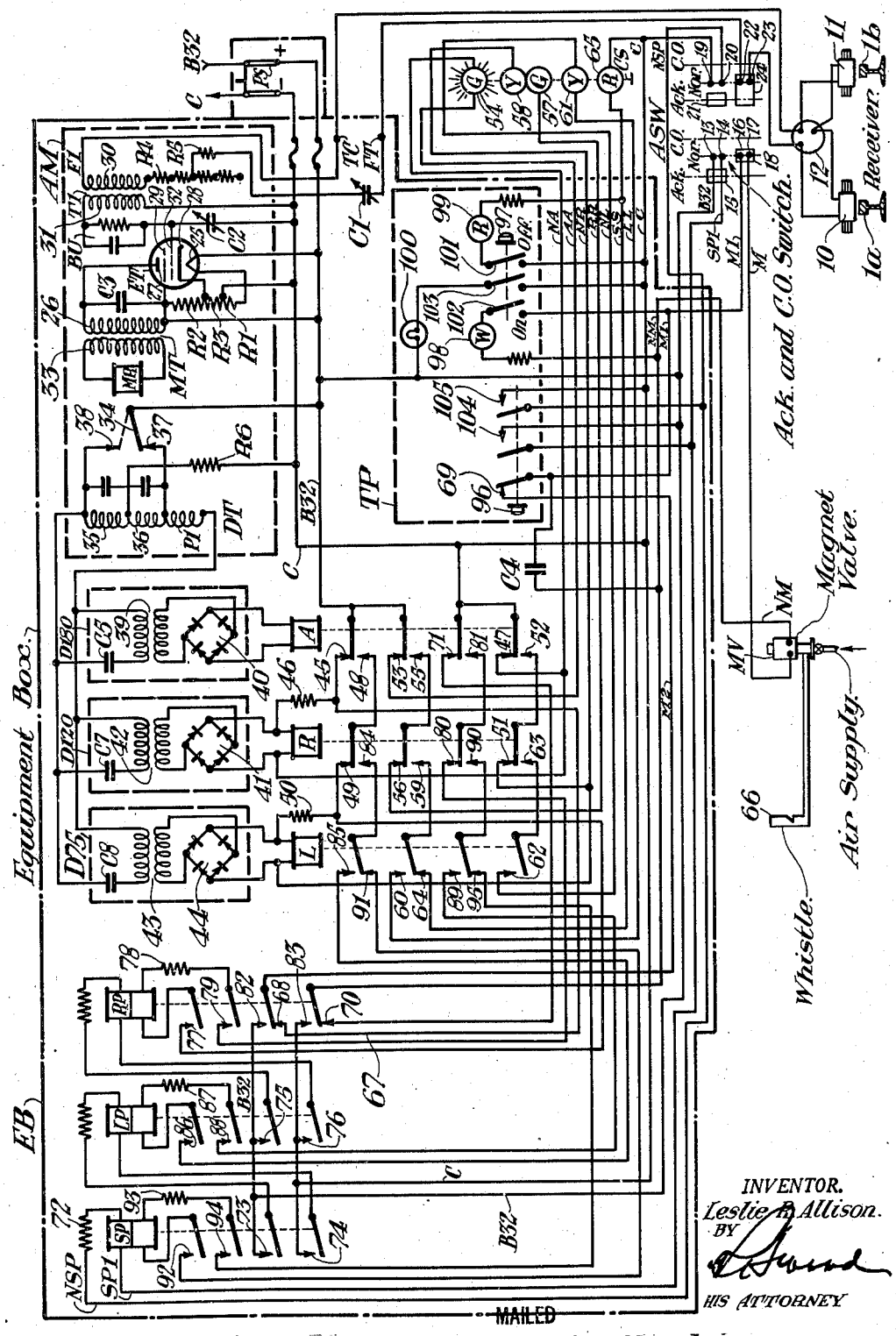
Feb. 22, 1949. L. R. ALLISON 2,462,454

TRAIN CARRIED CAB SIGNAL APPARATUS

Filed April 9, 1947



Patented Feb. 22, 1949 2,462,454

UNITED STATES PATENT OFFICE

2,462,454

TRAIN CARRIED CAB SIGNAL APPARATUS

Leslie R. Allison, Forest Hills, Pa., assignor to The Union Switch & Signal Company, Swissvale Pa., a corporation of Pennsylvania

Application April 9, 1947, Serial No. 740,311

4 Claims. (Cl. 246—63)

1

My invention relates to train carried cab signal apparatus, and more particularly to cab signal apparatus responsive to coded track circuit energy.

