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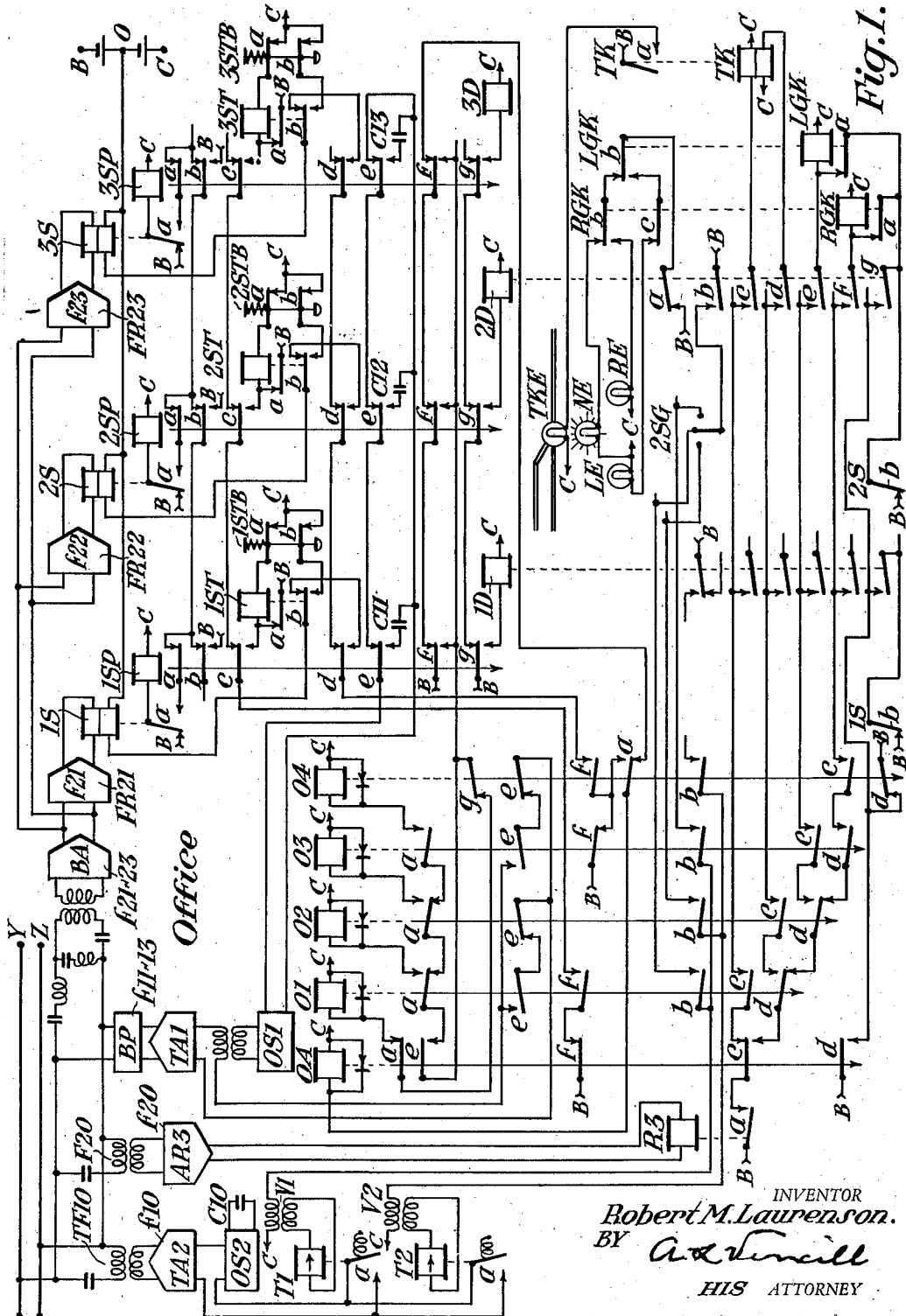
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2,394,080

