

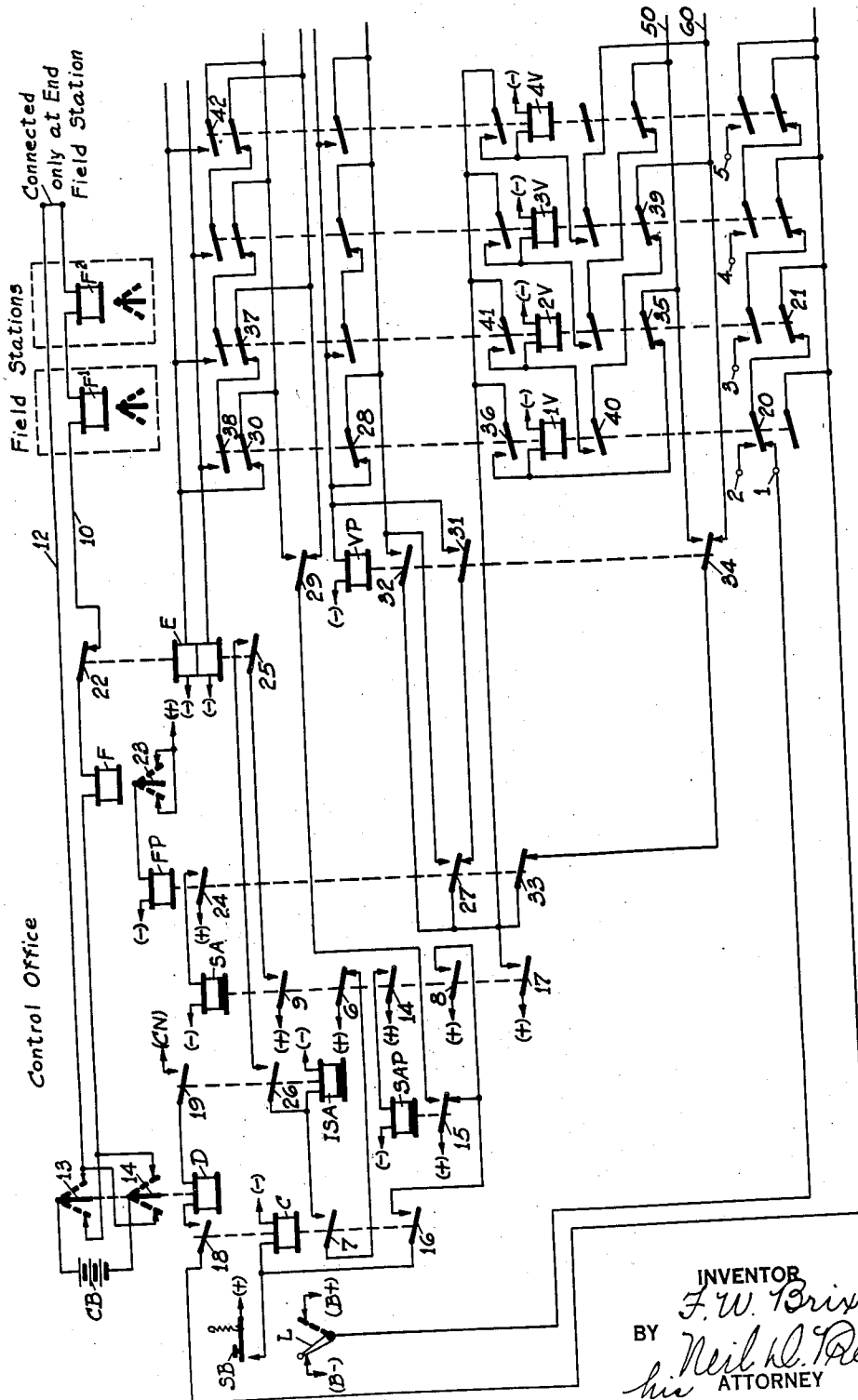
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CENTRALIZED TRAFFIC CONTROLLING SYSTEMS

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CENTRALIZED TRAFFIC CONTROLLING SYSTEM

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This invention relates to centralized traffic control systems for governing traffic on railroads, and more particularly pertains to the communication part of such systems.

