

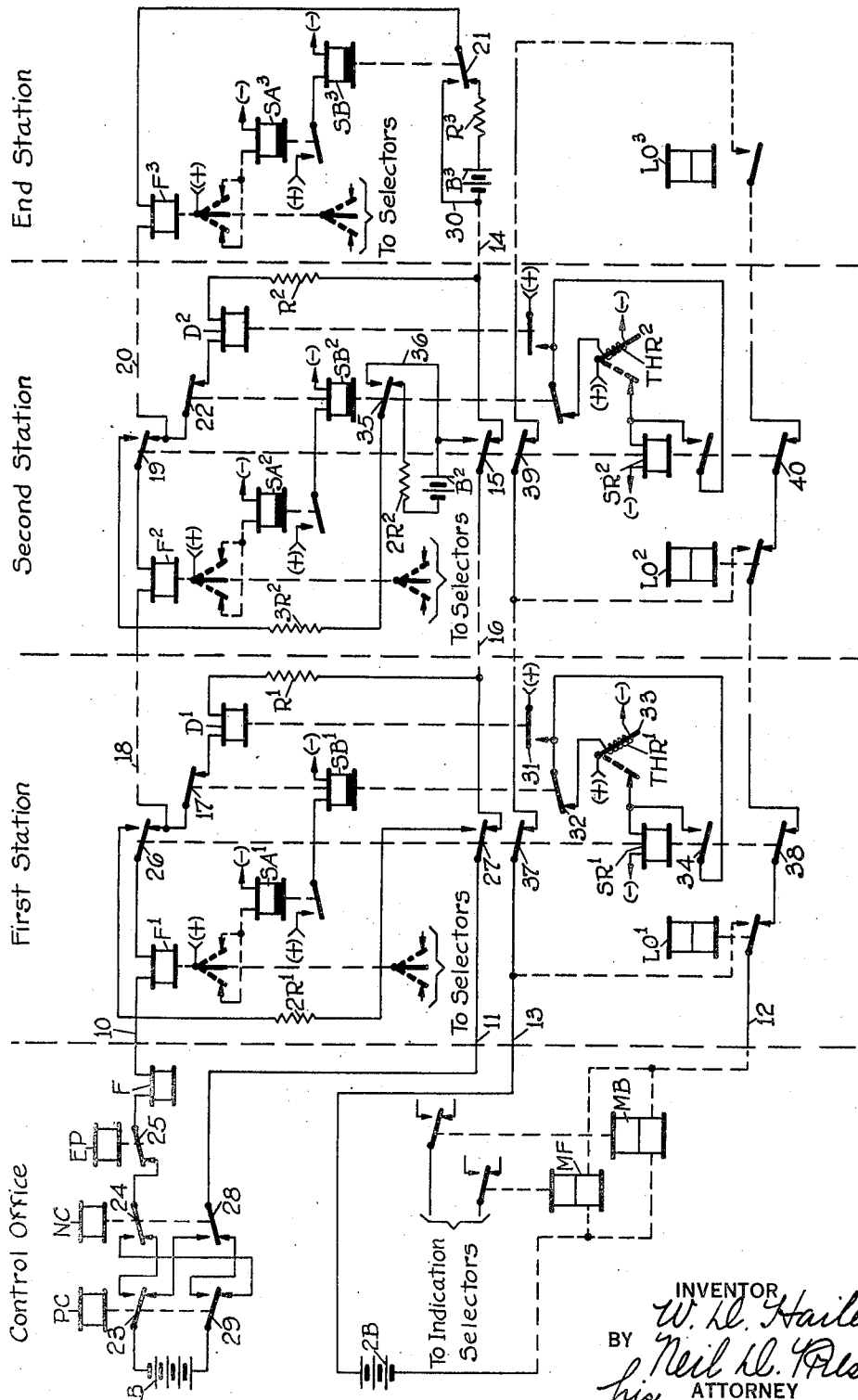
Nov. 26, 1940.