REMOTE CONTROL SYSTEM

Filed June 10, 1944

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

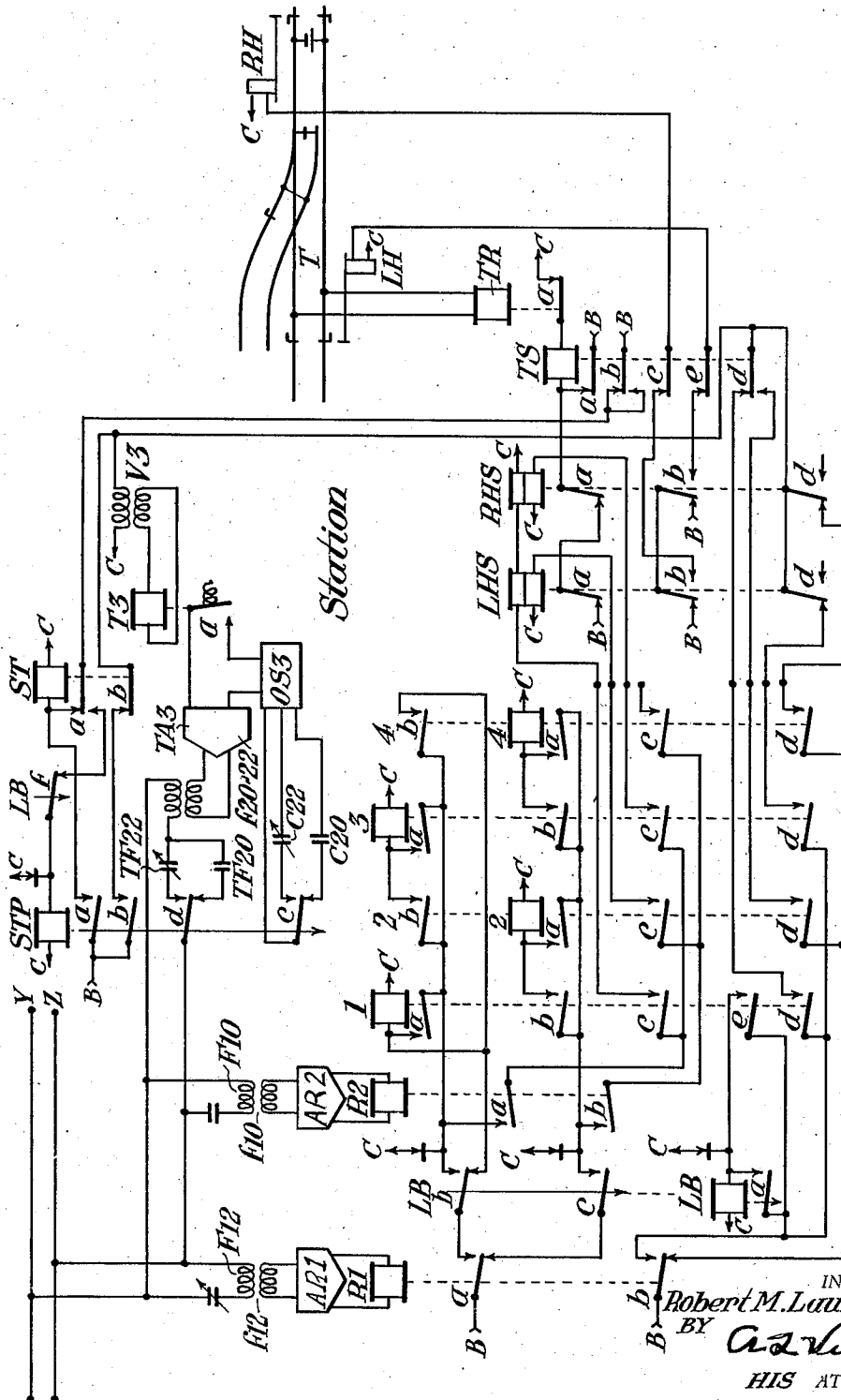


Fig. 2.

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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 and other traffic controlling devices from a central point such as a train dispatcher's office, and for the indication of such devices or for reporting train movements at the control office.

One object of my invention is the provision of a code system for communication between the control office and a plurality of field stations employing codes which comprise series of impulses of alternating currents, the frequency of which is in a range suitable for transmission over existing railroad communication circuits without interfering with their use for other purposes.

My invention includes the provision of coding units comprising chains of counting relays located at the office and at each station for counting the successive steps of a code, together with an operator's control board at the office having a plurality of individual panels each containing the control levers and indication lamps for a particular station, together with a group of individual selecting and indication relays and a starting push button by means of which the delivery of a code to such station is manually initiated.

Two oscillators or generators of high frequency currents are provided at the office, one of which serves to select the stations and may be adjusted to deliver different frequencies to which the coding units at different stations are selectively responsive, while the other oscillator is arranged to deliver a fixed frequency to which control apparatus at any station selected by its assigned frequency is responsive. Each station is provided with an oscillator adapted to deliver either of two frequencies, one of which is fixed at a value to which indication apparatus at the office is responsive, while the other varies from station to station and serves for station identification at the office. Each of the codes usually involves three frequencies and comprises a series of impulses of a station selecting frequency which operate counting relays at a particular station to establish two series of channels sequentially over which impulses of two other frequencies are transmitted for control and indication purposes.

One feature of my invention resides in a novel arrangement of the selecting relays for the different control panels whereby the different codes are initiated one at a time in order without interference. This is accomplished in such a manner that a second code cannot be transmitted to any station as long as another station has a code

stored for transmission. The codes are initiated either manually by the operation of starting push buttons at the office, or automatically in response to identifying impulses received from the stations; but in either case the selection of a particular code for transmission is effected by the operation of a novel system of selecting relays located at the office and interlocked locally so as to prevent interference independently of line conditions.

Other objects, features and purposes of my invention will be hereinafter pointed out.

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

Referring to the accompanying drawings, Figs. 1 and 2 taken together show one form of remote control system embodying my invention, Fig. 1 showing the office apparatus for the transmission of codes of four steps each to three or more stations, together with the individual control panel for a station No. 2 in its entirety and portions of the control panels for two other stations Nos. 1 and 3 in order to illustrate the mode of operation of the circuits for interlocking the panels. Fig. 2 shows the apparatus at a typical field station. Similar apparatus, differing only as to the frequencies used for station selection and identification, is provided at each of the stations.

The alternating currents which form the codes used in the system of my invention are transmitted between the office and stations over a pair of line wires Y and Z which extend from the office through each station in turn. The office and the several stations may be connected to the line wires in any desired order.

Similar reference characters refer to similar parts in both views.

Although the system of my invention is readily applicable to any situation where a centralized traffic control system may be advantageously used, I have chosen for illustration a relatively simple application, comprising the control of successive pairs of manual block signals LH and RH, as shown in Fig. 2, located at spaced points along a stretch of railway track. The system as shown is also arranged to indicate at the office the positions of pairs of polar stick control relays LHS and RHS provided for the control of the signals, and to also report the passage of trains through short detector track sections T at the signal locations. The office panel for each station includes a three-position signal lever such as the lever 2SG, Fig. 1, operable to a right-hand and a left-hand reverse position to effect the operation of

the corresponding signal control relay RHS or LHS to its reverse position, and to its normal center position to restore these relays manually to their normal positions.

