

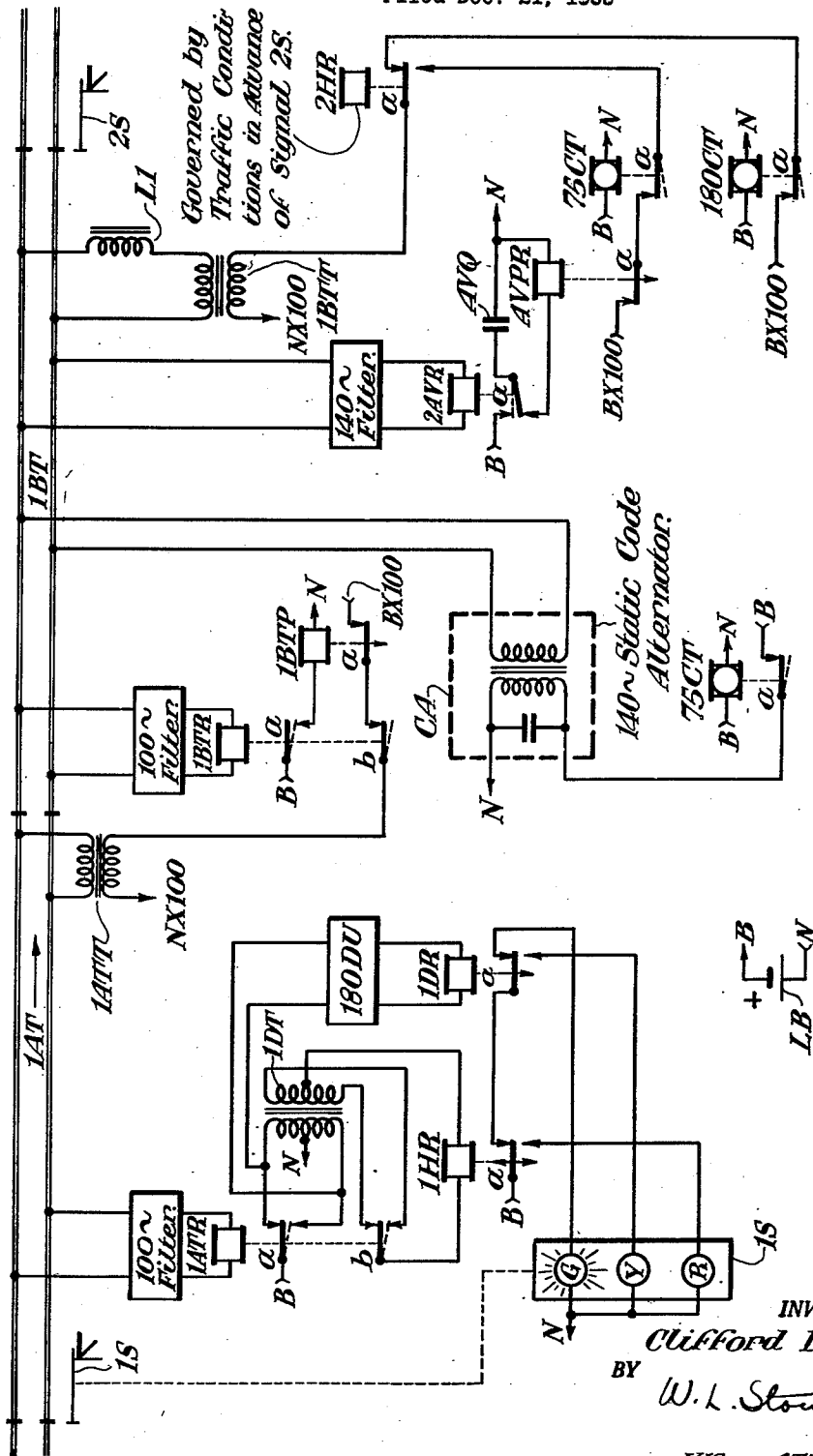
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CODED RAILWAY SIGNALING SYSTEM

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2,816,219

CODED RAILWAY SIGNALING SYSTEM

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My invention relates to coded railway signaling systems, and particularly to an improved arrangement for supplying coded energy in a coded railway signaling system for the control of cab signals and/or speed control equipment on vehicles traveling through a stretch of track equipped with apparatus embodying my invention.