W. D. HAILES

2,223,103

CENTRALIZED TRAFFIC CONTROLLING SYSTEM FOR RAILROADS

Filed Feb. 25, 1938



UNITED STATES PATENT OFFICE

2,223,103

CENTRALIZED TRAFFIC CONTROLLING
SYSTEM FOR RAILROADSWilliam D. Hailes, Brighton, N. Y., assignor to
General Railway Signal Company, Rochester,
N. Y.

Application February 25, 1938, Serial No. 192,575

10 Claims. (Cl. 177—353)

This invention relates to centralized traffic controlling systems for railroads, and more particularly pertains to means for automatically sectionalizing line circuits extending between a control office and a plurality of field stations in a coded centralized traffic controlling system.

In a coded communication system employing a line circuit extending from a control office to several field stations, and including in series electro-responsive means for such stations, it is advantageous to provide sectionalizing means for such circuit at intermediate points in such a manner as to render that portion of the system operative from the control office to the most distant station on the control office side of an abnormally opened condition of the line circuit.

This invention is to be considered an improvement over the prior application of R. M. Phinney, Ser. No. 145,542, filed May 29, 1937, now Patent No. 2,157,864 granted May 9, 1939, in that a sectionalizing scheme is provided which operates in a positive manner, irrespective of variations in the timing of devices employed at different points.

Another object of this invention is to provide for the automatic restoration to the system of that section of the line circuit rendered inoperative by a break in the control line circuit at any given point as soon as the circuit is again closed at that point.

Other objects, purposes and characteristic features of the present invention will be in part obvious from the accompanying drawings and in part pointed out as the description of the invention progresses.

In describing the invention in detail, reference will be made to the accompanying drawing which shows one embodiment of the present invention as applied to line circuits extending between a control office and certain ones of a series of field stations. Similar parts of the system have been designated by similar reference characters, which have been made distinctive by exponents and preceding numerals.

In order to simplify this disclosure, reference is made from time to time to functions common to all parts of a similar character by use of the letter reference characters without exponents or preceding numerals. It is to be understood that such a reference applies to any parts designated in the drawing by reference characters which are similar except for preceding numerals.

For the purpose of facilitating in the explanation and for simplifying the illustration, the various parts and circuits constituting the em-

bodiment of the invention have been shown diagrammatically and certain conventional illustrations have been employed, the drawing having been made more with the purpose of facilitating the disclosure of the invention as to the principles and mode of operation, than with the idea of illustrating the specific construction and arrangement of parts that would be employed in practice. Thus the various relays and their contacts are illustrated in a conventional manner, and symbols are used at times to indicate connections to the terminals of batteries, or other sources of electric current, instead of showing all of the wiring connections to these terminals.

The symbols (+) and (—) are employed to indicate the positive and negative terminals respectively, of suitable batteries, or other source of direct current, and the circuits with which these symbols are used, always have current flowing in the same direction.

In order to simplify the disclosure of this invention dotted lines have been used to indicate the inclusion of apparatus and circuits not shown which can be provided in accordance with the prior art or as typically shown and described in this disclosure.

With reference to the accompanying drawing this invention has been shown as having been applied to a selector type of communicating system such as is shown, for example, in the Judge et al. Patent No. 2,082,544, dated June 1, 1937. It is to be understood, however, that the scope of the present invention is not limited to the system shown, and that the present form is used only to facilitate and simplify this disclosure.

In order that the application of the present invention to the above mentioned Judge et al. patent may be readily apparent, reference characters for relays shown in this disclosure have been made to correspond with reference characters provided for relays performing similar functions disclosed in that patent.

The above mentioned communication system provides two-way communication between a control office (indicated on the left-hand side of the drawing) and a series of field stations. Controls for devices at various field stations are transmitted from the control office to the field stations by means of different series of positive and negative impulses applied to the line wires 10 and 11 by the selective energization of relays PC and NC and by the marking off of the impulses by an impulsing relay EP.