Each detector track section T is provided with the usual normally energized track circuit having a track relay TR, and each track relay TR controls a stick repeating relay TS, arranged in a well-known manner so that each train movement past a clear signal restores it to stop and requires the return of the signal control relay to normal by lever operation before the signal can be again cleared.

To simplify the drawings I have shown the various circuits as extending only to the terminals of the local sources of current, these being identified by the references B and C, respectively. Relay TS, for example, has a pick-up circuit extending from one terminal B of the local source of current at the station over the normal contacts *a* of relays LHS and RHS, through the winding of relay TS and over front contact *a* of the track relay TR to the other terminal C of the same source. When relay LHS or RHS is reversed, the closing of its right-hand contact *b* completes a circuit over front contact *c* or *e* of relay TS for clearing the corresponding signal LH or RH. Relay TS is held energized over a stick circuit extending to terminal B over its own front contact *a* until a train enters the detector section to release relay TR, whereupon the signal is put to stop due to the release of relay TS by relay TR.

As shown in Fig. 1, a group of indication stick relays TK, LGK and RGK is provided for each panel, which relays are controlled by code impulses as determined by the positions of relays TS, LHS and RHS at the corresponding station. These indication relays control a group of signal indication lamps LE, NE and RE associated with the corresponding signal lever and also control a lamp TKE located in the corresponding portion of a miniature track diagram of the controlled territory.

Each office panel is provided with a starting push button such as the button 2STB which controls a normally energized starting relay such as the relay 2ST, by means of which a code may be manually initiated for delivery to the corresponding station. The selection of a particular panel is governed by groups of serially interlocked relays shown in the upper right-hand portion of Fig. 1. Each such group includes a selector relay such as the relay 2S, which is of the stick polar type and may be operated locally to reverse either by releasing the associated starting relay or by the transmission of a station identifying impulse of a distinctive frequency from the associated station.

Each selector relay S controls a normally energized repeating relay, such as the relay 2SP, the release of which is adapted to effect the energization of a delivery relay such as the relay 2D, by means of which the corresponding signal lever and group of indication relays are selectively associated with the line circuit, one panel at a time.

Although the system may readily be modified to employ codes having any desired number of steps, as shown, it is arranged to use codes having four steps only, since these are sufficient to illustrate my invention. The code steps are formed by the transmission of a series of stepping impulses generated by an oscillator OS1 and delivered by stepping means comprising a chain of counting relays O1 to O4, inclusive. These re-

lays are made slow to release by the connection of electronic rectifiers across their terminals, as shown, and serve both to count the impulses and to time them at a suitable rate. An auxiliary relay OA serves to initiate the operation of the counting relays and to time the intervals between successive codes. Oscillator OS1 is adjustably arranged to generate any one of a plurality of related frequencies, identified as *f*11, *f*12, *f*13, etc., by connecting tuning condensers such as C11, C12, C13, etc. thereto over back contacts *e* of different relays SP. Relay OA is normally energized over a circuit extending from terminal B at front contact *f* of relay 1SP over front contacts *f* of all the SP relays in series and over back contact *a* of relay O4 through relay OA to terminal C. If relay 2SP, for example, becomes released, the circuit for relay OA is opened and prior to its release a circuit is closed from terminal B over back contact *f* of relay 2SP, back contact *g* of relay O4 and front contact *a* of relay OA through relay O1 to terminal C, over which relay O1 is picked up to begin the first code step. Contact *e* of relay O1 then connects oscillator OS1 to the line wires Y and Z through a suitable band pass filter BP and transmitting amplifier TA1 to impress current of the frequency generated thereby on the line wires Y and Z. Since condenser C12 is connected to oscillator OS1 over back contact *e* of relay 2SP, this current is of the frequency *f*12 in the case described. Relay OA releases after a suitable period, opening the circuit for relay O1 and closing a circuit at its back contact *e* including front contact *a* of relay O1 over which relay O2 is picked up to begin the second code step. Contact *e* of relay O2 opens and disconnects the oscillator OS1 from the line to terminate the transmission of the impulse of frequency *f*12. Relay O1 then releases in turn, opening the circuit for relay O2 and completing one for relay O3 over back contact *a* of relay O1 and front contact *a* of relay O2, thereby causing relay O3 to pick up. The closing of front contact *e* of relay O3 causes oscillator OS1 to deliver current of frequency *f*12 to the line again, corresponding to the third code step. Relay O2 in its turn releases to pick up relay O4, which terminates the transmission of current of frequency *f*12, thereby beginning the fourth step. The code steps thus comprise alternate periods of energization and deenergization of the line circuit by current of a selected frequency. During these four steps four control channels may be sequentially established over contacts *b* of relays O1 to O4, for the transmission of control impulses of a given frequency *f*10, and at the same time, four indication channels are established over contacts *c* and *d* of these relays over which the indication relays are controlled in response to received impulses of a second given frequency *f*20.

