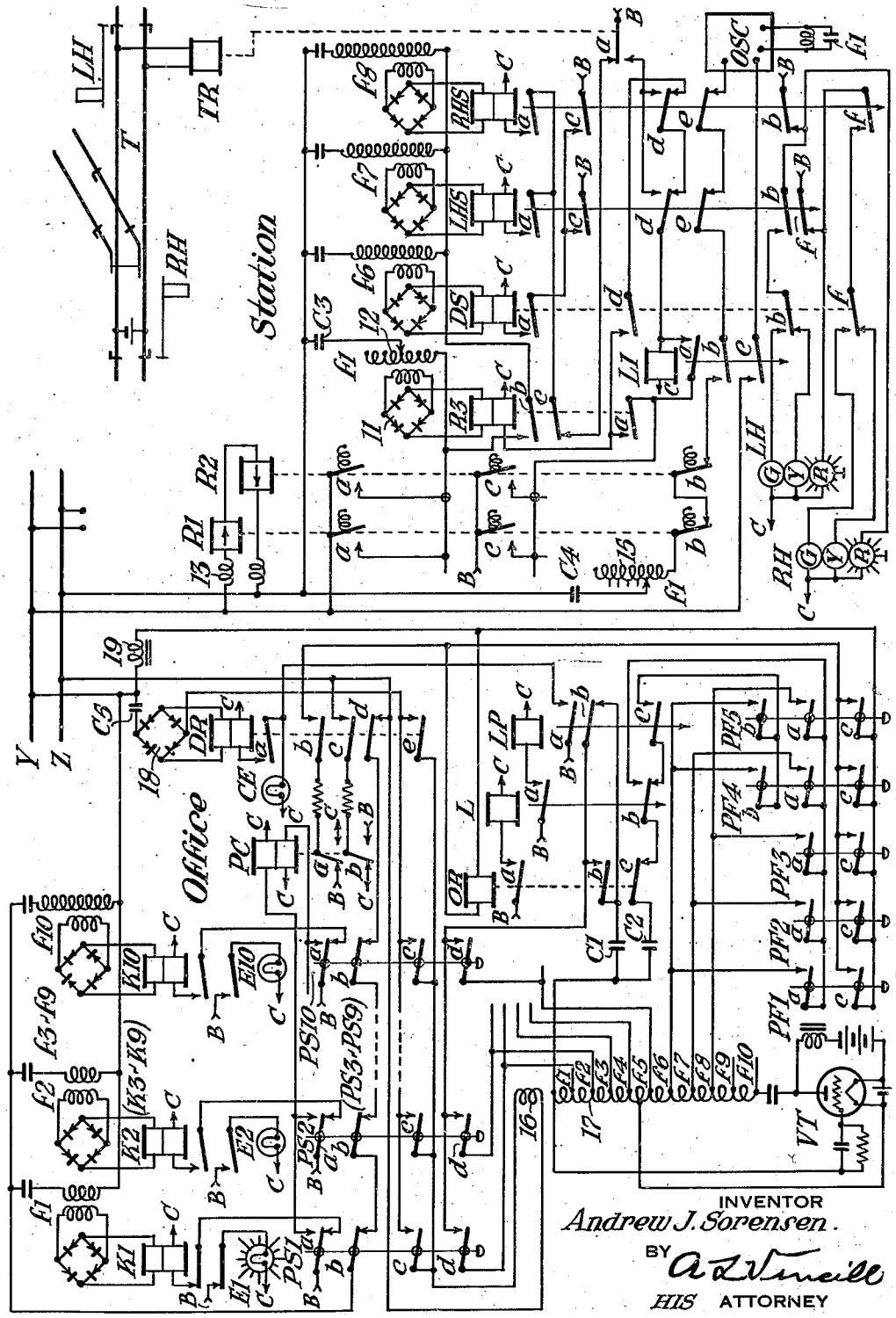
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REMOTE CONTROL SYSTEM

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REMOTE CONTROL SYSTEM

Andrew J. Sorensen, Edgewood, Pa., assignor to The Union Switch & Signal Company, Swissvale, Pa., a corporation of Pennsylvania

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8 Claims. (Cl. 177—353)

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

The transmitting portion of the system of my invention is claimed in my divisional application, Serial No. 561,563, filed November 2, 1944, for Transmitting apparatus for remote control systems.