In conventional coded railway signaling systems, energy coded at one or another of several different rates, say, for example, 180 or 75 times per minute, is supplied to the rails of a stretch of track at the exit end thereof, and flows over the rails to apparatus located at the entrance end of the stretch, which apparatus is selectively responsive to the reception of impulses of energy at the various code rates to thereby control wayside signals or other traffic controlling devices. Continuous inductive cab signals or automatic speed control for vehicles which travel over the stretch may be provided by employing alternating current energy for the trackway codes, and providing suitable apparatus on the vehicles for detecting the presence of such codes in the track rails of the stretch over which the vehicle is traveling. Such cab signal apparatus is usually arranged so that the cab signal aspect repeats the aspect of the wayside signal previously passed by the train. That is, when a train passes a signal displaying a green or clear aspect, coded energy at a particular rate, say, for example, 180 times per minute, is being supplied to the rails of the stretch at the exit end thereof. The reception of code at the 180 code rate by the train-carried apparatus will cause the cab signal apparatus to display a green or clear aspect. If the train passes a signal displaying a yellow or approach aspect, the apparatus is usually arranged so that coded energy at the 75 code rate is supplied to the rails of the stretch in advance of the signal, so that the cab signal apparatus will display a yellow or approach aspect in the cab of the vehicle. The presence of steady energy, the absence of energy, or the presence of energy at a frequency which is ineffective to operate the cab signal apparatus will each cause the cab signal to display a restrictive or caution aspect. It will accordingly be seen that when a train passes a wayside signal displaying an approach aspect with the signal in advance displaying a red or stop aspect, the cab signal apparatus will continue to display a yellow or approach aspect throughout the entire length of the stretch. It is sometimes preferred to provide what is known in the railway signaling art as a code change point at an intermediate point in the track stretch between wayside signals so that energy coded at the 75 code rate may be supplied to the rails of the section from the code change point to the signal in the rear, but steady energy or no energy is supplied to the section in advance of the code change point, that is, the section between the code change point and the signal in advance.

Such an arrangement is particularly useful for wayside signals which display an absolute stop aspect, requiring all trains to come to a stop and remain stopped as long as the signal displays its stop aspect. With such

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an arrangement, if the wayside signal is displaying its stop aspect, the next signal in the rear will display its approach aspect. A train passing the next signal in the rear will receive 75 code energy, and accordingly an approach cab signal aspect will be displayed, until the train passes the code change point, at which time the cab signal will operate to display its restrictive or caution aspect, thus giving additional warning to the engineer that he is approaching an absolute stop signal. Under such circumstances, the apparatus must be arranged so that, when the signal in question displays a clear or approach aspect, energy coded at the 180 code rate will be supplied to the rails of the section immediately in the rear of the signal, and will be cascaded at the code change point intermediate in the stretch, so that the section in the rear of the code change point is also supplied with energy coded at the 180 code rate. However, when the signal in question is at stop, the apparatus must be arranged in such manner that, while a train is in the rearmost section of track, that is, the section between the code change point and the next signal in the rear of the signal in question, energy at the 75 code rate will be supplied to the rails of the stretch between the signal in question and the next signal in the rear and no energy will be supplied to the track while a train is in the section extending between the code change point and the signal in question.

Although a number of methods have been proposed in the past for providing such operation and providing suitable equipment for use with code change points, such apparatus usually has the disadvantage of requiring line wire control circuits extending between the signal locations and the code change point location.

Accordingly, it is an object of my invention to provide an improved coded railway signaling system, arranged to provide a code change point location in a stretch of track extending between two wayside signal locations, with the apparatus arranged so as to require no line wire in the areas between either of the signal locations and the code change point location.