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 to indicate the connections to the terminals of batteries or other suitable sources of electric current instead of showing all of the wiring connections to these terminals.

5 In a centralized traffic control system of the type contemplated by this invention, communication is established between a central control office and a large number of outlying field stations by means of a coded type communication system over which the various traffic controlling devices at the several outlying field stations are governed by an operator in the control office. In a communication system of the coded type, a plurality of series of impulses of different code combinations are transmitted over the line wires connecting the control office and the field stations for first selecting the field stations and then for transmitting the controls to the particular station which is selected. In a system of this type, the selective apparatus at the control office and at the field station is resynchronized automatically at the end of each series of impulses by reason of the absence of impulses for a prolonged period between successive series.

The symbols (+) and (−) are employed to indicate the positive and negative terminals respectively of suitable batteries, or other sources of direct current; and the circuits with which these symbols are used, always have current flowing in the same direction. The symbols (B+) and (B−) indicate connections to the opposite terminals of suitable batteries, or other direct current sources which have central or intermediate taps designated (CN); and the circuits with which these symbols are used, may have current flowing in one direction or the other depending upon the particular terminal used in combination with the intermediate tap (CN).

Communication system generally.—A centralized traffic control system in which the present invention is more particularly useful, consists of a control office and a large number of outlying field stations. Communication is established between the control office and the field stations for the transmission of controls to govern the traffic controlling devices at the field stations, and for the transmission of indications to give indications in the control office of the condition of the operated devices and the location of trains.

This communication is established over a selector or coded type communication system in which a small number of line wires is employed and in which selective communication between the control office and a particular field station is established by the transmission of suitable codes. These features of transmission have been disclosed in various types of systems, such for example as shown in the application of N. D. Preston et al., Ser. No. 455,304, filed May 24, 1930. Thus, it is considered sufficient for an understanding of the present invention, to merely illustrate how controls, for example, may be transmitted over a line circuit.

With reference to the accompanying drawing, a control office has been illustrated as connected with two outlying field stations by a line circuit including a control line wire 10 and a common return line 12. These line wires are employed to complete what is termed a control line circuit including a three position polarized biased-to-neutral line relay F at the control office and at each of the outlying field stations.

In the control office, a control battery CB is provided to energize the control line circuit with impulses, the polarities of which are selected by

10 In accordance with the present invention, it is proposed to provide means by which the system may not only be resynchronized at the end of each cycle or series of impulses, but also may be resynchronized irrespective of whether the system fails to continue a cycle during the application of an impulse or between two successive impulses. Other features of the present invention reside in the various specific circuit arrangements particularly adaptable for systems of this type.

15 These characteristic features of the invention thus briefly stated, will be explained more in detail in the following description of one embodiment of the invention; and various other characteristic features, functions and advantages of a system embodying this invention will be in part pointed out and in part apparent as the description progresses.

In describing the invention in detail, reference will be made to the accompanying drawing, in which the various parts are designated by suitable reference characters, and in which:—

The accompanying drawing illustrates in a diagrammatic manner the apparatus and circuits provided in accordance with the present invention in a control office of a coded type communication system.

For the purpose of simplifying the illustration, and facilitating in the explanation, the various parts and circuits constituting the embodiment of the invention have been shown diagrammatically and certain conventional illustrations have been employed, the drawing having been made more with the purpose of making it easy to understand the principles and mode of operation, than with the idea of illustrating the specific

a polarity determining relay D. The time spacing between these impulses of selected polarity is measured by an impulsing relay E in combination with a stepping relay bank which is responsive to the impulses applied to the line circuit. This stepping relay bank includes stepping relays 1V, 2V, 3V and 4V together with a half step relay VP.