In the foregoing it has been assumed that the repeating relay 2SP is the only one released. The delivery relay 2D in this case is energized over back contact *g* of relay 2SP, and if lever 2SG is in its normal position as shown, a circuit is closed on the first step of the code from terminal B at contact *b* of relay 2D and the center contact of lever 2SG over contact *b* of relay O1 through the primary winding of an impulse transformer V1 to terminal C. A transmitter relay T1 of the biased polar type, is connected across the secondary winding of transformer V1 and operates in response to the current induced therein to close its contact *a* for a brief period, corresponding to the central portion of the code step,

and connects oscillator OS2 through a selective filter TF10 and a transmitting amplifier TA2 to the line wires Y and Z. Oscillator OS2 is adapted to generate a particular frequency f_{10} , as determined by a fixed timing condenser C10. It will be seen that a control impulse of frequency f_{10} is impressed upon the line during the first or third step of the code provided a circuit is completed over contact b of relay O1 or O3. Relay T2 and transformer V2 provide means similar to that just described whereby an impulse of frequency f_{10} may be impressed on the line during the second or fourth step of the code provided a circuit is completed over contact b of relay O2 or O4, that is to say, relay T1 functions during the odd-numbered steps and relay T2 during the even-numbered steps.

The receiving portion of the office coding unit includes a line relay R3 which is connected across the line wires Y and Z through a filter F20 and amplifier and rectifier AR3 by which relay R3 is rendered selectively responsive to line current of a particular frequency f_{20} only, to establish four indication channels over contacts c and d of relays O1-O4 for the control of the indication relays K of a selected panel. The receiving portion also includes an amplifier and band pass filter BA arranged to pass a band of received frequencies f_{21} - f_{23} and to the output circuit of which connections extend as shown through filtering and rectifying devices FR21, FR22, FR23, etc., to the upper windings of the polar stick selecting relays 1S, 2S, 3S, etc., by means of which each such relay may be selectively operated to its reverse position when a station identifying impulse of a particular frequency f_{21} , f_{22} , f_{23} , etc. is received over the line, to thereby initiate the delivery of a code to the station at which such impulse originated.

The receiving portion of the station apparatus, Fig. 2, includes two line relays R1 and R2 similar to relay R3, but connected across the line wires through selective filters F12 and F10 and the amplifier-rectifier units AR1 and AR2. The filters interposed in the connection of relays R1 at the different stations are adjusted to different frequencies f_{11} , f_{12} , f_{13} , etc. It is assumed that the station of Fig. 2 is the one having the office panel including relay 2D which employs the station selecting frequency f_{12} and the station identifying frequency f_{22} , and the filter interposed in the circuit for relay R1 is accordingly designated F12. Relay R2, on the other hand, is arranged at each station to respond to the same control frequency f_{10} .

In response to the operation of the office counting relays O1-O4, relay R1 responds at one station only to operate stepping means comprising a chain of counting relays 1 to 4, governed by a slow release relay LB, which counting relays operate one at a time substantially in unison with the corresponding office counting relays to establish control channels sequentially over their contacts c whereby the polar stick relays LHS and RHS are rendered responsive to the operation of relay R2 by impulses of frequency f_{10} on the corresponding steps of the code.

The transmitting apparatus at each station is generally similar to that associated with the office relay T1, and comprises a biased polar relay T3 connected to the secondary winding of an impulse transformer V3 the primary winding of which is controlled over contact b of relay R1 and contacts d of the counting relays 1 to 4, and of the relays LHS, RHS and TS, the positions

of which are to be indicated. An oscillator OS3 controlled by a tuned circuit including condenser C20 is normally adjusted to deliver current of the indication frequency f_{20} , an impulse of which frequency is supplied to the line through a transmitting amplifier TA3 and a selective filter F20 when relay T3 is energized on any step. Whereas at the office two relays T1 and T2 are required, only one relay T3 is needed at the station, relay T3 being operable on successive steps because the circuit for transformer V3 is interrupted by contact b of relay R1 at the end of each step.

The station apparatus also includes a starting relay ST and a slow release repeating relay STP by means of which the frequency delivered by oscillator OS3 may be changed at times in order to deliver a station identifying impulse of a characteristic frequency to the line for transmission to the office to initiate the operation of the system in response to a change in conditions at the station.

The starting relay ST is normally energized in a well-known manner over a stick circuit including its own front contact a and either a front or a back contact of each relay by which the operation of the system is to be initiated, these including only the front and back contacts b of relay TS in the arrangement shown, whereby relay ST is adapted to be released in response to a change in the position of relay TS. Relay ST upon releasing completes a circuit from terminal B at contact b of relay TS over its own back contact a and back contact f of relay LB through relay STP to terminal C. Relay STP is thereby energized and shifts the connections for oscillator OS3 at its contact c and d to replace the tuning condenser C20 by a different condenser C22 and to replace the transmitting filter TF20 by filter TF22, and thereby conditions the oscillator OS3 to generate and deliver to the line wires Y and Z current of a characteristic station identifying frequency f_{22} instead of the indication frequency f_{20} . When relay STP becomes energized, relay ST picks up over contact a of relay STP to reestablish its stick circuit and to open the circuit for relay STP, completing a circuit momentarily from terminal B over contacts b of relays STP and ST through the primary of transformer V3 to terminal C to cause relay T3 to close its contact a momentarily to supply an impulse of frequency f_{22} to the line, which impulse, as already mentioned, is selectively received at the office through the filter rectifier FR22, and reverses the selecting relay 2S of the corresponding panel.

It will be understood that the apparatus at each station is arranged to deliver a different frequency f_{21} , f_{22} , f_{23} , etc. to the line when relay STP is picked up, but that all deliver the same frequency f_{20} if relay T3 is operated when relay STP is released.