In response to the energization of the control line wires 10 and 11, a biased-to-neutral polar-

ized relay at the control office and at each station is positioned, and the positioning of that relay causes the operation of selector means associated therewith. Such selector means, together with the distinctive polarity of the impulses, provides for the control of several devices at each field station over a single line circuit extending from the control office.

The relays SA and SB are neutral relays which are picked up at the beginning of the transmission of a series of impulses, and which remain up throughout that series due to their slow action in dropping away.

When a field station has indications to transmit, if the system is at rest, the neutral relay LO at that field station picks up and closes the indication line circuit including line wires 12 and 13. Relay LO stays up throughout the series of impulses for the indication cycle.

It is to be understood that the return line wires 11 and 13 for the control and indication circuits could as well be combined into a common return wire, although separate wires have been shown for the purpose of simplifying this disclosure.

In the control office the relays MF and MB detect the closed condition of the indication line circuit and initiate the transmission over the control line circuit of a series of impulses for operating the stepping of the selector at the control office in synchronism with the selector at the field station which is transmitting the indications.

The neutral relays D are of a high resistance type which has a low operating current at a low voltage for purposes hereinafter set forth.

The sectionalizing relays SR are neutral relays and their pick-up circuits are closed only after their associated thermal relays THR have completed their operation to close operating contacts.

Batteries B have been shown in certain of the circuits for the control office and for the field stations, but it is to be understood that those same batteries could be used for other purposes such as furnishing energy for local circuits, and that other suitable sources of energy could as well be used.

Compensating resistors R are provided at various points in order to maintain certain standard conditions throughout the system.

Other characteristic features of the present invention are believed to be more clearly understood by considering the mode of operation of the system under various normal and abnormal operating conditions.

Operation

Normal conditions.—Under normal conditions each of the relays D is energized from the battery B³ at the most distant field station. Relay D¹ is energized from the positive terminal of battery B³ through a circuit including line wire 14, back contact 15 of relay SR², line wire 16, resistance R¹, winding of relay D¹, back contact 17 of relay SB¹, line wire 18, winding of relay F², back contact 19 of relay SR², line wire 20, winding of relay F³, back contact 21 of relay SB³, and resistance R³, to the negative terminal of battery B³. Relay D² is normally energized from the positive terminal of battery B³ through a circuit including line wire 14, resistance R², winding of relay D², back contact 22 of relay SB², line wire 20, winding of relay F³, back contact 21 of relay SB³, and resistance R³ to the negative terminal of battery B³.

As has heretofore been pointed out, relays D

are constructed to operate from a comparatively low voltage, and to operate on a comparatively low current. The characteristics of the relays D are such that the current required for the energization of all of the relays D in multiple is less than the current required for the energization of the relays F, whereby the positioning of relays F is unaffected by the energization of the relays D from the field batteries, although the relays F are included in the energizing circuit for those D relays.

Having considered the condition of the system when it is at rest, assume the line circuit to be energized positive from the control office, as would be the case at the beginning of a series of control impulses, conveniently termed a control cycle, in which that polarity is selected for the initiating impulse.

Under such conditions relay PC is picked up and the control line circuit is closed, to position the relays F, from the positive terminal of battery B through a circuit including front contact 23 of relay PC, back contact 24 of relay NC, back contact 25 of relay EP, winding of relay F, line wire 10, winding of relay F¹, back contact 26 of relay SR¹, line wire 18, winding of relay F², back contact 19 of relay SR², line wire 20, winding of relay F³, back contact 21 of relay SB³, resistance R³, battery B³, line wire 14, back contact 15 of relay SR², line wire 16, back contact 27 of relay SR¹, line wire 11, back contact 28 of relay NC and front contact 29 of relay PC, to the negative terminal of battery B.

