

June 11, 1935.

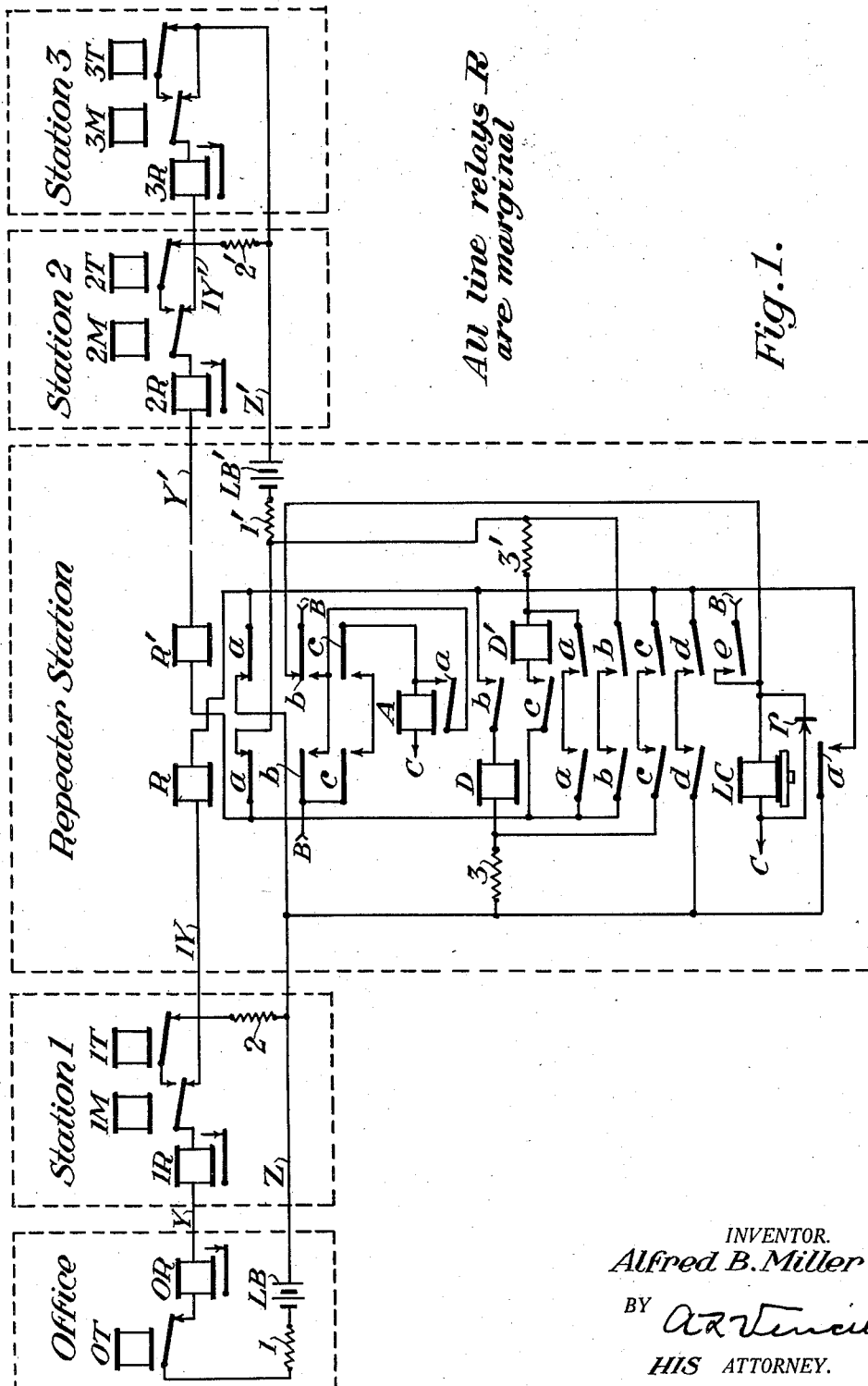
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2,004,209

REMOTE CONTROL SYSTEM

Filed Sept. 15, 1932

2 Sheets-Sheet 1



All time relays R are marginal

Fig. 1.