One object of my invention is the provision of a system suitable for the direct control of unattended manual block signals employing currents of such a character that they may be transmitted at times over existing railroad communication circuits without interfering materially with their use for other communication purposes.

Another object of my invention is the provision of a system for communicating by code between a control office and a plurality of remote stations, in which the codes comprise different sequences of impulses of alternating currents of different frequencies within a band of frequencies preferably in the voice frequency range or at least in a range which is suitable for transmission over existing telephone circuits.

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

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 reference characters Y and Z designate a pair of line wires which it is to be understood provide a telephone circuit extending from a control office at which the apparatus at the left of the drawing is located, through a plurality of stations situated at spaced points along a stretch of railway at each of which stations a pair of manual block signals LH and RH is located, as indicated by the track diagram, each station being provided with apparatus similar to that shown at the right of the drawing, having a connection to the line wires Y and Z as shown. It may be assumed that the stretch is not provided with track circuits except for a short detector section T at each station having a track relay TR for the control of the signals, and for indicating the movements of trains past the stations, and that train movements through the stretch are governed primarily by train orders, supplemented by manual control of the signals.

In its specific embodiment, as shown, the system of my invention provides facilities by which the signals at each of ten stations may be selectively controlled to give proceed, permissive or stop indications by the lighting of the lamps G, Y or R, respectively of the signals LH and RH, in response to the operation of suitable push buttons PS and PF at the control office, and also provides means for lighting selected indication lamps E at the office to indicate when the corresponding signals are at stop, each lamp E being lighted automatically when a train enters the corresponding detector section.

The apparatus provided at each station includes three selector relays R1, R2 and R3, three signal control relays LHS, RHS and DS, and an indication transmitting relay LI. At five of the stations, adjustable connections are made to contacts *a* and *c* of relay R1 to render relay R3 responsive to line signals when relay R1 is energized. At the remaining five stations, the connections are shifted to contacts *a* and *c* of relay R2 to render relay R3 responsive to line signals when relay R2 is energized. Each selector relay R3 is arranged to be energized through a rectifier unit F1, when the unit is supplied with alternating current from a tuned circuit comprising a coil 12 and a condenser C3. Each such tuned circuit is adapted to pass sufficient current to energize the associated relay only when supplied with current of a particular frequency received over the line wires Y and Z. In the system as shown, the control of ten stations is contemplated, and a band of ten frequencies *f1* to *f10* is used, five of which, namely, the frequencies *f1* to *f5*, are employed to select the stations.

In the drawing, the reference characters *f1*, *f2*, etc. indicating the frequency to which each tuned circuit is responsive, are shown adjacent the circuit, the circuit for relay R3, for example, at the station shown, being selectively responsive to the frequency *f6*.

The relays R1 and R2 are direct current relays of the biased polar type which respond selectively to the steady component of the current supplied to the line wires Y and Z, a reactor 13 being interposed in the line connections, relay R1 responding only when line wire Y is positive and relay R2 only when line wire Y is negative, with respect to line wire Z. At each of five stations, relay R3 is arranged to respond to a different one of the frequencies *f1* to *f5* provided relay R1 is picked up, the line connection for the tuned

circuits including contact *a* of relay R1 as shown. At each of the remaining five stations, relay R3 is responsive to a different one of the frequencies *f1* to *f5* provided relay R2 is picked up, its tuned circuit being adjustably connected to contact *a* of relay R2, and it follows therefore that the relay R3 at any one of the ten stations may be selectively energized by a single impulse of pulsating current having one of two polarities and one of five frequencies.

Each relay R3 is provided with a stick circuit extending from the positive terminal B of a local source of direct current at the station over contact *c* of the relay R1 or R2 which controls its pick-up circuit, as indicated diagrammatically on the drawing, over the front contact *a* and lower winding of relay R3 to the negative terminal C of the local source. It follows that relay R3 at a selected station may be held picked up, along with relay R1 or R2, after the alternating current impulse is terminated, provided direct current continues to be supplied to the line. Under these circumstances the tuned circuits for relays DS, LHS and RHS, which are responsive to alternating currents of frequencies *f6*, *f7* and *f8*, respectively, in the same manner as relay R3, are connected to the line over contact *a* of relay R1 or R2 and contact *b* of relay R3, and if a second impulse of frequency *f6*, *f7* or *f8* is supplied to the line, relay DS, LHS or RHS may be energized, while if a second impulse of frequency *f7* or *f8* followed by a third impulse of frequency *f6* is supplied to the line, relay LHS or RHS may be energized and relay DS in addition. Each of the relays LHS and RHS is provided with a stick circuit including its own front contact *a*, a back contact *c* of relay R3 and a front contact *a* of the track relay TR of the detector track section T, consequently if either relay RHS or LHS is energized it may be released manually by operation of relay R3, or automatically by a train entering section T. Relay DS has a stick circuit including its own front contact *a* and front contact *c* of relay LHS or RHS and consequently will be released along with relay LHS or RHS, if energized. Relays LHS and DS jointly control the lamps R, Y and G for signal LH, and relays RHS and DS similarly control those for signal RH in a well-known manner which may be readily ascertained from the drawing.

