

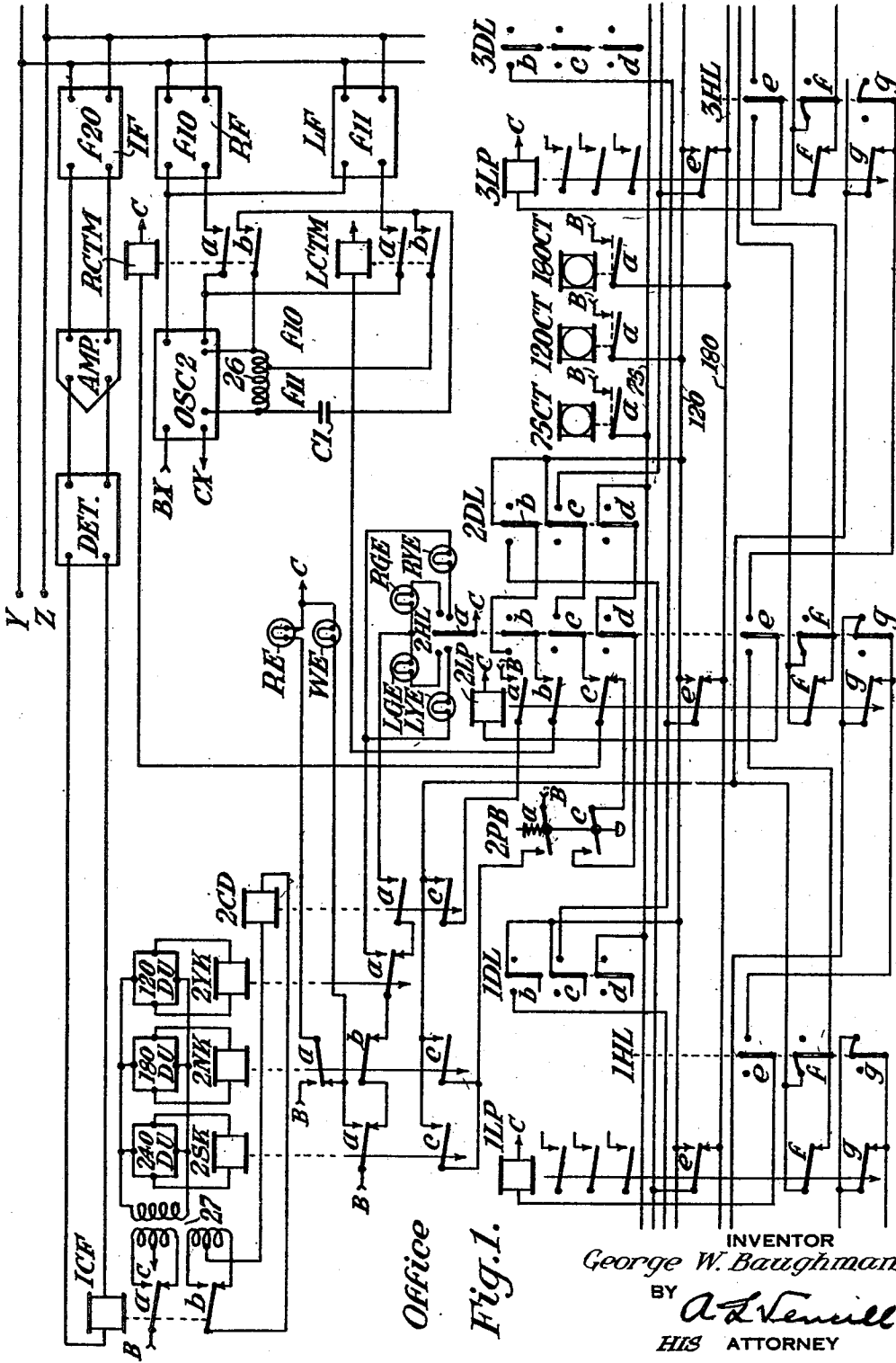
May 22, 1951

G. W. BAUGHMAN
MANUAL BLOCK SIGNALING SYSTEM FOR RAILWAYS
NOT HAVING CONTINUOUS TRACK CIRCUITS

2,554,000

Original Filed Dec. 18, 1943

2 Sheets-Sheet 1



May 22, 1951

G. W. BAUGHMAN