The control of the stepping relay bank is accomplished by a neutral line repeating relay FP, which is energized each time the line relay F is energized, irrespective of the particular polarity of such energization, together with a slow acting relay SA which is picked up at the beginning of a cycle of operation and is dropped at the end of such cycle of operation. A relay SAP is a repeater of the relay SA.

A starting button SB is provided for actuating a starting relay C, which stores the momentary actuation of the starting button SB and causes the system to be initiated into a cycle of operation. As representative of how the character of the impulses transmitted over the control line circuit may be selected in accordance with the position of code jumpers and control levers, a single control lever L has been illustrated as determining the character of the first impulse of a series, the remaining impulses being determined in accordance with the position of other suitable controlling contacts.

An inverse slow acting relay ISA is employed in combination with the slow acting relay SA for restoring the system to normal conditions irrespective of the particular part of a cycle in which the operation is interrupted.

Although the control office has been illustrated in a rather specific manner and the field stations have been merely indicated by dotted rectangles including three position polar line relays, it is to be understood that suitable selecting apparatus is associated with the three position polarized line relays at each of the field stations, all of which will be well understood by those skilled in the art.

The control office and field stations include various sources of current supply, indicator lamps or the like, bus wires, and such other devices and circuit connections as may be required for the proper functioning of such a communication system.

It is believed that further description of the present invention will be best set forth by the description of various characteristic or typical operations of the system.

Operation

The system of the present invention is normally in a condition of rest, but may be initiated into a cycle of operation from the control office whenever there are controls ready to be transmitted. When a cycle of operation is initiated for the transmission of controls, a plurality of distinctive impulses are placed upon the control line circuit to accomplish the step-by-step operation at the control office and at the several stations to select the desired station and to transmit the controls of that selected station.

The application of a plurality of impulses to the control line circuit, irrespective of their character, to comprise a cycle of operation causes the step-by-step operations of the stepping relay banks. In the control office, the operation of the stepping relay bank is associated with the impulsing relay E in such a manner as to cause the impulses to be applied to the control line circuit

at time spaced intervals in accordance with the actual response of the system.

Insofar as the embodiment of the present invention is concerned, the circuits are normally de-energized.

Initiation of the system.—The system may be initiated by the actuation of the starting button SB following of course the proper positioning of the control levers in accordance with the controls desired to be transmitted to a selected field station. Although only a single starting button SB has been illustrated, and although the lever L is illustrated as controlling the character of the first impulse, it is to be understood that there is a group of code jumpers and control levers for each field station and a starting button SB for each of these groups with a code determining bank of relays provided, so that only one group of code jumpers and control levers is effective to govern the character of the impulses of any one cycle of operation. Also the starting buttons are so arranged with storing relays in combination with the code determining relays, that irrespective of the number of starting buttons which are actuated at any one time or in rapid succession, only one particular group of levers is rendered effective, all of which has been disclosed for example in the above mentioned application of Preston et al., Ser. No. 455,304.

However, as typical of all such starting operations, it is considered sufficient for an understanding of the present invention to know that the actuation of a starting button SB results in the energization of the starting relay C. Although such energization of the relay C may be accomplished indirectly through the medium of the code determining means and interlocked bank of relays (above mentioned, but not shown), it is considered sufficient to disclose the present invention to illustrate the relay C as energized through a pick-up circuit closed directly by the starting button SB.

This pick-up circuit for relay C is closed upon the actuation of the starting button SB from (+), through a circuit including the back point of the starting button SB, windings of the relay C to (—). As soon as the contacts of the relay C respond to its energization, a stick circuit is closed from (+), through a circuit including back contact 15 of relay SAP, front contact 16 of relay C, windings of relay C to (—).

The picking up of the contacts of the relay C closes a pick-up circuit for the inverse slow acting relay ISA from (+), through a circuit including back contact 6 of slow acting relay SA, front contact 7 of starting relay C, windings of slow acting relay ISA, to (—).

