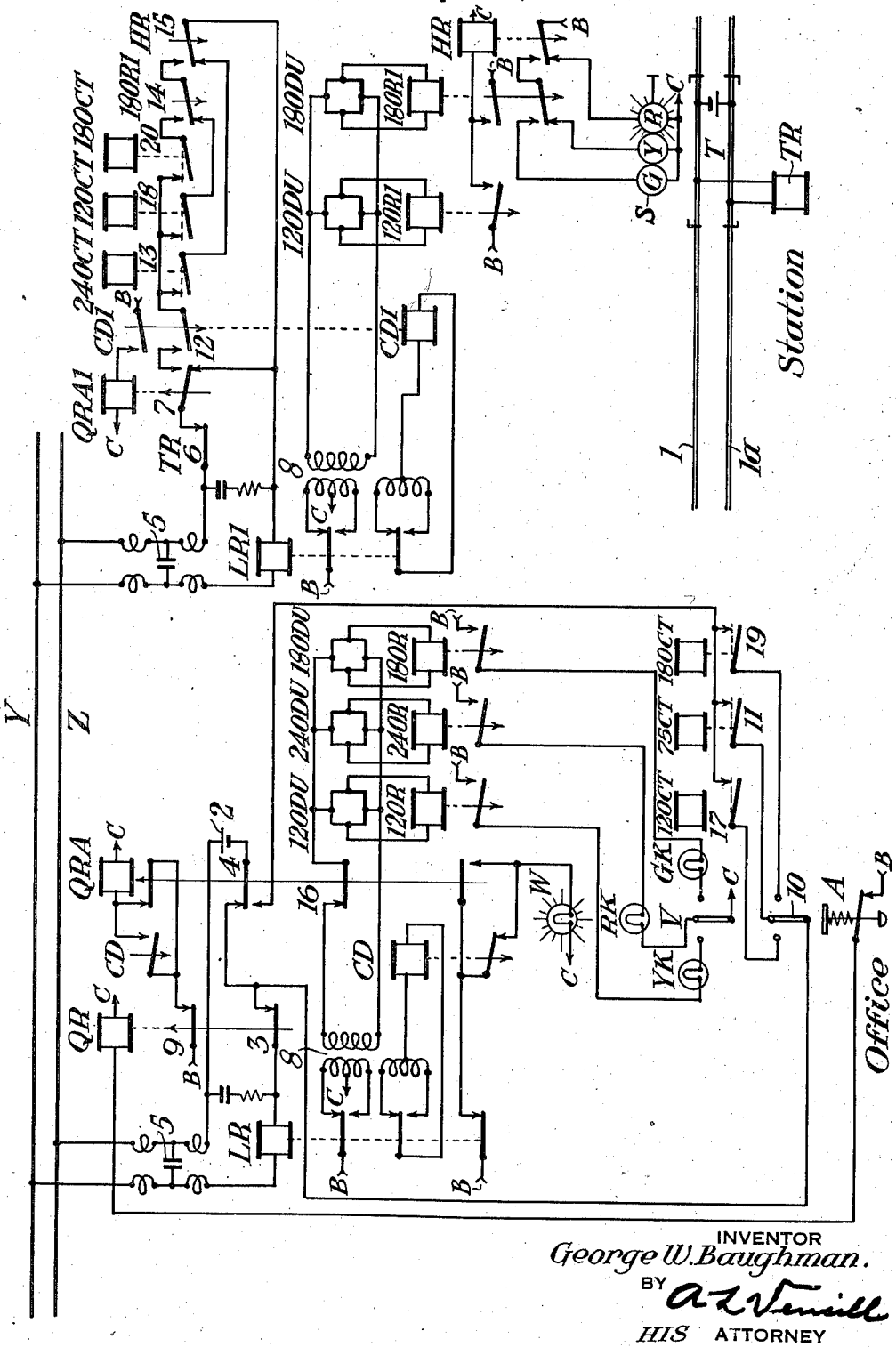
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REMOTE CONTROL SYSTEM

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REMOTE CONTROL SYSTEM

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My invention relates to remote control systems, and more particularly, to centralized traffic control systems for railroads. In its specific embodiment, as herein illustrated, my invention has as its principal object the provision of an improved system for the control of a manual block signal governing traffic movements into a stretch of track not equipped with continuous track circuits, and for positively indicating the condition of such a signal at a distant control office.

