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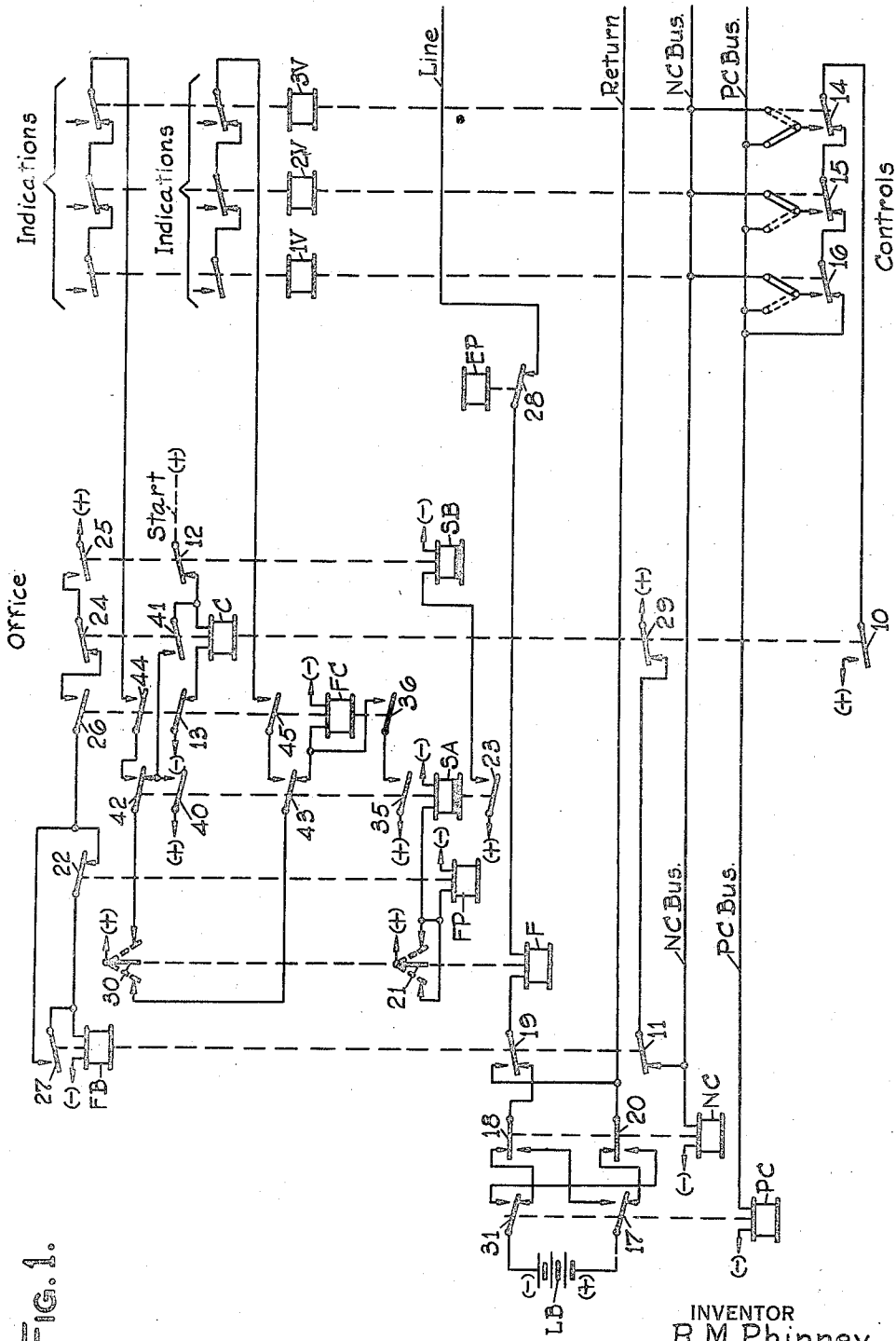
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2,132,126

CENTRALIZED TRAFFIC CONTROLLING SYSTEM FOR RAILROADS

Filed March 30, 1937

2 Sheets-Sheet 1



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Oct. 4, 1938.

