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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 office, and for the indication of such devices at the control office.

One object of my invention is the provision of means for at times controlling a visual indicator at the office according to the condition of the corresponding device in the field and at other times controlling such device according to the position of a manually operable lever at the office over the same line channel, by means of continuously transmitted codes of impulses of a distinctive frequency. The system of my invention is arranged to employ existing communication circuits in order to effect the transmission of such controls and indications reliably and economically over long distances, and 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.

My invention is an improvement upon that disclosed in a copending application for Letters Patent of the United States Serial No. 400,287, filed June 28, 1941, by G. W. Baughman, for Remote control systems, and like that of Baughman, in its specific embodiment is illustrated as arranged for the control of a manual block signal for governing traffic movements into a stretch of track not equipped with track circuits, and for continuously indicating at the control office when such signal is in its stop position.

The apparatus of my invention is adapted to use line wires which are also used without interference, by a centralized traffic control code system of the impulse code type. A feature of my invention resides in arrangements for using such impulse codes, transmitted intermittently, for selecting the direction of transmission for non-interfering continuous codes of the frequency type, over the same line wires.

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 having a portion including a track switch W1. It is to be understood that switch W1 is controlled from a tower A1 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, for Remote control systems. When switch W1 is reversed, it connects this portion with a stretch of single track extending to a second tower A2, constituting a "manual block" having a short de-

tor section with a track relay 2TS directly in advance of signal R2, but otherwise not provided with track circuits, and over which train movements are governed by the manual block signals R2 and L4. Signal R2 is governed 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 C. T. C. 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, the windings of code responsive line relays 0R, 1R, etc., for controlling the coding units of the C. T. C. system, and also including contacts of transmitter relays such as 0T, 1T, etc., by means of which different impulse codes are delivered to the line circuit. This line circuit as shown differs from that shown in the above-mentioned Lewis patent, in that suitable low pass filters are interposed between the C. T. C. apparatus and the line wires in the manner shown in Fig. 1 of Letters Patent of the United States No. 2,208,446, granted July 16, 1940, to George W. Baughman for Remote control apparatus. For simplicity only the C. T. C. 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.

In addition, the line wires Y and Z afford a simplex or phantom circuit comprising the two line wires in multiple with earth return, which may be used either as a control line channel over which the manual block signal R2 may be continuously controlled from the office at tower A1, or it may be used as an indication line channel for the transmission of indications continuously in accordance with the condition of the signal to effect the continuous control of a visual indicator at the office. These two channels may employ similar transmitting and receiving apparatus, since only one is in use at a time, and the selection as to whether controls or indications are to be transmitted is effected manually, in

accordance with my invention, by means of non-interfering impulse codes transmitted over the same line wires through the medium of the above-mentioned C. T. C. system. The line signals transmitted over the control and indication channels are preferably of the continuous code type, and in the specific form shown, are transmitted as impulses of alternately opposite polarity derived from a direct current source and having a constant frequency of the order of 75 to 180 cycles per minute. The impulses are received by the line relays PR1 and PR2, and these relays govern apparatus which is selectively responsive to frequencies of this order, which apparatus is adapted to convert the impulses into pulsating direct current to govern the signal relays 2HR and 2DR and the indication relay 2NK.

Signal R2 is illustrated as the usual three-position color light signal having lamps G, Y and R for indicating clear, permission or stop, respectively. Lamp Y or G is lighted when one or both, respectively, of two signal relays 2HR and 2DR, and also the track relay 2TS for the short detector section in advance of signal R2 are energized and lamp R is lighted when relay 2TS or 2HR is deenergized.

The signal relays 2HR and 2DR are governed by continuous codes of frequencies of 75 and 180 cycles per minute, respectively, transmitted over the control line channel in accordance with the position of a signal control lever 2L and of a push button 2PB, as hereinafter pointed out. Lever 2L has a dual function, and in addition to governing the signal relays it also governs the transmission of C. T. C. codes and in this respect functions like lever HK, shown in Fig. 5 of the above mentioned Patent No. 2,229,249. That is, with lever 2L in its right-hand or reverse position, if a starting key SK is pressed momentarily, an impulse code is transmitted by the office unit of the C. T. C. system during which wire 104 is energized, and this code is received selectively by the station unit at the location of signal R2 to energize wire 85 momentarily to pick up a signal control relay RHS. Relay RHS then remains picked up over a stick circuit including wire 86 until a different code is received in response to a subsequent operation of key SK with lever 2L in its left-hand or normal position, whereupon relay RHS releases due to the deenergization of wire 86. The reference characters for those portions of the C. T. C. system shown herein are the same as those for corresponding parts in Patent No. 2,229,249, in which these operations are more fully explained, relay RHS, for example, being shown in Fig. 8 of the patent. It is to be noted, however, that the circuits for relay RHS shown herein differ from those of the patent, in that as shown herein relay RHS is not released when a train enters the associated track section and furthermore, it cannot be released by a C. T. C. code unless the signal relay 2HR is already in its release position.