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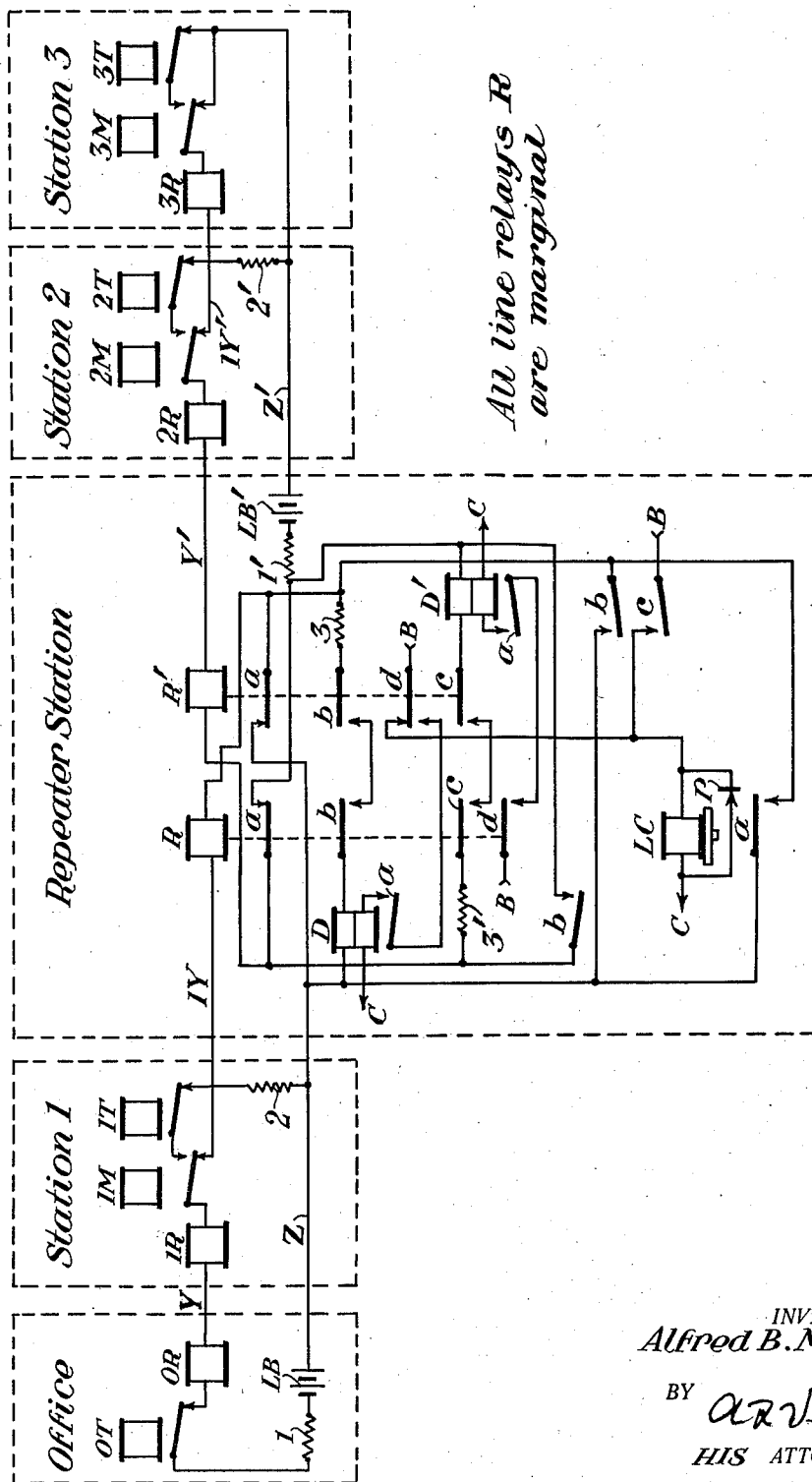
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2 Sheets-Sheet 2



All line relays R are marginal

Fig. 2.

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2,004,209

REMOTE CONTROL SYSTEM

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Application September 15, 1932, Serial No. 633,308

25 Claims. (Cl. 177—353)

My invention relates to remote control systems for the control and indication at a central office of devices located at widely separated points, and more particularly, relates to systems having a control office and a plurality of remote stations connected by line wires.