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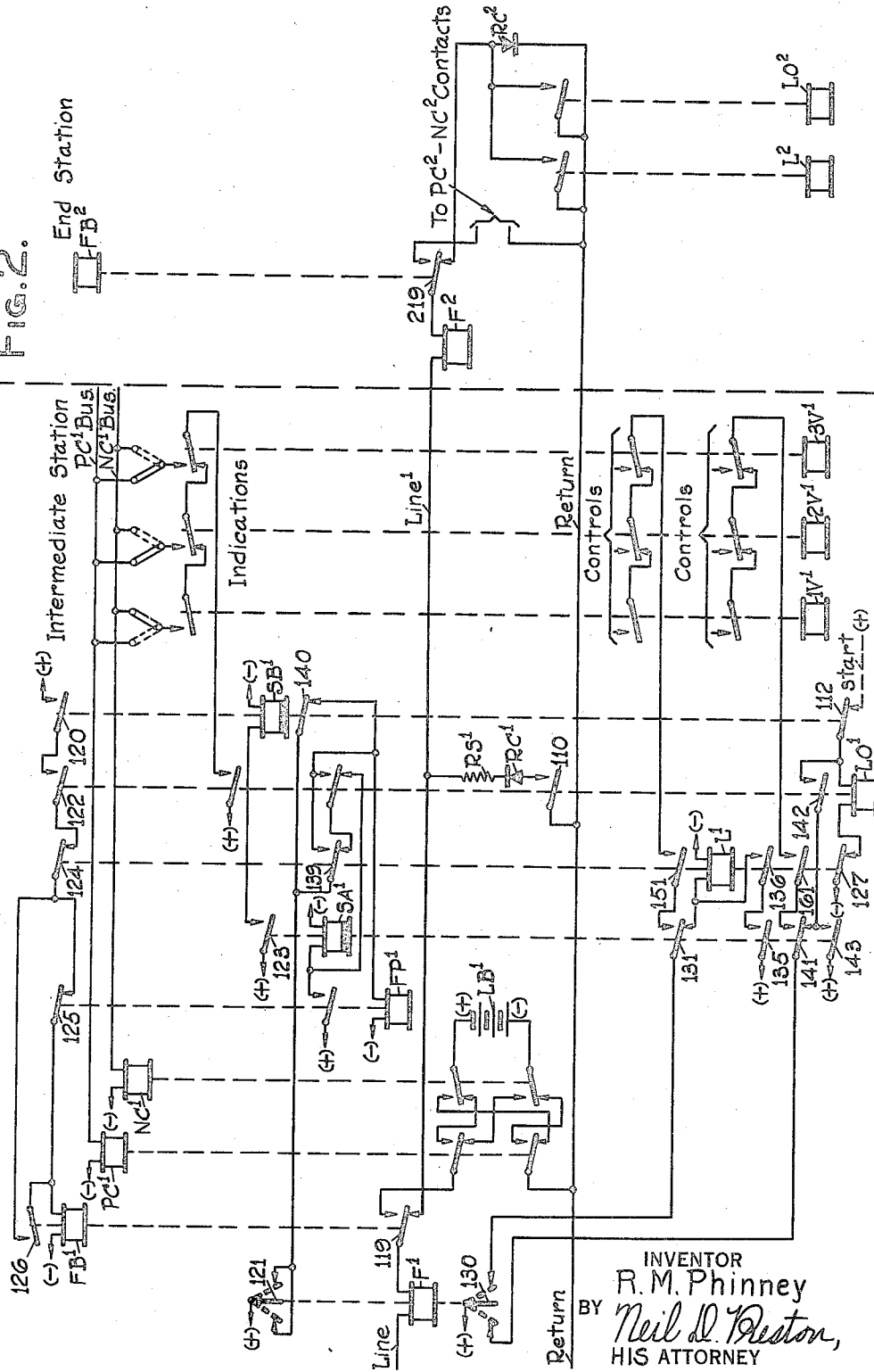
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CENTRALIZED TRAFFIC CONTROLLING SYSTEM FOR RAILROADS

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2 Sheets-Sheet 2

FIG. 2.



UNITED STATES PATENT OFFICE

2,132,126

CENTRALIZED TRAFFIC CONTROLLING
SYSTEM FOR RAILROADSRobert M. Phinney, Rochester, N. Y., assignor to
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Application March 30, 1937, Serial No. 133,856

8 Claims. (Cl. 177—353)

This invention relates to remote control systems of the type involving a control office and a plurality of remote field stations connected by a single line circuit and it more particularly pertains to the communication part of a centralized traffic controlling system for railroads.

This invention is in the nature of an improvement over the lockout feature disclosed in Judge Patent 2,045,713 issued June 30, 1936, and I propose to claim only the improvement herein. This invention is also in the nature of an improvement over the application of Preston, Ser. No. 179,982, having an effective filing date of May 16, 1936, which does not employ a lockout feature but does employ a rectifier in the line circuit, and no claim is made herein to any invention disclosed in said Preston application.

The present invention contemplates a centralized traffic controlling system, in which the switches and signals at a plurality of stations, located along a railroad trackway, are controlled from the control office and their indications are transmitted to the control office, by means of a two wire line circuit.

One object of the present invention is the provision of a novel lockout arrangement in a centralized traffic controlling system, whereby only one station is given access to the communication system, in the event that two or more stations attempt to send indications at the same time.