A further object of my invention is the provision of an improved system of this character which is adapted to use the line wires of an existing telephone circuit or the like, for the transmission of signal controls and indications reliably and economically over relatively long distances, without interfering with the use of the line wires by other communication facilities. My system employs code signals of the continuous frequency type possessing a high degree of immunity against foreign current interference.

The present invention is an improvement upon that of my prior application for Letters Patent of the United States, Serial No. 400,287, filed June 28, 1941, for Remote control systems.

A feature of my invention is the utilization of the same line wires to provide communication channels for the transmission of control codes at times and of indication codes at other times, the codes being characterized by the sustained modulation or periodic interruption of the current delivered to the line circuit from a current source located at the office, although the modulation may be effected either at the office or at the remote station at which the controlled signal is located. To clear the signal, a control code is transmitted from the office for a time sufficient to cause the signal to assume the required position, as determined by the selected rate of modulation. The control code is then discontinued and replaced in the line by an indication code transmitted from the station under the control of the signal, the indication code serving to maintain the signal in its operated position and to also indicate its position at the control office. The signal may be put to stop manually, by opening the line at the office, or automatically, by opening the line at the station by the operation of a detector track relay, in which case the signal will remain at stop, subject to further manual control, after the controlling track section is vacated.

My invention also includes provisions for obtaining a positive indication of the continuous code type, repeating the stop indication of the signal.

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 drawing, the refrence characters 1 and 1a designate the rails of a stretch of railway track comprising a "manual block" over which traffic movements are governed by a railway signal S, which as shown, is of the usual color light type. It is to be understood that except for a short detector section T having a track relay TR, the stretch of track in advance of signal S is not provided with track circuits, and that signal S is manually cleared or put to stop by the operation of a signal lever V located at a distant control office, and is also put to stop automatically when a train enters the stretch. The reference characters Y and Z designate a pair of telephone line wires or the like extending from the central office to the station comprising the location of signal S, which provide a control channel over which signal S is manually governed at times, and at other times provide an indication channel for continuously indicating its condition at the office, and for also indicating when a train passes the signal as reflected by the release of the detector track relay TR. As will be clear from the drawing, these communication channels include a line battery 2, contacts 3 and 4 of relays QR and QRA, the windings of a line relay LR and a low pass filter 5 at the office, line wires Y and Z, and at the station, the windings of a similar filter 5 and of a line relay LR1, and also the front contact 6 of the track relay TR and the back contact 7 of a relay QRA1, all in series. The relays QRA and QRA1 serve as switching relays for channel selection, the control channel including the back contacts 4 and 7, and the indication channel the front contacts 4 and 7 of these relays.

It is to be understood that suitable local sources of current are provided at the office and station for energizing the apparatus, the reference character B designating the positive or supply terminal and C the negative or common return terminal of the local source.

As shown, lever V is in its normal or stop position, signal S indicates stop, its red lamp R being lighted, and the apparatus is in an inactive condition with the line relays LR and LR1 steadily energized. The signal indication lamps GK, YK and RK, which when the apparatus is active repeat the indications of the signal, are all dark. The indication lamp W is steadily lighted over an obvious circuit including the lower front contact of relay LR, and since the line circuit in-

cludes front contact 6 of the track relay TR, lamp W indicates that the detector section T is unoccupied.

The signal lever V is to be understood to be of the push-turn type, such as is shown in Letters Patent of the United States to Snavely and Zetwo, No. 2,289,736, issued July 14, 1942, for Circuit controllers. For an understanding of the present invention it will suffice to note that lever V is locked in each of its three control positions by a spring detent, and can be turned from one control position to another only if the lever is first pressed in an axial direction so as to release the detent and to open contact A, which controls a quick release, slow pick-up relay QR. Relay QR is preferably of a type which assumes its released position within 0.1 second after its circuit is opened, and has the characteristic that when its circuit is closed the return of the relay to its energized position is delayed for about 1.2 seconds.