The station apparatus also includes a source of alternating current of a particular frequency in the band of frequencies *f1* to *f10*, which source as shown may be understood to be an electron tube oscillator OSC similar to the one including the tube VT at the office as hereinafter described. The output circuit of oscillator OSC is adapted to be connected to the line wires Y and Z, at times, in response to the operation of relay L1, to indicate that relays LHS and RHS are released and that the signals are consequently at stop. When relays R1 or R2, R3 and DS are operated, relay LHS or RHS will be released by relay R3, if energized, and relay L1 picks up over the circuit extending from terminal B at contact *c* of relay R1 or R2, front contact *a* of relay R3, front contact *d* of relay DS, back contacts *d* of relays LHS and RHS through relay L1 to terminal C, and is held energized over the stick circuit including its own front contact *a*, and extending to terminal B at contact *c* of relay R1 or R2. When relay L1 is picked up by a control impulse in this manner, its energizing circuit is opened as soon as the line becomes free, as indicated by the release of relay R1 or R2 and if relays LHS and RHS are both in their released positions, an impulse of current of a selected frequency in the band *f1*—*f10* will be supplied to the line wires over back contacts *e* of relays LHS and RHS, front contacts *b* and *c* of relay L1, back contacts *b* of relays R1 and R2, coil 15 and condenser C4, the impulse terminating with the release of relay L1, which relay is slow acting. Relay LHS or RHS is released automatically following the release of relay TR by a train, and since relays LHS and RHS are slow to release, as shown, relay L1 becomes energized over a circuit closed momentarily which extends from terminal B at back contact *a* of relay TR, over front contact *d* of relay LHS or RHS through relay L1 to terminal C and the indication impulse will be transmitted during the release period of relay L1 following the release of relay LHS or RHS.

It will be seen that since back contacts *b* of both line relays R1 and R2 are included in the circuit for transmitting the indication impulse, its transmission cannot occur when the line is in use for transmitting control impulses to any of the ten stations.

At the control office, the indication receiving apparatus includes a set of ten indication relays K1 to K10, of which but three are shown, each controlled over a tuned circuit similar to that provided for the station relays but tuned to a different one of the ten frequencies *f1* to *f10*. Relay K1, having its circuit tuned to the frequency *f1*, responds to the indication impulse received from the station shown and is then held energized over a stick circuit until manually released, lighting a lamp E1 to indicate that the signals LH and RH at the corresponding station stand at stop.

The office transmitting apparatus includes ten sets of manually operable selecting contacts, controlled by a series of push buttons PS, for selecting the stations, of which for simplicity but three are shown, namely PS1, PS2 and PS10; five sets of manually operable control contacts, controlled by another series of push buttons PF1 to PF5, inclusive, for governing the signal control relays at the selected station; a set of five relays PC, DR, OR, L and LP for governing the transmission of the impulses, and an oscillator including the electron tube VT for generating the alternating current of the desired frequencies.

The operation of contact *a* of any of the push buttons PS opens the stick circuit for the associated indication relay K, and closes a circuit for energizing relay PC, which relay is of the polar stick type and serves as a pole changer to govern the polarity of the direct current supplied to the line from a local source having the terminals B and C, as shown. It is to be understood that the operation of any one of the buttons P1 to P5 energizes the upper winding of relay PC to cause it to operate its contacts *a* and *b* to the left as shown to render the relays R1 responsive, while the operation of any one of the buttons P6 to P10 energizes the lower winding of relay PC to cause it to operate its contacts to the right, to render the relays R2 responsive to the steady component of the line current. The opening of contact *b* of any of the buttons PS disconnects the circuits controlling the indication relays K1 to K10 from the line, rendering these relays nonresponsive to the control impulses. The closing of the contact *c* of any of the buttons PS completes a connection from the line wires Y and Z to the output coil 16 for the oscillator VT, through a rectifier 18 and a condenser C5, while the closing of contact *d* of the operated button