Another object of my invention is to provide an improved coded railway signaling system in which a code change point is provided at an intermediate point in a stretch of track between two wayside signals, the control of the apparatus being provided by the use of energy having different frequencies supplied to the track rails, one frequency of which is effective to govern wayside and cab signal apparatus of vehicles moving over the stretch; the other frequency, employed for controlling the energy having the first frequency, being of such frequency so as to be ineffective to operate the wayside apparatus or train-carried apparatus.

A further object of my invention is to provide a railway signaling system in which, at a code change point, coded energy at a given frequency, ineffective to operate wayside or cab signal apparatus, is continuously supplied to the rails and transmitted therethrough to the exit end of the section, where the reception of this energy causes the supply of energy, effective to operate cab signaling or wayside signaling apparatus, from the exit end of the section to the code change point where it is received and retransmitted to the section in the rear of the code change point to operate cab signal or wayside signal apparatus.

Other objects of my invention and features of novelty thereof will become apparent from the following description taken in connection with the accompanying drawing.

In practicing my invention, I provide, in a coded railway signaling system using trackway codes of alternating current having a given frequency for the control of cab signal equipment of trains which move through a section

of track, apparatus which transmits energy from the normal entrance end of the section to the normal exit end of the section. This energy is of a type which is not effective to operate the wayside or train-carried signaling equipment. The reception of this energy at the exit end of the section governs suitable means for controlling the supply of the trackway code to the rails of the section at the exit end thereof.

In a preferred embodiment of my invention, the energy having the second frequency is supplied by a shock-excited tuned circuit which supplies impulses of energy, at a second frequency ineffective to operate the wayside or train-carried coded signaling apparatus, to the rails of a section of track at the entrance end thereof. At the exit end of the section, I provide code impulse receiving apparatus which is responsive only to energy impulses having the second frequency. Accordingly, when no train is occupying the section, the code responsive apparatus at the exit end of the section will be energized. Under these conditions, the code impulse receiving apparatus is controlled to supply trackway code at the first, or effective frequency, to the rails of the section at the exit end, in accordance with traffic conditions in advance of the section. However, if a train occupies the section, the code responsive means at the exit end of the section will be deenergized. The code responsive means is arranged to govern the transmission of the trackway code in such manner that, when the code responsive means is deenergized, the character of the trackway code is changed from a condition of low code rate to no code, to thereby cause the cab signal apparatus to display its most restrictive or caution aspect, provided that traffic conditions in advance of the section are such that the most restrictive aspect should be displayed.

The single accompanying drawing is a diagrammatic view of a stretch of railway track equipped with a signaling system embodying my invention.

Referring to the drawing, there is shown a stretch of railway track extending between two wayside signals 1S and 2S, and divided into a rearward section designated by the reference character 1AT and a forward section designated by the reference character 1BT. The wayside signals 1S and 2S govern the movements of traffic through the stretches in advance of the respective signals, signal 1S governing the movement of traffic into the stretch including sections 1AT and 1BT. The signals may be of any of the well-known types, and as here shown, signal 1S is a color light type of signal having a green lamp G which when lighted provides a clear aspect, a yellow lamp Y which when lighted provides an approach aspect, and a red lamp R which when lighted provides a stop aspect. The arrangement for governing the lamps of signal 2S is not shown in the drawing, since it is not essential to an understanding of my invention, and may be arranged in a manner similar to that shown for signal 1S.

As indicated by the arrow in the drawing, traffic normally moves through the stretch of track including sections 1AT and 1BT in the direction from left to right. It is assumed that vehicles or trains moving through this stretch are equipped with cab signal or train control apparatus of the type well known in the art, which cab signal apparatus responds, through the medium of inductive pickup apparatus on the vehicle or train, to the presence of alternating current energy of a predetermined frequency supplied at different code rates to the section rails. A detailed description of the vehicle-carried apparatus is not included herewith, since this apparatus may be any one of a number of suitable types, and may be, for example, of the type shown and described in Letters Patent of the United States No. 2,462,454, issued to Leslie R. Allison on February 22, 1949, for Train Carried Cab Signal Apparatus. It is deemed sufficient to point out that the apparatus on the vehicles or trains which move through the stretch of track is arranged so that

alternating current energy having a frequency of 100 cycles per second and supplied to the rails of the track stretch at the rate of 180 times per minute will cause the display of a clear aspect on the cab signal apparatus, whereas the presence of 100 cycle per second energy in the rails coded at the 75 code rate will cause the display of an approach aspect on the cab signal apparatus, and the presence of steady energy having a 100 cycle per second frequency, or the absence of any energy will cause the apparatus to display a more restrictive aspect in the cab of the vehicle or train. It is also to be pointed out that the vehicle-carried apparatus will not respond to any coded energy other than that having the 100 cycle per second frequency.