The slow release relay LB by which the counting relays 1 to 4 are controlled is arranged to be picked up for the duration of each code received at the corresponding station, but remains released while codes are being delivered to other stations. Relay ST is therefore free to deliver its identifying impulse to the line at any time except when a code is being received. If relay ST releases due to a change occurring while a code is being received, relays ST and STP are held released by relay LB and transmit the identifying impulse following the release of relay LB at the end of such code. This initiates a second code and insures that any change occurring during the

transmission of the preceding code will be correctly indicated at the office even though the change occurs after the corresponding code step is transmitted.

Having thus described the different components of the system of my invention, I shall now explain its operation under different assumed conditions.

I shall first assume that with the apparatus in its normal condition as shown, the operator wishes to clear signal 2HR at station No. 2 and accordingly moves lever 2SG to the right and presses the starting button 2STB.

When button 2STB is pressed, relay 2ST releases due to the opening of its stick circuit at the button contact *a*, and when button 2STB is released, a circuit is completed from the middle terminal O of the office source of current through the lower winding of relay 2S from right to left and over contacts *b* of relay 2ST and button 2STB to the negative terminal C of the source, thereby reversing relay 2S. Under the conditions assumed, the indication relays RGK and LGK are both energized over stick circuits extending to terminal B over the normal contact *b* of relay 2S, and the stop indication lamp NE is lighted over the front contacts *b* of relays RGK and LGK and back contact *a* of relay 2D. The reversal of relays 2S therefore releases relays RGK and LGK and extinguishes lamp NE, the panel lights remaining dark until new indications are received. The opening of the normal contact *a* of relay 2S deenergizes relay 2SP, provided all similar relays at the right, such as relay 3SP, are picked up. Relay 2SP releases after a brief period and connects terminal B at its back contact *b* to the front contacts *a* and *b* of relay 1SP and thereby prepares circuits by which the release of any similar relay at the left of relay 2SP is prevented in the event the corresponding selector relay such as the relay 1S becomes reversed. It follows that with relay 2SP or 3SP released, relay 1SP is maintained energized regardless of the position of relay 1S. A circuit is now closed from terminal B at front contact *g* of relay 1SP over back contact *g* of relay 2SP through the delivery relay 2D to terminal C, and relay 2D picks up, all other relays D being held released. A tuning circuit is now completed for oscillator OS1 over front contact *e* of relay 1SP and back contact *e* of relay 2SP through condenser C12, other similar condensers such as C11 and C13 being disconnected from oscillator OS1. The dropping of contact *f* of relay 2SP deenergizes relay OA and energizes relay O1, whereupon relay O1 picks up closing its contact *e* to impress an impulse of frequency *f*12 upon the line wires Y and Z as hereinbefore explained.

When relay O1 picks up, and prior to the release of relay OA, the starting relay 2ST is reenergized over a circuit extending from terminal B at contact *f* of relay OA over contact *f* of relay O1, front contact *c* of relay 1SP, back contact *c* of relay 2SP through relay 2ST to terminal C at contact *a* of the starting button 2STB, relay 1ST completing a stick circuit by closing its own front contact *a*.

At the selected station relay R1 of Fig. 2 picks up in response to the impulse of frequency *f*12 and completes a circuit at its front contact *a* over back contact *b* of relay LB through relay 1 to terminal C, over which relay 1 picks up. Relay 1 by closing its front contact *e* completes a pick-up circuit for relay LB over contact *b* of relay R1, and relay LB becomes energized com-

pleting a stick circuit at its own front contact *a*. Relay LB maintains relay 1 energized over a stick circuit including front contacts *a* of relays R1 and 1 and front contact *b* of relay LB. The closing of front contact *d* of relay 1 completes a circuit over the front contact *d* of relay TS to energize transformer V3 on this step, consequently relay T3 operates to deliver an impulse of frequency *f*20 to the line to which the office line relay R3 of Fig. 1 responds. Relay R3 completes a circuit from terminal B at its front contact *a* over contacts *c* of relays OA and O1, contact *c* of relay 2D through the upper winding of relay TK to terminal C. Relay TK which is of the polar stick type, is thereby energized momentarily in the normal direction as shown.

Relay OA now releases, deenergizing relay O1 and causing relay O2 to pick up. Relay O2 by opening its back contact *e* terminates the first impulse of frequency *f*12. The station line relay R1 of Fig. 2 therefore releases, completing a circuit at its back contact *a* over front contacts *c* of relay LB and contact *d* of relay 1 to pick up relay 2, and opening the stick circuit for relay 1, which relay therefore releases at the beginning of the second step, whereas the corresponding office relay O1 serves as a timing relay and its release marks the end of the second step. Referring now to Fig. 1, when relay O1 releases relay O2 becomes deenergized and relay O3 picks up to begin the third step, and by closing its front contact *e* impresses a second impulse of frequency *f*12 upon the line.

At the selected station, relay R1, Fig. 2, picks up to energize relay 3 and to hold relay LB picked up, relay 2 releasing at the beginning of the third step. The closing of front contact *b* of relay O3, Fig. 1, completes a circuit for transformer VI over the right-hand contact of lever 2SG extending to terminal B at contact *b* of relay 2D, causing relay T1 to supply a control impulse of frequency *f*10 to the line thereby energizing relay R2 at the selected station. As shown in Fig. 2, relay R1 completes a circuit from terminal B at front contact *a* of relay R1 over front contact *b* of relay LB, contact *a* of relay R2 and contact *c* of relay 3 through the lower winding of relay RHS to terminal C to operate relay RHS to reverse. The closing of front contact *d* of relay 3 at the selected station completes a circuit over contact *d* of relay LHS to energize transformer V3 causing relay T3 to supply an impulse of frequency *f*20 to the line thereby energizing relay R3 in Fig. 1 to complete a circuit from terminal B at its contact *a* over back contacts *c* and *d* of relays OA and O1, front contact *d* of relay O2, contact *c* of relay O3, contact *e* of relay 2D through relay LGK to terminal C. Relay LGK therefore picks up, and completes a temporary stick circuit at its contact *a* over contact *g* of relay 2D extending to terminal B over back contacts *d* of relays O4 and OA in multiple.