One object of my invention is the provision in a system of this character of a repeater station located at some point between the office and the more remote stations for the purpose of repeating the signals transmitted over the line wires from the office to such stations and for also repeating the signals transmitted from the more remote stations to the office.

One advantage of a repeater station as herein disclosed and described is that it permits transmission over a greater distance because to a large extent it overcomes the limitation to transmission distance introduced by line resistance, leakage, or capacity. A repeater is sometimes of advantage where the transmission distance is but moderate, in that it permits the use of smaller wire or use of cable having relatively high electrostatic capacity as compared with open line wires.

I will describe two forms of repeater station embodying my invention, and will then point out the novel features thereof in claims.

In the accompanying drawings, Fig. 1 is a diagrammatic view showing a line circuit of a typical remote control system to which my repeater station is applicable, and includes one form of repeater station of my invention. Fig. 2 shows the line circuits for the same system as Fig. 1, and includes a repeater station of my invention differing somewhat in detail but operating generally in the same manner as that of Fig. 1.

In the accompanying drawings, the repeater station is illustrated as applied to a centralized traffic control system for railways employing a single line circuit or pair of wires for connecting the office with each of the remote stations. On the office side of the repeater station, these wires include a control wire leading from station to station of which two sections are indicated by the references Y and Y' respectively, and a common return wire Z, while on the side of the repeater station more remote from the office, the control wire is designated as Y' or Y' and the common return wire as Z'. A system having line circuits as herein illustrated and to which my repeater station is particularly suited is the so-called "time code" system, disclosed in a copending application of Lloyd V. Lewis, Serial No.

600,786, filed March 23, 1932, entitled Remote control systems, which system is described in a book entitled "Centralized Traffic Control System—Time Code Scheme, Manual No. 502", dated September, 1931, and published by The Union Switch & Signal Company, Swissvale, Pennsylvania. This system employs a single line circuit extending from the office through each station in turn and including the winding of a line relay R with identifying prefix at the office and at each station, a current limiting resistance 1 and a source of energy comprising the line battery LB at the office. The line circuit also includes at the office a normally closed contact of a transmitter relay OT which may repeatedly open to transmit control code signals from the office to actuate the line relays at the office and at each station in unison. The line circuit also includes a back contact of a sectionalizing relay M at each station, as illustrated by the circuit through back contact of relay IM at station 1. When an indication code is to be transmitted from a station to the office, for example, from station 1, relay IM picks up, disconnecting the line relays of all more remote stations from the line to the office, and closing a branch of the line circuit which includes the contact of a transmitter relay IT and a compensating resistance 2. Relay IT then operates repeatedly to transmit indication code signals from the station to actuate line relays OR and IR. The line circuit is thus a normally closed circuit; the apparatus is normally at rest and is actuated for relatively brief intervals to transmit signals from the office to the stations or from any station to the office. The sectionalizing means, as described, prevents interference in the event two stations start transmission at the same time, since when this occurs, the station nearest the office retains command of the line to the office and holds the line open to more remote stations until its signaling is completed. The apparatus is arranged at each station so that the station is unable to start transmission except when the line is steadily closed.

In Fig. 1, I have shown one station between the office and the repeater station, but it is obvious that this section of line may include a number of stations. The system is also arranged to prevent interference in the event that the office and a station start transmission at the same time. This is accomplished by arranging the code of signals employed so that each code initiated by a station begins with a short interruption while a code originating at the office begins with a long interruption. For example, if relay OT picks up

at substantially the same time that relays IM and IT pick up, the line circuit will be open at two points. The closing of the contact of relay IT prior to the closing of the contact of relay IT will be without effect, and the apparatus at the station is so arranged that the prolonged opening of the line by relay OT causes the sectionalizing relay IM to release to permit the transmission of the control code signal from the office to the stations, while the indication code signal is stored and is transmitted as soon as the line circuit is rendered available.