Another object of the present invention relates to an improved means for giving preference to the sending of controls from the office, when a station has indications ready for transmission at the same time the office has controls ready to send.

Other objects and advantages of the present invention will be hereinafter set forth in the specification and claims and further details will be better understood by referring to the accompanying drawings, which illustrate one method of carrying out the invention by way of example.

The drawings illustrate in a diagrammatic manner the apparatus and circuits used in connection with the two wire line circuit for the provision of the novel lockout features above mentioned. For convenience in describing the invention in detail, those parts having similar features and functions are designated in the different figures by like reference letters, generally made distinctive either by the use of distinctive exponents representative of their location, or by the use of suitable preceding numerals repre-

sentative of the order of their operation, and in which:—

Fig. 1 illustrates the apparatus and circuits most closely related to the line circuit and located at the control office.

Fig. 2 illustrates the apparatus and circuits most closely related to the line circuit and located at a field station. A small portion of the apparatus and circuits at the end station of the system is illustrated in the right hand portion of Fig. 2, in order to indicate how the two wire line circuit is terminated at the last station of the series.

The present invention is shown in abbreviated form in the drawings, since it discloses a means for providing the lockout features in a normally deenergized two wire line system of the simplex type, such for example as disclosed in Judge Patent No. 2,045,713. This patent shows a source of current at the office and a separate source of current at each station, reversibly connected to the line for providing outbound coded polar control impulses and inbound coded polar indication impulses.

In describing the present invention, it will be understood that the two wire line circuit of the above mentioned Judge patent is modified as shown in the accompanying drawings to provide the desired operation. For example, the polar CS relays of the Judge patent are replaced by neutral type relays PC and NC, operated in the manner and for the purpose of applying polar control impulses to the line circuit, as shown for example, in Patent No. 2,082,544 dated June 1, 1937.

With the above in mind, it will now be explained how the lockout features of the present invention are provided.

Control office equipment.—The control office (Fig. 1) includes a quick acting polar line relay F, which maintains its contacts in their neutral positions when the line circuit is deenergized, positions its contacts to the right when a positive impulse is applied to the line from the control office and positions its contacts to the left when a negative impulse is applied to the line from the control office.

A quick acting line repeating relay FP of the neutral type repeats each energization of relay F, irrespective of the polarity of the impulse which energizes relay F. Slow acting relay SA is energized each time relay F operates its contacts to the right or left and, due to its slow acting characteristics, relay SA remains in its picked up position during the intervals between the impulses which are applied to the line circuit. Relay SA

is energized at the beginning of a cycle, remains picked up throughout the cycle and is dropped away at the end of the cycle, when the line circuit is deenergized for a comparatively long interval of time. Relay SB, also of the slow acting type, repeats the position of relay SA, that is, relays SA and SB are picked up in sequence at the beginning of a cycle and are dropped out in sequence at the end of the cycle.

Code sending relays PC and NC are selectively operated during a cycle for determining the polarity of the impulses applied to the line circuit, by means of their pole changing contacts. Office start relay C is picked up at the beginning of a cycle initiated at the control office and is stuck up throughout such a cycle. Field start relay FC is picked up at the beginning of a cycle initiated from a field station and is stuck up throughout such a cycle. Relay EP provides the time spaced impulses in the line circuit.

The purpose of relay FB is to transfer the line circuit from the source of current in the office to a closed circuit condition, by being picked up at the start of an indication cycle, so that the line circuit may be energized from the field station source of current. A bank of stepping relays IV, 2V and 3V serve to mark off the steps of each cycle of operations, that is, a stepping relay is picked up during each time space between impulses for selecting the PC or NC relay for providing the next control impulse. These stepping relays also select the indication circuits, which are energized in accordance with the position assumed by the polar contacts of relay F during an indication cycle.

Field station equipment.—The field station equipment is similar to the control office equipment, with certain exceptions now to be pointed out. For example, relays F¹, FP¹, SA¹, SB¹, PC¹, NC¹, FB¹ and the stepping relays perform functions similar to corresponding relays in the control office, as above explained. Likewise, the stepping relays illustrated in Fig. 2 select the control circuits to be energized in accordance with the polarity of the control impulses repeated by the position of the lower polar contact of relay F¹. These stepping relays also select the indication circuits which are used to selectively operate relays PC¹ and NC¹ for providing polar indications, in a manner similar to the selection of the PC and NC relays in the office for providing polar controls. It is not believed necessary to illustrate the circuits for controlling these code selecting relays in detail, since they are fully disclosed and explained in the above mentioned patent and application.

Relays L¹ and LO¹ are provided at the field station for effecting the lockout operations as will be described in detail. Rectifier or valve RC¹ is for the purpose of permitting current to flow over the line circuit, when the system is initiated from the field station, from the source of energy which is normally connected to the line in the control office. Resistance unit RS¹ is provided to equalize the line circuit resistance, irrespective of the location of the station which is transmitting. For example, resistance RS¹ at the illustrated station will be of the proper value to compensate for the resistance of the line extending from this station to the end of the line, so that the line circuit resistance will be approximately the same during transmission from any field station.