The operation of the polar contacts of the relays F to a right-hand position closes an obvious circuit for energizing relays SA, such circuit having been shown dotted to indicate that a more indirect means of control can be provided, as has been shown in the above mentioned Judge et al patent. The picking up of relays SA causes the energization of relays SB through an obvious circuit, and, due to the slow acting characteristics of those relays, they remain in an energized position throughout the series of impulses.

The picking up of relay SB³ in the conditioning period closes a circuit including wire 30 for shunting the battery B³ out of the line circuit, and the picking up of relays SB¹ and SB² causes the dropping away of relays D¹ and D², due to the opening of the circuits for those D relays at back contacts 17 and 22 respectively.

After the last impulse in the series has been applied, the dropping of relays F causes the de-energization of the relays SA and SB in turn to mark the end of the series of impulses and to restore the system to the above described condition during a period of rest. Back contact 21 of relay SB³, when closed, provides energy from battery B³ for the energization of the relays D at each field station.

The application of a negative impulse to the line circuit at the beginning of a control cycle due to the picking up of relay NC causes a similar mode of operation through the same circuits that have been heretofore described in detail, the battery B³ being over-powered by the battery B in the control office which has a much higher voltage.

To initiate an indication cycle, the relay LO is picked up at a field station and its energization closes a circuit through its front contact as indicated by dotted lines to energize either of relays MF or MB to mark the beginning of the conditioning period for an indication cycle. After

such a beginning has been registered, relay NC is picked up and a series of impulses is applied to the line circuit in a similar manner to that described for a control cycle, thus, providing the same mode of operation of the system with respect to the control of sectionalizing devices.

Operation under abnormal conditions.—A line circuit is subject to broken wires at times from a number of sources, such as the weight of ice on the wires, wires broken as a result of fallen trees, land slides, and a number of other conditions. A break in the circuit can also occur at connections from the line circuit to the F relays and other devices. The conditions of the system hereinafter described are to be assumed as resulting from breaks in the circuit due to conditions such, for example, as those mentioned above.

Assume a break to occur in the line circuit, while the system is at rest, between relays F¹ and F², or in that section of the return line represented by wire 16. Under such conditions, relay D¹ is deenergized due to a break in its circuit in either or both of wires 18 and 16, and the dropping away of that relay initiates the picking up of the sectionalizing relay SR¹, through the medium of a time delay means.

Under such conditions the winding of thermal relay THR¹ is energized from (+), through a circuit including back contact 31 of relay D¹, back contact 32 of relay SB¹, and winding of thermal relay THR¹, to (-). After thermal relay THR¹ has completed its operation, a circuit is closed for energizing relay SR¹ from (+), through a circuit including contact 33 of relay THR¹, and winding of relay SR¹, to (-). After relay SR¹ picks up, a stick circuit is closed from (+), through a circuit including back contact 31, of relay D¹, front contact 34 of relay SR¹ and winding of relay SR¹, to (-).

The picking up of relay SR¹ closes a loop circuit from relay F in the control office including line wire 10, winding of relay F¹, front contact 26 of relay SR¹, compensating resistor 2R¹, front contact 27 of relay SR¹, and line wire 11 back to the control office. Thus, it is obvious that conditions are set up whereby relay F¹ can be energized in response to the transmission of impulses from the control office, and that it has a similar mode of operation throughout the series of impulses as has been heretofore described.

Due to the fact that the stick circuit for relay SR¹ is dependent upon back contact 31 of relay D¹, it is obvious that the line circuit will be maintained sectionalized at that point until the break in the line circuit has been closed.

After the break in wires 16 and 18 has again been closed, a circuit is closed for energizing relay D¹ through the same circuit as has been heretofore described for the energization of that relay during normal conditions.

The picking up of relay D¹ opens the stick circuit for relay SR¹ and causes the closing of back contacts 26 and 27 to again restore the line circuit to normal conditions.