The repeater station of my invention, although for simplicity shown as applied to a system having but one line circuit, is also applicable to remote control systems having a plurality of line circuits, such for example, as the so-called "circuit code" system illustrated in a copending application Serial No. 538,380, filed May 18, 1931, by C. S. Snively, A. B. Miller and R. H. Tunell, for Remote control systems, which system is described in a book entitled "Centralized Traffic Control System—Circuit Code Scheme, Manual No. 501", dated April, 1931, and published by The Union Switch & Signal Company, Swissvale, Pennsylvania. This system employs three line wires arranged to provide two control circuits having control wires X and Y, respectively, and a common return wire Z, and the repeater of my invention may be applied to this system by employing one set of apparatus as illustrated in Fig. 1 or Fig. 2 for the line circuit including the control wire X and common return wire Z, and another similar set of repeater apparatus for the line circuit including the control wire Y and common return wire Z. The operation of this system is in general similar to that of the time code system in respect to the operation of the repeater station, but it differs in that the speed of transmission is determined in part by the speed of operation of the receiving station; thus, in the circuit code system, when the transmitter contact IT at the station opens the line, it results in the deenergization of the line relay at the office, and the latter relay actuates transmitter relay OT to hold the line open locally until the code element is registered by the operation of certain register relays.

It will be clear from the foregoing that operation of a repeater station in connection with a remote control system of either of the types described involves problems quite different from those encountered in repeaters in telegraph circuits. The usual telegraph repeater constitutes two line circuits so interconnected that an interruption of either one will interrupt the other, but so arranged that the interruption in the second circuit will not prevent the first circuit from again becoming closed, and during normal transmission, the repeater is controlled wholly by the contact in the transmitting section of the line, even though the receiving operator may, if necessary, interrupt transmission by opening the more remote station of the line. By contrast, the repeater of my invention is so arranged that when either section is opened, the other section becomes open and introduces a second break in the section first opened, and the sending section cannot be closed until the more remote section is closed. It follows therefore that the integrity of the more remote section of the line is the governing factor in transmission.

I will now describe in detail the operation of the repeater station of Fig. 1. It is to be understood that a local source of direct current is pro-

vided for the operation of the repeater relays, but for simplicity I have illustrated the circuits diagrammatically and in lieu of showing the local source and the wires leading thereto in detail, I have only shown the terminals of the source which I have designated in each case by the reference characters B and C. My repeater station comprises two line relays R and R' connected respectively in series in the line circuit leading to the office and in the line circuit leading to the more remote stations. Each of these line relays has a normally closed front contact *a* in the other line circuit. For example, one normally closed line circuit may be traced from the left-hand terminal of line battery LB at the office through resistor 1, closed contact of transmitter relay OT, line relay OR, line wire Y and the winding of line relay IR, back contact of sectionalizing relay IM at station 1, line wire IY, the winding of line relay R and front contact *a* of line relay R' of the repeater station, thence over the common return wire Z to the other terminal of the line battery LB at the office. The other line circuit may be traced from the left-hand terminal of line battery LB' at the repeater station through resistor 1', front contact *a* of relay R, winding of relay R', line wire Y', the winding of relay 2R, back contact of the sectionalizing relay 2M at station 2, line wire IY', winding of relay 3R and back contact of relay 3M at station 3, common return wire Z' to the other terminal of the line battery LB'. Both line relays at the repeater station are thus normally energized. If, now, the contact of relay OT is opened, relays OR, IR and R are released, and the latter relay opens its contact *a* so that relays R', 2R and 3R are released. Relay R' opens its contact *a*, introducing another break in the line from the repeater station to the office. When R' releases, a local circuit is closed from terminal B of the local source of energy, back contacts *c* of relays R and R', winding of relay A to terminal C. Relay A picks up and closes a shunt around contact *a* of relay R' which includes resistor 3, the winding of a detector relay D and contact *b* of relay A, and also closes a similar shunt around contact *a* of relay R which includes resistor 3', the winding of detector relay D' and contact *c* of relay A. The line relays R, IR, etc., are preferably of relatively low resistance, since they are employed in a circuit having a number of similar relays in series, while the detector relays D and D' are preferably of a much higher resistance so that these relays will pick up on a smaller current which is not sufficient to pick up any of the R relays of the normal line circuit. The resistors 3 and 3' in series with relays D and D' respectively, are preferably of such a value as to permit the detector relay to pick up when the circuit is energized but to prevent the low resistance line relays of the circuit from picking up. It follows, therefore, that in the case described, since the contact of OT is open, shunting the line circuit to the office through the detector relay D, will be without effect, but since the relays 2M and 3M are deenergized, the line circuit to the more remote stations will be completed through the winding of D', so that this relay will pick up to close its front contacts. When OT releases, relay D will also become energized and pick up. This will at once complete a shunt around contact *a* of relay R' which includes front contacts *d* of relays D and D', so that relay R and the other line relays of the circuit to the office will pick up, and at the same time, the energization of relay D