The apparatus located at the first signal location, that is, the location of signal 1S, includes a code following track relay 1ATR connected across the rails of section 1AT through a 100 cycle filter, which filter is constructed and arranged in the usual manner so that only alternating current energy having a frequency of 100 cycles per second can be supplied therethrough to operate the relay 1ATR. For detecting the code following operation of the relay 1ATR, there is provided a decoding transformer 1DT, which governs the operation of a signal control relay 1HR, and also governs a clear signal control relay 1DR through a decoding unit 180DU, the relays 1HR and 1DR governing the aspect displayed by the wayside signal 1S. At the code change point, located at a point intermediate in the stretch, and at the point of adjacency of the track sections 1AT and 1BT, there is provided a track transformer 1ATT having a secondary winding connected across the rails of track section 1AT, and having a primary winding supplied with energy by a circuit including a contact of the code following track relay 1BTR which is connected to the rails of section 1BT through a 100 cycle filter, and a back contact repeater relay 1BTP, which is governed by a back contact of the track relay 1BTR. At the code change point, there is also provided a static code alternator CA, the detailed description of which will be provided later, which is governed by a coding device 75CT so that the code alternator continuously supplies impulses of energy at a particular frequency, in this instance, 140 cycles per second, to the rails of section 1BT at the code change point location.

At the second signal location, there is provided a track transformer 1BTT having a secondary winding connected across the section rails of section 1BT through a reactor L1, and having a primary winding which is supplied with coded energy having a frequency of 100 cycles per second by a circuit which is governed by the signal control relay 2HR, which relay is governed by traffic conditions in advance of signal 2S. The supply of 100 cycle coded energy to the primary winding of transformer 1BTT is additionally governed by the contacts of a coding device 75CT and a coding device 180CT, these coding devices having contacts which are recurrently operated at the rates of 75 and 180 times per minute, respectively. Additionally, at the second signal location, there is provided an approach code following relay 2AVR, connected to the rails of section 1BT through a 140 cycle filter arranged and disposed in such manner that only energy having a frequency of 140 cycles per second will be passed by the filter to cause operation of the contacts of relay 2AVR. The code following operation of relay 2AVR is detected by an approach detector relay AVPR, which is recurrently supplied with energy from a decoding capacitor AVQ, and the contacts of relay AVPR are utilized to govern the supply of coded energy to the rails of section 1BT.

Energy for the operation of various of the relays is furnished by a suitable source of low voltage direct current, such as the battery LB shown, having its positive terminal designated by the reference character B and its negative terminal designated by the reference character N. It is to be understood that such a source is provided at

each of the three locations shown on the drawing. The 100 cycle energy supplied for the operation of the coded track circuits and the cab signal equipment on trains moving through the stretch is supplied from a suitable source of alternating current energy having terminals designated by the reference characters BX100 and NX100, respectively, and it is to be understood that such energy may be furnished through the medium of a suitable transmission line extending along the stretch of track.

It is believed that a better understanding of my invention may be had by a detailed analysis of the operation of the arrangement shown in the drawing under various traffic conditions.