Rectifier valve RC² is provided at the end station for the purpose of preventing the line being

energized from the source of current in the control office, which is connected to the line in a reverse direction and for permitting the line to be energized when the office initiates a cycle by connecting the source of current to the line in a normal direction.

These valves may be of any type desired, such for example, as the copper oxide, the electrolytic, the vacuum tube, or the like.

It is believed that the nature of the invention, its advantages and characteristic features may be best understood with further description being set forth in a manner relating to certain typical operations of the system, reference being had to the above mentioned Judge patent and the above mentioned British patent for a complete detailed operation of the system, including those features which do not relate to the lockout function.

Operation

While the system is at rest, the line circuit is normally deenergized because office line battery LB is connected to the line in such a manner that rectifier RC² prevents current flow. The relays and circuits of the system are normally deenergized, with a few exceptions. For example, relay NC of Fig. 1 is normally energized over a circuit extending from (+), back contact 29 of relay C, back contact 11 of relay FB and winding of relay NC, to (—).

Manual start.—With the system at rest, the control office operator can initiate a cycle for the transmission of controls by actuating the desired control levers (not shown) to their proper positions and then operating the start or station selecting button (not shown). The actuation of the starting button is effective to apply (+) energy to the start conductor illustrated in the upper, center portion of Fig. 1. This results in the picking up of relay C over a circuit extending from (+) applied to the start conductor, back contact 12 of relay SB, winding of relay C and back contact 13 of relay FC, to (—).

The picking up of relay C deenergizes relay NC at open back contact 29 and closes a circuit for picking up relay PC which extends from (+), front contact 10 of relay C, back contacts 14, 15 and 16 of relays 3V, 2V and 1V respectively and winding of relay PC, to (—). The dropping of relay NC and the picking up of relay PC changes the reverse connection from battery LB to a normal connection, so that the line is now energized with a (+) impulse over a circuit extending from the (+) terminal of battery LB, front contact 17 of relay PC, back contact 18 of relay NC, back contact 19 of relay FB, winding of relay F, back contact 28 of relay EP, line conductor, line relay F¹, back contact 119 of relay FB¹, line¹ conductor, winding of relay F², back contact 219 of relay FB², valve RC², return conductor, back contact 20 of relay NC and front contact 31 of relay PC, to the (—) terminal of battery LB.

The (+) energization of the line positions the polar contacts of relays F, F¹, F² and the like, to their right hand positions. Relay FP, in the office, is picked up over an obvious circuit closed at contact 21 of relay F and relay FP¹, in the illustrated field station, is picked up over a circuit extending from (+), contact 121 of relay F¹ in its right hand dotted position, back contact 140 of relay SB¹ and winding of relay FP¹, to (—). Contact 21 of relay F also closes an obvious circuit for picking up relay SA and, as above mentioned, relay SA remains picked up during the impulses applied to the line throughout the cycle

of operations. Relay SA closes an obvious pick up circuit for relay SB at front contact 23.

At the station, relay L¹ is picked up over a circuit extending from (+), contact 130 of relay F¹ in its right hand dotted position, back contact 131 of relay SA¹ and winding of relay L¹, to (-). After the picking up of relay SA¹, the pick up circuit of relay L¹ is opened at back contact 131, and a stick circuit is completed for relay L¹ extending from (+), front contact 135 of relay SA¹, front contact 136 and winding of relay L¹, to (-). The picking up of relay SA¹ closes an obvious circuit at its front contact 123 for picking up relay SB¹. Relay SB¹ opens the above described pick up circuit for relay FP¹ at back contact 140, but a substitute circuit for relay FP¹ is completed at front contact 139 of relay L¹. The picking up of relay L¹ and the consequent opening of its back contact 124 opens the pick up circuit for relay FB¹ so that this latter relay will remain down to maintain the line circuit connection intact to the end of the line. The picking up of relay L¹ and the consequent opening of its back contact 127, opens the circuit of relay LO¹, so that this relay cannot be picked up during a control cycle. Similarly, at the end station the picking up of the relay L² opens the pick-up circuit (not shown) for relay LO² and by its front contact shunts rectifier RC² to allow a following impulse of negative polarity to pass through the line circuit.