will complete a shunt around the winding of relay D' and resistor 3' which includes contacts b of relays D and D' so that relay R' and the other line relays of the more remote section can pick up. Each of these last named shunts, of course, also diverts the flow of current from the windings of relays D or D', but these relays remain energized for a short time by reason of snubbing circuits which are provided for that purpose, the snubbing circuit for relay D being from the left-hand terminal of relay D through front contacts c of relays D and D', contact b of relay A, to the right-hand terminal of relay D. The snubbing circuit for relay D' is similar but includes front contacts a of relays D and D' and contact c of relay A. Relay A is provided with holding circuits which extend from terminal B through back contacts b of relays R and R' in multiple, front contact a and winding of relay A to terminal C, so that relay A becomes released when both relays R and R' pick up. When relay A releases, the snubbing circuits of relays D and D' are opened and the repeater circuits are thus restored to normal.

It is clear from the foregoing that repeated interruptions of one line by operation of the contact of relay OT at the office causes the interruption of both lines at the repeater station, and that the closing of the sending section is dependent on the continuity of the more remote section. Since the circuits are symmetrical, it is obvious that the interruption of the more remote section by picking up relays 3M and 3T will interrupt the section of the line leading to the office and that the closing of the more remote section, when this is the sending section of the line, is dependent upon the continuity of the section leading to the office. Thus if relays 3M and 3T pick up, and this causes relay OT to pick up, as will be the case when my repeater station is used with the circuit code system, it will be clear that the subsequent closing of the contact of 3T will be without effect and relays R' and 3R will not pick up until the contact of relay OT becomes closed, precisely the result desired as already described in connection with the time code system in the event that a station and an office start transmission at the same time. It is also precisely the result desired in the circuit code system in transmitting from station 3 to the office in which case OT will pick up when its line is opened as a result of the energization of relay 3T and will thus hold the transmitting station until the code element is registered at the office and relay OT is released.

My repeater station thus, in effect, comprises potential operated means for signaling over a line circuit to indicate at the repeater station when a remote transmitter contact is closed, without picking up the line relays of the circuit connecting the repeating station and the sending station.

One advantage of my repeater station when used with the circuit code system is that a sending and receiving station are thus kept in step even though they are located in separate line circuits in exactly the same manner as if the stations were connected in series in the same line circuit. Another advantage of my repeater station is that temporary failure of a receiving section of the line will have exactly the same effect as if the failure occurred in the sending section. Both systems referred to function in such a manner that if a failure of the sending line circuit occurs, transmission is stopped, and

will start anew when the line circuit is restored so that the possible loss of code signals is prevented, and it is obvious that this desirable feature is not sacrificed even though the line circuits include the repeater station of my invention, with the repeater apparatus as so far described. This is true in respect to transmission in either direction, namely, from the office to the stations, or from a station to the office. However, in respect to transmission from the office to the stations, it is desirable to have the repeater apparatus so arranged that a prolonged failure of the more remote section of the line will not prevent operation of the line circuit from the office to the repeater station, provided the latter line circuit is intact and in operating condition. To secure this result, I provide automatic sectionalizing apparatus comprising a normally energized slow release relay LC having a circuit from terminal B, front contact b of relay R', winding of relay LC to terminal C, and a branch circuit from terminal B, front contact e of relay D', winding of relay LC to terminal C. When relay R' is released, if the more remote section is intact, relay D' will become energized within a very brief period and when relay D' becomes deenergized in normal operation, relay R' becomes energized, from which it follows that in normal operation, relay LC will only become deenergized for brief intervals. To prevent its release during these intervals I provide an obvious snubbing circuit through its winding and asymmetric unit r. However, if the more remote line circuit becomes deenergized for a prolonged interval, relay LC becomes released and closes its back contact a to close a shunt around front contact a of relay R' in the line circuit to the office as long as the more remote section remains open, so that the line circuit from the office to the repeater station will thereby be restored to the operative condition.