Considering first the normal condition of the apparatus, as shown in the drawing, the track sections 1AT and 1BT are unoccupied, and the signal control relay 2HR is picked up in accordance with traffic conditions in advance of signal 2S, so that signal 2S will display a clear aspect by the operation of circuits which, although not shown, may be similar to those shown for governing the lamps of signal 1S. At this time, with relay 2HR picked up, a circuit is established for supplying coded energy to the primary winding of the transformer 1BTT, which circuit may be traced from terminal BX100 at contact *a* of the 180CT coding device, over front contact *a* of relay 2HR, and through the primary winding of transformer 1BTT to terminal NX100. The impulses of 100 cycle energy supplied 180 times a minute to the primary winding of transformer 1BTT cause corresponding impulses of energy to be supplied from the secondary winding of this transformer through the reactor L1 to the rails of section 1BT. At the code change point, the impulses of 100 cycle energy are passed by the 100 cycle filter and cause the recurrent operation of the contacts of relay 1BTR at a corresponding rate, namely, 180 times per minute. Each time that contact *a* of relay 1BTR is released, an obvious circuit is established for supplying energy to the winding of the slow release back contact repeater relay 1BTP, so that at this time relay 1BTP is picked up, and since the relay is of the slow release variety, its contacts will remain picked up during the short intervals in which contact *a* of relay 1BTR is not in its released position. Each time that contact *b* of relay 1BTR is picked up, a circuit is established for supplying impulses of 100 cycle energy to the primary winding of transformer 1ATT, which circuit may be traced from terminal BX100 at front contact *a* of relay 1BTP, over front contact *b* of relay 1BTR, and through the primary winding of transformer 1ATT to terminal NX100. Accordingly, it will be seen that impulses of 100 cycle energy are supplied to the rails of section 1AT in step with the impulses of 100 cycle energy received from section 1BT, the apparatus in this instance functioning in the usual manner of a front contact code repeating cut-section. At the entrance end of section 1AT, the 100 cycle impulses are passed by the 100 cycle filter and cause the recurrent operation of the contacts of track relay 1ATR at the rate of 180 times per minute.

The recurrent operation of contact *a* of relay 1ATR causes the supply of direct current energy alternately to the upper and lower halves of the primary winding of the decoding transformer 1DT, and the energy thus induced in the secondary winding of the transformer is mechanically rectified by the recurrent operation of contact *b* of relay 1ATR, the rectified energy being supplied to the winding of the signal control relay 1HR. Accordingly, relay 1HR is picked up at this time. Additionally, energy is supplied by recurrent operation of contact *a* of relay 1ATR to the 180 decoding unit 180DU, and since the contacts of relay 1ATR are operating at the 180 code rate, sufficient energy will be passed by the decoding unit 180DU to the winding of relay 1DR to pick up the contacts of this relay. With the contacts of relays 1HR and 1DR both picked up, a circuit is es-

tablished for supplying energy to the green lamp G of signal 1S, which circuit may be traced from terminal B at front contact *a* of relay 1HR, over front contact *a* of relay 1DR, and through the green lamp G of signal 1S to terminal N. The signal 1S is accordingly displaying a clear aspect at this time.