MANUAL BLOCK SIGNALING SYSTEM FOR RAILWAYS
NOT HAVING CONTINUOUS TRACK CIRCUITS

2,554,000

Original Filed Dec. 18, 1943

2 Sheets-Sheet 2

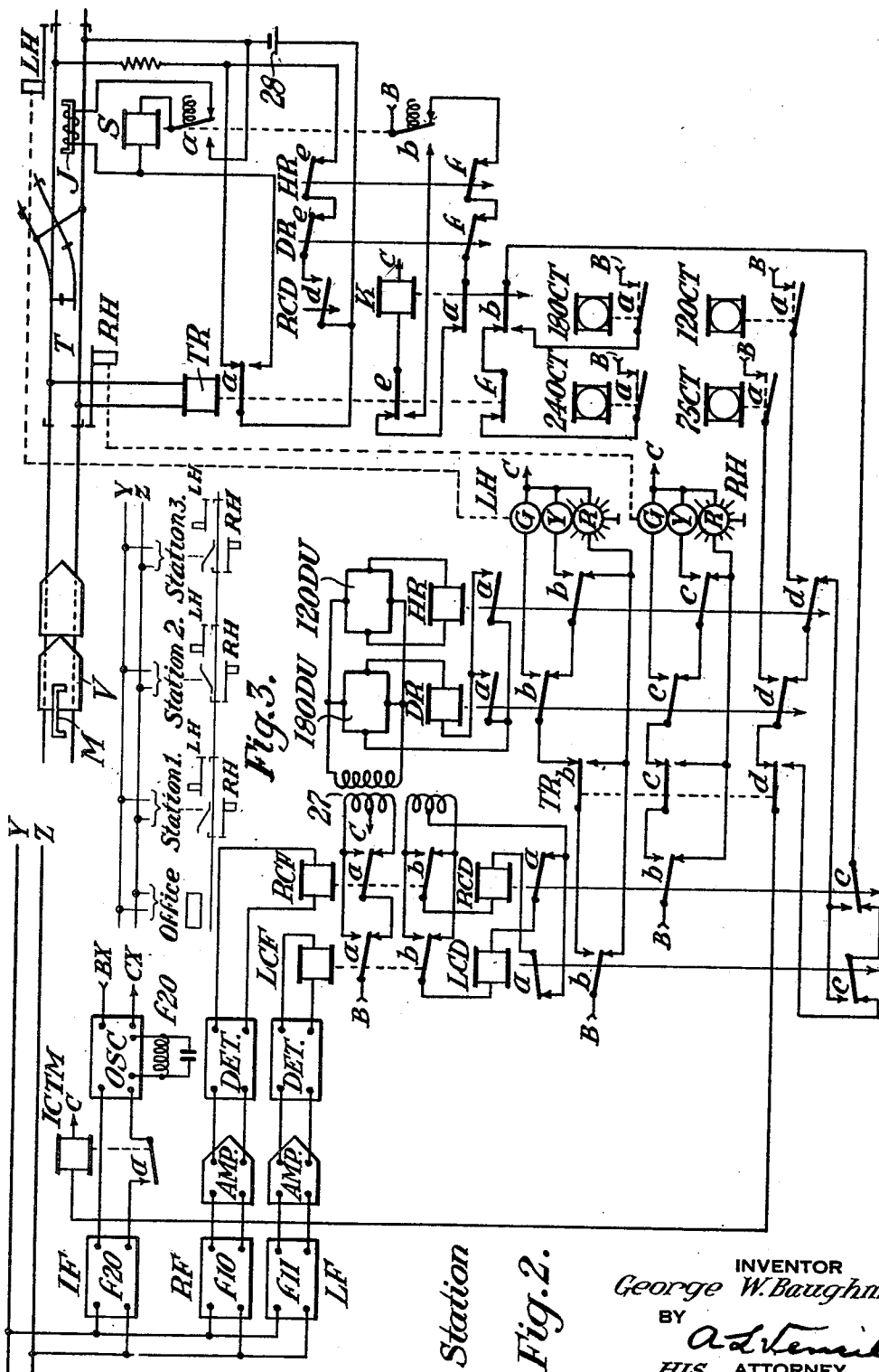
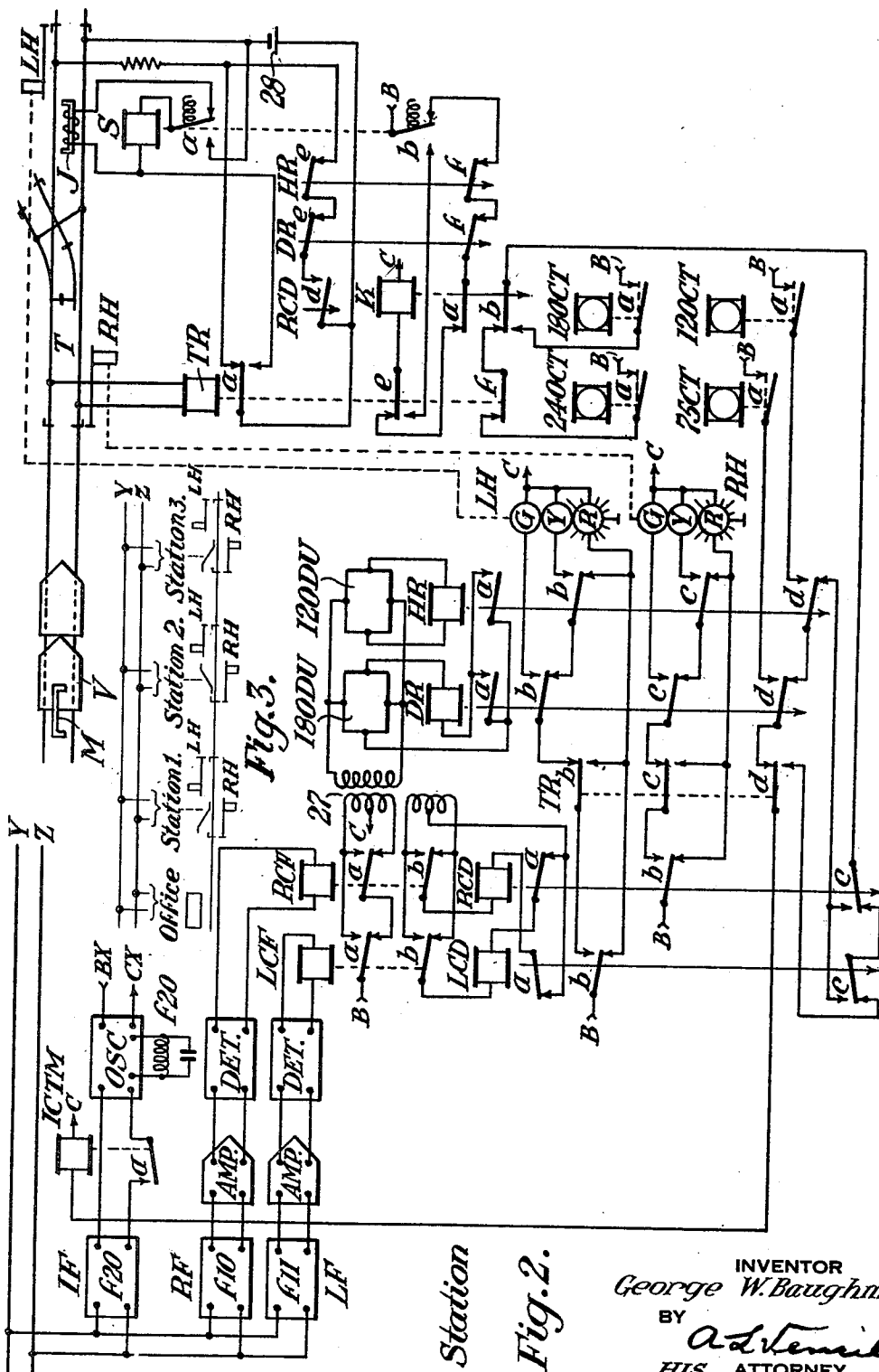


Fig. 2.