A very similar mode of operation is employed for the system in case the line circuit is open between relays F² and F³ or in the line return circuit wire 14. Such a break in the circuit, while the system is at rest, causes the deenergization of relays D¹ and D², due to the opening of the circuit for these relays in wire 20 or wire 14, and the dropping away of those relays causes the picking up of relays SR¹ and SR², respectively. Relay SR² is energized through obvious circuits

of which the circuits heretofore described in detail for relay SR¹ are typical.

The picking up of relay SR² closes a circuit for energizing relay D¹ from the positive terminal of battery B² through a circuit including front contact 15 of relay SR², line wire 16, resistance R¹, winding of relay D¹, back contact 17 of relay SB¹, line wire 18, winding of relay F², front contact 19 of relay SR², resistor 3R², back contact 35 of relay SB² and resistor 2R², to the negative terminal of battery B².

The picking up of relay D¹, under such conditions, opens the circuit for the winding of thermal relay THR¹ to prevent further operation of that relay and also opens the stick circuit for relay SR¹ so as to cause that relay to drop away, provided that relay should have picked up at the same time or prior to the picking up of relay SR². Thus, the line circuit becomes sectionalized so as to render relays F¹ and F² responsive to the transmission of impulses from the control office in a similar manner to their energization during the transmission of impulses when the line circuit is closed through all of the F relays.

It is readily apparent that the connection established between front contacts 19 and 15 of relay SR² is similar to the connection established at the most distant station in the line circuit and that the circuit is closed through battery B² during the period at the beginning of a series of impulses until relay SB² picks up to close a shunt circuit around that battery including wire 36.

It is obvious, considering the above example of the operation of the system, that a large number of points of sectionalization can be provided and that the point of sectionalization nearest the abnormally opened condition of the line circuit, toward the control office, is given superiority for sectionalization over all other points.

Should the line circuit be abnormally opened during the transmission of a series of impulses, the relays F are deenergized, and their deenergization of course causes the restoration to normal of other relays associated therewith including relays SA and SB. The dropping away of relays SB under such conditions closes a circuit for allowing the energization of all of the relays D included at stations between the control office and the abnormally opened condition of the line circuit, thus effecting the sectionalizing of the control line circuit at the point which will render the system operative between the location of that opened condition and the control office.

It is necessary when sectionalizing a control line circuit to also sectionalize the indication line circuit in order to prevent a station beyond the sectionalized point from initiating an indication cycle when the relay LO at that station is picked up. It is necessary to prevent such a condition because the transmission of indications from a field station can be effective only so long as the stepping is provided for the selector means at that station by the transmission of impulses from the control office over the control line circuit. If a station were allowed to initiate the transmission of an indication cycle which could not be completed at that station, the continued registration of a start for an indication cycle by that station would cause undesirable operation of the system. Thus, the indication circuit is opened by the picking up of sectionalizing relay SR¹ at back contacts 37 and 38, and the indication circuit is also opened when relay SR² is picked up to open the circuit at back contacts 39 and 40. The dropping away of relays SR¹ and SR² of

course restores the indication line circuit to normal conditions when the abnormally opened condition in the control line circuit has been closed.

Although only particular ones of a series of field stations have been shown and described, it is to be understood that apparatus for other stations can be included in the line circuit between the apparatus which has been shown for the particular stations, and that apparatus at such stations can provide operation, as shown in the above mentioned prior Judge et al patent, without provision for automatic sectionalizing, can provide a manual control switch for sectionalizing the line circuit or can provide automatic sectionalizing means in accordance with this invention.

Having described automatic sectionalizing means applied to one particular type of communication system as one specific embodiment of the present invention, it is desired to be understood that this form is selected to facilitate in the disclosure of the invention rather than to limit the number of forms which it may assume; and, it is to be further understood that various modifications, adaptations and alterations may be applied to the specific form shown to meet the requirements of practice, without in any manner departing from the spirit or scope of the present invention except as limited by the appended claims.