In the modified form of my repeater station shown in Fig. 2, I have omitted the auxiliary relay A and provided the relays D and D' each with an auxiliary holding winding. The operation of the repeater station of Fig. 2 is as follows: Assume that relays 3M and 3T are energized at station 3, the more remote line circuit will be opened to release relay R' and this relay will by means of its normally closed contact a open the line circuit to the office, and as soon as relay R releases, front contact a of relay R' will be shunted through the branch circuit which includes resistor 3, back contacts b of relays R' and R and the upper winding of relay D. If now the contact of relay OT at the office is closed, relay D will pick up, closing its holding circuit from terminal B, back contact d of relay R', front contact a and lower winding of relay D to terminal C. Relay D will close its front contact b which is in shunt with contact a of relay R in the more remote line circuit. It follows that when the contact of relay 3T becomes closed relay R' will at once pick up and close its contact a to reestablish the normal line circuit to the office, and at the same time will open its back contact d to release relay D.

When relay R released during the operation just described, it completed a shunt for front contact a in the more remote line circuit which included resistor 3', back contacts c of relays R and R' and the upper winding of relay D', but since this shunt was bridged by the closing of front contact b of relay D before energy was applied to the more remote section, relay D' did

not pick up. However, it is evident from the symmetry of the circuits that if the more remote section becomes closed first, relay D' would have been energized and relay D would have been prevented from picking up, and that it is immaterial which one of the relays D or D' picks up first, and that either one when energized will restore the other line circuit. I have, in Fig. 2, also shown line sectionalizing apparatus comprising the slow release relay LC operating in the same manner as already described in Fig. 1.

Although I have herein shown and described only two forms 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, a normally closed line circuit including a home station and a remote station, a second normally closed line circuit including another remote station, a transmitter contact and a receiving line relay at each station included in the line circuit at such station, a repeater comprising a pair of line relays including one in each line circuit, each controlling a normally closed contact in the other line circuit which opens when the relay is released, means for momentarily opening a transmitter contact to release the line relays of both circuits, means responsive to the release of said pair of relays to restore the line circuits through the repeater station, said means being effective to prevent the line relays of either line circuit from picking up until both line circuits are closed, and slow acting means responsive to a prolonged opening of the one of said line circuits to shunt the repeater relay contact in the other line circuit whereby said other line circuit may be restored to operative condition in the event of failure of said one line circuit.

2. In combination with a line circuit including a normally energized line relay, means responsive to the deenergization of said line relay when the line circuit is opened for inserting an impedance in said line circuit to prevent the line relay from picking up when the line circuit is again closed, a detector relay in series with said impedance, and means responsive to the energization of the detector relay when the line circuit becomes closed for shunting said impedance to cause the line relay to pick up.

3. In combination with a line circuit including a normally energized line relay and a normally closed contact controlled by said line relay, means rendered effective when said line relay is deenergized and said normally closed contact is opened for bridging said contact by a high impedance shunt including the winding of a detector relay, and means for bridging said high impedance including a front contact of said detector relay, whereby said detector relay and said line relay become energized sequentially when their circuits are closed.

4. In combination with a line circuit including a normally energized line relay and a transmitting contact, means controlled by said line relay and operating when the contact is opened for preventing the line relay from picking up when said contact is again closed, a detector relay responsive to the closing of said contact provided the line relay is released, and means controlled by said detector relay when actuated for causing

said line relay to become energized to restore said line circuit to normal.

5. In combination with a normally closed line circuit including a line relay and a transmitting contact, means actuated by said line relay and operating in response to the opening of the line circuit by said contact for inserting a high impedance in said line circuit to prevent the line relay from picking up when said contact is again closed, and means responsive to the flow of current through said impedance when said contact becomes closed for causing normal current to flow in said line circuit to pick up said line relay.

6. In combination with a normally closed line circuit including a line relay and a transmitting contact, means controlled by said line relay and rendered effective when the line circuit is opened by said contact for preventing the line relay in said circuit from picking up when said contact is again closed, and other means responsive to the closing of said contact for causing said line relay to again become energized.