Station

INVENTOR
George W. Baughman
BY
A. L. Tennill
HIS ATTORNEY

Fig. 3.



UNITED STATES PATENT OFFICE

2,554,000

MANUAL BLOCK SIGNALING SYSTEM FOR
RAILWAYS NOT HAVING CONTINUOUS
TRACK CIRCUITS

George W. Baughman, Swissvale, Pa., assignor to
The Union Switch & Signal Company, Swiss-
vale, Pa., a corporation of Pennsylvania

Original application December 18, 1943, Serial No.
514,812. Divided and this application Novem-
ber 28, 1944, Serial No. 565,450

4 Claims. (Cl. 246—3)

1

My invention relates to signaling systems for railways, and more particularly to systems for the control of railway signals or other traffic controlling devices from a central point of control, such as a train dispatcher's office, and for the indication at the control office of the condition of such devices or of train movements.

This application is a division of my copending application, Serial No. 514,812, filed December 18, 1943, for Remote Control Systems, now Patent No. 2,398,572, issued April 16, 1946.

One object of my invention is the provision of a system of remote control suitable for the direct control of unattended manual block signals in the absence of the usual continuous track circuits.

Another object of my invention is the provision of an improved system of remote control in which the signals at a distant station are continuously controlled and indicated over existing railroad communication circuits without interfering with their use for other communication purposes.

A feature of my invention is the use of modulated carrier currents for continuous code signaling, the codes used for control and indication purposes possessing a high degree of immunity against such interference as is likely to occur as a result of the joint use of the same line wires by other communication facilities, and also possessing immunity from interference by the foreign currents occasionally encountered in long distance line circuits. These carrier currents are transmitted over different communication channels all employing the same line wires but each including circuit elements rendering the channel selectively responsive to a particular frequency or related band of frequencies.

A feature of my invention resides in arrangements whereby the transmission of current from the office over a particular control channel to select a signal for clearing results in the transmission of current from the selected station over a related indication channel to control apparatus at the office to render the signal responsive to the operation of its control lever. The signal controls and indications are thus made dependent upon the continuous transmission of current over two channels, thereby increasing the reliability of operation of the system.

Another feature of my invention resides in the provision of means for interlocking the circuits for controlling signals at different locations so as to prevent the simultaneous clearing of two opposing signals governing traffic movements into the same block and also of two successive signals

2

governing traffic movements in the same direction.

Other objects, features and purposes of my invention will be pointed out as the description proceeds.

My invention is an improvement upon those disclosed in Letters Patent of the United States No. 2,332,963, granted to me on October 26, 1943, for Remote Control Systems, and in my copending application for Letters Patent of the United States, Serial No. 484,397, filed April 24, 1943, for Remote Control Systems, now Patent No. 2,379,674, issued July 3, 1945, and also upon that disclosed in the copending application for Letters Patent of the United States, Serial No. 514,642, filed December 17, 1943, by Willard P. Place, for Remote Control Systems, now Patent No. 2,420,093, issued May 6, 1947.

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

Referring to the accompanying drawings, Fig. 1 illustrates a portion of the operator's control board located in a train dispatcher's office or other suitable point of control showing the circuits and apparatus of the control panel for the signals at one field station in its entirety, together with portions of the adjoining panels, including circuits by means of which the signals at one station are electrically interlocked with those at the next station in either direction.

Fig. 2 shows the apparatus at a typical field station arranged for communication with the apparatus of Fig. 1 over a pair of line wires Y and Z, while Fig. 3 comprises a track plan for a typical portion of a signaling system embodying my invention. As shown diagrammatically in Fig. 3, the line wires Y and Z extend from the control office of Fig. 1 through a plurality of stations, designated 1, 2 and 3, each similar to the one shown in Fig. 2, located at spaced points along a stretch of single track railway.

Similar reference characters refer to similar parts in each of the views.

In its specific embodiment as shown, the apparatus of my invention is arranged for the control of a pair of manual block signals LH and RH at each station, as shown in Fig. 2, and it may be assumed that the stretch is not provided with track circuits except for a short detector section T at each station energized by a battery 28 and having a track relay TR for the control of the signals and for indicating the movement of trains past the station, train movements through the stretch being governed primarily by train

orders, supplemented by manual control of the signals.

The signals as shown are to be understood to be of the usual color light type arranged to give proceed, permissive or stop indications by the lighting of suitable green, yellow and red lamps G, Y and R, as shown. The circuits for the signal lamps are controlled by a group of code controlled signal relays LCD, RCD, HR and DR, in accordance with the positions of the corresponding signal levers at the office, shown in Fig. 1 and designated HL and DL prefixed by 1, 2 or 3, according to the station of Fig. 3 at which they are located. Any signal which has been cleared in response to the reversal of its lever is restored automatically to stop when a train enters section T, due to the release of the track relay TR and the consequent change in the position of its contacts *b* and *c* in the signal lamp circuits. Relay TR is a stick relay which is normally held energized over its own front contact *a*. This contact, as may be seen from the drawing, is included in that portion of the circuit for relay TR which extends from the upper track rail to the lower terminal of battery 28.