When relay O2 releases, relay O3 becomes deenergized and relay O4 picks up to begin the fourth step opening its contact *e* to terminate the impulse of frequency *f*12. Relay R1, Fig. 2, releases to pick up relay 4, releasing relay 3 and deenergizing relay LB. In the code being described the control and indication channels remain open on this step. When relay O3, Fig. 1, releases to terminate the step circuits are closed from terminal B at its back contact *f* over front contact *a* of relay O4 to pick up relay OA and over front contact *f* of relay O4, front contact

d of relay 1SP, back contact *d* of relay 2SP, front contact *b* of relay 2ST through the lower winding of relay 2S to terminal O, restoring relay 2S to normal. The closing of the left-hand contacts *a* and *b* of relay 2S reenergizes relay 2SP and establishes the normal stick circuit for relay 2LKG. Relay 2SP picks up and by opening its back contact *g* releases relay 2D to disconnect lever 2SG and the associated indication relays from the counting relays and to complete a circuit at contact *a* of relay 2D to light lamp 2RE.

Relay O4 now releases and the dropping of its contact *a* shifts the circuit for relay OA to the branch including the front contacts *f* of the relays SP. If all of these relays are picked up, relay OA remains energized and the office apparatus remains in its normal condition as shown until the next code is initiated. At the selected station relays LB and 4 of Fig. 2 release in turn, completing the restoration of the system to its normal at rest condition.

If at this time one of the relays SP of Fig. 1 is in its released position, relay OA becomes de-energized when relay O4 releases, and relay O1 becomes energized over back contact *g* of relay O4 and front contact *a* of relay OA to deliver the first impulse of a second code to the line wires Y and Z. If this is delivered to a different station, the successive operations of relays R1, LB and 1 of Fig. 2 will be similar to those already described, but if it is delivered to the same station as the preceding code, relay R1 may pick up before relay LB releases, in which case relay 4 will be in its energized position and relay 1 will pick up over the front contact *b* of relay 4.

I shall next assume that a train moving toward the right passes signal RH of Fig. 2 at clear releasing relay TR, which relay in turn releases relay TS. Relay TS releases relay ST, thereby energizing relay STP and causing relay T3 to deliver an impulse of frequency *f*22 to the line to selectively reverse relay 2S of Fig. 1. Relay 2S releases relay 2SP to initiate the transmission of a code similar to the one already described, except that the starting relay 2ST has not been released, and the indication impulse of frequency *f*20 by which relay R3 is operated is delivered on the second step instead of on the first due to the fact that relay TS is now in its released position. This impulse is supplied to the lower winding of relay TK by relay R3 causing relay TK to reverse and lamp TKE to become lighted. The signal indication lamps are extinguished for the duration of the code as in the preceding example.

I shall next assume that the operator restores lever 2SG to normal and operates button 2STB to initiate a code in which an impulse of frequency *f*10 is supplied on the first step restoring relay RHS to normal. The indication relays LKG and RKG in this case are picked up by the impulses received on the third and fourth steps, lighting lamp NE. When the train vacates the detector section to pick up relay TR, Fig. 2, relay TS picks up over the normal contacts *a* of relays LHS and RHS and initiates a code including an indication impulse on the first step which restores relay TK of Fig. 1 to normal, extinguishing lamp TKE.

The operations involved in the control of signal LH are similar to those for signal RH and a description of these is deemed unnecessary.

Considering next the arrangements for preventing interference, it has already been pointed

out that a station can deliver its identifying impulse of a frequency in the band *f*21—*f*23 either when the system is at rest or when a code is being delivered to another station. If relay ST of Fig. 2 at any station becomes released while a code is being received at that station, relays ST and STP are held released as long as relay LB remains picked up so that the station identifying impulse is stored for delivery following the release of relay LB at the end of the code.

The office starting buttons STB, Fig. 1, are free to be operated at any time. The release of any of the selector repeating relays such as relay 2SP prevents the release of those at the left, but any relay SP at the right of one which is released is free to release while the system is in operation. This however causes no interference because the release of any relay SP interrupts the circuits controlled by the similar relays at its right.

Assuming for example that relays 1S and 3S reverse during the transmission of a code initiated in response to the release of relay 2SP by relay 2S as hereinbefore described. Relay 3SP releases but relay 1SP is held energized over the reverse contact *a* of relay 1S, its own front contact *a* and back contact *b* of relay 2SP. When relay 2SP picks up following the restoration of relay 2S to normal at the end of the code, relay 1SP is maintained energized over front contact *b* of relay 2SP and back contact *b* of relay 3SP, and relay 3D becomes energized to deliver the second code. If relay 2S reverses again, relay 2SP is held energized over a branch of the circuit by which relay 1SP is held energized and these relays will release together at the end of the second code. Relay 1SP then completes a circuit for relay 1D and opens the circuit for relay 2D. It follows that the third code will be delivered by relay 1D after which relay 1SP is reenergized so that the fourth code will be delivered by relay 2D. It will be clear that if relay 3SP releases again during the transmission of the third or fourth codes, the fifth code will be delivered by relay 3D. It will be seen, therefore, that in the event that changes in traffic conditions occur so frequently as to cause continuous operation of the system, the codes are transmitted in a fixed order and a second code cannot be transmitted to any station as long as one is stored for transmission to another station and the delivery relays D operate one at a time in sequence through repeated cycles.