The coded current for influencing cab signal apparatus of the type here contemplated is generally supplied across the track rails at the exit end of a track section so that current flows in one rail through the train shunt and back in the other rail when a train occupies the section. Two inductors are mounted on the train ahead of the leading pair of wheels with one inductor over each rail to inductively pick up an electromotive force due to the rail current. The general practice is to use alternating current of the order of 100 cycles per second and to code the current by periodically interrupting it at the rates of 180, 120 and 75 times per minute according to clear, approach-medium and approach traffic conditions in advance of the track section. In some systems only two codes of the rates of 180 and 75 interruptions per minute are used to reflect clear and approach traffic conditions, and it is apparent that additional codes can be used to reflect additional traffic conditions if desired.

The electromotive forces picked up by the inductors have the frequency and code rate of the rail current, and the two inductors are connected for their two electromotive forces to add their effects. The resulting electromotive force is amplified and used to operate a code following relay which governs decoding units that are selectively responsive to the code rate at which the relay is operated. The decoding units govern in turn cab signals and other warning devices through a group of decoding relays, there being an individual decoding relay for each decoding unit.

Acknowledging means is generally provided with cab signal apparatus of this type wherewith the train operator or engineman is required to acknowledge a change in the cab signal indication when the change is to a more restrictive indication.

The requisites of cab signal apparatus are very exacting because the safety of the train is involved. For example, the requisites require the apparatus to have a sensitivity that assures satisfactory train shunt detection and broken rail protection. Also, a substantially uniform response over a relatively wide range in the magnitude of the rail current as caused by different local conditions and the shunting out of the rail impedance when the train moves toward the exit end of the section is necessary. The amplifier

2

must be immune to extraneous energy picked up by the inductors due to the rails carrying propulsion current and stray currents from power systems. Also, operation of the apparatus must be satisfactory when the train carried source from which energy is derived for energizing the apparatus varies widely in its voltage. Code distortion must be minimized. False operation due to broken or misplaced circuit elements must be avoided. Ample manufacturing tolerance must be permitted. The apparatus must withstand severe vibrations and shocks due to train movements. Again, the apparatus must be such that inspection and testing can readily and quickly be made before trains leave the terminal.

In view of the foregoing and additional requisites, a main object of my invention is the provision of improved cab signal apparatus having a high order of reliability of operation and having a simple construction.

Another feature of my invention is the provision of cab signal apparatus of the type here involved incorporating improved decoding means to increase the margin against the possibility of false operation due to an intermittent circuit fault.

Again, a feature of my invention is the provision of improved cab signal apparatus having identical decoding and acknowledging relays for complete interchangeability.

Another feature of my invention is the provision of cab signal apparatus incorporating a novel arrangement of acknowledging circuits wherewith the time between the reception of a more restrictive code and the initiating of a warning signal is varied inversely starting from the clear code.

A further feature of my invention is the provision of cab signal apparatus incorporating an improved manner of housing to facilitate inspection and maintenance.

Other features, objects and advantages of my invention will appear as the specification progresses.

The foregoing objects, features and advantages of my invention I attain by provision of a single stage low voltage amplifier unit, decoding units, one for each code, and each unit tuned to resonance at a frequency corresponding to the respective code, decoding relays and acknowledging relays identical in construction, a test panel and a circuit network, the vital circuits of which are of a double break type. This apparatus is grouped in an assembly that is arranged to afford a high order of protection against vibration, shock

and faulty circuit elements and also in a manner that facilitates inspection, testing and maintenance.

For a fuller understanding of my invention, reference may be had to the accompanying drawing, which is a diagrammatic view showing one form of apparatus embodying my invention when used with a four indication cab signal system for railways.

It is to be understood that the invention is not limited to a four indication cab signal system, and this application serves to illustrate the many places the apparatus is useful.

Referring to the drawing, the reference characters *1a* and *1b* designate the track rails of a railway, and which rails are divided in the usual manner with a track section provided with a track circuit which includes the rails and a current source connected across the rails adjacent the exit end of the section. This track circuit current is coded at any one of a plurality of different code rates according to different traffic conditions. The trackway apparatus for supplying the coded current to rails *1a* and *1b* is not shown since it forms no part of my invention and may be any one of several well-known arrangements. This trackway apparatus may be, for example, similar to that disclosed in Letters Patent of the United States No. 1,986,679, granted January 1, 1935, to Lloyd V. Lewis, for Railway traffic controlling apparatus.

In order to better understand my invention, I shall assume that the current supplied to rails *1a* and *1b* is an alternating current of the frequency of the order of 100 cycles per second, and it is coded at the rates of 180, 120 and 75 interruptions per minute to reflect clear, approach-medium and approach traffic conditions, respectively, the absence of rail current or the presence of non-coded current reflecting slow speed traffic conditions. It is to be understood that the invention is not limited to the above mentioned frequencies and codes for the track circuit current, and other frequencies and codes can be used.