The continuous frequency codes which my system employs consists of periodic interruptions of the line current at different rates, such as 75, 120, 180 or 240 times per minute. These codes are delivered to the line by the periodically operating contacts of one or another of a plurality of continuously active code transmitters, each of which bears the designation CT prefixed by a numeral identifying its rate of operation in impulses per minute. As shown on the drawing three such code transmitters are employed at the office and three others at the station, these preferably being of the type shown in Letters Patent of the United States No. 1,858,876, issued May 17, 1932, to P. N. Bossart for Coding apparatus.

The upper front and back contact of each line relay LR or LR1 is effective, when the relay is responding to code, to complete circuits from terminal B alternately in opposite directions through the primary of a decoding transformer 8 to terminal C, so that current impulses of alternately opposite polarity are generated therein at the code rate and delivered by the upper secondary winding of transformer 8 to a plurality of resonant decoding units DU, each of which is effective to selectively energize an associated decoding relay such as the relay 180R or 180R1 when impulses of a particular frequency are supplied thereto. The designation of each resonant decoding unit DU and the associated decoding relay includes a numerical prefix indicating the frequency, in impulses per minute, to which it is responsive. These decoding units and the circuits for the decoding relays are of a well-known type, substantially similar to those shown in Letters Patent of the United States to Bossart, No. 1,773,472, issued August 19, 1930, for Railway traffic controlling apparatus, and a detailed description thereof in the present application is deemed unnecessary.

The line relays LR and LR1, and the decoding units DU which they control, thus provide means for decoding the impulse currents supplied to the line wires, to selectively energize relay 120R, 180R or 240R, and relay 120R1 or 180R1, according to the frequency of the impulses. The relays 120R1 and 180R1, together with the slow release repeating relay HR which they control, serve as signal control relays for selectively lighting the lamps R, Y and G of signal S, and also serve to determine the frequency of the impulse currents by which the relays 120R, 180R and 240R are controlled, the latter serving as indication relays for selectively lighting the lamps RK, YK and GK to indicate the condition of signal S.

The energization of the decoding transformer by the code operation of the associated line relay also induces alternating current of the corresponding code frequency in its lower secondary winding, which current is rectified by the operation of the second contact of the line relay to energize a code detector relay CD or CD1. The circuits for these relays correspond to those for relay H in Letters Patent of the United States to Nicholson and Allison, No. 2,237,788, issued April 8, 1941, for Railway traffic controlling apparatus. The relays CD and CD1 are preferably arranged to pick up at the start of a code having any of the frequencies mentioned, after about 1.5 cycles of operation of the associated line relay, and to release in a period not exceeding one second, after the code operation of the line relay is terminated.

The operation of the system of my invention under different assumed conditions will now be described. As shown, the apparatus is in an inactive condition which it may assume as a result of a temporary interruption of the line circuit. The signal indication lamps RK, YK and GK associated with the signal lever V are dark, but lamp W is lighted, indicating that the detector section T is unoccupied and that the line circuit is closed and available for use.

I shall first assume that the operator at the control office desires to obtain a positive indication that signal S is at stop, as manifested by the lighting of lamp RK. The operator will move lever V to the center position, as shown, or if it is already in that position, he will press the lever for a brief period, thereby opening contact A momentarily to release relay QR, which in turn, by opening its contact 9, will release a similar quick release, slow pick-up relay QRA. By opening its contact 3, relay QR will release the line relays LR and LR1, and relay LR will extinguish lamp W.