PS completes a tuned circuit including coil 17 and condenser C1 for controlling the frequency generated by the electron tube VT and delivered to the line by coil 16. Contacts *d* of buttons PS1 to PS5 are each connected to a different tap on coil 17 to cause the generation of a different one of the frequencies *f1* to *f5*, respectively, buttons PS6 to PS10 being similarly connected to cause the generation of the same frequencies.

Having thus described the various components of the system of my invention, I shall now explain its mode of operation, assuming first that with the apparatus as shown, the operator desires to obtain a recall indication from the station shown to verify the fact that the signals are at stop. He will first operate button PS1, releasing relay K1 and thereby cancelling the existing indication displayed by lamp E1, and operating relay PC to normal, as shown. The oscillator tube VT will be set into operation to supply current to the line wires of frequency *f1* over the connection to coil 16 including contact *c* of button PS1 and rectifier 18. Contacts *a* of relays R1 and R2 at each station are now open and the alternating current delivered to the line is principally due to the capacity between line wires Y and Z. This, however, is of a value sufficient to pick up the detector relay DR, provided the oscillator delivers the proper voltage and its connections to the line wires are intact so as to include the line capacity in its output circuit. When relay DR picks up, unidirectional current is supplied to the line circuit including the relays R1 and R2, over the connection from terminals B and C at contacts *a* and *b* of relay PC, contacts *b* and *c* of relay DR through the direct current relay OR and coil 19 to the line wires Y and Z, thereby picking up relay OR and also the relays R1 at all stations to open their contacts *b* in the indication circuits, and to close their contacts *a* so that relay R3 at the selected station also picks up. The closing of contact *a* of relay OR completes a circuit for energizing a chain of timing relays illustrated by the relays L and LP which pick up successively, the closing of contact *a* of relay LP lighting a control lamp CE and completing a local stick circuit for relay DR. It will be noted that the tuned circuit including coil 17 and condenser C1 which was completed initially over back contact *b* of relay LP is now completed over front contact *b* of relay OR, and that contact *e* of relay DR provides a connection from coil 16 to the line in parallel with contacts *c* of buttons PS. It will be also noted that if two of the buttons PS which control different frequencies are inadvertently operated at the same time, a portion of the coil 17 will be short circuited by their contacts *d* to prevent the generation of alternating current by the tube VT, the selection of more than one relay R3 at a time being thereby prevented.

When lamp CE becomes lighted, the operated button PS1 may be released. The opening of its contact *d* terminates the delivery of the alternating current component of the impulse, relays OR, L, LP, DR at the office, and relays R1 and R3 at the selected station remaining energized due to the flow of unidirectional current in the line circuit.

The operator will now press one of the buttons PF1 to PF5. Button PF1 controls relay DS only, for the purpose of initiating a return indication when the signals are at stop. Buttons PF2 and PF3 control relays LHS and RHS, respectively, to cause the selected signal to display its permissive indication, while buttons PF4 and PF5 control relays LHS and RHS, respectively, and relay DS in addition, to cause the selected signal to indicate proceed.

Assuming that button PF1 is now operated, relay OR will be shunted by the closing of the push button contact *c* and will release, opening its contact *b* in the circuit for condenser C1 controlled by the buttons PS1 to PS10, and completing a tuned circuit at its back contact *c* from the upper terminal of coil 17, condenser C2, front contact *b* of relay L and contact *a* of button PF1, to the terminal of coil 17 marked *f6*, causing tube VT to deliver current of frequency *f6* to the line to energize relay DS, which in turn energizes relay L1 at the selected station. The release of relay OR deenergizes relay L, which releases after a brief period to terminate the impulse, releasing relay DS. Relay L deenergizes relay LP which releases after a second brief period, in turn releasing relay DR to interrupt the steady line current thereby releasing relay R1. The release of relay LP extinguishes lamp CE, indicating the return of the control apparatus to normal, whereupon button PF1 may be released, while the release of relay R1 deenergizes relays R3 and L1 and initiates the return indication impulse of frequency *f1* to energize relay K1 and light the lamp E1.