The indication relay 2NK controls a lamp 2RE for indicating to the operator when the manual block signal R2 is at stop, and is governed over the indication line channel by a continuous code having a frequency of 180 cycles per minute.

With relay RHS released, as shown, a circuit is closed from one terminal B of a local source of direct current over its back contact 3 and the back contact 4 and winding of a relay

180CT1 to the other terminal C of the same source. The relay 180CT1 is a code transmitter of a suitable type, such for example, as shown in Letters Patent of the United States No. 1,858,876, granted May 17, 1932, to Paul N. Bossart for Coding apparatus, which when energized operates its contacts repeatedly at the rate of 180 times per minute, and its two lower contacts 5 and 6 serve as a pole changer for supplying impulses of alternately opposite polarity from the local direct current source to the indication line channel, and since this channel employs a ground return, condensers are interposed so that the same battery may be used for the control of other circuits which are to be maintained free from grounds, in accordance with the usual practice in the railway signaling art.

This indication line channel may be traced from ground at condenser 16 over contact 5 of relay 180CT1, back contacts 9 and 10 of relays 2HR and 2DR to terminal B, thence through the local source of current to its other terminal C, contact 6 of relay 180CT1, resistor 17, back contact 11 of relay RHS to the mid-point connection of condensers 7, thence through condensers 7 and coils 8 to line wires Y and Z and through similar coils 3 and condensers 7 at the office, front contact 12 of relay 2NK, and the winding of the line relay PR1 to ground. When relay 2NK is released, the indication channel may be completed over its back contact 12 provided the normal contact 13 of lever 2L is closed, as shown.

The line relay PR1 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 180CT1 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 stray currents of less than a predetermined value. Relay PR1 controls a code following repeating relay CD1, which is a neutral relay of the usual railway signaling type, and when the indication line channel is completed as described its contacts repeat the code operation of the contacts of relay 180CT1, operating 180 times per minute.

Relay CD1 delivers impulses of alternately opposite polarity to a decoding transformer and thence to a resonant decoding unit 180DU1 including a tuned circuit and a rectifier by means of which the normal indication relay 2NK is selectively energized. These decoding circuits are substantially similar to those for relay K3 shown in Letters Patent of the United States No. 1,773,472, granted August 19, 1930 to Paul N. Bossart, for Railway traffic controlling apparatus, and provide a high degree of selectivity for the reasons explained in the patent, so that relay 2NK responds selectively to 180 code only.

A front contact 14 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, 2DR and RHS remain closed.

It will now be assumed 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

2L and presses the starting key SK with the object of effecting a movement of a train from left to right through the manual block.

The closing of contact 15 of lever 2L completes a circuit from terminal B and a normal contact of push button 2PB, the back contact and winding of relay 75CT to terminal C. Relay 75CT is a code transmitter similar to 180CT1 in type but differing therefrom in that when energized relay 75CT operates its contacts repeatedly at the rate of 75 times per minute.

The operation of key SK causes a C. T. C. impulse code to be transmitted by the office coding unit as already mentioned, and since wire 104 is now energized over a reverse contact of lever 2L, relay RHS picks up when this code is fully received at the station, that is, after about 3 seconds, whereupon the opening of its back contacts 3 and 11 stops the transmission of the indication code and the closing of the corresponding front contacts conditions the continuous code apparatus at the station to receive a control code. The code operation of relays PR1 and CD1 therefore stops. Relay 2NK releases, extinguishing the red light 2RE, and by closing its back contact 12 completes the control line channel over the reverse contact 13 of lever 2L to cause 75 code impulses to be delivered thereto. This channel may be traced from ground at condenser 18, reverse contact 19 of lever 2L, normal contact 20 of push button 2PB, contact 21 of relay 75CT to terminal B, through the local source of direct current at the office to terminal C, thence over contacts 22, 23, 13 and 12 to condensers 7, thence over line wires Y and Z as already traced and over front contact 11 of relay RHS through the line relay PR2 to ground.