What I claim is:

1. In a remote control system having a control office and a plurality of field stations, a control relay at the control office and at each of the field stations, a control line circuit serially connecting all of said control relays, a source of energy at the control office, transmitting means at the control office for applying different series of time spaced impulses of current from said office source to said control line circuit, another source of energy at the field station most distant from the control office, means at said most distant field station for energizing said line circuit from said source at that station during the time between successive series of impulses and also during the first impulse of a series but not during the remaining impulses of a series and of insufficient potential to dominate said office source, a detector relay connected across said line circuit at an intermediate field station so as to be responsive to the energization of said line circuit by said another source of energy at said most distant field station between successive series of impulses, and sectionalizing means at said intermediate field station responsive to the deenergization of said detector relay for shunting out the line circuit extending away from such intermediate field station towards said most distant field station if said line circuit is deenergized for more than a predetermined period of time between successive series of impulses, whereby an open condition in said line circuit at any point more remote from said intermediate field station causes said line circuit to be automatically sectionalized at said intermediate station.

2. In a remote control system, a control office and several field stations, a line circuit including in series electro-responsive means for each of said field stations, a source of energy at said control office, circuit means for energizing said line circuit from said source with different series of impulses, means including a field source for energizing said line circuit from the most distant field station during the time between each of said series of impulses, a detector relay shunted across

said line circuit at certain intermediate stations responsive between said series of impulses only to the energization of that line circuit from said field source at a station more distant from the control office, said field source having a potential sufficient to energize said detector relays but insufficient to energize said electro-responsive means, means responsive to the deenergization of each of said detector relays for shunting out the section of said line circuit extending beyond that station from said control office, said means for shunting including circuit means for energizing that portion of said line circuit nearest the control office from that station between said series of impulses, circuit means for maintaining said shunting means effective only when said detector relay for that station is deenergized, whereby each of said relays detects an abnormally opened condition of the section of the line circuit between the station with which that relay is associated and the next distant station having said means for shunting, whereby the line circuit is sectionalized at a point to render all stations operative between the control office and a point where that line circuit has been abnormally opened, and whereby the portion of the line circuit shunted out is automatically restored to a portion of the line circuit nearer the control office when the abnormally opened section is closed.

3. In a remote control system, a line circuit connecting a control office and a plurality of field stations, a control line relay connected in series in said line circuit at said control office and at each of said field stations, normally inactive transmitting means at the control office for at times energizing said line circuit with different series of positive and negative current impulses from a source of current located at the control office, a detector relay at an intermediate field station connected in multiple across said line circuit on that side of said control line relay at such intermediate station remote from said control office, said detector relay being of relatively high resistance but requiring a relatively low potential across said line circuit for its operation, means including a field source at the most remote field station for applying a potential to said line circuit, said potential being of a value sufficient to operate said detector relay but insufficient to operate said control line relays and also insufficient to interfere with the control of said control line relays by said office source of current irrespective of the polarity arrangement of said office source in said line circuit at a particular time, a sectionalizing relay at said intermediate field station, circuit means controlled by said sectionalizing relay when it is energized for opening said line circuit at said intermediate field station between said control line relay at that station and the point at which said detector relay is connected across said line circuit and for shunting said line circuit on the control office side of such opening, and means rendered effective a predetermined time after the deenergization of said detector relay for energizing said sectionalizing relay.

