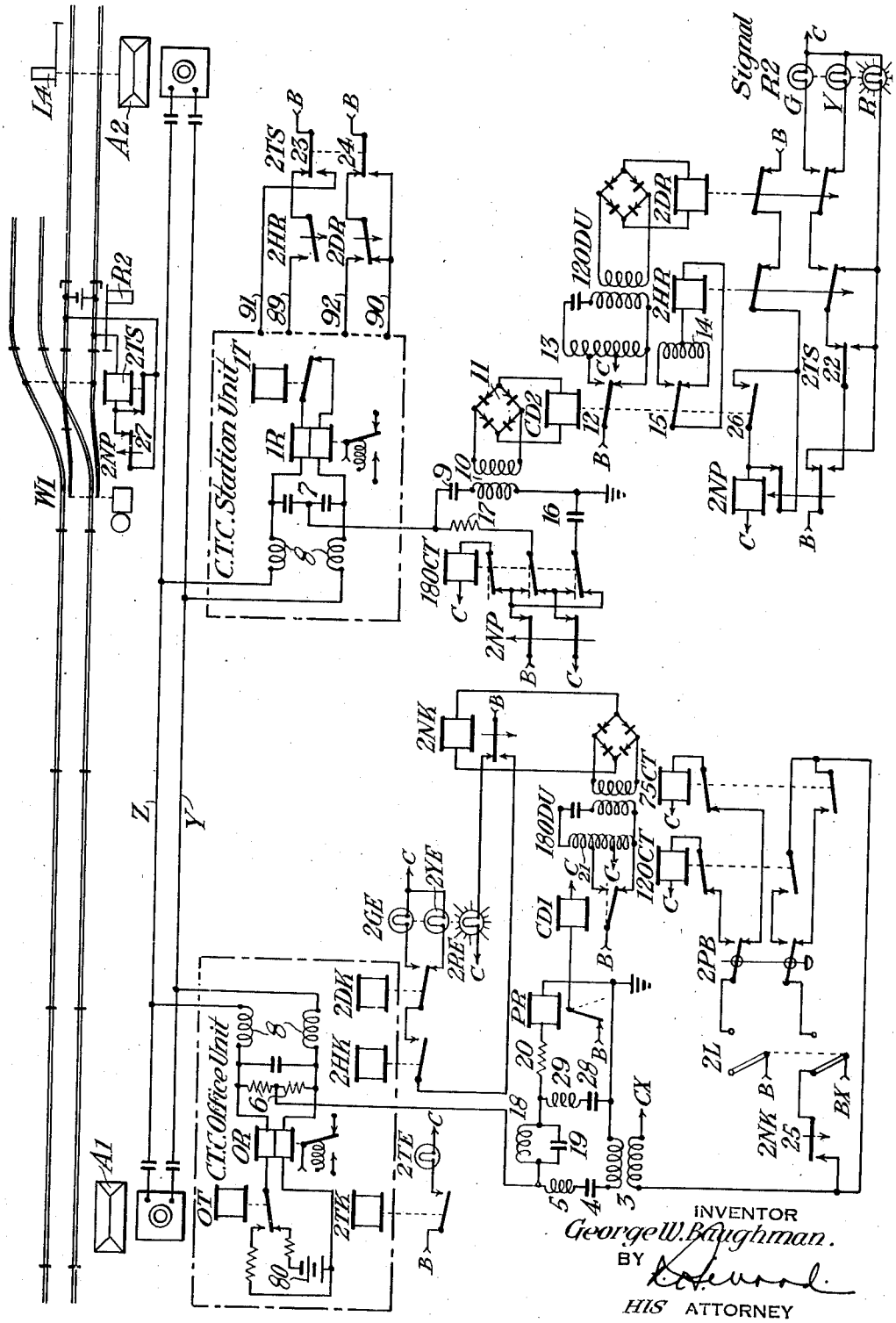
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REMOTE CONTROL SYSTEM

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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 for the control of railway signals, track switches or the like, from a central point of control, such as a train dispatcher's office, and for the indication of such devices at the control office.