With the starting relay C already picked up with its front contact 18 closed, a circuit for the polarity determining relay D is completed at front contact 19 as soon as the inverse slow acting relay ISA responds to its energization; while the particular polarity with which the relay D is energized is dependent upon the code jumpers and control contacts selected by the stepping relay bank. It is to be understood, of course, that only one group of code jumpers and control levers may be effective for any one cycle of operation.

Polarity selection of impulses

Assuming for the time being that the impulsing of the line circuits results in the step-by-step operation of the stepping relay bank, the operation of which will be explained later, we may

consider the selection of the polarities of the various impulses of the cycle.

Upon the closure of front contacts 18 and 19 of relays C and ISA respectively, the relay D is successively connected to a series of terminals 5 selected through the stepping relay bank, including relays 1V, 2V, 3V and 4V, in such a way that the relay D is connected to terminal 1 before the first step is taken; is connected to terminal 2 10 when the first stepping relay 1V is picked up; is connected with terminal 3 when the second stepping relay 2V is picked up; is connected to terminal 4 when the third stepping relay 3V is picked up; and is connected to the terminal 5 when the 15 stepping relay 4V is picked up.

In actual practice, those particular code jumpers and control levers which are selected by the code determining means, are connected to these terminals 1, 2, 3, 4 and 5 in such a way that positive or negative potentials will be applied to the relay D dependent upon the particular position of the code jumper or the control lever selected by the stepping relay bank.

Representative of such control, the control lever L is illustrated as connected to the terminal 1, so that immediately upon the closure of front contact 19 of relay ISA, the relay D is energized with a polarity dependent upon the position of this lever L.

For example, with the lever L in a left-hand position, a circuit is closed from (B-), through a circuit including lever L in a left-hand position, terminal 1, back contact 20 of relay 1V, back contact 21 of stepping relay 2V, front contact 18 of starting relay C, winding of polarity determining relay D, front contact 19 of the inverse slow acting relay ISA to (CN). This energization of the relay D causes its contacts 13 and 14 to be actuated to left-hand positions thereby applying negative potential to the line circuit from the control battery CB. This energization of the line circuit is repeated by the three position biased to neutral polar line relays F at the control office and at each of the field stations.

After the energization of the line circuit for a sufficient period of time, measured off as hereinafter described, the relay E is energized thereby opening back contact 22 and causing the de-energization of the line circuit. While the contact 22 is open, the first stepping relay is picked up connecting the relay D to the terminal 2 through front contact 20 of stepping relay 1V and back contact 21 of stepping relay 2V, so that the relay D assumes a position in accordance with the polarity applied to this terminal 2. Thus, upon the closure of back contact 22 of the impulsing relay E, the proper polarity is applied to the line circuit.

Similarly, upon the remaining steps marked off by the stepping relay bank, the control of the relay D is shifted to the succeeding terminals 3, 4 and 5 during the de-energized condition of the line circuit, so as to prepare the relay D prior to the closure of the line circuit.

Impulsing and step-by-step operation

Each impulse applied to the line circuit is repeated by the three position biased to neutral polar line relays F at the control office and at each field station. The particular character of each impulse is effective to accomplish the desired control at the field stations on the corresponding step of the cycle.

However, irrespective of the particular polarities of the impulses of a cycle, the system is so arranged that the half-step relay VP at each location assumes a new position for each energized condition of the line circuit, and the associated stepping relay bank takes one step for each de-energized period of the line circuit. In order to accomplish this, a quick acting line repeating relay FP is provided at the control office and at each field station for repeating each impulse applied to the line circuit regardless of its character (relays VP and FP at the field stations are not shown).

For example, the relay FP in the control office repeats the energized condition of the relay F with polar contact 23 in either a right-hand or a left-hand position.

At the beginning of a cycle, the repeating of the first impulse by the relay FP closes front contact 24 and energizes the slow acting relay SA which after a time picks up. This slow acting relay SA is so designed that its pick-up time is somewhat longer than the other neutral relays of the system (for example, relay FP), but such pick-up time is relatively short compared to its drop-away time. This prolonged drop-away time for the slow acting relay SA is sufficiently long to maintain its contacts in picked up positions between its successive energizations during a cycle of operation.