The line relay PR2 is a stick-polar relay similar to PR1 and controls a neutral relay CD2 governing a decoding transformer and decoding unit 180DU2 similar to those controlled by the line relay PR1, but relays PR2 and CD2 now operate 75 times per minute and relay 2DR controlled by the decoding unit 180DU2 consequently remains released. Front contact 3 of relay RHS being closed, contact 24 of relay CD2 supplies impulses of alternately opposite polarity to the associated decoding transformer and these impulses are rectified by contact 25 of that relay to energize 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 April 8, 1941 to F. H. Nicholson and L. R. Allison, for Railway traffic controlling apparatus, and relay 2HR is responsive to either 75 or 180 code but non-responsive to foreign alternating currents such as might be supplied thereto, for example, through the decoding transformer from an alternating current battery charger connected across terminals B and C of the local source.

Relay 2HR now picks up, lighting lamp Y to cause signal R2 to display a permissive indication, and contact 26 of relay 2HR connects terminal B to wire 89 of the station coding unit of the C. T. C. system to initiate the transmission of an indication code as explained in Patent No. 2,229,249, to pick up the indication stick relay 2HK at the office, thereby lighting the signal indication lamp 2YE.

It will now be assumed that the operator presses the push button 2PB. The closing of contact 27 energizes relay 180CT2, similar to 180CT1, in place of 75CT, and contacts 20 and 23 of push button 2PB interpose the pole changer contacts 28 and 29 of relay 180CT2 in the control

line channel in series with the office battery to supply this channel with 180 code to which relays PR2 and CD2 respond, so that relays 2HR and 2DR are now both energized to light lamp G causing signal R2 to indicate clear. Similarly, contact 30 of relay 2DR applies energy to wire 92 to initiate an indication code by the C. T. C. system to pick up the indication stick relay 2DK to light lamp 2GE at the office in place of lamp 2YE.

It will be apparent from the foregoing that to cause signal R2 to indicate permissive or clear, the operation of two independent transmission systems is involved; that is, relay RHS is first picked up by an impulse code and relays 2HR and 2DR are then picked up by continuous codes. After relay 2HR has once been picked up, its contact 31 holds relay RHS picked up locally, so that the continuity of the control line channel cannot be interrupted inadvertently by any C. T. C. code, and the signal is held at permissive or clear solely by the continuous code transmitted over the lever contacts 13 and 19.

It will be assumed that a train governed by signal R2 now enters the detector track section, releasing the track relay 2TS. The dropping of contact 32 of relay 2TS causes signal R2 to indicate stop, even through relays 2HR and 2DR remain energized. The dropping of contacts 33 and 34 of relay 2TS initiates an impulse code which releases relays 2HK and 2DK and picks up the track indication stick relay 2TK, so that lamp 2TE is lighted, and lamp 2GE or 2YE is extinguished, but lamp 2RE does not become lighted at this time.

It will be seen that the track relay 2TS is a stick relay and will remain released after the train vacates the detector section unless relay RHS is released to close its back contact 35, but relay RHS is now held energized over contact 31 of relay 2HR. To pick up relay 2TS, the operator must first restore lever 2L to normal to discontinue the continuous code and thereby release relay 2HR, and must then operate key SK momentarily to transmit an impulse code to release relay RHS. Assuming that the operator performs these operations, the release of relay RHS with relays 2HR and 2DR deenergized will re-initiate the transmission of 180 code over the indication line channel to pick up relay 2NK and light lamp 2RE. Then when the train vacates the detector section, relay 2TS picks up over contact 35 of relay RHS, and by deenergizing wire 91, initiates an impulse code to release relay 2TK, thereby extinguishing lamp 2TE and restoring the apparatus to the normal condition as shown.

It will be seen that relay 2TS functions as an ordinary non-stick relay when a train moving from right to left passes through the detector section, since in this case lever 2L remains in its normal position and relay RHS is not picked up.

It will also be seen that the arrangement is such as to insure that lever 2L is returned to normal after each train movement from left to right past signal R2, and that relay 2TS cannot be picked up after the train vacates the detector section as a result of a temporary failure of the circuit for controlling signal R2 as long as lever 12 is reversed.