One object of my invention is the provision of an improved system of this character in which a visual indicator at the office is continuously and directly controllable according to the condition of the corresponding device in the field, and in which such device may be controlled according to the position of a manually operable lever at the office, by means of continuously transmitted codes of impulses of a distinctive frequency, over the same line wires.

A further object of my invention is the provision of an improved system of this character which is adapted to employ existing communication circuits in order to effect the transmission of such controls and indications reliably over relatively long distances in an economical manner, and which possesses a high degree of immunity against any interference resulting from the joint use of the same line wires by other communication facilities, or from any foreign current interference likely to occur in long distance line circuits.

A specific object of my invention is the provision of an improved system for controlling a manual block signal for governing traffic movements into a stretch of track not equipped with track circuits and for continuously indicating the condition of such a signal at a distant control office.

A further object of my invention is the provision of improved means for insuring that a manually controlled signal which has been put to stop by a passing train cannot be cleared again except at the will of the operator at the point of control.

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 linear diagram at the top represents a stretch of railway track of which it is to be understood that the portion which includes the track switch W1 in its normal position, as shown, is included within territory provided with continuous track circuits in which the track switches and signals are controlled by means of a centralized traffic control system of the impulse code type, such for example, as that disclosed in Letters Patent of the United States No. 2,229,249, granted January 21, 1941, to L. V. Lewis, the control office of the centralized traffic control system being located in the cabin or tower A1 shown at the left in the drawing. The track switch W1, in its reversed position, connects this portion with a stretch of single track extending to a second tower A2, constituting a "manual block" having a short detector section with a track relay 2TS directly in advance of signal R2, but otherwise not provided with track circuits over which train movements are governed by the manual block signals R2 and L4. Signal R2 is controlled by the apparatus of my invention as hereinafter described, by remote control from tower A1, while signal L4 is manually controlled by a local operator at tower A2.

The reference characters Y and Z designate two line wires extending between towers A1 and A2 which provide a telephone channel which may be used for the transmission of information to the operator at tower A2 as required for the manual control of signal L4 and for "OS"ing or reporting the passage of a complete train or reporting the position of signal L4 to the operator at tower A1.

The line wires Y and Z also provide a line circuit for the impulse code system by which the track switch W1 and other apparatus included within the centralized traffic control territory but not shown herein, is governed from tower A1. This line circuit is normally closed and energized from a central office battery 80 and comprises a metallic circuit including line wires Y and Z in series, with suitable low pass filters interposed between the centralized traffic control apparatus as in Fig. 1 of my Letters Patent of the United States No. 2,208,446, granted July 16, 1940, for Remote control apparatus, but for simplicity only the centralized traffic control office unit and one station unit are shown herein, and these only in diagrammatic form, since the details of construction and operation of this apparatus may be ascertained from the above-mentioned patents.

The apparatus of my invention is controlled over a grounded line circuit extending from tower A1 to the location of signal R2, which includes frequency discriminating apparatus at each end to provide separate non-interfering control and indication line channels, each of which include the line wires Y and Z in multiple, with earth return. The control line channel is employed for the transmission of alternating current of a suitable frequency such as 60 or 100 cycles from a

source at the control office, of which only the terminals are shown, these being designated BX and CX, respectively. This alternating current is modulated or interrupted at suitable rates such as 75 or 120 times per minute by a code transmitter 75CT or 120CT at the office, and is then delivered to the control line channel in accordance with the position of a signal control lever 2L. The code transmitter CT may be of any suitable type, such for example, as the one shown in Letters Patent of the United States No. 1,858,876, granted May 17, 1932, to P. N. Bossart, for Coding apparatus. With lever 2L in its normal position, as shown, the supply of current from terminal BX is normally cut off, under which condition signal R2 is caused to indicate stop by the lighting of its red lamp R. Under proper conditions lamp Y of signal R2 may be lighted to display a permissive indication by moving lever 2L to its right-hand or reverse position, and then lamp G may be lighted in place of lamp Y to cause signal R2 to indicate clear, by the operation of a push button 2PB.