When section T is unoccupied, relay TR may be energized over a pickup circuit which includes the front contact *d* of relay RCD and back contacts *e* of relays HR and DR. As hereinafter explained, this pickup circuit is closed by transmitting a distinctive code signal from the office when the signal levers are in their normal or stop position, as shown, to energize relay RCD without energizing relay HR or relay DR. It follows therefore that when relay TR is released by the passage of a train, the signal is put to stop and is retained at stop by relay TR after the train vacates section T, until the operator transmits the distinctive code signal referred to, following his restoration of the signal levers to normal to correspond with the stop indication displayed by the signals.

The signals at each station are controlled from an individual office panel by a separate set of control apparatus, each set being normally inactive. Each set of control apparatus includes a starting button such as the push button 2PB, a stick relay such as the relay 2LP controlled by the push button, for setting the control apparatus into operation, and a set of contacts operable manually by a pair of signal control levers such as the levers 2HL and 2DL. The apparatus for station 2 as shown is in its normal inactive condition, and to set it into operation with the object of clearing a signal the operator must press the button 2PB and hold its contacts closed until an indication of the response of the station apparatus is received, before moving either signal lever. Under this condition the closing of contact *c* of button 2PB causes the transmission of the distinctive code signal above referred to, by which relay RCD is energized, and as hereinafter explained, this results in the transmission of a return indication which energizes a code detector relay 2CD and an indication relay 2SK, and lights the lamps RE and WE. The signal lever 2HL, and subsequently the lever 2DL as well, may then be moved to their left-hand or right-hand positions for the transmission of a signal clearing code effective to cause the corresponding signal LH or RH to display its permissive or proceed indication, respectively. The transmission of a signal clearing code can be effected only when relay 2LP is energized. This relay picks up over the lever contact *e* when

lever 2HL is reversed, provided contact *c* of the indication relay 2SK and contact *a* of push button 2PB are both closed. When relay 2LP picks up, the push button 2PB may be released and this relay will remain energized to maintain the apparatus in operation due to the closing of a stick circuit which includes its own contact *a* and contact *c* of relay 2CD. Each panel also includes a group of indication lamps E, arranged to indicate the positions assumed by the signal control relays in response to their manual control and to also report automatically when a train governed by signal LH or RH passes the station and thereby releases the track relay TR. In prior manual block systems, employing local operators at the stations to operate the signals and to report their condition and the passage of trains to the central office operator, additional protection is afforded by requiring the local operators to observe the usual rear end markers before reporting the train, to insure that the block will not be reported clear unless the departing train is complete and intact. My system attains this end by the provision of apparatus at each station similar to that disclosed in my prior application for Letters Patent of the United States, Serial No. 396,745, filed June 5, 1941, now Patent No. 2,342,315, issued February 22, 1944, for Train Detecting and Reporting Apparatus. This apparatus includes portable markers in the form of permanent magnets M, one of which is mounted at the rear end of each train V, as indicated in the drawing, in such a position as to cooperate with an inductor J in each detector section T and to induce a voltage impulse therein to pick up a stick relay S, the energization of which indicates that the passing train is complete and intact. Each relay S is of the biased polar type and has associated therewith a slow release stick relay K for governing the transmission of indications of its operation, as hereinafter described.

My system employs alternating current codes of the continuous type for communication between the office and stations over the line wires Y and Z, characterized by the sustained modulation or periodic interruption of alternating carrier currents of selected frequencies. Each signal is controlled by modulated carrier current of a distinctive carrier frequency, a pair of related frequencies designated /10 and /11 being used to control signals RH and LH, respectively, at the station shown in Fig. 2. Each station employs a distinctive carrier frequency in another band of frequencies, designated as /20 for the station shown, for the transmission of indications from the station, this carrier frequency being variably modulated in accordance with conditions at the station and serving to selectively control a group of indication lamps E associated with the signal levers. It is to be understood that the carrier currents are generated by oscillators OSC of the electron tube type, of which one is provided for each pair of control frequencies, and one for each indication frequency. It is to be understood that each oscillator is normally energized over connections to terminals BX and CX of a local source of current, as indicated on the drawings. In Fig. 1, for simplicity, but one such oscillator is shown, designated OSC2 and adapted to generate either of the two frequencies /10 or /11 by the provision of an adjustable tuned circuit comprising a coil 26 and a condenser C1. A similar oscillator OSC at each station is arranged to generate a single frequency, this being /20 for the station shown.

The carrier currents generated by the oscillators OSC are delivered to the line circuit and at the same time are modulated or periodically interrupted in accordance with a distinctive frequency code, by the periodic operation of contacts *a* of coding relays RCTM, LCTM and ICTM. A second contact *b* of relays RCTM and LCTM serves to select the frequency *f*₁₀ or *f*₁₁ generated by oscillator OSC2 by completing the tuned circuit mentioned. The continuous frequency codes delivered by these coding relays CTM comprise periodic interruptions of the carrier current at different rates, such as 75, 120, 180 or 240 times per minute, which codes are generated by continuously operating code transmitters, each of which is identified on the drawings by the reference CT, prefixed by a number indicating its rate of operation. Three such code transmitters are provided at the office, as shown in Fig. 1, and a set of four is provided at each station, as shown in Fig. 2, all of which may be of the type shown in Letters Patent of the United States No. 1,858,876, issued May 17, 1932, to Paul N. Bossart, for Coding Apparatus. At the office the code transmitters CT supply coded currents to bus wires designated 75, 120 and 180, respectively, which afford connections for energizing the coding relays CTM of each panel.

The transmission of the carrier currents of different frequencies over the same line wires Y and Z without interference one with another, or with the use of the line wires for other communication purposes, is effected in a well-known manner, by interposing an electrical filter comprising a suitable arrangement of resonant circuit elements in each channel at each end of the line, designated LF, RF and IF, respectively, and it is to be understood that each such filter presents a low impedance to a designated frequency *f*₁₀, *f*₁₁ or *f*₂₀ as indicated on the drawings and also to the side band frequencies corresponding to its modulation, but presents a high impedance to other frequencies. The system of my invention thus employs two selective frequency channels per signal, or three channels per station, a single indication channel serving to indicate the condition of both of the signals at a station, since but one of these can be cleared at a time. It follows that the number of signals which may be controlled over the same line wires is limited only by the number of available channels. The carrier frequencies used are preferably of the order of from 4 to 17 kilocycles for one direction and from 17 to 30 kilocycles for the other direction. Since the modulation frequencies used are relatively low, the different channels may be closely spaced.