4. In a remote control system including a control office, an intermediate field station and a most remote field station, a control line relay at the control office and at each of the field stations, a line circuit connecting said control line relays in series, a normally inactive transmitting means at the control office including a source of current effective when set into operation to energize said line circuit with a control code comprising a

series of positive and/or negative current impulses, a detector relay connected across said line circuit on the remote side of the control line relay at said intermediate field station, said detector relay being of the high resistance low potential type, means including a field source at said most remote field station for applying a potential to said line circuit of a value sufficient to operate said detector relay but insufficient to operate said control line relays and also insufficient to interfere with the control of said control line relays by said office source of current irrespective of the polarity arrangement of said office source in said line circuit at a particular time, a sectionalizing relay at said intermediate field station, circuit means controlled by said sectionalizing relay when it is picked up for opening said line circuit between the control line relay at said intermediate field station and the point at which said detector relay is connected to said line circuit and for shunting said line circuit on the control office side of such opening, pick-up circuit means rendered effective a predetermined time after the deenergization of said detector relay for initially energizing said sectionalizing relay, stick circuit means for said sectionalizing relay for maintaining its energization so long as said detector relay is deenergized, and means controlled by said control line relay at said intermediate field station for disconnecting said detector relay from said line circuit and opening said pick-up circuit means for said sectionalizing relay during each series of impulses impressed on said line circuit by said transmitting means.

5. In a remote control system, a line circuit connecting a control office and a plurality of field stations, a control line relay connected in series in said line circuit at said control office and at each of said field stations, normally inactive transmitting means at the control office for at times energizing said line circuit with different series of positive and negative impulses from a source of current located at the control office, a detector relay at an intermediate field station connected in multiple across said line circuit on the side of said control line relay remote from said control office, said detector relay being of relatively high resistance but requiring a relatively low potential across said line circuit for its operation, means including a source of current at the most remote field station and governed by said control line relay at that station for applying a potential to said line circuit during the time between any two series of impulses and for removing said potential during any series of impulses but maintaining the continuity of said line circuit, said potential being of a value sufficient to operate said detector relay but insufficient to operate said control line relays, a sectionalizing relay at said intermediate field station, circuit means controlled by said detector relay when it is deenergized and by said control line relay at the intermediate field station for initially energizing said sectionalizing relay only if said control line relay is not receiving a series of impulses, circuit means for maintaining said sectionalizing relay energized so long as said detector relay is deenergized, and circuit means controlled by said sectionalizing relay when it is energized for opening said line circuit between said control line relay at said intermediate field station and the point at which said detector relay is connected and for shunting said line circuit on the control office side of such open condition.

6. In a remote control system, a control office

and a plurality of field stations, a control line relay at the control office and at each of the field stations, a line circuit extending between the control office and the field station for connecting all of said control line relays in series, transmitting means at the control office effective when initiated into operation for transmitting different series of positive and/or negative current impulses over said line circuit, a detector relay at an intermediate station connected across the line circuit at that station on the side of the control line relay at such station remote from the control office, a sectionalizing relay at said intermediate field station, circuit means controlled by said sectionalizing relay at said intermediate field station for opening said line circuit extending to the more remote field stations and for shunting said line circuit so as to render said control relay at that station energizable from the control office by said transmitting means, said opening and shunting of said line circuit being located between the control line relay for that station and the point of connection of said detector relay across said line circuit, means at the most remote field station including a source of energy for energizing said line circuit at a relatively low potential insufficient to operate said control line relays but of a sufficient value to operate said detector relay, circuit means at said intermediate field station responsive to the deenergization of said detector relay for a predetermined time to effect the initial energization of said sectionalizing relay and maintaining it energized until said detector relay is again energized, means at said intermediate field station governed by its control line relay in response to the application of a series of impulses to said line circuit by said transmitting means for disconnecting said detector relay from said line circuit and rendering it ineffective to energize said sectionalizing relay, and means at the most remote field station governed by its control line relay for removing its source or energy from said line circuit but effective to maintain the continuity of said line circuit, said means acting in response to any series of impulses applied to said line circuit during the operation of said transmitting means at the control office.