It is to be understood that my invention is not limited to the use of the particular type of continuous code signals described herein nor to the use of a simplex line circuit for the trans-

mission of these signals but other well-known forms may be substituted, for example, alternating current of a commercial frequency such as 60 or 100 cycles per second which is modulated or interrupted at a low rate such as 75 to 180 times per minute, may be used, as employed for controls in the system of the above-mentioned Baughman application. Also such currents or carrier currents of higher frequencies which may also be used may be connected so as to employ the line wires Y and Z in series, like the C. T. C. line circuit, with frequency discriminating apparatus at each point of connection, in place of the parallel connection with ground return, as shown, such an arrangement being preferred under certain circumstances, as for example, when my invention is applied to a railroad employing electrical propulsion and deriving the energy for the propulsion of trains from circuits having an earth return. In any case, the same line circuit may be used for transmission of continuous codes of like character in either direction, with the same insurance against improper operation of the receiving apparatus by the transmitting apparatus at the same end of the line circuit as provided in the particular form herein shown and described.

Thus for example, the 180 code transmitted over the indication line channel holds relay 2NK picked up, and front contact 12 of that relay maintains the continuity of the indication line channel regardless of the position of lever 2L until the operator disconnects the source of the indication code by picking up relay RHS. Similarly, the 75 or 180 code transmitted over the control line channel holds relay 2HR picked up, and contact 31 of that relay holds relay RHS picked up to maintain the continuity of the control line channel until the operator disconnects the source of the control code by restoring lever 2L to normal.

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 remote control system, two stations connected by line wires, a code transmitter at each station for delivering impulses to said line wires, a line relay at each station adapted to receive such impulses, a movable contact at each station which in a first position connects the associated code transmitter to said line wires and in a second position connects the associated line relay to said line wires, and means controlled by each line relay when receiving impulses from said line wires with the associated movable contact in its second position for maintaining said associated movable contact in its second position as long as the line relay continues to receive impulses.

2. In a remote control system, two stations connected by line wires, a code transmitter at each station for delivering impulses to said line wires, a line relay at each station adapted to receive such impulses, a movable contact at each station which in a first position connects the associated code transmitter to said line wires and in a second position connects the associated line relay to said line wires, manually operable means for governing the operation of the mov-

able contact at one station to its second position, means remotely controlled by said manually operable means for governing the operation of the movable contact at the other station to its second position, and means associated with each movable contact when operated to its second position for maintaining it in such position as long as the associated line relay is receiving impulses from said line circuit.

3. In a centralized traffic control system for railroads, a stretch of railway track including a block section, a signal for governing traffic movements into said block section, a signal relay for clearing said signal, a signal control relay at said signal location, a signal lever and an indication relay at a distant control office, a first and a second line circuit connecting said signal location with said office, means for transmitting impulse codes over the first line circuit to pick up said signal control relay when said lever is reversed and to release said signal control relay when said lever is restored to its normal position, a control channel including a reverse contact of said lever, said second line circuit and a front contact of said signal control relay for at times continuously energizing said signal relay, and an indication channel closed in response to the return of said lever to its normal position including said second line circuit, a back contact of said signal control relay and a contact closed when said signal indicates a stop for continuously energizing said indication relay.

4. In a centralized traffic control system for railroads, an office and a station connected by a line circuit, a signal at said station, a signal relay for clearing said signal, a signal control relay at said station, a signal lever and an indication relay at said office, means effective when said signal lever is reversed and said signal control relay is picked up to energize said line circuit at said office and to connect said signal relay thereto at said station, means effective when said signal lever is normal, said signal control relay is released, and said signal is at stop to energize said line circuit at said station and to connect said indication relay thereto at said office, and means including a second line circuit for controlling said signal control relay in accordance with the position of said signal lever.

5. In a centralized traffic control system for railroads, an office and a station connected by line wires, a signal, a signal relay and a signal control relay at said station, a signal lever and an indication relay at said office, a control circuit for energizing said signal relay including a source of current at said office, a reverse contact of said lever, said line wires, and a front contact of said signal control relay, an indication circuit for energizing said indication relay including a source of current at said station, a back contact of said signal control relay, said line wires, a normal contact of said lever, and a contact closed only when said signal indicates stop, means controlled by said signal relay when energized for clearing said signal, and means including a second line circuit for governing said signal control relay to prepare said control or indication circuit according to the position of said signal lever.