The closing of contact A upon the release of lever V reenergizes relay QR, reestablishing the line circuit after about 1.2 seconds, and since back contact 4 of relay QRA is closed, the line circuit now includes the center contact 10 of lever V and contact 11 of the code transmitter 75CT. The periodic operation of contact 11 effects the transmission of a control code by interrupting the line current delivered by battery 2 at the rate of 75 impulses per minute, resulting in the energization of the code detector relays CD and CD1, and causing relays LR and LR1 to be operated periodically to supply impulses of alternately opposite polarity to the primary windings of their respective transformers 8. The currents thereby induced in the lower secondary windings of transformers 8 are rectified by the relays LR and LR1, about 1.2 seconds after the front contacts of relays CD and CD1 close, the switching relay QRA and a similar relay QRA1 pick up, whereupon the control code is cut off by the opening of back contact 4 of relay QRA, and an indication code initiated by the closing of front contact 7 of relay QRA1. Since the circuit for lamp W is closed each time relay LR picks up, the character of the control code transmitted is indicated by the flashing of lamp W, this lamp remaining dark after relay QRA picks up.

After relay QRA1 picks up, the line circuit includes its front contact 7, contact 12 of relay CD1, contact 13 of code transmitter 240CT and back contact 15 of relay HR. The indication code

transmitted as a result of the periodic operation of contact 13 therefore has a frequency of 240 impulses per minute, and it maintains the relays CD and CD1 picked up and in addition the code is supplied over front contact 16 of relay QRA to the decoding unit 240DU to energize the resonant decoding indication relay 240R, causing lamp RK to be lighted. Lamp W remains dark, since relays CD and QRA are both picked up.

I shall next assume that the operator moves lever V to the left, to cause signal S to indicate caution by the lighting of lamp Y. The operation of contact A causes relay QR to release and then pick up as in the first example, releasing relays QRA and 240R in turn, and opening the line for a time sufficient to release relays CD, CD1 and QRA1. When relay QR picks up, a control code of 120 impulses per minute is delivered to the line over the left-hand contact 10 of lever V and the periodically operating contact 17 of the office code transmitter 120CT. Lamp W flashes at the 120 code rate, and relays SCD and CD1 pick up, and also the control relay 120R1, thereby energizing relay HR to light the signal lamp Y. Then relays QRA and QRA1 pick up to terminate the control code and initiate an indication code of the same frequency, and although the office transmitting contact 17 is removed from the circuit when relay QRA picks up, the modulation of the line current continues at the same rate, due to the insertion of the station transmitting contact 18 in the circuit when relay QRA1 picks up, the line circuit now including front contacts 7 and 12 of relays QRA1 and CD1, the periodically operating contact 18 of the station code transmitter 120CT, back contact 14 of relay 180R1 and front contact 15 of relay HR. Those relays already energized remain picked up to maintain the signal lamp Y lighted, and in addition, the indication relay 120R becomes energized to light the indication lamp YK, due to the closing of front contact 16 of relay QRA. Relay 120R responds to indication codes only, since it is controlled over a front contact 16 of relay QRA and the control codes are transmitted over the back contact 4 of relay QRA.

I shall next assume that the operator moves lever V from left to right to change the indication of signal S from caution to proceed, lighting lamp G. The operation of contact A causes relay QR to release and then pick up as in the preceding examples, releasing relays QRA and 120R in turn, and opening the line for a time sufficient to release relays CD, CD1 and QRA1 and terminating the delivery of 120 code to relay 120R1, which relay also releases, opening the circuit for relay HR.

When relay QR picks up, a control code of 180 impulses per minute is delivered to the line over the right-hand contact 10 of lever V and the periodically operating contact 19 of the office code transmitter 180CT. Lamp W flashes at the 180 code rate and relays CD and CD1 pick up. The signal control relay 180R1 also picks up to hold relay HR energized, lighting lamp G.

In the foregoing it is to be understood that relay 120R1 will release before relay 180R1 picks up, although these relays have a release period considerably in excess of that of relay CD1, due to the energy storage in the resonant decoding units DU. It follows that in a change of the signal indication from caution to proceed or from proceed to caution, the energization of relay HR is temporarily interrupted. Relay HR is made sufficiently slow release to remain picked up under this condition, that is to say, provided the lever contact A is not left open for an abnormal length of time, thereby avoiding a flash of the red lamp R during a change from caution to proceed, or vice versa.