The system operates similarly in respect to the order of transmission of codes initiated by operation of the office starting buttons, with one exception. It may happen that a starting button such as 2STB is operated while a code is being delivered to the corresponding station thereby releasing relay 2ST, and preventing the restoration of relay 2S to normal when relay O4 picks up on the last step and causing the indication relays LKG and RKG to be released by the opening of contact *d* of relay OA when relay OA picks up on the last step. Relay 2SP remains released, holding relay 2D energized and relay OA becomes deenergized when relay O4 releases at the end of the code, thereby causing the counting relays to operate through a second cycle to deliver a second code from the same panel. This insures that if lever 2SG and button 2STB are operated during transmission of a code from the corresponding panel, a second code including control impulses corresponding to the last operated posi-

tion of lever 2SG will be transmitted in its entirety.

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 plurality of stations connected by line wires, a plurality of chains of counting relays including one at the office and one at each station the relays of each chain being operable one at a time in a given order, a series of control relays at each station, a plurality of manually operable lever contacts at the office including one for each control relay, a plurality of station selecting relays at the office including one for each station, means including contacts of corresponding counting relays at the office and at a selected station for establishing a series of control channels each such channel including said line wires and selective circuit elements rendering the channel effective for the transmission of alternating current of a given frequency only, means controlled by each station selecting relay for initiating the operation of the office counting relays and for transmitting impulses of alternating current of a distinctive frequency over said line wires, means selectively controlled by the impulses of said distinctive frequency for operating the counting relays at the selected station only to sequentially establish said control channels, and means governed by said lever contacts for supplying alternating current of said given frequency to selected ones of said channels to operate the corresponding control relays.

2. In a remote control system, an office and a plurality of stations connected by line wires, a plurality of chains of counting relays including one at the office and one at each station the relays of each chain being operable one at a time in a given order, a series of control relays at each station, a plurality of manually operable lever contacts at the office including one for each control relay, a plurality of station selecting relays at the office including one for each station, means including contacts of corresponding counting relays at the office and at a selected station for establishing a series of control channels each such channel including said line wires and selective circuit elements rendering the channel effective for the transmission of alternating current of a given frequency only, means controlled by each station selecting relay for initiating the operation of the office counting relays, means controlled by the office counting relays for transmitting impulses over said line wires of alternating current of a distinctive frequency characteristic of a particular selector relay, means selectively controlled by the impulses of said distinctive frequency for operating the counting relays at the corresponding station only to sequentially establish said control channels, means governed by said lever contacts for supplying alternating current of said given frequency to selected ones of said channels to operate the corresponding control relays, means rendering said selector relays effective only one at a time to determine the frequency of the impulses for operating the station counting relays, and means for operating each selector relay.

3. In a remote control system, an office and a plurality of stations connected by line wires, a plurality of chains of counting relays including one at the office and one at each station the relays of each chain being operable one at a time in a given order, a plurality of selector relays at the office including one for each station, a series of indication relays at the office for each station, means including contacts of each selector relay for establishing a series of indication channels for the control of the associated series of indication relays one at a time in response to the operation of corresponding counting relays at the office and at the selected station each such channel including said line wires and selective circuit elements rendering the channel effective for the transmission of alternating current of a given frequency only, means controlled by each station selecting relay for initiating the operation of the office counting relays and for transmitting impulses of alternating current over said line wires of a different frequency characteristic of a particular selector relay, means selectively controlled by the impulses of said different frequency for operating the counting relays at the corresponding station only to sequentially establish said indication channels, means at such station for supplying alternating current of said given frequency to selected ones of said channels to operate the corresponding indication relays, means rendering said selector relays effective only one at a time to determine the frequency of the impulses which operate the station counting relays, and means at each station for at times supplying an impulse of alternating current of a distinctive station identifying frequency to the line wires to operate the corresponding selector relay.

4. In a remote control system, an office and a plurality of stations connected by line wires, a series of selector relays at the office including one for each station each selectively responsive to impulses of a different frequency transmitted over said line wires, means at each station for at times transmitting an impulse over the line wires of the frequency to which the corresponding selector relay is responsive to selectively operate such relay, step-by-step means set into operation when any selector relay is operated for establishing a series of indication channels sequentially between the office and the corresponding station only, means at each station for transmitting indication impulses of a distinctive frequency over said channels when established, a plurality of groups of indication relays at the office, and means controlled by the operated selector relay for selecting a particular group of indication relays for operation in accordance with that series of said indication impulses which are transmitted from the corresponding station.

5. In a remote control system, an office and a plurality of stations connected by line wires, a series of groups of relays at the office including one group for each station each group including a selector relay of the stick polar type, a repeating relay and a delivery relay, an energizing circuit for each repeating relay including a normally closed contact of the associated selector relay, a stick circuit for the repeating relay of each group except the last of the series closed upon the reversal of the associated selector relay provided the repeating relay of any succeeding group is released, an energizing circuit for each delivery relay including a back contact of the associated repeating relay the circuit for the delivery relay of each group except the first also

including front contacts of the repeating relays of the preceding groups of the series, and means set into operation upon the release of any one of said repeating relays for establishing a series of channels selected by the associated delivery relay for communicating between the office and the corresponding station over said line wires.