6. In a centralized traffic control system for railroads, an office and a station connected by line wires, a signal, a signal relay and a signal control relay at said station, a signal lever and an indication relay at said office, a control circuit including a reverse contact of said lever.

said line wires and a front contact of said signal control relay, an indication circuit including a back contact of said signal control relay, said line wires and a normal contact of said lever, means at the office for supplying current periodically varied at a low frequency rate to said control circuit to selectively energize said signal relay, means at the station effective only when said signal indicates stop to supply current periodically varied at a low frequency rate to said indication circuit to selectively energize said indication relay means controlled by said signal relay when energized for clearing said signal, and means controlled over said line wires for at times governing said signal control relay to prepare said control or indication circuit according to the position of said signal lever.

7. In combination, an office and a station connected by line wires, a manually operable lever at said office, a control relay at said station governed in accordance with the position of said lever, a signal relay at said station, an indication relay at said office, a control circuit for said signal relay including a reverse contact of said lever, said line wires and a front contact of said control relay, an indication circuit controlled by said signal relay, including a back contact of said control relay and said line wires, for controlling said indication relay, and means for completing said indication circuit in response to the return of said lever to its normal position comprising a normal contact of said lever.

8. In combination, an office and a station connected by line wires, a manually operable lever and an indication relay at said office, a control relay at said station governed in accordance with the position of said lever, a movable device at said station, a control circuit including a reverse contact of said lever, said line wires, and a front contact of said control relay for selectively controlling said movable device, an indication circuit including a back contact of said control relay, said line wires and said indication relay for selectively indicating the condition of said movable device, and means for completing said indication circuit in response to the return of said lever to its normal position comprising a normal contact of said lever.

9. In combination, an office and a station connected by line wires, a manually operable lever and an indication relay at said office, a control relay and a movable device at said station, a control circuit including a reverse contact of said lever, said line wires, and a front contact of said control relay, an indication circuit including a back contact of said control relay, said line wires and a normal contact of said lever, means at the office for supplying current periodically varied at a low frequency to said control circuit when said lever is reversed, means at the station for supplying current periodically varied at the same low frequency to said indication circuit when said movable device occupies a given position, means controlled over said control line circuit including selective circuit elements tuned to electrical resonance at said low frequency for selectively controlling said movable device, means controlled over said indication line circuit including other selective circuit elements tuned to electrical resonance at said low frequency for controlling said indication relay, and means for operating said control relay in accordance with the position of said lever.

10. In combination, an office and a station connected by line wires, a manually operable lever and an indication relay at said office, a control relay and a movable device at said station, means at the office and station for delivering spaced impulses of alternately opposite polarity to said line wires, polar relays at the office and station operable alternately between two positions in response to such impulses and held magnetically in their last operated positions between impulses, a control circuit for transmitting said impulses from the office to the station including a reverse contact of said lever, said line wires, a front contact of said control relay and the polar relay at said station, means effective when the polar relay at said station is operated repeatedly by impulses received over said control circuit for controlling said movable device, an indication circuit for transmitting said impulses from the station to the office including a back contact of said control relay, a normal contact of said lever and the polar relay at said office, means effective when the office polar relay is operated repeatedly by impulses received over said indication circuit for controlling said indication relay, and means for operating said control relay in accordance with the position of said lever.

11. In combination, an office and a station connected by line wires, a detector section of railway track at said station, a manually operable lever at said office, a stick track relay normally held energized over its own front contact and the track rails of said section, a signal for governing traffic movements into said section, a signal relay and a signal control relay, a circuit for clearing said signal including front contacts of said signal relay and said track relay, a line circuit for maintaining said signal relay energized including a reverse contact of said lever, said line wires and a front contact of said signal control relay, a pick-up circuit for said track relay including a back contact of said signal control relay and the track rails of said section, and line controlled means for energizing said signal control relay in response to a movement of said lever to its reverse position and for releasing said signal control relay in response to a movement of said lever to its normal position.

12. In combination, an office and a station, a detector section of railway track at said station, a manually operable lever at said office, a stick track relay normally held energized over its own front contact and the track rails of said section, a signal for governing traffic movements into said section, a signal relay and a signal control relay, a circuit for clearing said signal including front contacts of said signal relay and said track relay, a direct wire line circuit for maintaining said signal relay energized including a reverse contact of said lever and a front contact of said signal control relay, a pick-up circuit for said track relay including a back contact of said signal control relay and the track rails of said section, a second line circuit for controlling said signal control relay in accordance with the position of said lever, and means including a front contact of said signal relay for maintaining said signal control relay energized when said first line circuit is energized irrespective of the condition of said second line circuit.

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