When relays QRA and QRA1 pick up to terminate the 180 control code, an indication code of the same frequency is initiated, as in the case of the 120 code already described the line circuit now including front contacts 7 and 12 of relays QRA1 and CD1, the periodically operating contact 20 of the station code transmitter 180CT, and front contacts 14 and 15 of relays 180R1 and HR. Those relays already energized remain picked up to maintain the signal lamp G lighted, and in addition, the indication relay 180R becomes energized to light the indication lamp GK.

The operations resulting from a movement of letter V from right to left to change the indication of signal S from proceed to caution are similar to those last described and consequently a detailed explanation appears unnecessary.

Assuming that signal S indicates proceed or caution, it is obvious that it may be returned manually to stop by returning lever V to its center position as shown, contact A then functioning as in the first example given. Signal S is also arranged to be put automatically to stop by a train entering section T, in which case the line circuit is opened at contact 6 upon the release of the track relay TR, all of the indication lamps becoming dark under this condition. When the train vacates section T, contact 6 closes, completing the line circuit to cause lamp W to be steadily lighted. The operator will then restore lever V to its center position if he wishes the signal to remain at stop, or will press the lever momentarily if he wishes the signal to clear again, thereby setting the system into operation as already described. It will be seen that the clearing of signal S allows only one train to enter the manual block; that is to say, if the operator happens to leave the signal lever reversed after the detector track section has been vacated, the line relays will be steadily energized and the signal will remain at stop. It follows therefore that my system is so arranged that a separate manual control is enforced for each train movement.

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

Having thus described my invention, what I claim is:

1. In a remote control system, an office and a station connected by line wires normally supplied with line current, means including a control lever and a code transmitter at the office for at times modulating said line current at a given frequency, a control relay at the station, decoding means at the station selectively responsive to said line current modulated at said given frequency for energizing said control relay, a normally inactive code transmitter at the station, switching means at the office for automatically stopping the modulation of said current by the office code transmitter after a time sufficient to effect the energization of said control relay, and switching means at the station for then rendering the station code transmitter effective if said control relay becomes energized to continue the modulation at said given frequency of the current sup-

plied to said line wires to maintain said control relay energized.

2. In a remote control system, an office and a station, a normally closed line circuit extending from the office to the station including a source of current at the office, means including a control lever and a code transmitter at the office for at times modulating the current delivered to the line circuit at a given frequency, a control relay at the station, decoding means at the station selectively responsive to said line current modulated at said given frequency for energizing the control relay, a normally inactive code transmitter at the station, switching means at the office and switching means at the station, each rendered effective in response to the operation of the office code transmitter for a given period of time during which the control relay becomes energized, means controlled by the switching means at the office for rendering the office code transmitter inactive, and means controlled by the switching means at the station for rendering the station code transmitter active to continue the modulation of the line current at said given frequency to maintain said control relay energized.

3. In a remote control system, an office and a station, a normally closed line circuit extending from the office to the station including a source of current at the office, means including a control lever and a periodically operating contact at said office for at times repeatedly interrupting the current delivered to the line circuit from said source, a control relay at the station, decoding means at the station controlled over said line circuit and selectively responsive to said repeatedly interrupted line current for energizing said control relay, and means including a front contact of said control relay and a periodically operating contact at said station for at other times repeatedly interrupting the current delivered to the line circuit from said source to maintain said control relay energized.

4. In a remote control system, an office and a station connected by a line circuit normally supplied with line current, a control lever and an indication relay at the office, a control relay at the station, code transmitters at the office and station, switching means at the office responsive to an operation of the control lever to a reverse position for causing the office code transmitter to modulate the current supplied to the line circuit for a given period of time, decoding means at the station responsive to the modulated current supplied to the line circuit for energizing said control relay, switching means at the station rendered effective by said control relay when energized for causing the station code transmitter to modulate said current at the end of said given period of time to thereby continue the supply of modulated current to the line circuit to maintain said control relay energized, decoding means at the office responsive to the modulated current supplied by said station code transmitter for energizing said indication relay.