The picking up of the contacts of the relay SA closes front contact 14 energizing slow-acting repeating relay SAP, which is a slow release relay. As the relay SA picks up before the relay SAP, the stick circuit for the relay C is maintained closed from (+), through a circuit including front contact 8 of relay SA, front contact 16 of relay C, windings of relay C to (-). In other words, when the relays SA and SAP are picked up successively, the stick circuit for the relay C is maintained energized, but when the relays SA and SAP are de-energized successively in that order, the stick circuit for the relay C is momentarily opened. Thus, the relay C is picked up at the beginning of a cycle and is maintained energized throughout that cycle, until the relays SA and SAP are de-energized successively, as later explained.

The opening of back contact 6 of slow acting relay SA at the beginning of a cycle of operation causes the inverse slow acting relay ISA to be dependent upon the operation of the relay E for opening the line circuit. In order words, the relay E is periodically picked up for opening the line circuit and upon each such operation, the relay ISA is energized by reason of a circuit from closed (+), through a circuit including front contact 9 of relay SA, front contact 25 of relay E, front contact 26 of relay ISA, windings of relay ISA, to (-).

The inverse slow acting relay ISA has slow acting characteristics similar to the relay SA, that is, it is slow in picking up while its drop-away period is relatively longer than its pick-up period. This lengthened drop-away period is sufficiently long to maintain its contacts picked up between the successive de-energizations of the line circuit.

In other words, the line circuit is energized with time spaced impulses throughout a cycle of operation. These impulses are repeated so as to energize the slow acting relay SA periodically, while the de-energized condition between successive impulses, as caused by the relay E, periodically energizes the relay ISA. Thus, the relay SA, which marks off the cycles of operation, is dependent upon the occurrence of successive impulses; while the inverse slow acting relay ISA which also marks

off the cycle of operation, is dependent upon the occurrence of successive openings of the line circuit.

The step-by-step operation of the relay bank in the control office is made dependent upon the relay SA; while the energization of the line circuit is made dependent upon the relay ISA. Thus, should the next impulse in a cycle of operation fail to be applied, the relay SA would be de-energized and return the system to normal; while if an impulse in a cycle of operation fails to be removed, the relay ISA is de-energized and returns the system to normal. These functions of the relays SA and ISA will be more readily apparent as the further operation of the system is set forth.

At the beginning of the cycle of operation, after the SA relay is picked up upon the application of the first impulse, the VP relay is energized by a circuit from (+), through a circuit including front contact 17 of relay SA, front contact 27 of relay FP, back contact 28 of relay 1V, windings of relay VP, to (-).

The picking up of the contacts of the relay VP occurs during the pick-up period of the relay SAP, but as soon as the relay SAP has responded to the closure of front contact 14 of relay SA an energizing circuit is completed for the impulsing relay E from (+), through a circuit including front contact 15 of relay SAP, front contact 29 of relay VP, back contact 30 of relay 1V, upper winding of the relay E, to (-). The picking up of the relay E opens the control line circuit marking the end of the first impulse. Also, the closure of front contact 25 of the relay E energizes the inverse slow acting relay ISA, as previously mentioned.

The de-energization of the control line circuit is repeated by the relays F and FP, but the relay SA is sufficiently slow acting to maintain its contacts in picked up positions between successive energizations of the control line circuit, as repeated by the relay FP.

With the control line de-energized, the half step relay VP is maintained energized through a stick circuit from (+), through a circuit including front contact 17 of relay SA, back contact 27 of relay FP, front contact 31 of relay VP, windings of relay VP, to (-).