At the code change point, the 75CT coding device is recurrently operating its contact *a* at the rate of 75 times per minute, and each time that the contact *a* of coding device 75CT is closed, energy is supplied to the 140 cycle static code alternator CA by the circuit which may be traced from terminal B at front contact *a* of the coding device 75CT, through the primary winding of the code alternator transformer to terminal N. The code alternator may be constructed and arranged in the manner shown and described in detail in Letters Patent of the United States No. 2,348,525, issued on May 9, 1944, to Austin M. Cravath, for Apparatus for Generating Coded Alternating Current. It is deemed sufficient for the purposes of this disclosure to point out that the equipment is arranged so that the supply of direct current energy to the primary winding of the code alternator transformer causes the build-up of energy in the magnetic field of the transformer, and when the contact *a* of coding device 75CT interrupts the supply of direct current energy to the primary winding of the transformer, the magnetic field collapses, and with the capacitor shown connected across the primary winding of the transformer properly proportioned, the circuit will oscillate at a rate determined by the parameters of the circuit. It will be assumed in the present case that the apparatus is arranged so that, each time that contact *a* of coding device 75CT opens, a damped train of oscillations having a frequency of 140 cycles per second will be set up in the resonant circuit of the code alternator, which energy is supplied to the rails of section 1BT by the connections from the secondary winding of the code alternator transformer. Accordingly, it will be seen that the rails of section 1BT are continuously supplied with damped impulses of 140 cycle energy occurring at a 75 code rate, these impulses being supplied to the section rails at the code change point. At the exit end of section 1BT, the impulses of 140 cycle energy are supplied through the 140 cycle filter to the approach code following relay 2AVR, so that the contacts of this relay are recurrently operated at a 75 code rate by the 140 cycle energy supplied from the opposite end of the section. The code following operation of the contacts of relay 2AVR is detected by a circuit which includes the capacitor AVQ, which is connected across the direct current source each time that contact *a* of relay 2AVR is picked up, the capacitor being connected across the winding of the approach detector relay AVPR each time that contact *a* of relay 2AVR is released, so that the capacitor discharges the energy through the winding of the relay AVPR. Relay AVPR is sufficiently slow in releasing its contacts so that with the contact *a* of relay 2AVR recurrently operating, the relay AVPR will remain picked up during the short intervals in which no energy is being supplied to its winding. Accordingly, it will be seen that when relay 2AVR is operating its contacts at the 75 code rate, relay AVPR will be picked up. It is to be noted that the reactor L1 in the circuit for connecting the secondary winding of transformer 1BTT across the rails of section 1BT will retard the flow of the 140 cycle energy through the secondary winding of the transformer, thereby reducing the shunting effect of the secondary winding of this transformer on the 140 cycle energy. Because of the presence of the 100 cycle filter in the connections of the winding of track relay 1BTR to the rails of section 1BT, the track relay 1BTR will be unaffected by the impulses of 140 cycle energy supplied to the rails of the section at that end. Similarly, at the exit end of section 1BT, the presence of the 140 cycle filter in the connections of the winding of relay 2AVR to the rails of section 1BT will prevent the operation of relay

2AVR by the impulses of 100 cycle energy supplied from the secondary winding of transformer 1BTT.

With the apparatus in its normal condition as described above, with signals 2S and 1S displaying a clear aspect, and 100 cycle energy coded at the 180 code rate present in both sections 1AT and 1BT, it will now be assumed that a train moving from left to right passes signal 1S and enters section 1AT. The shunting effect of the wheels and axles of the train in section 1AT will cause relay 1ATR to release and remain released, so that the supply of energy to relays 1HR and 1DR is interrupted and these relays will release after a short time interval. With contact *a* of relay 1HR released, the circuit previously traced for supplying energy to the green lamp G of signal 1S is interrupted, and an obvious circuit is established over back contact *a* of relay 1HR for supplying energy to the red lamp R of signal 1S, so that signal 1S displays a red or stop aspect.

On the train, the train-carried cab signal equipment will pick up impulses of the 100 cycle energy in the rails of section 1AT, which is flowing through the section through the wheels and axles of the train, and the energy thus induced in the pickup coils of the train-carried equipment will cause the operation of the cab signal apparatus to display a clear aspect on the cab signal of the vehicle. When the train moves into section 1BT, the shunting effect of the wheels and axles of the train will cause relay 1BTR to release and remain released, so that its front contact *b* interrupts the supply of energy to the winding of transformer 1ATT, so that 100 cycle energy is no longer supplied to section 1AT at this time. The 100 cycle energy supplied to the rails of section 1BT from the secondary winding of transformer 1BTT will cause the cab signal apparatus to indicate a clear aspect on the vehicle, as the vehicle traverses section 1BT. Additionally, the presence of the train in section 1BT will shunt the supply of impulses of 140 cycle energy supplied from the code alternator at the code change point, so that energy will no longer be supplied to the winding of relay 2AVR and its contact *a* will release and remain released, resulting in the subsequent release of relay AVPR.

When the train moves out of section 1AT and occupies section 1BT only, the supply of 100 cycle energy to section 1AT will continue to be cut off, since relay 1BTR will remain released at this time because of the presence of the train in section 1BT. Accordingly, relay 1ATR will continue in its released position, and the relays 1HR and 1DR will both be released so that signal 1S continues to display its red or stop aspect. The cab signal apparatus on the locomotive or vehicle moving through section 1BT will continue to be operated by the energy induced in the vehicle pickup coils as the result of the 100 cycle energy supplied to the rails of section 1BT from transformer 1BTT, until the train passes signal 2S and moves out of the section.