7. In a sectionalizing system for a series line circuit connecting a control office and a plurality of field stations; apparatus for any given one or more of said field stations for sectionalizing the line circuit at that station or stations including at each such station a detector relay connected in multiple across said line circuit on the side of a series control line relay at that station more remote from said control office; sectionalizing means initially responsive to the deenergization of said detector relay only after a predetermined time and only if the control line relay is not receiving a series of impulses for opening said line circuit between the control line relay at that station and the point at which said detector relay is connected across said line circuit, said means also shunting the control office side of the open point in said line circuit so as to render the control line relay at that station available for energization, said means also remaining effective until said detector relay is again energized; means controlled by said control line relay for rendering said detector relay disconnected from said line circuit and rendering the initial control of said sectionalizing means by said detector relay ineffective; and means controlled by said line relay only if said sectionalizing means at that

station is effective for applying a potential to the control office side of said line circuit sufficient to operate a detector relay but insufficient to operate a control line relay, said means removing said potential during the reception of a series of impulses by said control line relay but also maintaining the continuity of said control line circuit as shunted by said sectionalizing means.

8. In a remote control system, a control office and a plurality of field stations, a polarized control line relay at each of the field stations, a line circuit connecting the control office and the several field stations and including said polarized line relays in series, code transmitting means at the control office for transmitting different series of positive and negative impulses over said line circuit, a detector relay at certain of said field stations connected across said line circuit and responsive to a lower potential than said line relays, means at the most remote field station for applying a potential to said line circuit sufficient to operate said detector relays but insufficient to operate said control line relays, sectionalizing means at each of said certain field stations for opening said line circuit on the remote side of the control line relay at its respective field station and shunting said line circuit to render the line circuit closed on the control office side of such open condition; means for initially rendering said sectionalizing means active when said detector relay at its station is deenergized only providing said control line relay at that station is inactive but causing said sectionalizing means to remain active so long as said detector relay is deenergized, means at each of said certain field stations for disconnecting said detector relay at its station from said line circuit in response to a series of impulses on said line circuit and also for preventing the initial control of said sectionalizing means at that station by said detector relay, and means at each of said certain field stations for applying a potential to said line circuit on the control office side only if the sectionalizing means at that station is active and only while said control line relay at that station is inactive said potential being sufficient to operate said detector relays but insufficient to operate said control line relays.

9. In a remote control system, a control office and a plurality of field stations, a line circuit including in series electro-responsive means at said control office and at each of said field stations, a source of energy at said control office, circuit means for energizing said line circuit

from said source with different series of impulses, means including a field source for energizing said line circuit from the field station most distant from said control office during the time between each of said series of impulses, said field source having insufficient potential to energize said electro-responsive means, a first relay shunted across said line circuit at an intermediate station and responsive to the energization of said line circuit from the field source at said field station between series of impulses and disconnected from said line circuit during series of impulses, a second relay responsive to the deenergization of said first relay for a predetermined time only if said first relay is then connected to said line circuit for shunting out the section of said line circuit extending beyond that intermediate station from said control office, whereby an open condition in said line circuit can be detected between said series of impulses and whereby said line circuit can be automatically sectionalized.

10. In a remote control system, a control office and several field stations, a line circuit including in series a line relay for each of said field stations, circuit means for energizing said line circuit with different series of electrical impulses from an office source at said control office, means for energizing said line circuit from a field source at the most distant field station during the time between each of said series of impulses, said field source being of insufficient potential to energize said line relays, a detector relay connected across said line circuit at an intermediate station responsive to the energization of that line circuit from the field source at said most distant station between series of impulses and disconnected from said line circuit during each series of impulses, a sectionalizing relay responsive to the deenergization of said detector relay for a predetermined time when said detector relay is not disconnected from said line circuit for shunting out the portion of said line circuit which extends beyond that intermediate station from said control office, and circuit means for maintaining said means for shunting effective only while said detector relay is deenergized, whereby a break in said line circuit can be detected, whereby said line circuit can be automatically sectionalized, and whereby the portion shunted out by such sectionalization can be automatically restored to the other portion of the line circuit when the circuit is again closed at the point of that break.

WILLIAM D. HAILES.