The train carried apparatus includes as essential elements, a receiver, an amplifier unit, decoding means, acknowledging means, signaling means, and a test panel as well as a suitable source of power.

The receiver comprises inductors **10** and **11** which are mounted on the train ahead of the leading pair of wheels for inductive relationship with rails *1a* and *1b*, respectively. It follows that an electromotive force of a frequency and code corresponding to that of the rail current is inductively picked up by each inductor **10** and **11**. The value of these electromotive forces picked up from the track circuit will be proportional to the value of the track circuit current.

The two inductors **10** and **11** have their terminals connected together at a junction box **12** to add their electromotive forces and the terminals of the junction box are in turn connected to input terminals FT and TC of an amplifier unit to be described shortly, the connection including contacts **22**, **23** and **24** of an acknowledging and cut-out switch ASW, as will be apparent from an inspection of the drawing.

The acknowledging and cut-out switch ASW is a three position manually operable switch having an acknowledging position ACK, a normal position NOR and a cut-out position CO. This switch ASW is provided with a handle, not shown, for moving it to its different positions

and the switch would be mounted on the train where it is convenient to the train operator for operation by him. The arrangement of this switch is such that movable contact members **13** and **14** engage a stationary contact **15** at the acknowledging position ACK, movable contacts **16** and **17** engage a stationary contact **18** at the normal position, movable contacts **19** and **20** engage a stationary contact **21** at the acknowledging position, and movable contacts **22** and **23** engage stationary contact **24** at both the normal and acknowledging positions. At the cut-out position CO, all circuit connections are open.

It is to be pointed out that the train carried source of power for the cab signal apparatus may be any convenient direct current source, the terminals B32 and C of which are connected to a double pole cut-out switch PS. The voltage of this power source may be of any suitable value and preferably the cab signal apparatus is designed to use 32 volt direct current so that the usual train lighting source can be used to energize the cab signal apparatus without voltage conversion devices.

The amplifier unit is indicated as a whole by a dotted rectangle AM. This amplifier unit may take different forms, and it may be similar to that disclosed in Letters Patent of the United States No. 2,336,766, granted December 14, 1943, to Leslie R. Allison and Carl Volz, for Railway traffic controlling apparatus, except to include an approved arrangement wherewith the value of voltage to be applied to the input of the unit can be adjusted to take care of track circuits of high and low energy levels. This unit comprises as essential elements a filter F1, an electron tube ET, a master transformer MT, a code following relay MR and a decoding transformer DT.

The tube ET is disclosed as an indirectly heated tetrode which is designed for operation from a single 32 volt source of current, but other types of tubes can be used. A filament or heater **25** is connected across the B32 and C power leads through a resistor R1 for heating the tube. Two resistors R2 and R3 in series are connected across the power source to provide a voltage divider from which suitable voltages are applied to the tube. An anode-cathode circuit for the tube, extends from the positive terminal of the voltage divider, through winding **26** of the master transformer MT, anode **27** and tube space to cathode **28** and to the junction terminal of resistors R2 and R3 of the voltage divider, a by-pass capacitor C3 being preferably connected across winding **26** of the master transformer. A screen grid or electrode **29** of the tube is connected directly to the positive terminal of the voltage divider.

The input of the tube ET is connected to the terminals TC and FT through a gain control unit BU, filter F1 and a tuning capacitor C1. Specifically, a first winding **30** of a transformer T1 of the filter is connected across terminals TC and FT through a selected portion of a variable resistor R4, another resistor R5 and tuning capacitor C1; and a second winding **31** of the transformer has one terminal connected to control electrode **32** of the tube through unit BU, and the other terminal connected to cathode **28** of the tube through resistor R3 of the voltage divider. An adjustable capacitor C2 is connected across the winding **31** of the transformer T1. The gain control unit BU comprises a resistor and a capacitor in multiple and functions in the usual

manner for such devices and I have found that with tube ET constructed with proper operating characteristics this unit may not be required and can be omitted from the input circuit of the tube.

It is clear that the input circuit for the tube can be tuned by the capacitor C1 and filter F1 to pass only energy of the frequency of the track circuit current and to substantially suppress energy of other frequencies, and the magnitude of the voltage applied to the tube can be adjusted by selection of the connection to the different terminals of resistor R4.