When lever 2L is reversed, a circuit is closed from terminal B of a suitable local source of current over the upper set of contacts of lever 2L and push button 2PB through the interrupted contact and winding of the code transmitter 75CT or 120CT, depending upon the position of push button 2PB, to the other terminal C of the source, and at the same time, a local circuit is closed from the terminal BX of the alternating current source through the lower set of contacts of lever 2L and push button 2PB and the intermittently closed contacts of code transmitter 75CT or 120CT through the primary of transformer 3 to the other terminal CX of the alternating current source. The transmitter 75CT or 120CT then operates continuously at the rate of 75 or 180 times per minute, respectively, so that coded alternating current is delivered by the secondary of transformer 3 to the control line channel. This channel extends from a connection to ground at the office through the secondary of transformer 3, condenser 4 and coil 5, tuned to series resonance at the frequency of the alternating current source, to the mid-point connection of the simplex resistors 6, thence through coils 8 and the line wires Y and Z in multiple to the centralized traffic control station, where it extends through coils 8 and condensers 7 to the midpoint connection of condensers 7, and thence to ground through condenser 9 and transformer 10, which are also tuned to resonance at the frequency of the alternating current source. A code following relay CD2 is energized from transformer 10 through a rectifier 11, and therefore repeats the operation of the code transmitter 75CT or 120CT at the office.

The operation of contacts 12 of relay CD2 completes circuits extending from one terminal B of the local source alternately in opposite directions through the primary 13 of a decoding transformer to the other terminal C of this source, so that current impulses of alternately opposite polarity are generated in winding 13 and delivered to a resonant decoding unit 120DU by means of which the signal control relay 2DR is selectively energized. This decoding circuit is substantially similar to that for relay K2 in Letters Patent of the United States No. 1,773,472, granted August 19, 1930, to P. N. Bossart, and provide a high degree of selectivity for the reasons explained in this patent, so that relay 2DR responds to 120 code only.

The energization of winding 13 induces code frequency alternating current in a secondary winding 14, which current is mechanically rectified by the operation of contact 15 of relay CD2 to energize a second signal control relay 2HR. The circuits for relay 2HR correspond to those for relay H in Letters Patent of the United States No. 2,237,788, granted to Nicholson, et al., and is similarly responsive to either 75 or 120 code but non-responsive to foreign alternating current in winding 14, such as might be supplied thereto, for example, through winding 13 from an alternating current battery charger connected across terminals B and C of the local source.

Signal R2, as shown, if of the usual color light type, and assuming that the track relay 2TS is picked up and relay 2NP is released, it will be seen that when lever 2L is reversed and button 2PB is pressed, relays 2HR and 2DR are both picked up to light lamp G, and that with lever 2L reversed and button 2PB normal, relay 2HR is energized but relay 2DR is released to light lamp Y, while under other conditions lamp R is lighted.

Inasmuch as the signal lighting is controlled directly by contacts of the signal control relays, back contacts of these relays are employed to control a back lock or signal indication relay 2NP which when energized causes the transmission of a continuous code for indicating the stop condition of the signal at the control office.

Relay 2NP is normally energized over a stick circuit from terminal B over back contacts of relays 2DR and 2HR and its own front contact and winding to terminal C, and a front contact of relay 2NP completes a circuit from terminal B over the interrupter contact and winding of a code transmitter relay 180CT to terminal C. The latter is similar in type to the relays CT at the office but operates its contacts 180 times per minute in response to the energization of its circuit by relay 2NP. The lower contact of relay 180CT is connected through a condenser 16 to ground, and the middle contact through resistor 17 to the line at the mid-point connection of condensers 7. These contacts are also connected to terminals B and C of the local alternating current source as long as relay 2NP is energized, and serve as a pole changer to deliver impulses of alternately opposite polarity to the indication line channel extending over line wires Y and Z to the mid-point connection of resistors 6, thence through coil 18 or condenser 19, resistor 20, relay PR to ground.