The line is impulsed and the stepping relays at the office and at the stations are operated in synchronism, in the same manner disclosed in the above mentioned Judge patent and the polarity of energization of the line for each impulse is determined during the preceding time space between impulses, the code sending relays PC and NC being controlled in the same manner disclosed in the above mentioned Patent No. 2,082,544. These polar impulses position contact 130 of relay F¹ (and other similar contacts at other stations) to the required positions for energizing the control circuits, as selected through front contacts 131 and 141 of relay SA¹, front contacts 151 and 161 of relay L¹ and the channel selecting circuits of the stepping relays to which the legend "controls" is applied in Fig. 2. It is believed unnecessary to illustrate this feature of the system or to explain its operation further.

During the operation of relay F in the control office, contact 30 is ineffective, since relay FC is not picked up during a control cycle. When relay SA in the control office picks up and before relay SB is picked up, a stick circuit is closed for maintaining relay C energized during the cycle which extends from (+), front contact 40 of relay SA, front contact 41 of relay C, winding of relay C and back contact 13 of relay FC, to (-).

Automatic start.—The system may be initiated into a cycle of operations for the transmission of indications by a change in conditions at a field station. For example, the track switch at the station may be changed from one position to another, or a signal may be changed from one condition to another for initiating a field start. The manner of starting the system in response to such a field station change has not been illustrated in the present embodiment, since it may be provided in any desired manner, such for example as illustrated in the above mentioned patents. Such a start condition is effective to apply (+) to the start conductor illustrated in the lower center portion of Fig. 2 and relay LO¹ is picked up over a circuit extending from (+) applied to this conductor, back contact 112 of

relay SB¹, winding of relay LO¹ and back contact 127 of relay L¹, to (-).

The picking up of relay LO¹ completes a circuit for energizing the line with a (-) impulse, which circuit extends from the (+) terminal of battery LB, back contact 17 of relay PC, front contact 29 of relay NC, return conductor, front contact 110 of relay LO¹, valve RC¹, resistor RS¹, back contact 119 of relay FB¹, winding of relay F¹, line conductor, back contact 28 of relay EP, winding of relay F, back contact 19 of relay FB, front contact 18 of relay NC and back contact 31 of relay PC, to the (-) terminal of battery LB. This positions the polar contacts of the F relays to the left, following which the line repeater relays and the slow acting relays are picked up, as previously described, and the system steps through a cycle of operations as before. In this instance, however, relay L¹ at the station is not picked up, because contact 130 of relay F¹ is not positioned to the right before relay SA¹ is picked up. A stick circuit for relay LO¹ is completed immediately upon the positioning of contact 130 to the left, which stick circuit extends from (+), contact 130 of relay F¹ in its left hand dotted position, back contact 141 of relay SA¹, front contact 142 of relay LO¹, winding of relay LO¹ and back contact 127 of relay L¹, to (-). When relay SA¹ picks up, a permanent stick circuit is completed for maintaining relay LO¹ energized throughout the cycle, which stick circuit extends through front contact 143 of relay SA¹.

During an indication cycle, contact 130 of relay F¹ is ineffective to energize the control circuits because of open front contacts 151 and 161 of relay L¹. During an indication cycle, contact 30 of relay F in the control office is effective to energize the local indication circuits in accordance with the polarity of the indication impulses, because of closed front contacts 42 and 43 of relay SA and closed front contacts 44 and 45 of relay FC.

The (-) energization of the line closes a circuit for picking up relay FC in the control office which extends from (+), contact 30 of relay F in its left hand dotted position, back contact 43 of relay SA and winding of relay FC, to (-). When relay SA is picked up, the pick up circuit for relay FC is opened at back contact 43 but a stick circuit is closed which extends from (+), front contact 35 of relay SA, front contact 36 and winding of relay FC, to (-).

Relay FB¹ at the station is picked up during the first time space, following the first energization of the line, over a circuit extending from (+), front contact 120 of relay SB¹, front contact 122 of relay LO¹, back contact 124 of relay L¹, back contact 125 of relay FP¹ and winding of relay FB¹, to (-). During the following cycle, relay FB¹ is stuck up over a circuit extending from (+), front contact 120 of relay SB¹, front contact 122 of relay LO¹, back contact 124 of relay L¹, front contact 125 and winding of relay FB¹, to (-). Relay FB¹, remaining picked up throughout the cycle, completes the circuit by way of its front contact 119 to the pole changing contacts of relays PC¹ and NC¹, so that these contacts are effective to apply polar impulses to the line from the source of current LB¹.

Referring to the control office, relay FB is likewise picked up during the first time space, following the first impulse, over a circuit extending from (+), front contact 25 of relay SB, back contact 24 of relay C, front contact 26 of relay FC, back contact 22 of relay FP and winding of relay FB, to (-). Relay FB is stuck up through-

out an indication cycle over an obvious circuit completed at its front contact 27, which circuit is similar to that traced for the stick circuit for relay FB¹. The closure of front contacts 19 of relay FB completes a loop circuit for the line in the control office and the opening of back contact 19 disconnects the circuit of the line which leads to the office code sending relays.