The electrode or screen grid 29 of tube ET is provided with a positive potential with respect to cathode 28 equal to the voltage drop of resistor R2 and the control grid 32 is biased negative in potential with respect to the cathode by the voltage drop across resistor R3. This establishes a given normal anode circuit current, the anode current being preferably made substantially zero in the absence of input voltage. By this arrangement the direct current component of the anode circuit current caused by energy picked up from the track circuit is maintained approximately constant over a wide range of the voltage of the train carried source because the voltage across resistor R3 varies directly with the voltage applied to the anode 27 and screen electrode 29. It also remains approximately constant over a wide range of track circuit current because of the automatic gain control unit BU.

The master relay MR is preferably a stick polar relay operating to reversibly actuate its polar armature 34 in response to electromotive forces of opposite polarity and of a given value. The operating winding of relay MR is connected across secondary winding 33 of master transformer MT, and the relay is operated in step with the pulses of electromotive force induced in secondary winding 33 due to the on and off code periods of the electromotive force picked up by the receiver from the track circuit energy.

Two portions 35 and 36 of a winding P1 of decoding transformer DT are alternately supplied with direct current from the 32 volt source through the polar contacts 37 and 38 of the code following relay MR, a resistor R6 being preferably included in the circuit. Thus, an alternating voltage is created across winding P1 of the decoding transformer when relay MR is operated, the frequency of the alternating voltage corresponding to the code rate at which relay MR is operated. The winding P1 of the decoding transformer is connected to the decoding means, which comprises three decoding units identified by the dotted rectangles D180, D120 and D75, and three decoding relays A, R and L, there being an individual decoding relay for each decoding unit. These three decoding units are similar except for their tuning and are preferably of the construction disclosed in my copending application for Letters Patent of the United States, Serial No. 660,961, filed April 10, 1946, for Reactance devices, now Patent No. 2,446,624, granted August 10, 1948.

Looking at the decoding unit D180, for example, it includes a transformer 39, a capacitor C5, and a rectifier 40. The input terminals of the unit are connected across winding P1 of the decoding transformer and the output terminals of the unit are connected to the respective decoding relay A. This unit D180 is tuned to resonance at the frequency of the alternating voltage created in the decoding transformer when relay MR

is operated at a rate corresponding to the 180 code of the track circuit current. When unit D180 is energized by alternating voltage of this frequency, sufficient rectified current is passed to the relay A to effectively energize the relay and the relay is picked up. Alternating voltages of other frequencies when applied to the unit D180 are substantially blocked and relay A is not energized or is energized to such a low order that it is not picked up.

Similarly, the unit D120 includes a transformer 42, a capacitor C7 and a rectifier 41 and is connected across winding P1 of decoding transformer DT. It is tuned to resonance at the frequency of the alternating voltage created in the decoding transformer when relay MR is operated at the rate corresponding to the 120 code rate of the track circuit current. Thus the decoding relay R is effectively energized by current passed by the unit D120 when relay MR is operated in response to track circuit current of 120 code rate but is ineffectively energized when relay MR is operated at other code rates.

Again, the unit D75 includes a transformer 43, a capacitor C8 and a rectifier 44 and is connected to winding P1 of the decoding transformer. It is tuned to resonance at the frequency of the alternating voltage created in the decoding transformer when relay MR is operated at the rate corresponding to the 75 code rate of the track circuit current, and thus the decoding relay L connected with the output terminals of the unit D75 is effectively energized in response to the 75 code of the track circuit current and is ineffectively energized in response to the other code rates.

It is to be pointed out that the decoding relay R is provided with an alternative energizing circuit which includes power lead B32, front contact 45 of relay A, resistor 46, winding of relay R, front contact 47 of relay A, and power lead C. Thus when energy of the 180 code rate is picked up from the track rails and decoding relay A is energized due to the operation of relay MR, the relay R is also energized due to its alternative circuit. Similarly, the decoding relay L is provided with an alternative circuit which includes power lead B32, back contact 48 of relay A, front contact 49 of relay R, resistor 50, winding of relay L, front contact 51 of relay R, back contact 52 of relay A, and power lead C. Consequently when energy of the 120 code rate is picked up from the track rails and the decoding relay R is energized due to the rectified current passed by the decoding unit D120, the relay L is also energized due to its alternative circuit.

The decoding relays govern operating circuits for a cab signal CS which is located in the cab convenient to the train operator. In practicing the invention, a plurality of cab signals similar to the signal CS are located on the train near the positions of different members of the train crew, but in the drawing only the one signal CS is shown for the sake of simplicity because the other signals are duplications thereof.