At the receiving end of the line, each selective frequency channel includes a suitable amplifier designated AMP connected to the line through a filter as mentioned, which amplifier delivers the modulated current of the corresponding carrier frequency to a demodulator or detector DET to convert it to a form suitable for operating a code following relay RCF, LCF or ICF. It follows that when one of the coding relays CTM is set into periodic operation at a rate determined by one of the code transmitters CT this periodic operation is repeated by the corresponding code following relay CR at the distant end of the line. Contact *a* of the operated relay CF then completes circuits from one terminal B of a suitable local source of direct current alternately in opposite directions through the primary of a decoding transformer 27 to the other terminal C

of the same source, so that voltage impulses of alternately opposite polarity are generated therein and impressed by its upper secondary winding upon a plurality of resonant decoding units DU, each of which controls a slow release relay, such as the signal relays HR and DR in Fig. 2, or the indication relays 2SK, 2NK and 2YK in Fig. 1. The designation of each decoding unit DU includes a numerical prefix indicating the frequency in impulses per minute to which it is selectively responsive, these units being of a well-known type such as is shown in Letters Patent of the United States No. 1,773,472, issued August 19, 1930, to Paul N. Bossart, for Railway Traffic Controlling Apparatus.

The periodic operation of a code following relay CF as above described also induces alternating current of the corresponding code frequency in the lower secondary winding of the associated decoding transformer 27, which current is rectified by the periodic operation of contact *b* of the code following relay CF to energize a slow release code detector relay, such as RCD, LCD or 2CD, the circuits for relays RCD and LCD being interlocked over their back contacts *a* so that but one of these relays can be energized at a time.

It will be seen therefore that relay RCD responds selectively to a control code of the frequency *f*₁₀ and relay LCD to one of frequency *f*₁₁, and that these relays serve to select signal RH or LH, respectively, for clearing. The lamps R of signals LH and RH are both lighted to cause the signals to indicate stop when the track relay TR is released or when the code detector relays RCD or LCD are released as shown, the signals also remaining at stop when a 75 code of the carrier frequency *f*₁₀ is received, this code serving to pick up relay RCD without energizing relay HR or DR as will readily be understood.

Normally, the signals stand at stop as shown, with the control apparatus inactive and the oscillators OSC disconnected from the line wires and all of the relays released except relays TR and K at the station, which relays are held normally energized over their respective stick circuits. The system is set into operation by depressing a push button such as 2PB, as already mentioned. If the associated signal levers 2HL and 2DL are in their normal positions as shown, the operation of the push button 2PB completes a circuit for relay RCTM which is interrupted at the 75 code rate, thereby effecting the transmission of 75 code current of frequency *f*₁₀ over the line wires Y and Z, to which relay RCF at the selected station responds so that relay RCD becomes energized. Assuming that the track relay TR is picked up, relay RCD completes a circuit for relay ICTM which is interrupted at either the 240 or 180 code rate, dependent upon whether relay K is picked up or released, resulting in the transmission of an indication code of frequency *f*₂₀ to the office to operate relay ICF at the 240 or 180 code rate, thereby energizing the indication relay 2SK or 2NK to complete circuits for lighting one or both of the indication lamps RE or WE, and also energizing the code detector relay 2CD. The lighting of the red lamp RE indicates that the signals LH and RH stand at stop, while the lighting of the white lamp WE indicates that relay K has been picked up. Relay K is released upon clearing either signal and is picked up when relay S of the train reporting device is operated by a magnet M following the release of the track relay TR, conse-

quently the lighting of lamp WE indicates the passage of a complete train through section T.

When the red lamp RE becomes lighted, signal LH or RH may be caused to display its permissive indication by moving lever 2HL to the left or right, respectively, while holding button 2PB depressed. This results in picking up a stick relay 2LP associated with the lever, thereby completing a circuit for relay LCTM or RCTM whereby a control code is transmitted having a carrier frequency f_{11} or f_{10} , depending upon whether the lever 2HL is in its left-hand or right-hand position, which frequency is modulated at the 120 code rate so as to energize relay HR along with relay LCD or RCD, thereby causing the yellow lamp Y of the selected signal to become lighted. The energization of relay HR changes the rate of modulation of the indication current of frequency f_{20} to the 120 code rate, thereby energizing relay 2YK along with relay 2CD, in place of relay 2SK or 2NK, to light the yellow indication lamp LYE or RYE which repeats the permissive indication of the selected signal.

The push button 2PB may now be released and relay 2LP will be held energized over its stick circuit by relay 2CD as long as the transmission of the control code of frequency f_{10} or f_{11} and of the resulting indication code of frequency f_{20} continues. Relay 2LP thus serves as a slotting relay such as is provided in conventional interlocking plants in order to make it necessary to restore the lever which controls a signal to its normal position following each train movement authorized by the signal. Additionally relay 2LP makes the permissive and proceed indications of the signals dependent upon the continuous transmission of current over two channels, since it serves to maintain the signal control relay HR energized, subject to track circuit and lever control, only as long as the indication code continues to be received.

When lamp LYE or RYE becomes lighted, the selected signal may be caused to display its proceed indication under certain conditions as hereinafter pointed out, by moving lever 2DL to its left-hand or right-hand position corresponding to the operated position of lever 2HL. This results in a change in the rate of operation of relay LCTM or RCTM, to the 180 code rate, to energize relay DR in place of relay HR, along with relay LCD or RCD, thereby causing the green lamp G of the selected signal to become lighted, and relay DR then changes the rate of modulation of the indication current of frequency f_{20} to the 75 code rate, releasing relay 2YK but maintaining relay 2CD energized to light the green lamp LGE or RGE which repeats the proceed indication of the selected signal.