Relay PR is a sensitive relay of the stick polar type and its contact is operated to the right or left according to the polarity of each impulse delivered by relay 180CT, and is held magnetically by a definite biasing force in its last-operated position during the intervals between impulses, being rendered thereby non-responsive to strap currents of less than a predetermined value. Relay PR controls a code following repeating relay CD1, which is a neutral relay of the usual railway signaling type, and its contacts repeat the code operation of the contacts of relay 180CT and therefore operate 180 times per minute.

Relay CD1 controls decoding apparatus similar to that controlled by relay CD2, and delivers impulses of alternately opposite polarity to a decoding transformer 21 and thence to a resonant decoding unit 180DU by means of which the normal indication relay 2NK is selectively energized. This decoding circuit is substan-

tially similar to that for relay K3 in the above-mentioned Bossart Patent No. 1,773,472, and relay 2NK responds selectively to 180 code only. A front contact of relay 2NK controls a red lamp 2RE located on the operator's control panel at the office adjacent the signal lever 2L.

Lamp 2RE therefore is normally maintained lighted only as long as the communication line extending to the location of signal R2 is energized and intact and the back contacts of relays 2HR and 2DR remain closed to hold relay 2NP picked up.

Assume now that the apparatus is in its normal condition as shown, and that the operator at tower A1, knowing that the manual block is unoccupied, reverses switch W1 by means of the centralized traffic control system and then reverses lever 2L and presses button 2P, with the object of effecting the movement of a train from left to right through the manual block. The code transmitter 120CT becomes energized, delivering alternating current interrupted 120 times per minute to the control line channel to operate relay CD2, thereby energizing relays 2HR and 2DR and consequently releasing relay 2NP. Lamp G of signal R2 therefore becomes lighted, and lamp R is extinguished, but only as long as the communication line is intact and lever 2L and button 2PB remain in their operated positions.

The release of relay 2NP by the signal control relays stops the delivery of 180 code indication impulses to the indication line channel and consequently relay 2NK releases and lamp 2RE becomes dark.

The indication apparatus may be arranged in a manner which will be readily apparent to one skilled in this art, so that a different continuous code, say of 75 impulses, is now transmitted over the indication channel to light a lamp 2YE or 2GE at the office, to indicate whether signal 2R is displaying its permissive or clear indication. However, such indications, and likewise an indication of when a train passes signal R2 and releases the track relay 2TS, being of value only as information, may be transmitted more economically by means of impulse codes over the centralized traffic control system by the use of existing facilitates otherwise idle, and accordingly are so arranged. Thus it is to be understood the wires 89, 90, 91 and 92 leading to the C. T. C. station unit are the same as the corresponding numbered wires shown in Fig. 7 of Patent No. 2,229,249, hereinbefore mentioned, which govern the transmission of certain indication codes. As far as the present invention is concerned, it will suffice to point out that when relay 2HR or 2DR picks up, an impulse code is transmitted to pick up the corresponding centralized traffic control indication relay 2HK or 2DK at the office, which relay is then held energized locally until another indication code is transmitted in response to the release of relay 2HR or 2DR. Similarly, an impulse code is transmitted whenever relay 2TS releases, to pick up the centralized traffic control indication relay 2TK to light the "OS" lamp 2TE, and another code is transmitted when relay 2TS picks up to release relay 2TK to extinguish lamp 2TE.

Under the condition being described, that is, with signal R2 cleared for an approaching train, lamp 2GE is lighted and the remaining office indication lamps shown are dark.

Assume now that the train enters the detector track section, releasing relay 2TS. The dropping of contact 22 of relay 2TS causes signal 2R to indicate stop, even though relays 2HR and 2DR remain energized. The dropping of contacts 23 and 24 of relay 2TS initiates an impulse code, releasing relays 2HK and 2DK and picking up relay 2TK so that lamp 2TE becomes lighted and lamp 2GE is extinguished.