7. In combination with a normally closed line circuit including a normally energized line relay and a control contact, means operating when the line relay is released by the momentary opening of said contact for reestablishing the continuity of the line circuit through an impedance sufficient to prevent the line relay from picking up, and means responsive to the flow of current through said impedance to reestablish said normally closed line circuit to cause said relay to pick up.

8. In combination with a normally closed line circuit including a line relay, a normally closed contact controlled by said relay, a shunt for said contact including the winding of a detector relay and a contact closed only when the line relay is deenergized, and a second shunt for said contact including a front contact of said detector relay.

9. A repeater for a remote control system having two line circuits, comprising a line relay for each circuit, each having its winding in one circuit and a front contact in the other, a normally deenergized detector relay for each line circuit, a shunt for each line relay front contact including the winding of the detector relay for the circuit including said contact, means for closing said shunt when both line relays are deenergized, and a second shunt for each line relay front contact including a front contact of the detector relay for the other line circuit.

10. A repeater for a remote control system having two line circuits, comprising a line relay for each circuit, each having its winding in one circuit and a front contact in the other, a normally deenergized detector relay for each line circuit, a shunt for each line relay front contact including the winding of the detector relay for the circuit including said contact, means for closing said shunt when both line relays are deenergized, a second shunt for each line relay front contact including a front contact of the detector relay for the other line circuit, and a third shunt for one line relay front contact adapted to become closed when the line relay and the detector relay for the other line circuit remain open for a predetermined time interval.

11. A repeater for a remote control system having two line circuits each including a plurality of relatively low resistance line relays, comprising one of the line relays of each circuit and a contact in each circuit closed when a line relay of the other line circuit is energized, a normally open shunt for each of said contacts each includ-

ing a winding of a relatively high resistance detector relay, means effective to close said shunt when both of said line relays become deenergized, and a second shunt for each of said contacts each including a front contact of the detector relay for the other line circuit.

12. A repeater for a remote control system comprising two line circuits each including a normally energized line relay, a transmitting contact and a front contact of the line relay for the other line circuit, a high impedance shunt including the winding of a detector relay for each of said front contacts, each shunt being of sufficient impedance to prevent the line relay but not the detector relay from picking up when the shunt is included in the line circuit and the transmitting contact in said circuit becomes closed, means effective to close said shunt when both said line relays become deenergized, and means including front contacts of said detector relays for bridging said shunts.

13. In combination with two normally closed line circuits each including a plurality of line relays, a transmitting contact and a normally closed contact controlled by one of the line relays of the other circuit, detector means for each circuit responsive to the opening of a transmitting contact and the consequent release of the line relays of both circuits for detecting when potential is again applied to such circuit, and means controlled by the detector means for each circuit for restoring the other line circuit to its normally closed condition when potential is applied to both line circuits.

14. A repeater station for connecting two normally closed line circuits, comprising a normally energized line relay in each circuit, each controlling a normally closed contact in the other circuit, means controlled by each line relay and rendered effective when by its release it has opened the other line circuit and thereby opened its own line circuit for reestablishing the continuity of its own circuit through an impedance sufficient to prevent the relay in such circuit from picking up, and means responsive to the flow of current through the impedance in each line circuit for restoring the other line circuit to permit the other line relay to pick up.

15. A repeater station for connecting two line circuits, each including a transmitter contact and a plurality of line relays, comprising one of the line relays of each circuit and a normally closed contact in each circuit controlled by a line relay of the other circuit, restoring means effective when both line circuits have been opened, said means being responsive when the transmitter contact in one line is closed to bridge the normally closed contact in the other line thereby permitting the energization of the line relays of said other line provided the transmitter contact in said other line is closed whereby the energization of the line relays of said one line is made dependent upon the energization of the line relays of the other line, and means effective when the line relays of both lines are energized for releasing said restoring means.

16. A repeater for a remote control system having two line circuits each including a normally energized line relay and a contact in each circuit closed when the line relay of the other line circuit is energized, a stick relay having a pick-up circuit closed when both of the line relays become deenergized and a stick circuit closed when said relay becomes energized and opened when both of the line relays become energized, a shunt

for each of said contacts each including the winding of a detector relay and a front contact of said stick relay, and a second shunt for each of said contacts each including front contacts of both detector relays.