I shall now describe the operation of the system of my invention under different assumed conditions by tracing the various circuits in detail starting with the apparatus in its normal inactive condition as shown, and assuming that the operator desires to clear signal LH to permit a train moving from right to left to enter the block including section T and the non-track circuited stretch to the left of section T, it being understood that this block is unoccupied at the time.

The operator will first press the push button 2PB completing a circuit from terminal B at the periodically operated contact a of the code transmitter 75CT, Fig. 1, over the normal contacts d of levers 2DL and 2HL, contact c of push button 2PB, back contact c of relay 2LP, through relay

RCTM to terminal C. Relay RCTM therefore operates to deliver 75 code current of frequency f_{10} to the line to operate relay RCF, Fig. 2, at the 75 code rate, as already described, thereby energizing relay RCD to complete a circuit from terminal B at contact a of the code transmitter 240CT at the station over front contact f of relay TR, front contact b of relay K, front contact c of relay RCD, and contacts d of relays HR, DR and TR through relay ICTM to terminal C. Relay ICTM therefore operates to deliver 240 code current of frequency f_{20} to the line to operate relay ICF, Fig. 1, at the 240 code rate thereby energizing relays 2CD and 2SK. Relay 2SK completes a circuit from terminal B at its front contact a through the white lamp WE to terminal C, a branch of which extends over back contact a of relay 2NK through the red lamp RE to terminal C, consequently lamps WE and RE become lighted.

It is to be understood that the signal LH controlled by lever 2HL is the one at station 2 in Fig. 3, and that the block for which this signal LH constitutes the entering signal extends to another station 1 similar to the one shown in Fig. 2, and also that station 1 has an opposing entering signal RH controlled by another signal lever 1HL of which only the contacts e , f and g are shown in Fig. 1. It will be assumed that this opposing signal RH at station 1 is at stop, in which case lever 1HL will be in its normal or left-hand position or if it has been inadvertently moved to its right-hand position, the associated stick relay 1LP will be in its released position.

As soon as the red indication lamp RE associated with lever 2HL becomes lighted, the operator moves that lever to its left-hand position while continuing to hold the button 2PB pressed, thereby completing a circuit from terminal B at contact a of button 2PB over front contact c of relay 2SK, contacts f of relay 1LP and lever 1HL, left-hand contact e of lever 2HL through relay 2LP to terminal C.

Relay 2LP therefore picks up, completing a stick circuit extending from terminal B at its front contact a over front contact c of relay 2CD, contacts f of relay 1LP and lever 1HL, left-hand contact e of lever 2HL, through relay 2LP to terminal C. Relay 1LP is provided with circuits similar to those for relay 2LP including the right-hand contact e of lever 1HL and contacts g of relay 2LP and lever 2HL, and since these contacts g are now open, relay 1LP cannot be picked up to clear the signal RH at station 1, controlled by lever 1HL, nor can the clearing of the signal LH at station 2, controlled by lever 2HL, be interfered with by the subsequent manipulation of lever 1HL.

When relay 2LP picks up, the energizing circuit for relay RCTM is opened and one for relay LCTM completed, extending from terminal B at the periodically operated contact a of the code transmitter 120CT, Fig. 1, over contacts b of levers 2DL and 2HL and of relay 2LP through relay LCTM to terminal C. Relay LCTM therefore operates to deliver 120 code current of frequency f_{11} to the line to operate relay LCF, Fig. 2, at the 120 code rate, thereby releasing relay RCD and also energizing the signal control relay HR.

The opening of back contact f of relay HR opens the normally closed stick circuit for the indicating relay K, which extends from terminal B at the back contact b of relay S over back contacts f of relays HR and DR, front contact a of relay K, front contact e of relay TR through re-

lay K to terminal C, thereby releasing relay K and cancelling the indication of the report clear device which otherwise would be displayed by lamp WE if lever 2HL were to be restored to its normal position prior to the movement of a train into section T. The closing of front contacts b of relays LCD and HR completes an obvious circuit for lighting the yellow lamp Y of signal LH, the red lamp R of this signal becoming dark. The closing of front contact d of relay HR completes a circuit from terminal B at contact a of the code transmitter 120CT, Fig. 2, over contacts d of relays HR, DR and TR through relay ICTM to terminal C. Relay ICTM therefore operates to deliver 120 code current of frequency f_{20} to the line to operate relay ICF at the 120 code rate, thereby releasing relay 2SK and energizing relay 2YK, relays 2CD and 2LP remaining picked up. Lamp LYE now becomes energized over the circuit extending from terminal B at the back contact a of relay 2SK, back contact b of relay 2NK, front contact a of relay 2YK through lamp LYE to terminal C over the left-hand contact a of lever 2HL, lamps WE and RE becoming dark. The push button 2PB may now be released, relay 2LP being held energized over its stick circuit under the control of relay 2CD.

It will be noted that the system of circuits by which relay 2CD is supplied with coded current to hold relay 2LP energized includes front contacts d of relays TR and HR, Fig. 2, relay HR being supplied with code current over a system of circuits including the left-hand contacts b and e of lever 2HL and front contact b of relay 2LP. Consequently the signal LH may be returned manually to stop by restoring lever 2HL to normal, or automatically in response to the release of the track relay TR by a train entering the detector track section T.

When the yellow indication lamp LYE becomes lighted indicating that signal LH is displaying its permissive indication, the operator may move lever 2DL to the left-hand position, whereupon contact b of lever 2DL shifts the circuit for the coding relay LCTM to a branch extending over back contact e of relay 1LP associated with the next signal in advance, and thence to contact a of the code transmitter 180CT, thereby energizing the signal relay DR over front contact a of relay HR, relay DR completing a stick circuit at its own front contact a. Relay LCD remains picked up, and relay HR releases, causing signal LH to display its proceed indication. Contact d of the signal control relay DR shifts the circuit of the coding relay ICTM from contact a of the code transmitter 120CT of Fig. 2 to that of the code transmitter 75CT, resulting in the release of the indication relay 2YK. Relay 2CD remains energized in response to the 75 code, and serves as an indication relay to light the green lamp LGE in place of lamp LYE. It will be noted that the arrangement is such that the signal can be caused to display its proceed indication only if it is first caused to display its permissive indication, that is to say, the indications stop, permissive and proceed are displayed progressively.