The following cycle is therefore effective for receiving polar indications in the office and energizing the local indication circuits in accordance with the positions of contact 30 of relay F. It will be obvious that the picking up of relay FB and the consequent opening of its back contact 11 drops relay NC, so that this relay remains deenergized throughout an indication cycle. The opening of back contact 13 of relay FC, removes energy from office start relay C, so that an office start condition will be ineffective, in the event that the operator attempts to initiate a control cycle from the office during a cycle which is transmitting indications.

A plurality of stored start conditions.—As already explained, the FB relays can only be picked up during the time space following the first impulse. This means that the line circuit connections, including contacts 19 and 119, will remain as illustrated in the drawings during the first or initiating impulse, and during this initiating impulse conditions will be established for determining the direction of transmission.

For example, it will be assumed that the office and the illustrated field station attempt to initiate the system at substantially the same time. If the office start is sufficiently in advance of the field start to pick up relay C, drop relay NC, pick up relay PC, position relay F¹ to the right and pick up relay L¹, then the field start condition is ineffective because of open back contact 127 of relay L¹. Furthermore, since the dropping of relay NC removes negative energy from the line, even though relay LO¹ is picked up it cannot be stuck up because contact 130 of relay F¹ will not go to the left, consequently relay LO¹ will drop away when relay L¹ picks up and opens its back contact 127.

If the field start is sufficiently in advance of the office start to pick up relay LO¹, position relay F to the left and pick up relay FC, then the office start condition is ineffective because of open back contact 13 of relay FC.

If relays C and LO¹ are picked up at the same time or in rapid succession, then the office takes precedence because the circuit of relay C is opened in the initiation period only by the picking up of relay FC, and FC cannot pick up unless the line is first energized with a negative impulse. The picking up of relay C drops relay NC, which prevents the negative energization of the line during the initiating period.

On the other hand, if the station can energize the line with a negative impulse long enough to pick up relay FC, then the station takes precedence, because relay C cannot be energized. If the start conditions are such that relays C and FC are both picked up at substantially the same time, then relay C will drop because of open back contact 13 and keep relay NC energized to position contact 30 to the left for holding FC up, which in turn holds relay C open, thus giving the station preference.

Lockout between field stations.—In the event that changes have taken place at two or more stations simultaneously or in rapid succession, so that more than one field station is ready to trans-

mit its indications at the beginning of a cycle, it is necessary to provide means for preventing more than one station from obtaining access to the communication circuit at one time. In this embodiment, preference is given to the field station nearest the control office.

It is believed that the lockout feature may be best understood by assuming that two start conditions exist at the same time for picking up two lockout relays. Assuming that lockout relay LO¹ of Fig. 2 is picked up and that a corresponding lockout relay at the next station farther out the line is picked up, the line will be energized with negative energy by way of valve RC¹ as previously described. The path through this valve is a shunt across the line, which may or may not be sufficient to prevent the operation of the line relay at the more distant station. If this shunt is sufficient to prevent the distant line relay from operation, then this distant station is immediately locked out because its associated line repeating and slow acting relays will not be operated. Then when relay FB¹ of the preferred station is picked up, during the time space following the initiating impulse, the line extending from the preferred station to the more distant station is opened at back contact 119, thus locking out the distant station during the following cycle.

If the shunt is ineffective to prevent the operation of the distant line relay, then its associated line repeating and slow acting relays will be picked up during the initiating period, but when relay FB¹ at the preferred station is picked up, during the time space following the initiating period, the opening of back contact 119 opens up the line outward from the preferred station, thus dropping out the line, line repeater and slow acting relays at the inferior station. The preferred station will then transmit its indications during the following cycle in the manner disclosed in the above mentioned patents.

At the inferior station, the lockout relay is stuck up while the associated SA relay is up, by means of a circuit similar to that including front contact 143 of relay SA of Fig. 2. During the interval between the dropping of the SA and SB relays, however, this stick circuit is opened and the lockout relay is dropped out. At the superior station, contact 143 maintains the stick circuit of relay LO¹ complete until the end of the cycle.

The invention of this application has certain advantages over the system disclosed in the Judge Patent No. 2,045,713, in that the lock-out arrangement is such that the same source of current, namely the office battery, is used for rendering either the office or a field station effective. For instance, if a field station is ready to transmit an indication it allows current of normal polarity to flow from the office battery, as by shunting the rectifier RC²; whereas if the office is ready to transmit a control it reverses the polarity of the same office battery and causes current of the opposite polarity to flow in the line circuit to thereby lock out all field stations and allow the office to transmit. Obviously, since the same source is used to cause current to flow of one polarity or another no conflict can occur. In the system of the Judge patent a field battery and the office battery may be simultaneously applied to the line circuit resulting in a conflict of two batteries opposing each other, and a suitable time element device has been interposed to determine whether the office or the station shall first have access to the line. In applicant's construction no such conflict of two batteries oppos-

ing each other can occur. This application also distinguishes from numerous applications and patents of common ownership by the provision of a potential normally applied to a line circuit

5 closed for current flow in the opposite direction and without allowing the flow of current from said potential, thus having the advantage of the presence of a potential without the expense of a continuous current flow.