The cab signal CS may take different forms and as shown it is a color light signal capable of displaying four distinctive aspects. When decoding relay A is picked up in response to track circuit energy of the 180 code, a signal operating circuit can be traced from power lead B32, through front contact 53 of relay A, wire AA, lamp 54 of signal CS, wire NA and front contact 47 of relay A to power lead C; and the lamp 54 is illuminated to display a green light as a clear

signal indication. When relay A is released and relay R is picked up in response to track circuit energy of the 120 code, a signal operating circuit is formed from power lead B32 through back contact 55 of relay A, front contact 56 of relay R, wire RR, lamp 57—58 of signal CS, wire NR, front contact 51 of relay R, back contact 52 of relay A to power lead C; and lamp 57—58 is illuminated to display a yellow light over a green light as an approach-medium signal indication. With decoding relays A and R released and relay L picked up in response to track circuit energy of the 75 code, a signal operating circuit is formed from power lead B32 through back contacts 55 and 59 of relays A and R, respectively, front contact 60 of relay L, wire LL, lamp 61, wire NL, front contact 62 of relay L and back contacts 63 and 52 of relays R and A, respectively, to power lead C, and the lamp 61 is illuminated to display a yellow light as an approach signal indication. In the event the track circuit energy is shunted by a train in advance, the relay MR is not operated and all the decoding relays are released. Under this condition, a signal operating circuit is formed from power lead B32 through back contacts 55, 59 and 64 of relays A, R and L, respectively, wire SS and lamp 65 to power lead C, and the lamp 65 is illuminated to display a red light as a slow speed indication.

It was explained hereinbefore that relay R is energized by its alternative circuit when the relay A is energized in response to the 180 code. Thus, a change from clear traffic condition to approach-medium traffic condition changing the track circuit code from 180 to 120 so that relay A is deenergized and relay R is energized through the associated decoding unit, there is no loss of time in getting the decoding relay R picked up to complete the approach-medium signal operating circuit. Also, the possibility of a red signal flash during the change in traffic conditions is minimized. Similarly, when a change from approach-medium to approach traffic conditions occurs, changing the track circuit code from 120 to 75, there is no loss of time in getting the relay L picked up to complete the approach cab signal circuit because relay L is energized by its alternative circuit while the relay R is energized by the 120 code.

An audible cab signal in the form of an air whistle 66 is provided, this whistle being used to warn the train operator of a change to a more restrictive indication. This whistle, once initiated, continues to sound until the operator acknowledges the cab signal change. The whistle 66 is actuated through a magnet valve MV, the arrangement being such that when the magnet valve is energized the supply of air is blocked and when deenergized the air supply is exhausted through the whistle causing it to sound. In practicing my invention, several air whistles would preferably be provided at different points on the train where they would be heard by the different members of the train crew.

It is obvious that the magnet valve MV can be used to set into operation train brake controlling devices.

The magnet valve MV is governed through a group of acknowledging relays SP, LP and RP and the acknowledging switch ASW. It is believed that the acknowledging relays and their circuits can best be understood by a description of the operation of the apparatus.

In describing the operation of the apparatus

I shall first consider that clear traffic conditions exist and the track circuit current is of the 180 code so that the decoding relay A is picked up in the manner explained hereinbefore. With relay A picked up, the circuit for the clear cab signal light 54 and the alternative circuit for the relay R are closed. Also, a circuit is formed for the magnet valve MV, this latter circuit extending from power lead B32, through front contact 45 of relay A, wire 67, back contact 68 of relay RP, wire M2, normally closed contact 69 of a switch 96 of a test panel TP to be referred to later, wire M1, contacts 16, 17 and 18 of switch ASW, wire M, winding of magnet valve MV, wire NM, back contact 70 of relay RP and front contact 71 of relay A to power lead C. It is to be noted that a capacitor C4 is connected across the current source in multiple with the winding of the magnet valve MV, and the capacitor C4 is normally charged at the voltage of the current source.

I shall next assume that traffic conditions change from clear to approach-medium changing the track circuit current from the 180 to the 120 code. This causes decoding relay A to be released, and decoding relay R to be energized by current passed by the associated decoding unit D120. Under these circumstances the approach-medium cab signal 57—58 is illuminated and the decoding relay L is energized by its alternative circuit. The release of relay A opening front contacts 45 and 71 opens the circuit for magnet valve MV and that valve is deenergized and the whistle 66 is sounded to call attention to this change to the more restrictive cab signal. There is a delay period in the release of the magnet valve MV equal to the discharge period of the capacitor C4 through the winding of the magnet valve. Capacitor C4 is selected to provide a predetermined delay period of the order of 2 seconds, although other delay periods can be used.