Assuming next that the operator presses button PS1 as above described and then after releasing button PS1 presses button PF2 or PF3, an impulse of frequency *f7* or *f8* will be delivered to the line for the duration of the release period of relay L to operate relay LHS or RHS, which relay will then be held energized over its stick circuit including front contact *a* of relay TR, but relay L1 will not be operated and no indication impulse will be transmitted, consequently lamp E1 will remain dark.

If button PF4 or PF5 is operated in place of button PF2 or PF3, an impulse of frequency *f7* or *f8* will likewise be delivered to the line for the duration of the release period of relay L, to operate relay LHS or RHS, but in this instance a tuned circuit will be completed upon the release of relay L including coil 17, condenser C2, back contacts *c* and *b* of relays OR and L, front contact *c* of relay LP and contact *b* of the operated button, so that an impulse of frequency *f6* will be delivered to the line for the duration of the release period of relay LP to operate relay DS, which relay will then be held energized over its stick circuit including contact *c* of relay LHS or RHS. In this case relay L1 is not operated because its circuit is opened at back contact *d* of relay LHS or RHS prior to the closing of front contact *d* of relay DS, and therefore no indication impulse is transmitted and lamp E1 remains dark. It will be seen that relay L1 is operated by relay DS to initiate a return indication impulse only when the operation of relay DS is due to the operation of button PF1, as hereinbefore described.

It will also be seen that after the signal LH or RH has been cleared, it may be put manually to stop and the return indication initiated to light lamp E1 by pressing buttons PS1 and PF1, or it will be put automatically to stop the lamp E1 lighted, due to the release of the track relay TR when a train governed by the signal enters section T, in which case the signal will remain at stop, due to the release of the stick relay LHS or RHS after section T is vacated.

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, two line relays at each station, one of which is responsive to direct current in said line wires and the other to alternating current of a distinctive frequency, said alternating current line relay being connected to the line wires over a front contact of the direct current line relay through tuned circuit elements responsive to a frequency to which the corresponding circuit elements at other stations are non-responsive, a holding circuit for each alternating current line relay including front contacts of both line relays at that station, a plurality of control relays at each station having holding circuits controlled locally and having energizing circuits including front contacts of both line relays at that station and also including tuned circuit elements rendering said control relays selectively responsive to alternating currents of different frequencies in said line circuit, and control means at the office for supplying direct current to the line wires for a brief period and for supplying two impulses of alternating current of selected frequencies to the line wires successively during such period to selectively energize a particular control relay at a selected station.

2. In a remote control system, an office and a plurality of stations connected by line wires, said stations being arranged in two groups, a polarized relay at each station responsive to steady current in said line wires, the polarized relays at the stations of one group being responsive to line current of normal polarity and those at the stations of the other group to line current of reverse polarity, another line relay at each station responsive to alternating current of a distinctive frequency and connected to the line wires over a front contact of the associated polarized relay through tuned circuit elements responsive to a frequency to which the corresponding circuit elements at other stations of the same group are not responsive, a holding circuit for each such alternating current line relay including a front contact of the associated polarized line relay, a plurality of control relays at each station having holding circuits controlled locally and having energizing circuits including front contacts of both line relays at that station and also including tuned circuit elements rendering each control relay at a station selectively responsive to alternating current in the line wires of a frequency different from that to which the other relays at such station are responsive, and control means at the office for supplying steady current of a selected polarity to the line wires for a brief period and for supplying two impulses of alternating current of selected frequencies to the line wires during such period to selectively energize a particular control relay at a selected station.

3. In a remote control system, an office and a plurality of stations connected by line wires, a first line relay at each station selectively responsive to current of a distinctive character, a second line relay at each station connected to the line wires over tuned circuit elements to render such relay selectively responsive to alternating current of a particular frequency in said line wires, corresponding circuit elements at different stations being tuned to different frequencies, a holding circuit for each second line relay including a front contact of the associated first line relay, a plurality of control relays at each station having holding circuits controlled locally and having energizing circuits including front contacts of both line relays at that station and also including tuned circuit elements rendering each control relay at a station selectively responsive to alternating current in the line wires of a frequency different from that to which the other relays at such station are responsive, and control means at the office for supplying current of said distinctive character to the line wires for a brief period to energize the first line relay at each station and for supplying a series of impulses of alternating current, each of a different frequency, to the line wires to selectively and successively energize the second line relay and one or more of the control relays at a selected station during such period.