17. In combination with two normally closed line circuits each including a transmitting contact, a plurality of line relays and a normally closed contact controlled by one of the line relays of the other circuit, a slow release relay having a circuit closed only when one of said line circuits is energized, and a circuit for bridging the normally closed contact in the other line circuit comprising a back contact of said slow release relay whereby the line relays of said other line circuit are rendered responsive to the periodic operation of the transmitter contact in said circuit in the event of failure of said one line circuit.

18. In a remote control system, two normally closed line circuits, one extending from a home station to a remote station and the other from a point on said one circuit to another remote station, said circuits including a transmitter contact and a receiving line relay at each station, a repeater station comprising a pair of line relays including a relay in each line circuit having a front contact in the other line circuit, means for momentarily opening a transmitter contact to release the line relays of one circuit to thereby open both line circuits at the repeater station, and means responsive to the release of said pair of relays to restore the line circuits through the repeater station, including means to prevent the line relays of either circuit from picking up until both line circuits are closed.

19. In combination with a line circuit including a normally energized line relay and a transmitting contact, means for operating said contact to momentarily open said line circuit, means responsive to the deenergization of said line relay when the line circuit is opened for inserting an impedance in said line circuit to prevent the line relay from picking up when the line circuit is again closed, a detector relay in series with said impedance, and means responsive to the energization of the detector relay when the line circuit becomes closed for shunting said impedance to cause the line relay to pick up.

20. In combination with a line circuit including a normally energized line relay, a transmitting contact, and a normally closed contact controlled by said line relay, means for momentarily opening the transmitting contact to deenergize said line relay, a detector relay, a high impedance shunt for said normally closed contact including the winding of said detector relay, means effective to close said shunt when said line relay is deenergized and said normally closed contact is open, and means for bridging said shunt including a front contact of the detector relay, whereby said detector relay and said line relay become energized sequentially when said transmitting contact is closed.

21. A repeater for the line circuits of a remote control system, comprising two line relays each having its winding in one line circuit and a front contact in another, a shunt for each said contact including the winding of a detector relay and a contact closed only when the line relay has been deenergized, and a second shunt for said contact including a front contact of said detector relay.

22. A repeater for the line circuits of a remote control system, comprising two line relays each having its winding in one line circuit and a front

contact in another, a detector relay for each line circuit, a shunt for each said front contact including the winding of the detector relay for the circuit including said contact, means for closing said shunts when both line relays are deenergized, and means controlled by said detector relays for effecting the reclosing of said front contacts.

23. A repeater for a remote control system having two line circuits, comprising a line relay for each circuit, each having its winding in one circuit and a front contact in the other, a normally deenergized detector relay for each line circuit, a shunt for each line relay front contact including the winding of the detector relay for the circuit including said contact, means for closing said shunt when both line relays are deenergized, means to prevent each line relay from picking up when a detector relay is included in its circuit and the circuit is energized, and a second shunt for each line relay front contact including a front contact of the detector relay for the other line circuit.

24. A repeater for a remote control system having two line circuits, comprising a line relay for each circuit, each having its winding in one circuit and a front contact in the other, a normally deenergized detector relay for each line circuit, a shunt for each line relay front contact including the winding of the detector relay for the circuit

including said contact, means for closing said shunt when both line relays are deenergized, means to prevent each line relay from picking up when a detector relay is included in its circuit and the circuit is energized, a second shunt for each line relay front contact including a front contact of the detector relay for the other line circuit, and a third shunt for one line relay front contact adapted to become closed when the line relay and the detector relay for the other line circuit remain open for a predetermined time interval.

25. A repeater for the two line circuits of a remote control system, comprising two line relays each having its winding in one line circuit and a front contact in another, a stick relay, a pick up circuit for said stick relay closed when both of the line relays become deenergized, a stick circuit for said stick relay closed when it becomes energized and opened when both of the line relays become energized, a detector relay for each line circuit, a shunt for each of said contacts each including the winding of said detector relay and a front contact of said stick relay, means for preventing each line relay but not the detector relay from picking up when the shunt is included in its circuit and the circuit is energized, and a second shunt for each of said contacts each including front contacts of both detector relays.

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