The track relay 2TS is a stick relay which remains released after the train vacates the detector track section until the operator has restored his control lever to normal.

Assuming that the operator restores lever 2L to normal and releases button 2PB as soon as he is apprised that the train has entered the manual block by the light of lamp 2TE, relay 120CT becomes deenergized and the control code transmission is stopped, and a circuit is completed from terminal BX over the lower normal contact of lever 2L and a back contact 25 of relay 2NK through transformer 3 to terminal CX, to apply alternating current steadily to the control line channel. At the station, relay CD2 picks up and remains steadily energized and relays 2HR and 2DR release, completing a circuit for relay 2NP over contact 26 of relay CD2. Relay 2NP is a slow pick-up relay of a type requiring steady energization for about 1.2 seconds to pick up, and releasing in about 0.1 second after its circuit is opened. Consequently it is non-responsive to the code operation of relay CD2 which occurs when lever 2L is reversed, even though relays 2HR and 2DR fail to pick up in response to the code, and picks up only in response to the uncoded current supplied when lever 2L is normal.

When relay 2NP picks up, the code operation of relay 180CT is resumed, relay 2NK picks up and lamp 2RE becomes lighted. The opening of back contact 25 of relay 2NK discontinues the supply of steady alternating current to the control line channel and releases relay CD2, but relay 2NP remains picked up over its stick circuit.

The apparatus is now conditioned so that relay 2TS will pick up when the train vacates the detector section, or will pick up at once upon the restoration of lever L2 to normal if the train has already passed out of the detector section, whereupon relay 2TS initiates a centralized traffic control code by the deenergization of wire 91, releasing relay 2TK and extinguishing lamp 2TE, thereby restoring the apparatus to the normal condition as shown.

It is to be noted that relay 2NP might be an ordinary relay controlled only by back contacts of relays 2HR and 2DR, its control by relay CD2 being omitted, without loss of function in normal operation. In that case relay 2NP would pick up due to the deenergization of the signal control relays, in response to the restoration of lever 2L to normal. However, such deenergization might occur as a result of a circuit failure, and if the operator happened to leave the signal lever reversed after the detector section has been vacated, and the line wires were then temporarily grounded, for example, it might happen that the signal control relay 2HR would be released long enough to pick up relay 2NP and thereby reenergize relay 2TS. Then when the ground connection disappeared relay 2HR would become reenergized and the signal would clear again automatically, and thus defeat the purpose of the stick control of relay 2TS. With the arrangement shown, however, this cannot occur, because relay 2NP responds selectively to a signal of dis-

tinctive character transmitted only when the signal lever is normal.

It is also to be noted that relay 2TS functions as an ordinary non-stick track relay when a train moving from right to left passes through the detector section, since in this case the signal R2 has not been cleared and consequently relay 2NP remains picked up.

The question of possible interference with the normal operation of the line circuits of my invention will now be discussed.

The frequencies employed in the control and indication line channels differ widely, consequently condenser 4 presents a very high impendance to the indication code impulses, and the anti-resonant circuit comprising coil 18 and condenser 19 similarly presents a very high impendance to the control code current. The selectivity of the circuit for relay PR is further increased by the provision of a resonant shunt comprising condenser 28 and coil 29, similar to condenser 4 and coil 5.

At the field station, the condensers 7 provide a connection to the line wires for the control and indication line channels without affording a path for current from battery 80 to interfere with the operation of the centralized traffic control line relays such as relay IR. Condensers 7, 9 and 16 isolate the local battery from ground so that the same battery may be used to energize other circuits which are to be maintained free from grounds in accordance with the usual practice in respect to railway signaling circuits. The impulses delivered by relay 180CT to the line are also impressed upon condenser 9 and transformer 10, but the frequency and consequently the energy of these impulses is far too low to operate relay CD2, furthermore, the circuits are interlocked, back contacts of the relays controlled by relay CD2 being included in the circuit for relay 180CT, rendering relay 180CT wholly incapable of maintaining relays 2HR and 2DR picked up.