While the contact 27 of relay FP is changing from a front point to a back point thereby transferring the energization of a relay VP from its pick-up circuit to its stick circuit, the relay VP is energized by another stick circuit closed from (+), through a circuit including front contact 17 of relay SA, front contact 32 of relay VP, back contact 28 of relay 1V, windings of relay VP, to (-). This is possible in as much as the relay 1V does not pick up until the relay FP is de-energized and the stick circuit of relay VP including front contact 31 has already been closed. In other words, the stick circuit of relay VP including its front contact 32 allows contact 27 to be a regular contact instead of the make-before-break type. Also, upon the de-energization following the first impulse, the first stepping relay 1V is energized by a circuit closed from (+), through a circuit including front contact 17 of relay SA, back contact 33 of relay FP, front contact 34 of relay VP, back contact 35 of relay 2V, windings of relay 1V, to (-). As soon as the contacts of the relay 1V are picked up, a stick circuit is closed from (+), through a circuit including front contact 17 of relay SA, front contact 36 of relay 1V, windings of relay 1V, to (-).

The picking up of the relay 1V opens the energizing circuit for the relay E at back contact 30 and at the same time connects the relay D to the terminal 2, which has positive or negative energy applied thereto depending upon the control desired to be transmitted. Thus, upon the closure of back contact 22 of relay E, the second impulse of selected polarity is applied to the line circuit. The repeating of this impulse by the relay FP opens its back contact 27 and drops the relay VP, as there can be no pick-up circuit closed with only the first stepping relay 1V picked up.

The deenergization of the relay VP closes an energizing circuit for the relay E from (+), through a circuit including front contact 15 of relay SAP, back contact 29 of relay VP, back contact 37 of stepping relay 2V, front contact 38 of stepping relay 1V, lower winding of relay E, to (-).

The relay E again picks up its contacts opening the line circuit, and simultaneously energizing the inverse slow-acting relay ISA through front contact 25.

The deenergization of the control line circuit following the application of the second impulse, energizing the second stepping relay 2V by a circuit closed from (+), through a circuit including front contact 17 of relay SA, back contact 33 of relay FP, back contact 34 of relay VP, back contact 39 of relay 3V, front contact 40 of relay 1V, windings of relay 2V, to (-). The picking up of the contacts of the relay 2V closes a stick circuit from (+), through a circuit including front contact 17 of relay SA, front contact 41 of relay 2V, winding of relay 2V, to (-). The picking up of the relay 2V opens the energizing circuit for the relay E again causing the control line to be energized with a selected polarity, as previously explained.

Similar step-by-step impulsing of the control line circuit with selected polarities continues throughout the cycle of operation until the fourth stepping relay is picked up and the fifth impulse has been applied to the control line circuit, when the relay E is energized by a circuit closed from (+), through a circuit including front contact 15 of relay SAP, front contact 29 of relay VP, front contact 42 of relay 4V, upper windings of relay E, to (-).

This energization of the relay E opens the line circuit, but as the relay 4V is the last stepping relay, the relay E continues to be energized which prolongs the deenergized condition of the line until the relay SA drops. The dropping of the relay SA opens the stick circuits of the stepping relays and half step relay VP at front contact 17, as well as the stick circuit for the relay C at front contact 8. Thus, the relay C and the stepping relays assume deenergized positions at substantially the same time, but as the relay SAP is somewhat slow in releasing the relay E is not deenergized until the stepping relays and the half stop relay VP have dropped simultaneously. Thus, the relay D has plenty of time, as it is quick acting, to assume its biased to neutral position in response to the opening of front contact 18, while the relay E is dropping away and before the back contact 22 of relay E closes.

The system is thus restored to normal until the starting relay C is again energized in response to a starting button.

From the above description, it will be readily apparent that the stepping relay bank is made

dependent upon the energized condition of the relay SA; while the energization of the polarity determining relay D is made dependent upon the inverse slow acting relay ISA. Thus, the dropping of the relay SA upon the continued deenergization of the control line circuit causes the stepping relay bank to be deenergized, and prevents the operation of the half step relay VP and impulsing relay E, and thereby restores the system to normal at rest conditions. Similarly, the continued energization of the control line circuit causes the drop away of the inverse slow acting relay ISA, which then opens the energizing circuit for the polarity determining relay D, thus de-energizing the control line circuit. This de-energization of the control line circuit effects the de-energization of the slow acting relay SA, and thereby returns the system to a normal resynchronized condition.