5. In a remote control system, an office and a station connected by line wires, a control lever and indication means at the office, a plurality of control relays at the station, an indication channel including said line wires and contacts controlled by said control relays, code transmitters at the station adapted to transmit impulses over said indication channel for controlling the indication means to continuously indicate the condition of said control relays as long as the channel is established, means responsive to an operation of said lever from one control position to another for interrupting said indication channel and for then establishing a control channel including said line wires and contacts controlled by said lever, code transmitters at the office adapted to transmit impulses over said control channel for the control of said control relays in accordance with the position to which said lever is operated, for a given period of time, and means responsive to said impulses and effective at the end of said given period of time for automatically reestablishing said indication channel.

6. In a remote control system, an office and a station connected by line wires, a control lever and indication means at the office, a plurality of control relays at the station, an indication channel including said line wires and contacts controlled by said control relays, code transmitters at the station adapted to transmit impulses over said indication channel for controlling the indication means to continuously indicate the condition of said control relays as long as the channel is established, means responsive to an operation of said lever from one control position to another for interrupting said indication channel and for then establishing a control channel including said line wires and contacts controlled by said lever, code transmitters at the office adapted to transmit impulses over said control channel for operating said control relays selectively in accordance with the position to which said lever is operated, for a given period of time, means responsive to said impulses and effective at the end of said given period of time for automatically interrupting said control channel and for reestablishing said indication channel, and means at the station responsive to the impulses transmitted over said indication channel for maintaining said control relays in their last operated positions as long as said indication channel remains established.

7. In a remote control system, an office and a station connected by line wires, a control lever and an indication relay at the office, a control relay at the station, an indication channel including said line wires and contacts closed when the control relay is energized, a code transmitter at the station adapted to transmit impulses over said indication channel for continuously governing said indication relay as long as the channel is established, manually operable means at the office effective when operated to interrupt said indication channel and to then establish a control channel including said line wires, a code transmitter at the office adapted to transmit impulses over said control channel for energizing said control relay in accordance with the position of said control lever, switching relays initially governed over said control channel and effective after said control relay has been supplied with impulses for a predetermined time interval to interrupt the control channel and to establish the indication channel, and means including the impulses transmitted over said indication channel for maintaining the control relay energized as long as said indication channel remains established.

8. In a remote control system, an office and a station connected by line wires, a control lever and an indication relay at the office, a control relay at the station, an indication channel including said line wires and contacts controlled by the control relay, a code transmitter at the station for transmitting impulses over said indication channel for governing said indication re-

lay, a control channel including said line wires and contacts of said control lever, a code transmitter at the office for transmitting impulses over said control channel for operating said control relay, slow acting switching relays at the office and station respectively responsive to the impulses transmitted over said control channel and cooperating in a released position to establish said control channel and in an operated position to establish said indication channel, means comprising a manually controllable contact for maintaining said office switching relay energized until manually released, and means comprising the impulses transmitted over said indication channel for maintaining said station switching relay energized.

9. In a remote control system, an office and a station connected by line wires, a control relay at the station, a control lever and a slow pick-up relay at the office, an indication channel including a front contact of said slow pick-up relay and said line wires, a code transmitter at the station for transmitting impulses over said indication channel for continuously indicating the position of said control relay at the office as long as said indication channel is established, a control channel including a back contact of said slow pick-up relay and said line wires, a code transmitter at the office for transmitting impulses over said control channel for governing said control relay in accordance with the position of said control lever, a manually operable contact associated with said lever, a stick circuit for maintaining said slow pick-up relay normally energized, means responsive to a momentary operation of said manually operable contact for interrupting said stick circuit to release said slow pick-up relay and thereby establish said control channel, and means responsive to the impulses transmitted over said control channel for reenergizing said slow pick-up relay to interrupt said control channel after a limited period of time and to then reestablish said indication channel.

10. In a remote control system, an office and a station connected by line wires, a control lever and a switching relay at the office, a control relay and a second switching relay at the station, a control channel including contacts of said lever, said line wires and back contacts of said switching relays, means for transmitting impulses over said control channel to operate the control relay in accordance with the position of the control lever, an indication channel including front contacts of said control relay and of said switching relays, and said line wires; means for transmitting impulses over said indication channel to maintain the control relay in its operated position and to also indicate the position of said control relay at the office, means responsive to the impulses transmitted over said control channel for energizing said switching relays to establish said indication channel after said control channel has been established for a given time interval, means including a manually operable contact associated with said control lever, for controlling the continuity of said channels, a stick circuit controlled by said manually operable contact for maintaining the office switching relay energized, and means including the impulses transmitted over said indication channel for maintaining said station switching relay energized subject to control by said manually operable contact.