At the office, assuming a failure of the resonant circuit elements to occur, due to short circuits or otherwise, so that relay PR is rendered responsive to the coded alternating current delivered by 75CT or 120CT, it will be seen that in this case the contact of relay PR will vibrate during the "on" periods of the alternating current code and will be left either in its left-hand or right-hand position during the "off" periods, indeterminately, for the reason the code transmitters are non-synchronous with respect to the alternating current source. Relay CD1 is non-responsive to the pulsating current delivered during the "on" periods of the code, due to its relatively high reactance, and therefore picks up only when the contact of relay PR remains in its left-hand position during an "off" period. Consequently, the resulting operation of relay CD is not in accordance with any definite code pattern such as is required for the operation of relay 2NK. A cross or ground on one of the line wires would cause current from battery 80 to pass through relay PR but this being of one polarity only cannot cause its response to a centralized traffic control code. Such a failure, however, is immediately brought to the attention of the operator at tower A1 by the resulting noise produced by the code in his loud speaker normally connected to line wires Y and Z, due to circuit unbalance.

The use of different code frequencies for control and indication as illustrated provides in itself a definite check against false operation of relay 2NK, but this is not essential, as it will be clear from the foregoing that the system may be safely expanded to provide additional controls and indications by the use of the same code frequencies for transmission in two directions if desired.

Although I have herein shown and described only one form of remote control systems 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, two stations connected by line wires, a movable device at one station, means effective only when said device is in a given position for delivering spaced impulses of alternately opposite polarity and of a fixed frequency to said line wires, a polar relay of the magnetic stick type at the other station operable alternately between two positions in response to said impulses and held magnetically in its last operated position during the intervals between impulses, an indication relay, and means responsive to the continued operation of said polar relay including a circuit tuned to electrical resonance at the frequency of said impulses for selectively energizing said indication relay.

2. In a remote control system, two stations connected by a line circuit, means at one station including a source of direct current of reversible polarity in series with a condenser for delivering spaced impulses of alternately opposite polarity and of a fixed frequency to said line circuit without affording a metallic connection between said line circuit and said source, a polar relay of the magnetic stick type at the other station operable alternately between two positions in response to the impulses delivered to said line wires and held magnetically in its last operated position during the intervals between impulses, a circuit tuned to electrical resonance at the frequency of said impulses, means controlled by said polar relay for energizing said tuned circuit by impulses the relative polarity of which is dependent upon the position of said polar relay, an indication relay, and means including said tuned circuit for selectively energizing said indication relay.

3. In a remote control system, two stations connected by line wires, means at one station for delivering spaced impulses of alternately opposite polarity and of a fixed frequency to said line wires, a polar relay operable alternately between two positions in response to said impulses and held magnetically in its last operated position during the intervals between impulses, a circuit tuned to electrical resonance at the frequency of said impulses, means responsive to each energization of said polar relay by an impulse of given polarity to deliver an impulse of corresponding polarity to said tuned circuit, an indication relay, and means controlled by said tuned circuit and dependent upon the continued operation of said polar relay for selectively energizing said indication relay.

4. The combination with a stretch of railway track having a detector track section and a signal for governing traffic movements into said section with line wires connecting the location of said signal with a distant control office and affording a plurality of communication channels for the control from said office of traffic governing devices along the track including said signal and for indicating trackway conditions at said

office, of an additional channel comprising said line wires, a connection from said line wires to ground at said office including a polar relay of the magnetic stick type, and from ground through condensers to said line wires at the location of said signal, together with a pole changer, a local undergrounded source of direct current for controlling said signal connected to contacts of said pole changer and included in said condenser connection to ground, means for operating said pole changer repeatedly at a fixed rate when said signal is in a given condition, and means at said office dependent upon the continued operation of said polar relay at said fixed rate for visually indicating such condition.