In view of the fact that continuous track circuits for the protection of train movements are not available in a manual block signaling system of the type being described, it is considered desirable to restrict the simultaneous clearing of successive signals governing traffic movements in the same direction to the display of their permissive indications as is accomplished by the circuits for relay LCTM just traced. It will be seen

that if relay 1LP is picked up to clear the signal LH at station 1, controlled by levers 1HL and 1DL, contact e of relay 1LP shifts the circuit for relay LCTM above traced from contact a of the code transmitter 180CT to contact a of the code transmitter 120CT, thereby changing the aspect of the signal LH at station 2, controlled by levers 2HL and 2DL, from proceed to permissive. When relay 2LP is picked up, its contact e similarly controls the circuits governing the operation of the next signal LH at station 3 at the right, controlled by the levers 3HL and 3DL. It will be clear that the arrangement is such that two successive signals cannot display their proceed indications at the same time.

One purpose of this arrangement is to enforce closer attention to train movements by the operator by requiring him to delay operating any signal to proceed until the train has passed the next signal in the rear and has entered the block in approach to the signal.

I shall next assume that the train moving from right to left passes signal LH while displaying its permissive or proceed indication.

When the train enters section T, the track relay TR releases; the opening of its front contact a disconnects the track battery 28 from the track rails, the dropping of its contact b restores signal LH to stop, the opening of its front contact e releases relay K, and the opening of its front contact d stops the code operation of relay ICTM, the branches of the circuit for that relay which include back contact d of relay TR being open at back contact c of relay LCD, which relay is still energized. The code operation of relay ICF consequently ceases, releasing relay 2CD and also relay 2YK, if energized, extinguishing lamp LGE or LYE, the opening of contact c of relay 2CD releasing relay 2LP. This stops the code operation of relays LCTM and LCF, releasing relay LCD and also relay HR or DR.

The release of relay LCD completes a circuit from contact a of the code transmitter 180CT, Fig. 2, over back contact b of relay K, back contacts c of relays RCD and LCD and back contact d of relay TR through relay ICTM, which relay then operates to deliver 180 code current of frequency f_{20} to the line to operate relay ICF at the 180 code rate, thereby energizing relays 2CD and 2NK, and lighting the red lamp RE.

When the rear of the train passes through section T, the magnet M of its report clear device coacts with the inductor J to induce a voltage impulse first in one direction and then in the opposite direction in the circuit for relay S. This relay is of a sensitive biased polar type and operates its contacts to the left in response to one of these impulses and is then held energized over a stick circuit including battery 28, the left-hand contact a and winding of relay S, and back contact a of relay TR. Relay K now picks up over the circuit including the left-hand contact b of relay S and back contact e of relay TR. Since contact f of relay TR is now open, the opening of back contact b of relay K terminates the code operation of relays ICTM and ICF, thereby releasing relays 2CD and 2NK and extinguishing the red lamp RE. This indicates to the operator that substantially the entire train has passed through section T, or more particularly, that the rear end of the train has passed the inductor J and has conditioned the reporting device to function to report the passage of a complete train.

After lamp RE becomes dark, the operator returns levers 2HL and 2DL to normal and then

presses the push button 2PB, completing a circuit at its contact *c* to operate relay RCTM to deliver 75 code current of frequency *f*10 to the line as previously described, thereby energizing relay RCD, which by closing its contact *d*, connects battery 28 to the rails of section T. If the operator should happen to press button 2PB while section T is occupied, relay TR of course remains released and the only effect of the energization of relay RCD is to interrupt the circuit for relay ICTM at back contact *c* of relay RCD, to terminate the transmission of the indication code and to extinguish lamp RE, this lamp becoming lighted again when the button is released, provided section T is still occupied.

Normally button 2PB will be pressed after the train has vacated section T, in which case the track relay TR picks up when the closing of front contact *d* of relay RCD connects battery 28 across the rails of section T, whereupon front contact *a* of relay TR closes to complete its stick circuit to hold it energized. When relay TR picks up, relay S releases due to the opening of back contact *a* of relay TR, and completes the stick circuit for relay K extending from terminal B at the right-hand contact *b* of relay S over back contacts *f* of relays HR and DR, front contact *a* of relay K, front contact *e* of relay TR through relay K to terminal C, and relay ICTM is set into operation at the 240 code rate over the circuit including front contacts *f* and *b* of relays TR and K, and front contact *c* of relay RCD as already traced, thereby energizing relay 2CD, and also energizing relay 2SK to light lamps RE and WE as hereinbefore described. It will be clear that the lighting of the white lamp WE indicates that relay K has been reenergized by the operation of relay S, and consequently indicates the passage of a complete train through section T.

If push button 2PB is now released with lever 2HL in its normal position, the code transmission is terminated, the indication lamps become dark and the apparatus assumes its normal inactive condition as shown.

In the foregoing, the operations involved in clearing the signal LH have been traced in detail. These include the holding of push button 2PB in its depressed position, with levers 2HL and 2DL normal, to obtain a stop indication from the selected station; the successive reversal of lever 2HL and the release of the push button 2PB following the receipt of the stop indication; the reversal of lever 2DL following the receipt of an indication of the lighting of the permissive signal lamp Y in response to the reversal of lever 2HL, and finally, the lighting of the proceed signal lamp G in response to the reversal of lever 2DL, and the display of the corresponding proceed indication. Since the circuits for the two directions are symmetrical, it will be clear that signal RH may be cleared for a train V moving from left to right, as shown on the drawing, by operations similar to those described, levers 2HL and 2DL being operated to the right instead of to the left. In this case the control frequency will be *f*10 instead of *f*11, energizing relay RCD in place of relay LCD, the remaining operations being similar to those already described, consequently a detailed explanation is deemed unnecessary.