6. In a remote control system, an office and a plurality of stations connected by line wires, a series of groups of relays at the office including one group for each station each group including a selector relay of the stick polar type, a repeating relay and a delivery relay, an energizing circuit for each repeating relay including a normally closed contact of the associated selector relay, a stick circuit for the repeating relay of each group except the last of the series closed upon the reversal of the associated selector relay provided the repeating relay of any succeeding group is released, an energizing circuit for each delivery relay including a back contact of the associated repeating relay the circuit for the delivery relay of each group except the first also including front contacts of the repeating relays of the preceding groups of the series, starting means for each group for reversing the selector relay of such group, means set into operation upon the release of the repeating relay of any group by its selector relay for transmitting a distinctive series of impulses over said line wires to the corresponding station, means controlled by said impulses for establishing communication channels between the office and such station over contacts of the operated delivery relay, and means for restoring each selector relay to normal in response to the transmission of a predetermined number of impulses.

7. In a remote control system, an office and a plurality of stations connected by line wires, a series of groups of relays at the office including one group for each station each group including a selector relay of the stick polar type, a repeating relay and a delivery relay, an energizing circuit for each repeating relay including a normally closed contact of the associated selector relay, a stick circuit for the repeating relay of each group except the last of the series closed upon the reversal of the associated selector relay provided the repeating relay of any succeeding group is released, an energizing circuit for each delivery relay including a back contact of the associated repeating relay the circuit for the delivery relay of each group except the first also including front contacts of the repeating relays of the preceding groups of the series, starting means at each station adapted to transmit a station identifying impulse of distinctive character over said line wires to reverse the selector relay of the corresponding group, means set into operation upon the release of any repeating relay for transmitting a distinctive series of impulses over said line wires to the corresponding station, means controlled by said impulses for establishing communication channels between the office and such station over contacts of the operated delivery relay, and indication means at the office responsive to impulses transmitted over said channels.

8. In a remote control system, an office and a plurality of stations connected by line wires, a series of selector relays at the office each responsive to impulses of a different frequency transmitted over said line wires there being one selector relay for each station, starting means at each station responsive to a change in condi-

tions at such station for operating the selector relay therefor by transmitting a station identifying impulse over said line wires of the frequency to which the selector relay for such station is selectively responsive, step-by-step means set into operation when one or more of said selector relays is operated for establishing a series of indication channels sequentially between the office and the corresponding stations only one station at a time, means at each station for transmitting a series of indication impulses over said channels when established, a plurality of groups of indication relays at the office, means controlled by each operated selector relay for selecting a particular group of indication relays for operation in accordance with the impulses transmitted from the corresponding station, and means for restoring each operated selector relay to its normal position following the transmission of the last impulse of such series.

9. In a remote control system, an office and a plurality of stations connected by line wires, a series of selector relays at the office each responsive to impulses of a different frequency transmitted over said line wires there being one selector relay for each station, starting means at each station responsive to a change in conditions at such station for operating the selector relay therefor by transmitting a station identifying impulse over said line wires of the frequency to which the selector relay for such station is selectively responsive, step-by-step means set into operation when one or more of said selector relays is operated for establishing a series of indication channels sequentially between the office and the corresponding stations only one station at a time, means at each station for transmitting a series of indication impulses over said channels when established, a plurality of groups of indication relays at the office, means controlled by each operated selector relay for selecting a particular group of indication relays for operation in accordance with the impulses transmitted from the corresponding station, means for restoring each operated selector relay to its normal position following the transmission of the last impulse of such series, and means at each station for delaying the transmission of a second station identifying impulse over said line wires due to a change in conditions at such station occurring during the transmission of indication impulses from such station until the selector relay responsive thereto has been restored to its normal position.

10. In a remote control system, an office and a plurality of stations connected by line wires, a series of selector relays at the office each responsive to impulses of a different frequency transmitted over said line wires there being one selector relay for each station, starting means at each station responsive to a change in conditions at such station for operating the selector relay therefor by transmitting a station identifying impulse over said line wires of the frequency to which the selector relay for such station is selectively responsive, a series of repeating relays at the office including one for each selector relay, step-by-step means controlled by each repeating relay when actuated for establishing a series of communication channels between the office and the corresponding station only over said line wires, means for actuating each repeating relay in response to the operation of its selector relay arranged to render said repeating

relays effective only one at a time in a fixed order when a plurality of said selector relays are operated, means for transmitting impulses between the office and the selected station over said communication channels when established, and means for registering such impulses.

11. In a remote control system, an office and a plurality of stations connected by line wires, stepping means at the office and at each station for establishing two sets of communication channels between the office and stations including said line wires, means comprising selective circuit elements tuned to different frequencies at the different stations for rendering the stepping means at each station responsive only one at a time to impulses of a distinctive frequency received over said line wires, a group of control relays at each station, a plurality of groups of indication relays including one group for each station located at the office, means comprising selective circuit elements for rendering the control relays at a se-

lected station responsive to impulses of a given frequency transmitted over the one set of channels and for rendering a selected group of indication relays responsive to impulses of a second given frequency transmitted over the other set of channels, a selector relay at the office for each station, means controlled by each selector relay when operated for operating the office stepping means to deliver two series of impulses of different frequencies to the line wires including one series effective to operate the stepping means at the corresponding station only to establish said channels and another series effective to operate the control relays at such station over the channels thereby established, and means responsive to the operation of said station stepping means for simultaneously transmitting a series of impulses of said second given frequency to operate the indication relays associated with the operated selector relay over said other set of channels.

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