To silence the whistle, the train operator must move the switch ASW to the acknowledging position and then restore the switch to its normal position. At the acknowledging position of the switch ASW current flows from power lead B32 through the contacts 13, 14 and 15 of switch ASW, wire SP1, top winding of relay SP, resistor 72, wire NSP and contacts 19, 20 and 21 of the switch ASW to power lead C. This picks up acknowledging relay SP and with relay SP picked up the top winding of the relay LP is energized by an obvious pick-up circuit including front contacts 73 and 74 of relay SP, and with relay LP picked up the top winding of the acknowledging relay RP is energized by an obvious pick-up circuit including front contacts 75 and 76 of relay LP. That is to say, the acknowledging relays SP, LP and RP are picked up in sequence. When switch ASW is restored to its normal position, the circuit for relay SP is opened and the relay is released. The release of relay SP opens the circuit for the top winding of relay LP and relay LP is released, and with relay LP released the circuit for the top winding of relay RP is open but relay RP is now provided with a holding circuit that extends from power lead B32, through back contact 48 of relay A, front contact 49 of relay R, front contact 77 of relay RP, lower winding of the relay, resistor 78, front contact 79 of the relay, front contact 80 of relay R and back contact 81 of relay A to power lead C. Thus, the acknowledging relay RP remains energized subsequent to the restoring of the switch ASW to its normal position and a circuit is formed for the magnet

valve from power lead B32, through front contact 82 of relay RP, wire M2, contact 69, wire M1, contacts 16, 17 and 18 of switch ASW, wire M, winding of magnet valve MV, wire NM and front contact 83 of relay RP to power lead C. Magnet valve MV is now energized and the whistle 66 is made silent. Also the capacitor C4 is recharged.

I shall next assume that traffic conditions change from approach-medium to approach, causing the track circuit current to change from the 120 to the 75 code. This causes relays R and A to be released and the relay L to be energized by current supplied through the associated decoding unit D75. With relays A and R released and relay L picked up, the approach cab signal 61 is illuminated. The previous traced holding circuit for the relay RP is opened at front contacts 49 and 80 of relay R and relay RP is released to open the circuit for the magnet valve MV and the whistle 66 is sounded. This time there is a delay period in the release of the magnet valve subsequent to the change of the position of the decoding relays which is equal to the release period of relay RP plus the discharge period of capacitor C4. Assuming the discharge period of capacitor C4 is of the order of 2 seconds and the release period of relay RP is of the order of one second, the delay in the sounding of the whistle subsequent to the change from approach-medium to approach is substantially three seconds or one second longer than the delay period when the code changed from clear to approach-medium.

To silence the whistle 66 the operator moves the switch ASW to the acknowledging position and then back to the normal position the same as before. With the switch ASW at the position ACK the relays SP, LP and RP are energized in sequence as explained hereinbefore. When switch ASW is restored to its normal position the relay SP is released to open the pick-up circuit for relays LP but relay LP is now retained energized by a holding circuit, and which holding circuit receives power from power lead B32 through back contacts 48 and 84 of relays A and R, respectively, front contact 85 of relay L, front contact 86 of relay LP, lower winding of the relay, resistor 87, front contact 88 of relay LP, front contact 89 of relay L, and back contacts 90 and 81 of relays R and A, respectively, to power lead C. With relay LP picked up, then the relay RP is energized by its pick-up circuit including its top winding, and with relay RP picked up it completes the circuit previously traced for the magnet valve. Also, capacitor C4 is recharged.

I shall next consider that traffic conditions change from approach to slow speed and the track circuit current is shunted or non-coded so that the relays A, R and L are all released. Under these circumstances the slow speed cab signal 65 is illuminated. With relay L released, the relays LP and RP are deenergized one after the other and the magnet valve MV is without current and is deenergized to sound the whistle. This time the delay period between the release of the decoding relay L and the release of the magnet valve MV to sound the whistle is equal to the release period of relay LP, plus the release period of relay RP, plus the discharge period of capacitor C4. That is, the delay in sounding the whistle subsequent to the change from approach to the slow speed signal is made greater than the period when traffic conditions change from approach-medium to approach. This arrangement tends to cause the whistle to blow at a more nearly fixed distance beyond the code change point rather than after the expiration of a fixed time interval.

Again, the operator must acknowledge this change to the slow speed signal by actuating the switch ASW to the acknowledging position and then back to the normal position in order to silence the whistle. With the switch ASW at the position ACK the relays SP, LP and RP are energized in sequence as before explained. A holding circuit for relay SP is now provided from the power lead B32 through back contacts 48, 84 and 91 of the decoding relays A, R and L, respectively, front contact 92 of relay SP, lower winding of the relay, resistor 93, front contact 94 of relay SP, and back contacts 95, 90 and 81 of the relays L, R and A, respectively, to power lead C. With relay SP retained energized then the other two acknowledging relays LP and RP are held energized by their pick-up circuits and with relay RP picked up the magnet valve is energized over the previously traced circuit and the whistle is made silent.