11. In a remote control system, an office and a station connected by line wires, a control lever, a plurality of indication relays and a switching relay at the office, a plurality of control relays and a second switching relay at the station, a control channel including contacts of said lever, said line wires and back contacts of said switching relays, a plurality of code transmitters at the office controlled by said lever for transmitting impulse currents of different frequencies over said control channel to which said control relays are selectively responsive, in accordance with the position of said lever, an indication channel including front contacts of said switching relays, and said line wires, a plurality of code transmitters at the station including one controlled over a front contact of each control relay for transmitting impulse currents over said indication channel of the frequency to which such control relay is responsive, such impulse currents serving to maintain the control relay energized and to energize the corresponding indication relay to indicate its position at the office, means responsive to the impulse currents transmitted over said line wires for energizing said switching relays to establish said indication channel after said control channel has been established for a given time interval, means at the station for terminating the transmission of the impulse currents over said indication channel to release the station switching relay, but without releasing the office switching relay, and manually operable means for releasing the office switching relay to initiate the transmission of impulse currents over said control channel.

12. In a centralized traffic control system for railroads, an office and a station connected by a single line circuit normally supplied with line current, a signal lever at the office, a railway signal at the station for governing traffic movements into a stretch of track including a detector track section, a track relay for said section having a front contact in said line circuit, code transmitters at the office and station for modulating said line current, a slow pick-up switching relay at the station responsive to modulated current in said line circuit, relay means responsive to an operation of the control lever for causing the office code transmitter to supply modulated current to the line circuit for a given period of time only, for operating said switching relay, the rate of modulation of said current being dependent upon the position of said lever, decoding means responsive to the rate of modulation of said current for selectively clearing said signal, means governed by the signal and rendered effective in response to the operation of said switching relay for causing the code transmitter at the station to modulate said current to thereby continue the supply of modulated current at the same rate to maintain the signal at clear until said track relay is released, and indication means at the office controlled by the modulated current supplied to the line circuit after said switching means has operated for indicating the condition of the signal.

13. In a centralized traffic control system for railroads, an office and a station connected by a line circuit normally supplied with line current, code transmitters at the office and station for modulating said current, manually operable control means at the office, a railway signal and a switching relay at the station, means responsive to a momentary operation of said control means for causing the office code transmitter to modulate the current supplied to said line circuit to energize said switching relay, means for causing the station code transmitter to modulate the

current supplied to the line circuit after said switching relay is energized, at a rate dependent upon the condition of the signal, such modulation being effective to maintain the switching relay energized, indication means at the office selectively responsive to the rate of modulation of said current by the station code transmitter for indicating the condition of the signal, and means responsive to traffic conditions adjacent said signal for releasing said switching relay to discontinue the modulation of said line current until said control means is again operated.

14. In a centralized traffic control system for railroads, an office and a station connected by a line circuit normally supplied with line current, code transmitters at the office and station for modulating said current, manually operable control means at the office, a switching relay at the station, a railway signal at the station for governing traffic movements into a stretch of track including a detector track section, a track relay for said section having a front contact in said line circuit, means responsive to the momentary operation of said control means for causing the office code transmitter to modulate the current supplied to the line circuit for a limited time to energize said switching relay, means controlled by the switching relay when energized for causing the station code transmitter to modulate the current supplied to the line circuit at a rate dependent upon the condition of the signal, such modulation being effective to maintain the switching relay energized, signal indication means at the office selectively responsive to the rate of modulation of said current for indicating the condition of the signal, means for releasing said switching relay to terminate said modulation when said line circuit is temporarily opened by said track relay, and track indication means at the office responsive to the energized or deenergized condition of the line circuit after said switching relay is released for indicating the condition of said track relay.

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