Oct. 12, 1937. T. J. JUDGE 2,095,703

CENTRALIZED TRAFFIC CONTROLLING SYSTEM FOR RAILROADS

Filed Nov. 7, 1934 5 Sheets-Sheet 1

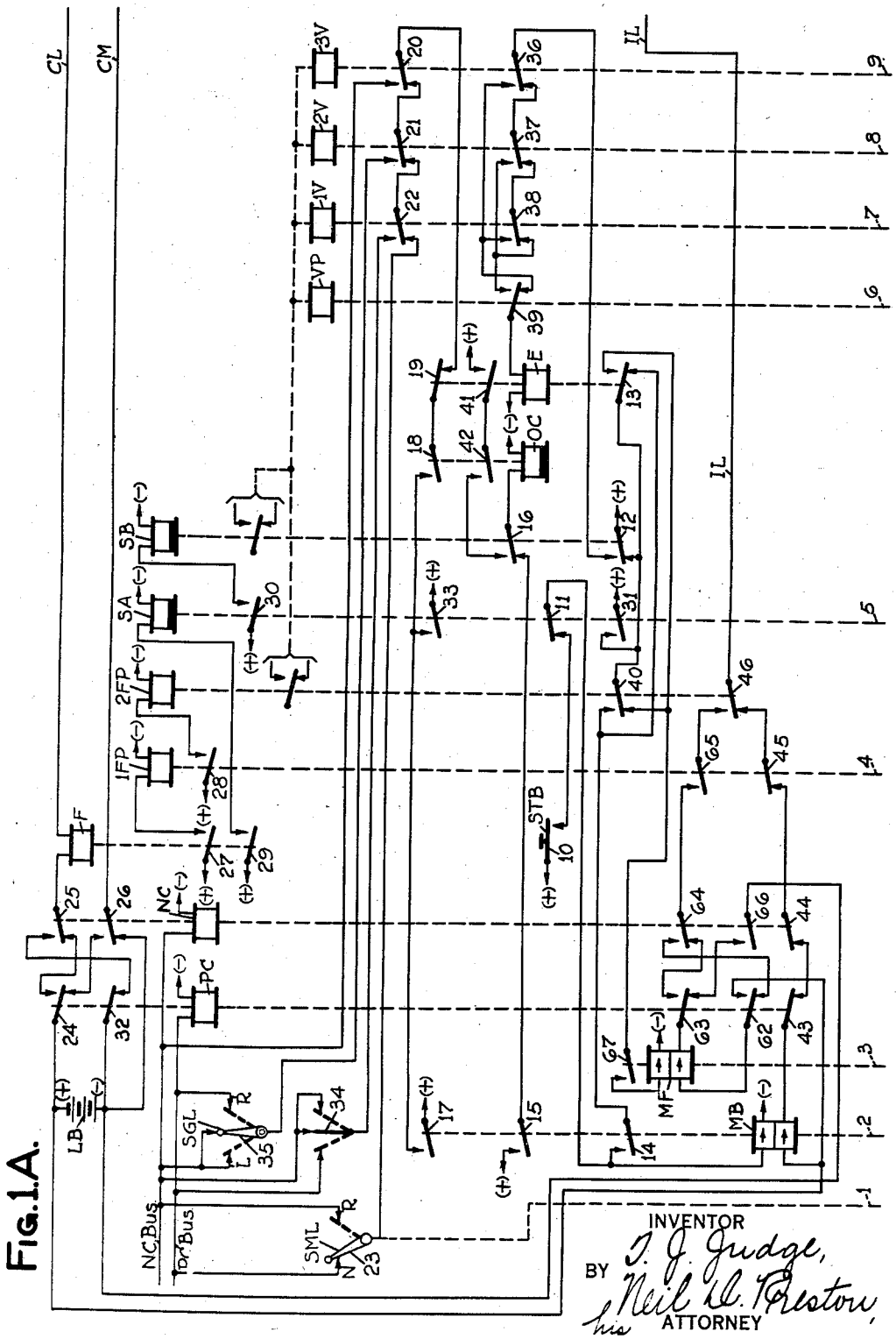


FIG. 1A.