10 It is not believed necessary to explain how the system is cleared out at the end of a cycle, since this function is immaterial to an understanding of the present invention and furthermore it has been clearly explained in the above mentioned

15 patents. It will also be understood that the same method of lockout operation is effective for other stations connected to the communication system, no matter how many stations attempt to transmit at the same time, remembering that the station nearest the office having indications ready for transmission will get its lockout relay up and pick up the associated FB relay, for connecting the line to the source of line current at the associated station.

25 Having thus described one specific embodiment of a centralized traffic controlling system, it is desired to be understood that the particular arrangements illustrated are only typical illustrations of applicant's invention and are not intended to illustrate the exact circuit design necessary to carry out the features of the invention, this particular form having been selected to facilitate in the disclosure rather than to limit the number of forms which it may assume.

35 What I claim is:—

1. In a remote control system; a control office and a plurality of field stations connected by a line circuit; a transmitter at each of said stations for transmitting signals over said line circuit

40 when the transmitter is rendered active; a selecting relay at each of said stations for associating the associated transmitter with the line circuit when the selecting relay is rendered active; a lockout relay at each of said stations having active and inactive positions; means for placing a plurality of said lockout relays in their active positions when the associated stations having signals ready to transmit at the same time; means responsive to the placement of the lockout

45 relay at that one of said stations which is nearest to said office in its active position for energizing said line circuit from the office to said nearest station, said last mentioned means including an electric valve allowing the flow of current in a particular direction and to block the flow of current if the polarity of the source from which it is derived is reversed; means responsive to the energization of said line circuit by the lockout relay at said nearest station for rendering the

50 associated selecting relay active; means jointly controlled by the lockout relay and the selecting relay at said nearest station for rendering the associated transmitter active; and means controlled by the selecting relay at said nearest station for isolating the line extending to a station more remote from said office than said nearest station.

2. In a remote control system, a control office and a field station connected by a line circuit

70 including in series therein a rectifier located at said station permitting the flow of current of one polarity and blocking the flow of current of the opposite polarity, a transmitter at said office and a transmitter at said field station for respectively transmitting messages to said station and

to said office when rendered active, means in said office for normally applying potential of said opposite polarity to said line circuit, means at said office for at times reversing the polarity of said potential to cause current of said one polarity

5 to flow through said rectifier, means for at times shunting said rectifier to cause the flow of current in said line circuit of opposite polarity, means responsive to the flow of current in said line circuit of said one polarity for rendering the

10 transmitter at said office active and the transmitter at said station inactive, and means responsive to the flow of current in said line circuit of the opposite polarity for rendering the transmitter at said station active and the transmitter

15 at said office inactive.

3. In a remote control system; a control office at a plurality of field stations connected by a line circuit; a transmitter at said office for transmitting messages over said line circuit to said stations when said transmitter is rendered active; a transmitter at each of said stations for transmitting messages over said line circuit to said office when the transmitter at the associated station is rendered active; a source of direct current

20 connected to said line circuit in a particular polar direction, an electric valve at the most remote station normally connected in said line circuit in a direction so that current from said source when so connected is prevented from flowing in said

25 line circuit; initiating means for reversing the polar direction of said source of current in said line circuit, whereby current of reverse polarity flows over said line circuit and through said electric valve; means for at times shunting said electric

30 valve to cause flow of current of said particular polarity; means responsive to said current of particular polarity to render the transmitter at said office inactive, means responsive to said current of reverse polarity for rendering the transmitters at said stations inactive; and means responsive to said initiating means for rendering the transmitter at said office active.

4. In a remote control system; a control office and a plurality of field stations connected by a

45 line circuit; a transmitter at said office for transmitting messages over said line circuit to said stations when said transmitter is rendered active; a transmitter at each of said stations for transmitting messages over said line circuit to said office when the transmitter at the said station is rendered active; a source of direct current reversibly connected to said line circuit to supply current of normal or reverse polarity, but normally supplying a potential of normal polarity; an electric valve at the most remote station normally connected in said line circuit in a polar direction so that current from said potential of normal polarity is prevented from flowing; a first initiating means for connecting said source

50 of current to said line circuit in a reverse direction, whereby current of a reverse polarity flows over said line circuit and through said electric valve; means responsive to said reverse current for rendering the transmitter at said office effective; a second initiating means at each of said stations which operates to shunt said electric valve out of said line circuit, whereby normal current flows over said line circuit; and means responsive to current of normal polarity over said

55 line circuit for rendering the transmitter at the associated station active and said transmitter at said office inactive.

