operative on the supply of direct current thereto to supply to such track section alternating current energy coded at the same code frequency as the direct current energy which is supplied to said track section, the circuit for supplying direct current to the supply device for each track section being governed by traffic conditions in such section and also by the auxiliary relay of the adjacent track section in advance and being complete when and only when said auxiliary relay is picked up and the track section to which energy is supplied by said device is occupied.

11. In a coded railway signaling system, in combination, a stretch of railway track over

which are operated locomotives equipped with signaling apparatus responsive to the presence of coded alternating current energy in the track rails of the track stretch, the rails of said track stretch being divided by insulated joints into successive block sections, the rails of each block section being divided by insulated joints into a forward, an intermediate and a rearward track section, each track section in the track stretch having at the entrance end thereof a code following track relay responsive to coded direct current and receiving energy over the section rails, each track relay having associated therewith an auxiliary relay which is picked up when and only when said track relay is responding to coded energy, the auxiliary relay for the rearward track section in each block section being operative when released to effect the supply of coded direct current of a first code frequency and when picked up to effect the supply of coded direct current of a second code frequency to the rails of the forward track section of the adjacent block section in the rear, the track relays of the forward and intermediate track section of each block section each being operative when responding to coded energy to supply coded direct current energy to the rails of the adjacent track section in the rear, the rearward track section in each block section each having a steady energy detecting track relay receiving energy over the section rails and being picked up when and only when steady uncoded direct current energy is supplied thereto, the auxiliary relay for the intermediate track section of each block section being operative when released to effect the supply of steady uncoded direct current to the rails of the rearward track section of such block section, each track section having at the exit end thereof alternating current supply means for supplying to the rails of such section alternating current energy coded at the same code frequency as the direct current energy supplied to the section rails, the alternating current supply means for the rearward and intermediate track section of each block section being governed by the auxiliary relay of the adjacent track section in advance and being operative to supply energy only when said auxiliary relay is picked up, the alternating current supply means for the forward track section of each block section being governed by the auxiliary relay and the steady energy detecting track relay of the adjacent track section in advance and being operative to supply energy only when said auxiliary relay or said steady energy detecting track relay is picked up.

12. In a coded railway signaling system, in combination, a stretch of railway track over which are operated locomotives equipped with signaling apparatus responsive to the presence of coded alternating current energy in the track rails of the track stretch, the rails of said track stretch being divided by insulated joints into a plurality of successive track sections including adjoining forward and rearward track sections, each of said track sections having at the entrance end thereof a code following track relay responsive to coded direct current and receiving energy over the section rails, the track relay for said forward section having associated therewith an auxiliary relay which is picked up when and only when said track relay is responding to coded energy, said auxiliary relay being operative when released to establish a first supply circuit to effect the supply of coded direct current energy of a

first code frequency and when picked up to establish a second supply circuit to effect the supply of coded direct current energy of a second code frequency to the rails of said rearward section, a transformer having its secondary winding connected in series with said supply circuits, an approach relay which is energized when and only when said rearward section is vacant, means operative when said approach relay is released to energize the primary winding of said transformer and thereby effect the supply to the rails of the rearward section alternating current energy coded at the same code frequency as the direct current energy which is being supplied to the section rails, and means operative when said approach relay is picked up to short circuit the transformer primary winding to thereby reduce the impedance of the transformer secondary winding and correspondingly increase the value of the impulses of direct current energy supplied over said supply circuits.

13. In a coded railway signaling system, in combination, a stretch of railway track over which are operated locomotives equipped with signaling apparatus responsive to the presence of coded alternating current energy in the track rails of the track stretch, the rails of said track stretch being divided by insulated joints into a plurality of successive track sections including adjoining forward and rearward track sections, each of said track sections having at the entrance end thereof a code following track relay responsive to coded direct current and receiving energy over the section rails, the track relay for said forward section having associated therewith an auxiliary relay which is picked up when and only when said track relay is responding to coded energy, said auxiliary relay being operative when released to establish a first supply circuit to effect the supply of coded direct current energy of a first code frequency and when picked up to establish a second supply circuit to effect the supply of coded direct current energy of a second code frequency to the rails of said rearward section, a transformer having its secondary winding connected in series with said supply circuits, an approach relay which is energized when and only when said rearward section is vacant, means operative when said approach relay is released and said auxiliary relay is picked up to energize the primary winding of said transformer and thereby effect the supply to the rails of said rearward section alternating current energy coded at the same code frequency as the direct current energy which is being supplied to the rails of said section, and means operative when said approach relay is picked up or said auxiliary relay is released to short circuit the transformer primary winding to thereby reduce the impedance of the transformer secondary winding and correspondingly increase the value of the impulses of direct current energy supplied over said supply circuits.

14. In a railway signaling system, in combination, a stretch of railway track over which are operated locomotives equipped with signal-apparatus responsive to the presence of coded alternating current energy in the track rails of the track stretch, the rails of said track stretch being divided by insulated joints into successive block sections, the rails of each block section being divided by insulated joints into a plurality of track sections, each track section having at the

entrance end thereof a direct current code following track relay receiving energy over the section rails, each track relay having associated therewith an auxiliary relay which is picked up when and only when the track relay is responding to coded energy, the auxiliary relay for the rearward track section in each block section being operative when released to effect the supply of coded direct current of a first frequency to the rails of the adjacent track section in the rear and when picked up to effect the supply of coded direct current of a second frequency to the rails of the adjacent track section in the rear, the track relays of each of the track sections except the track sections at the entrance ends of the block sections being effective when responding to coded direct current energy to supply coded direct current of the same frequency to the rails of the adjacent track section in the rear, each track section having at the exit end thereof means for supplying to the rails of such section alternating current energy coded at the same frequency as the direct current energy supplied to the rails of such section, the alternating current supply means for each track section being controlled by the auxiliary relay of the adjacent track section in advance so as to be effective to supply energy only when said auxiliary relay is picked up.

15. In a railway signaling system, in combination, a stretch of railway track over which are operated locomotives equipped with signaling apparatus responsive to the presence of coded alternating current energy in the track rails of the track stretch, the rails of said track stretch being divided by insulated joints into successive block sections, the rails of each block section being divided by insulated joints into a plurality of track sections, each track section having at the entrance end thereof a direct current code following track relay receiving energy over the section rails, each track relay having associated therewith an auxiliary relay which is picked up when and only when the track relay is responding to coded energy, the auxiliary relay for the rearward track section in each block section being operative when released to effect the supply of coded direct current of a first frequency to the rails of the adjacent track section in the rear and when picked up to effect the supply of coded direct current of a second frequency to the rails of the adjacent track section in the rear, the track relays of each of the track sections except the track sections at the entrance ends of the block sections being effective when responding to coded direct current energy to supply coded direct current of the same frequency to the rails of the adjacent track section in the rear, each track section having at the exit end thereof means for supplying to the rails of such section alternating current energy coded at the same frequency as the direct current energy supplied to the rails of such section, the alternating current supply means for each track section being controlled by traffic conditions in such section and by the auxiliary relay of the adjacent track section in advance so as to be effective to supply energy only when said auxiliary relay is picked up and the section to which the energy is supplied is occupied.

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