In the case the traffic conditions change from slow speed to approach so that relay L is picked up the acknowledging relay SP is released but the two relays LP and RP remain energized and the energizing circuit for the magnet valve is not disturbed and the whistle is not sounded at this change to a less restrictive signal. Again, a change from approach to approach-medium condition will result in relay R being picked up and this causes the acknowledging relay LP to become deenergized but the relay RP is retained energized by its holding circuit and the circuit for the magnet valve is not disturbed so that the whistle does not blow for this change to a less restrictive condition. If traffic conditions change to clear so that the decoding relay A is energized, then the acknowledging relay RP is released but the magnet valve is now energized over its traced circuit including front contacts 45 and 71 of relay A, and the whistle is not sounded due to this change in traffic conditions.

I have found that by tuning the decoding unit D75 in place of having this unit responsive to all codes as heretofore provided, the changes of a false indication due to intermittent circuit conditions is minimized.

Also the long retardation of the SP acknowledging relay as heretofore required in order to avoid loss of acknowledgment due to unnecessary picking up of decoding relay L is not required and relay SP can be made with a retardation of the same value provided for relays LP and RP. Furthermore, since the capacitor C4 provides the major portion of the delay time between change of code downward and release of magnet valve MV, it is not necessary to provide so much retardation in the decoding relays as has been the practice in the past. This permits the decoding relay to be made identical with the acknowledging relays with no larger copper ferrules for snubbing purposes than is necessary to insure that the acknowledging relays bridge the open circuit transition time of the decoding relays. The additional winding space thus obtained is utilized to increase the turns and the operating current for the decoding relay reduced, which reduction in operating current results in the aging of the rectifiers being reduced. These several features permit the decoding and acknowledging relays to be made identical in construction

and completely interchangeable, which greatly facilitates maintenance. In the case of the acknowledging relays, the leads of the usual two coils are separated and the two coils used independently so that the pick-up and holding circuits of the acknowledging relays are insulated from each other.

The apparatus including the amplifier unit, decoding means and acknowledging relays are housed in an equipment box indicated by the dot and dash rectangle EB. This box is made weatherproof and it is mounted generally on the train at some point outside of the cab due to the limited space in the cab. When the apparatus of the equipment box is remote from the position of the cab signal and acknowledging switch in the cab, testing and inspection of the apparatus generally requires two workmen in order to properly check the different elements, that is, to check agreement between the different conditions of the apparatus in the equipment box and the corresponding conditions of the cab signal and acknowledging switch. To facilitate testing and inspection, I provide a test panel which is made integral with the apparatus mounted in the equipment box. This test panel is indicated by a dotted rectangle TP and includes manually operable switches 96 and 97, test lamps 98 and 99 and an illuminating lamp 100. The lamp 99 is connected in multiple with slow speed lamp 65 of the cab signal when a contact 101 of the switch 97 is closed and the test lamp 98 is connected in multiple with magnet valve MV when contact 102 of switch 97 is closed. Preferably the lamp 99 displays a red light and the lamp 98 an opal light. The lamp 100 is connected across the power source through a contact 103 of the switch 97 and lamp 100 serves to illuminate the equipment box as an aid in testing the apparatus at night or when the light is bad. It follows that when the switch 97 is closed, the red lamp 99 indicates when all the decoding relays are down and the opal lamp 98 when illuminated indicates when the magnet valve is energized.

The other switch 96 of the test panel is a duplicate from a circuit standpoint of the acknowledging switch ASW, the two normally open contacts 104 and 105 of switch 96 being in multiple with contacts 15 and 21, respectively, of the switch ASW. Also, contact 69 of switch 96 is in series with the contact 18 of switch ASW.

At terminals where testing and inspection of the cab signal apparatus is generally done, a test track circuit is provided and the locomotive is run onto this test track circuit. The maintainer can check the normal release condition of the decoding relay by operating switch 97 and observing the lamp 99. That is, the lamp 99 is illuminated whenever the test track circuit is deenergized and is dark whenever a code is applied to the test track circuit. With any code of the test track circuit current, the acknowledging equipment can be checked by operation of the switch 96 subsequent to a change in the code of the track circuit current to a more restrictive code.

It is to be seen, therefore, that by the provision of test panel TP at the equipment box, the apparatus can be tested efficiently and quickly by the maintainer alone and without the maintainer leaving the position of the equipment box and climbing into the locomotive cab.