When the apparatus is in its normal inactive condition, as shown, it may happen that the track relay becomes accidentally released. If this occurs, relay K will release to initiate the

transmission of 180 code of frequency *f*20, thereby lighting the red lamp RE. Lamp RE will then remain lighted until the track relay TR is picked up by the operation of push button 2PB as described above, but since relay S has not been operated, relay K remains released and lamp WE is not lighted.

It may also happen that a cleared signal is restored manually to stop by movement of lever 2HL from one of its reverse positions to its normal position.

This opens the circuit for relay 2LP at the lever contact *e*, releasing that relay, the opening of contact *b* or *c* of lever 2HL stopping the code transmission and thereby restoring the apparatus to its inactive condition as shown, with the exception that relay K, which became released when the signal was cleared, will remain released. A subsequent operation of button 2PB would then result in the transmission of the 180 indication code, lighting lamp RE but not lamp WE, showing that the train reporting relay S had not been operated. It will be observed that the arrangement is such that the operator has full control of the signals regardless of the condition of the train reporting system, the latter being arranged so that the operator is free to control the signals as desired under conditions when the train reporting device is not operated, as for example, in the case of local switching moves. It is to be understood that under these circumstances the train would be reported clear by telephone or otherwise after it had vacated the block, a block telephone system having a telephone at each signal location being generally provided in systems of this character.

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

Having thus described my invention, what I claim is:

1. In a manual block signaling system having opposing signals at opposite ends of a single track block for governing traffic movements into the block; a control lever, a push button and a stick relay for each signal all located at a control office, an energizing circuit for maintaining each signal at clear at times including line wires extending from the office to the signal location, means for selectively controlling said energizing circuits comprising a control circuit for each signal including a reverse contact of the corresponding lever and a front contact of the associated stick relay, a pick-up circuit for each stick relay including a normally open contact of the corresponding push button and contacts controlled by the lever and stick relay for the opposing signal at the opposite end of the block arranged to prevent the closing of said circuit if such lever and stick relay are operated to positions to effect the clearing of said opposing signal, indication means at the office for each signal controlled over said line wires for continuously indicating its condition, and a stick circuit for each stick relay controlled by the indication means for the corresponding signal and closed only as long as such signal stands at clear.

2. In a signaling system for railways, an office and a station connection by line wires, a control lever, a push button and a stick relay at the office, a detector track section at the station hav-

ing a track relay, a railway signal for governing traffic movements into said section, normally inactive selecting means, and normally inactive control means, both located at the station but controllable from the office over said line wires, normally inactive indication means at the office controllable over said line wires for indicating the condition of the signal, means responsive to an operation of said push button when said lever is in its normal position and said track relay is picked up for actuating said selecting means, means governed by said selecting means when actuated for rendering said indication means active to indicate the condition of the signal, means responsive to an operation of said push button when said lever is in its reverse position and said indication means is active to pick up said stick relay, a stick circuit for said stick relay closed as long as said indication means remains active and said lever remains in its reverse position, means controlled by said stick relay when energized for rendering said lever effective to govern said control means to clear the signal, and means responsive to the release of the track relay for restoring said indication means to its inactive condition to release said stick relay.

3. In a signaling system for railways, an office and a station connected by line wires, a signal at said station, a control lever at the office having a normal and a reverse position, a push button, a stick relay, normally inactive indication means controllable over said line wires for indicating the condition of said signal, a detector relay at the station controllable over said line wires in response to the operation of said push button when said lever is in its normal position, means controlled by said detector relay when energized for rendering said lever effective to control the signal and for rendering said indication means effective to indicate its condition, a pick up circuit for the stick relay closed in response to the operation of said push button when said lever is in its reverse position and said indication means indicates that the signal is at stop, a stick circuit for holding said stick relay energized as long as said lever is reversed and said indication means remains active, a control circuit for the signal including a reverse contact of said lever and a front contact of said stick relay, and means including said control circuit for supplying energy to said line wires for clearing said signal and for maintaining said detector relay energized.

4. In a signaling system for railways, an office and a station connected by line wires, a signal at said station adapted to display stop, permissive

and proceed indications, signal lever means at the office having a normal position and a first and a second reverse position, a push button, a stick relay, normally inactive indication means controllable over said line wires for indicating the condition of said signal at the office, a detector relay at the station controllable over said line wires in response to the operation of said push button with said lever means in its normal position, means controlled by said detector relay when energized for rendering said lever means effective to control the signal and for rendering said indication means effective to indicate its condition, a pick up circuit for the stick relay closed in response to the operation of said push button when said lever means is reversed and said indication means indicates that the signal is at stop, a stick circuit for holding said stick relay energized as long as said lever means is reversed and said indication means remains active, a first control relay controllable over said line wires for causing the signal to display its permissive indication when energized along with said detector relay, means for selectively energizing said first signal control relay and for maintaining said detector relay energized, rendered effective when said lever means is in its first reverse position and said stick relay is energized, a second control relay controllable over said line wires for causing the signal to display its proceed indication when energized along with said detector relay, pick-up and stick circuits for said second control relay including a front contact of said first control relay, and its own front contact, respectively, and means for selectively energizing said second control relay and for maintaining said detector relay energized, rendered effective when said lever means is operated from its first reverse position to its second reverse position provided said stick relay is energized.

GEORGE W. BAUGHMAN.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
554,884	Leonard	Feb. 18, 1896
1,410,961	Shaver	Mar. 28, 1922
1,662,481	Wallace	Mar. 13, 1928
2,090,711	Van Horn	Aug. 24, 1937
2,313,903	Van Horn	Mar. 16, 1943
2,420,579	Young	May 13, 1947