5. In a remote control system, an office and a station, line wires connecting said office and station, a line relay at said station, a communication channel for energizing said line relay when alternating current is supplied to said channel at said office, comprising said line wires and selective circuit elements electrically resonant to the frequency of said current at said office and also at said station, manually controllable means at said office for at times supplying alternating current to said channel and for modulating said current to periodically operate said line relay at different low frequency rates, a railway signal at said station, a plurality of signal control relays, circuits controlled by said line relay for selectively energizing said signal control relays in accordance with its rate of operation, and means for causing said signal to display different proceed indications in accordance with the rate of operation of said line relay and to display a stop indication when said line relay is at rest as manifested by the condition of energization of said signal control relays.

6. In a remote control system, an office and a station, line wires connecting said office and station, a line relay at said station, a communication channel for controlling said line relay comprising a source of alternating current at said office, said line wires, and selective circuit elements electrically resonant to the frequency of said current at said office and also at said station, means at the office for modulating said current to cause periodic operation of said line relay at a fixed low frequency, manually operable lever contacts for controlling said means, a circuit tuned to electrical resonance at said low frequency, a railway signal at said station, and a signal control relay for clearing said signal controlled by said line relay over said tuned circuit.

7. In a remote control system, an office and a station, line wires connecting said office and station, a line relay at said station, a communication channel for controlling said line relay comprising a source of alternating current at said office, said line wires, and selective circuit elements electrically resonant to the frequency of said current at said office and also at said station, means at the office for modulating said current to cause periodic operation of said line relay at one or another low frequency, manually operable lever contacts for selectively controlling said means, a circuit tuned to electrical resonance at the higher of said low frequencies, a three-position railway signal at said station, a first signal control relay responsive to the low frequency operation of said line relay, a second signal control relay controlled by said line relay over said tuned circuit, and circuits controlled by said signal control relays for causing said signal to indicate clear when both relays are energized and to display a more restrictive indication when only said first signal control relay is energized, said signal indicating stop when both said signal control relays are deenergized.

8. In a remote control system, an office and a station connected by line wires, a railway signal at said station, a source of current at said office, a line relay at said station adapted to be controlled by said current over said line wires, means at said office for modulating said current to periodically operate said line relay, a manually operable signal lever having a reverse contact for supplying current modulated by said means and a normal contact for supplying unmodulated current from said source to said line wires, a signal control relay controlled by said line relay and selectively responsive to said modulated current for clearing said signal, an indication relay controlled by a front contact of said line relay and by a back contact of said signal control relay, and a visual indication at the office controlled by said indication relay.

9. In combination with a detector section of railway track, a track circuit for said section, a signal for governing traffic movements into said section, a line circuit extending from the location of said signal to a distant control office, a signal control lever at said office, a normally deenergized signal control relay at the location of said signal, a normally energized indication relay controlled over a back contact of said signal control relay, a stick track relay controlled over the rails of said detector section having a pick-up circuit controlled by a front contact of said indication relay, a circuit including a reverse contact of said lever and said line circuit for effecting the energization of said signal control relay, a circuit for clearing said signal effective only when said signal control relay and said track relay are both energized and a circuit requiring the energization of said line circuit over a contact of said lever in its normal position for effecting the reenergization of said indication relay.

10. In combination with a detector section of railway track, a track circuit for said section, a signal for governing traffic movements into said section, a line circuit extending from the location of said signal to a distant control office, a signal control lever at said office, a signal control relay at the location of said signal, a stick relay which releases when said track circuit is occupied, means requiring said signal control relay to be released and also requiring the energization of said line circuit by current of distinctive character with said signal control lever in its normal position to pick up said stick relay, means requiring the energization of said line circuit by current of a different character with said signal lever in its reversed position to pick up said signal control relay, and a circuit for clearing said signal including front contacts of said signal control relay and of said stick relay.

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