4. In a remote control system, an office and a station connected by line wires, a line relay at the station, a selective communication channel for controlling the line relay including a source of alternating current of controllable frequency at the office, said line wires, and tuned circuit elements resonant to a particular frequency, manually operable selecting means at the office including a relay for establishing said channel and means for supplying alternating current thereto of said frequency to energize the line relay, circuit means for maintaining both the office relay and the station line relay energized after the manually operable means is released and the delivery of alternating current to said channel is thereby interrupted, a plurality of control relays at said station, control channels for selectively energizing said control relays by alternating current from said source, following the release of said manually operable selecting means, each such channel including a front contact of said line relay and tuned circuit elements rendering each control relay responsive to current of a frequency different from those to which the line relay or the other control relays are responsive, manually operable control means at the office effective when operated to release said office relay, and timing means responsive to the release of said office relay effective to supply an impulse of alternating current of a particular frequency selected by said control means to said control channels to selectively energize a particular control relay, and to then release said line relay.

5. In a remote control system, an office and a station connected by line wires, a line relay at the station, a selective communication channel for controlling the line relay including a source of alternating current of controllable frequency at the office, said line wires, and tuned circuit elements resonant to a particular frequency, manually operable selecting means at the office including a relay for establishing said channel and means for supplying alternating current thereto of said frequency to energize the line relay, circuit means for maintaining both the office relay and the station line relay locally energized after the manually operable means is released and the delivery of alternating current to said channel is thereby interrupted, a plurality of control relays at said station, control channels for selectively energizing said control relays by alternating current from said source, following the release of said manually operable selecting means, each such

channel including a front contact of said line relay and tuned circuit elements rendering each control relay responsive to current of a frequency different from those to which the line relay or the other control relays are responsive, manually operable control means at the office effective when operated to release said office relay, and timing means responsive to the release of said office relay effective to supply successive impulses of alternating current of different frequencies selected by said control means to said control channels to energize a selected plurality of said control relays, and to then release said line relay.

6. In a remote control system, an office and a station connected by line wires, a line relay and a control relay at the station, selective communication channels for controlling said relays each including a source of alternating current of controllable frequency at the office, said line wires, and tuned circuit elements resonant to different frequencies, the channel for the control relay including a front contact of the line relay; a local holding circuit for the control relay including a back contact of the line relay, manually operable means at the office for establishing said channels one at a time for brief periods and for supplying alternating current thereto to which said relays are responsive, means responsive to one operation of said manually operable means for supplying to said channels alternating currents of both frequencies to energize the line relay and the control relay, and means responsive to another operation of said manually operable means for supplying to said channels alternating currents of only one frequency to energize the line relay only and thereby release said control relay.

7. In a remote control system, an office and a plurality of stations connected by line wires, a plurality of communication channels including said line wires and a source of alternating current of controllable frequency, a plurality of sets of manually operable selecting contacts at the office, including one set for each station, a slow release timing relay at the office, a plurality of control relays at each station each responsive selectively to a different frequency of current from said source, means responsive to the operation of each set of selecting contacts for preparing said channels for communication between the office and the corresponding station, and for closing a circuit for said timing relay, a plurality of sets of manually operable control contacts at the office, including one set for each control relay at a station, for controlling the frequency of the current supplied by said source, and means responsive to the operation of each set of control contacts for opening the circuit for said timing relay and for rendering said source effective during the release period thereof to supply current from said source to the prepared channels of a frequency to which the corresponding control relay is responsive.

8. In a remote control system, an office and a plurality of stations connected by line wires, a plurality of communication channels including said line wires and a source of alternating current of controllable frequency, a plurality of sets of manually operable selecting contacts at the office, including one set for each station, a chain of timing relays at the office, a plurality of control relays at each station, each responsive selectively to a different frequency of current from said source, means responsive to the operation of each set of selecting contacts for preparing said channels for communication between the office and the corresponding station and for energizing the relays of said chain, a plurality of sets of manually operable control contacts at the office, including one set for each control relay at a station, for controlling the frequency of the current supplied by said source, and means responsive to the operation of each set of control contacts for releasing said timing relays one at a time in order, and means effective during the release period of said timing relays for supplying current from said source to different ones of said prepared channels one at a time to successively energize a plurality of said control relays by currents of different frequencies, dependent upon which set of control contacts has been operated.

ANDREW J. SORENSEN.