When the train passes signal 2S, relay 2HR will be released, it being assumed that relay 2HR for signal 2S is governed in a manner similar to that described for relay 1HR associated with signal 1S. The release of contact *a* of relay 2HR interrupts the previously traced circuit for supplying 100 cycle energy coded at the 180 code rate to the primary winding of transformer 1BTT and transfers the connection of the primary winding of transformer 1BTT to a circuit including contact *a* of the coding device 75CT and front contact *a* of relay AVPR. Since relay AVPR is deenergized at this time with the rear of the train occupying section 1BT, no energy will be supplied to the primary winding of transformer 1BTT.

When the rear of the train has passed signal 2S, so that section 1BT is unoccupied, the 140 cycle energy supplied from the code alternator at the code change point will now be effective to operate the relay 2AVR, so that relay AVPR will close its front contacts. With

contact *a* of relay AVPR picked up, a circuit is established for supplying energy to the primary winding of transformer 1BTT, which circuit may be traced from terminal BX100 at front contact *a* of relay AVPR, over contact *a* of coding device 75CT, over back contact *a* of relay 2HR, and through the primary winding of transformer 1BTT to terminal NX100. Accordingly, 100 cycle energy coded at the 75 code rate will now be supplied to the rails of section 1BT at the exit end thereof. This 100 cycle energy will flow over the section rails and cause operation of the contacts of relay 1BTR at the 75 code rate. Each time that front contact *b* of relay 1BTR picks up, 100 cycle energy is supplied to the primary winding of transformer 1ATT by the circuit previously traced. Thus, 100 cycle energy coded at the 75 code rate is supplied to the rails of section 1AT at the code change point, and flows over the rails of section 1AT to cause operation of the contacts of relay 1ATR at the entrance end of section 1AT, at the corresponding 75 code rate.

With the contacts *a* and *b* of track relay 1ATR recurrently operating at the 75 code rate, energy will be supplied to the winding of relay 1HR so that this relay will pick up its contacts. However, insufficient energy is supplied to the decoding unit 180DU to pick up the contacts of relay 1DR, so that relay 1DR remains released at this time.

With relay 1HR picked up and relay 1DR released, a circuit is established for supplying energy to the yellow lamp Y of signal 1S, which circuit may be traced from terminal B at front contact *a* of relay 1HR, over back contact *a* of relay 1DR, and through the yellow lamp Y of signal 1S to terminal N.

From the foregoing, it will be seen that at this time, with the signal 2S displaying a stop aspect because of the traffic conditions in advance causing the release of relay 2HR, the rails of the sections 1AT and 1BT will be supplied with 100 cycle energy coded at the 75 code rate, and the reception of the 100 cycle energy coded at this rate at the location of signal 1S will cause this signal to display a yellow or approach aspect.

Let it now be assumed that, with signal 2S at stop and signal 1S displaying an approach aspect, a train moving from left to right passes signal 1S and enters section 1AT. As previously pointed out, the shunting effect of the wheels and axles of the train in section 1AT will cause the track relay 1ATR to release and remain released, resulting in the subsequent release of signal control relay 1HR, so that the yellow lamp Y of signal 1S is extinguished and energy is supplied to the red lamp R of the signal, so that the signal displays a red or stop aspect to the rear of the train. The 100 cycle energy supplied to the rails of section 1AT and coded at the rate of 75 times a minute will be picked up by the cab signal apparatus on the locomotive of the train, to thereby cause the cab signal to display an approach aspect. When the front of the train passes the code change point and enters section 1BT, track relay 1BTR is shunted and its contacts release and remain released so that the supply of energy to transformer 1ATT is cut off. Additionally, at this time, the supply of 140 cycle energy from the code alternator CA to the rails of section 1BT is shunted by the wheels and axles of the train, so that at the exit end of the section, relay 2AVR releases and remains released, which in turn releases approach detecting relay AVPR.