Although I have herein shown and described but one form of train carried cab signal 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 train carried cab signal apparatus for use with track circuit current coded at a first, a second and a third code rate for operating a train carried code following relay at a code rate corresponding to the code rate of the track circuit current, a decoding transformer connected to said code following relay to create an alternating voltage of a frequency corresponding to the code rate at which the relay is operated; a first, a second and a third decoding unit connected in multiple to said transformer; each said decoding unit including capacitance and inductance to tune the first, second and third units to resonance at the frequency of said alternating voltages for the first, second and third code rates, respectively; a first, a second and a third decoding relay connected to said first, second and third decoding unit, respectively, to effectively energize the first, second and third decoding relays in response to the first, second and third code rate, respectively; an alternative circuit including a current source and a front contact of said first decoding relay connected to the second decoding relay to energize the second decoding relay, and another alternative circuit including a current source, a back contact of said first decoding relay and a front contact of said second decoding relay connected to said third decoding relay to energize the third decoding relay.

2. In train carried cab signal apparatus for use with track circuit current coded at a first, a second and a third code rate for operating a train carried code following relay at corresponding code rates, a decoding transformer connected to said code following relay to create an alternating voltage of a frequency corresponding to the code rate at which the relay is operated, three decoding units one for each of said code rates, three decoding relays one for each of said decoding units, said decoding units having their inputs connected in multiple to said decoding transformer and their outputs connected to the respective decoding relays, each said decoding unit tuned to resonance at the frequency of the alternating voltage created when the code following relay is operated at the corresponding code rate to effectively energize each decoding relay only in response to the respective code rate, a first alternative circuit including a current source and a front contact of the decoding relay responsive to said first code rate connected to the decoding relay responsive to the second code rate; and a second alternative circuit including a current source, a back contact of the decoding relay responsive to the first code rate, and a front contact of the decoding relay responsive to the second code rate connected to the decoding relay responsive to said third code rate.

3. In train carried cab signal apparatus for use with track circuit energy coded at a first, a second and a third code rate for operating a train carried code following relay at a first, second and third code rate, respectively; a first, a second and a third decoding relay controlled by the code following relay each of which is effectively energized only when said code following relay is operated at said first, second and third code rate, respectively; a first, a second and a third acknowledging relay; a first pick-up circuit including a manually operable contact and

a first winding of the third acknowledging relay to energize that relay, a second pick-up circuit including a front contact of said third acknowledging relay and a first winding of said second acknowledging relay to energize the second acknowledging relay, a third pick-up circuit including a front contact of said second acknowledging relay and a first winding of said first acknowledging relay to energize the first acknowledging relay; a first holding circuit including a back contact of said first decoding relay, a front contact of said second decoding relay and a front contact and second winding of said first acknowledging relay; a second holding circuit including a back contact of each of said first and second decoding relays, a front contact of said third decoding relay and a front contact and second winding of said second acknowledging relay; a third holding circuit including a back contact of each of said decoding relays and a front contact and second winding of said third acknowledging relay, a warning signal, an operating circuit including a front contact of said first decoding relay to energize said signal, and an alternative operating circuit including a front contact of said first acknowledging relay to energize said signal.

4. In train carried cab signal apparatus for use with track circuit energy coded at a first, a second and a third code rate for operating a train carried code following relay at a first, a second and a third code rate, respectively; three decoding relays governed by said code following relay through tuned units to effectively energize an individual one of the decoding relays in response to each of said code rates, three acknowledging relays, circuit means including a normally open manually controlled contact to energize said acknowledging relays in sequence in a definite order, a first holding circuit including a back

contact of a first one of said decoding relays and a front contact of a second one of said decoding relays to retain energized a first one of said acknowledging relays, a second holding circuit including a back contact of each of said first and second decoding relays and a front contact of a third one of the decoding relays to retain energized a second one of said acknowledging relays, a third holding circuit including a back contact of each one of said decoding relays to retain energized a third one of said acknowledging relays, a signal controlling magnet valve, a capacitor; a first control circuit including a source of direct current, a front contact of said first decoding relay and said magnet valve and capacitor in multiple to provide a given delay period in the deenergizing of the magnet valve when the code changes from the first to the second code; and a second control circuit including said direct current source, a front contact of said first acknowledging relay and said magnet valve and capacitor in multiple to provide a delay period equal to said given period plus the release period of said first acknowledging relay for deenergizing the magnet valve when the code changes from the second to the third code, and a delay period equal to said given period plus the release periods of said first and second acknowledging relays in sequence when the code changes from the third code to no code.

LESLIE R. ALLISON.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,336,766	Allison et al.	Apr. 9, 1947