5. In a remote control system; a control office and a plurality of field stations connected by a

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line circuit; a transmitter at said office for transmitting messages over said line circuit to said stations when said transmitter is rendered active; a transmitter at each of said stations for transmitting messages over said line circuit to said office when the transmitter at the said station is rendered active; a source of direct current reversibly connected in said line circuit to supply a normal or a reverse polarity, and normally supplying a potential of normal polarity in said line circuit; an electric valve at one of said stations normally connected in said line circuit and so poled that current from the normal connection of said source of current to said line circuit is prevented from flowing; a first initiating means for reversing the connection of said source of current to said line circuit, whereby reverse current flows over said line circuit and through said electric valve; means responsive to said reverse current flow for rendering the transmitters at said stations inactive; means responsive to said first initiating means for rendering the transmitter at said office active; a second initiating means including an electric valve at each of said stations which operates to connect the electric valve at that station across said line circuit in a poled direction to allow the flow of current of normal polarity over said line circuit but to block the flow of current of reverse polarity; means responsive to normal current flow over said line circuit for rendering the transmitter at that station active and the transmitter at said office inactive; means momentarily interrupting current flow in said line circuit; and means responsive to said current flow interruption for rendering all but one of said station transmitters inactive if and when the second initiating means at more than one station operate simultaneously.

6. In a remote control system, a control office and a plurality of field stations connected by a single line circuit extending from the office to the nearest station and then from station to station to the most remote station, a polar line relay at said office and at each of said stations connected in series in said line circuit, a source of direct current at said office normally applying a potential of normal polarity to said line circuit, an electric valve at the most remote station included in series in said line circuit in a polar direction to prevent the flow of current of normal polarity in said line circuit, normally inactive transmitting means at said office and including the line relay at the office for transmitting messages over said line circuit to said field stations, normally inactive transmitting means at each of said field stations and including the line relay at such station for transmitting messages over said line circuit to said office, office initiating means for reversing said source of direct current in said line circuit to cause the flow of current of reverse polarity over said line circuit and through said electric valve, means responsive to said current of reverse polarity for rendering said transmitting means in said office effective, field station initiating means at each field station for by-passing said electric valve to allow the flow of current of normal polarity, means responsive to said current of normal polarity for rendering the associated transmitting means at such field station active, and means for momentarily opening said line circuit after a field station initiating means at a particular field station causes the flow of current in said line circuit and for

rendering all other field station initiating means inactive.

7. In a remote control system, a control office and a plurality of field stations connected by a single line circuit extending from the office to the nearest station and then from station to station to the most remote station, a polar line relay at said office and at each of said stations connected in series in said line circuit, a source of direct current at said office normally applying a potential of normal polarity to said line circuit, an electric valve at the most remote station included in series in said line circuit in a polar direction to prevent the flow of current of normal polarity in said line circuit, normally inactive transmitting means at said office and including the source of direct current and the line relay at the office for transmitting messages over said line circuit to said field stations, normally inactive transmitting means at each of said field stations and including the line relay and a source of direct current at such station for transmitting messages over said line circuit to said office, office initiating means for reversing said source of direct current in said line circuit to cause the flow of current of reverse polarity over said line circuit and through said rectifier, means responsive to said current of reverse polarity for rendering said transmitting means in said office effective, field station initiating means at each field station for by-passing said electric valve to allow the flow of current of normal polarity, means responsive to said current of normal polarity for rendering the associated transmitting means at such field station active, and means for momentarily opening said line circuit after a field station initiating means at a particular field station causes the flow of current in said line circuit for first disconnecting said office source from and then connecting the field transmitting means including its source of current to said line circuit.

8. In a remote control system, a control office and a field station connected by a single line circuit extending from the office to said station, a polar line relay at said office and at said station connected in series in said line circuit, a source of direct current at said office normally applying a potential of normal polarity to said line circuit, an electric valve at the station included in series in said line circuit in a polar direction to prevent the flow of current of normal polarity in said line circuit, normally inactive transmitting means at said office and including the line relay at the office for transmitting messages over said line circuit to said field station, normally inactive transmitting means at said field station and including the line relay at such station for transmitting messages over said line circuit to said office, office initiating means for rendering said office transmitting means active and for reversing said source of direct current in said line circuit to cause the flow of current of reverse polarity over said line circuit and through said electric valve, means responsive to said current of reverse polarity for rendering said transmitting means at said field station inactive, field station initiating means at said field station for by-passing said electric valve to allow the flow of current of normal polarity, and means responsive to said current of normal polarity for rendering the associated transmitting means active and for rendering the transmitting means at said office inactive.

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