Upon the release of relay AVPR, the circuit previously traced for supplying energy to transformer 1BTT is interrupted, so that the supply of 100 cycle energy at the rate of 75 times per minute to the rails of section 1BT at the exit end thereof is discontinued at this time.

Since 100 cycle energy is no longer supplied to the rails of section 1BT, the cab signal apparatus will be operated to display its most restrictive aspect, to thereby indicate to the engineman that a stop signal is being approached.

When the rear of the train vacates section 1AT, the supply of energy to the rails of section 1AT from transformer 1ATT remains interrupted, since contact *b* of relay 1BTR will continue to be released. Accordingly, signal 1S will continue to display a stop aspect.

Let it now be assumed that traffic conditions in advance of signal 2S become such that relay 2HR picks up. With contact *a* of relay 2HR picked up, the circuit previously traced for supplying 100 cycle energy coded at the rate of 180 times per minute to the winding of transformer 1BTT is again established, so that energy coded at this rate is supplied to the rails of section 1BT. Accordingly, the cab signal apparatus on the train occupying section 1BT will respond to provide a clear or proceed aspect in the cab on the locomotive.

When the train in question passes signal 2S and the rear of the train vacates section 1BT, the 100 cycle energy supplied at the exit end of the section will flow over the section rails to recurrently energize relay 1BTR at the code change point, at the rate of 180 operations per minute. As a result, relay 1BTP is again picked up and the circuit for supplying energy at the 180 code rate to transformer 1ATT is again established, so that relay 1ATR at the entrance end of the section 1AT is again operated at the 180 code rate.

Operation of the contacts *a* and *b* of relay 1ATR at the 180 code rate results in the picking up of relays 1HR and 1DR, so that the circuit previously traced for supplying energy to the green lamp G of signal 1S is again completed with the result that signal 1S again displays a clear aspect.

At the code change point, the supply of 140 cycle energy from the static code alternator will feed over the section rails of section 1BT to recurrently energize the contacts of relay 2AVR at the exit end of the section, with the result that relay AVPR is again picked up. Accordingly, it will be seen that the apparatus is now restored to its normal condition as shown in the drawing.

From the foregoing description, it will be seen that my invention provides an arrangement in which the use of line wires to govern the supply of coded energy to the forward section of the two track sections of a stretch is eliminated, but the system provides the essential requirement of causing the supply of coded energy to be cut off from the exit end of the forward section when a train enters the section and the signal in advance is displaying a stop aspect, so that the cab signal apparatus on the train or vehicle entering the section will display a restrictive aspect.

It will be obvious to those skilled in the art that other sources of energy may be used for providing the coded energy at the second frequency, other than the code

alternator herein shown and described, the only requirement being that the frequency so generated is sufficiently different from the frequency of the energy effective to operate the cab signal equipment that no mutual interference takes place.

Although I have herein shown and described only one form of coded railway signaling apparatus embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claim without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

In combination, a stretch of railway track over which trains equipped with cab signal apparatus responsive to alternating current of a first frequency coded at one or another code rate move in one direction, said stretch being divided into two sections to form a code change point; a wayside signal governing the entrance of trains into said stretch, a signal control relay at the exit end of the forward section, said relay having a first and a second contact closed accordingly as the track stretch next in advance is unoccupied or occupied; means for continuously supplying to the rails of said forward section adjacent the entrance end thereof coded alternating current having a second frequency different from said first frequency and incapable of operating cab signal apparatus, means at the exit end of said forward section responsive to alternating current of said second frequency and including a third contact closed only when said forward section is unoccupied, means controlled by said first contact for supplying to the rails of said forward section alternating current of said first frequency coded at said one code rate, means controlled by said second and third contacts for supplying to the rails of said forward section at the exit end thereof alternating current of said first frequency coded at said other code rate, means at said code change point responsive to the coded alternating current of said first frequency supplied to the rails of said forward section for supplying to the rails of the rear section alternating current of the same frequency coded at the same code rate, and means for controlling said wayside signal by the coded alternating current supplied to the rails of the rear section.

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