In other words, irrespective of whether a cycle of operation ceases to continue during the application of an impulse or during the absence of an impulse, one or the other of the slow acting cycles marking relays is de-energized and the dropping away of its contacts causes the system to be resynchronized or returned to normal at rest conditions.

Also, it can be seen that upon each energization of the control line circuit, the contacts of the relay VP assume new positions and upon each deenergization of the control line circuit the stepping relay bank takes one step. In other words, the control contact 34 of the relay VP causes the buses 50 and 60 to be alternately energized upon successive closures of back contact 33 of relay FP. The pick-up circuit of each stepping relay includes a front contact of the preceding stepping relay and a back contact of the succeeding stepping relay. These contacts for each circuit are made individual to that particular pick-up circuit, so that the number of contacts in the pick-up circuit for each stepping relay is the same (with the exception of the first and the last relays for each bank). Such an arrangement has the advantage that a long chain of contacts is not included in the various pick-up circuits thereby increasing the resistance of the circuits and reducing their reliability.

It will be noted that a similar arrangement is provided for the control of the relay E and the control of the relay VP, namely, that the fronts and backs of the stepping relays for the respective circuits are employed individually and only a front on one relay and the back on the succeeding relay is used. In other words, the present invention provides what may be termed a chain circuit for closing channel circuits upon successively without the use of a contact on each and every stepping relay of the bank included in each of the circuits.

A communication system has thus been described which is capable of resynchronization irrespective of where the operation fails to continue. Also, various circuit improvements for the control of such a selector type system have been provided.

Having described a centralized traffic control system as one 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 centralized traffic controlling system for railroads, a line circuit, a polarity determining relay having pole changing contacts included in said line circuit, an impulsing relay having a contact for opening said line circuit, means controlled by said polarity determining relay and said impulsing relay for impulsing said line circuit, step-by-step means responsive to impulses on said line circuit for operating said impulsing relay, a slow acting relay periodically energized by said impulses on said line circuit, whereby it is picked up at the beginning of a series of impulses and is dropped at the end of said series, an inverse slow acting relay periodically energized by said impulsing relay each time said line circuit is opened, whereby said inverse slow acting relay is picked up at the beginning of a series of impulses and is dropped at the end of said series, a first means including said slow acting relay for governing said impulsing relay, a second means including said polarity determining relay for governing said inverse slow acting relay, and means responsive to said first and said second means for preventing the impulsing of said line circuit.

2. In combination; a line circuit; a repeating relay for repeating the condition of said line circuit; means including an impulsing relay for controlling the energization of said line circuit; a first slow acting relay having an energizing circuit closed by a front contact of said repeating relay; a second slow acting relay energized by a back contact of said first slow acting relay and having an energizing circuit closed by its own front contact, a front contact of said first slow acting relay and a front contact of said impulsing relay; and other means controlled by said first and second slow acting relays for controlling the energization of said line circuit.

3. In combination; a line circuit; a line repeating relay for repeating the energized and deenergized condition of said line circuit; an impulsing relay for opening and closing said line circuit; a first slow acting relay having an energizing circuit including a front contact of said line repeating relay; a second slow acting relay having an energizing circuit including its own front contact, a front contact of said first slow acting relay and a front contact of said impulsing relay; a step-by-step means having energizing circuits including a front contact of said first slow acting relay and a back contact of said line repeating relay, said step-by-step means controlling said impulsing relay to open said line circuit after each step; and starting means effective to start impulsing by energizing said line circuit and said second slow acting relay only while said first slow acting relay is retracted but if once rendered effective to be maintained effective by said first and second slow acting relays until the impulsing ceases; whereby the response of the impulsing relay and step-by-step means must occur above a predetermined rate determined by the timing characteristics of said first and second slow acting relays.

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