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CENTRALIZED TRAFFIC CONTROLLING SYSTEM FOR RAILROADS

Filed Nov. 7, 1934 5 Sheets-Sheet 2

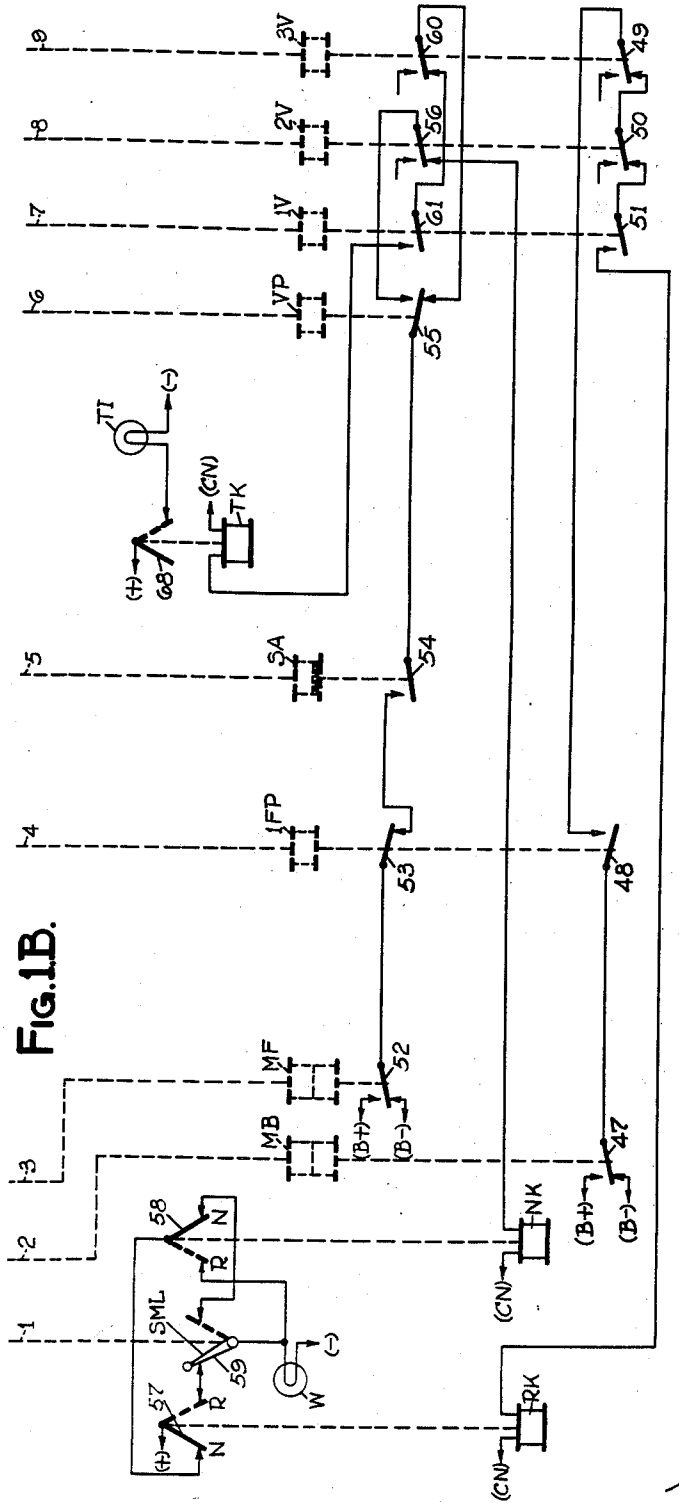


FIG. 1B.

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CENTRALIZED TRAFFIC CONTROLLING SYSTEM FOR RAILROADS

Filed Nov. 7, 1934 5 Sheets-Sheet 3

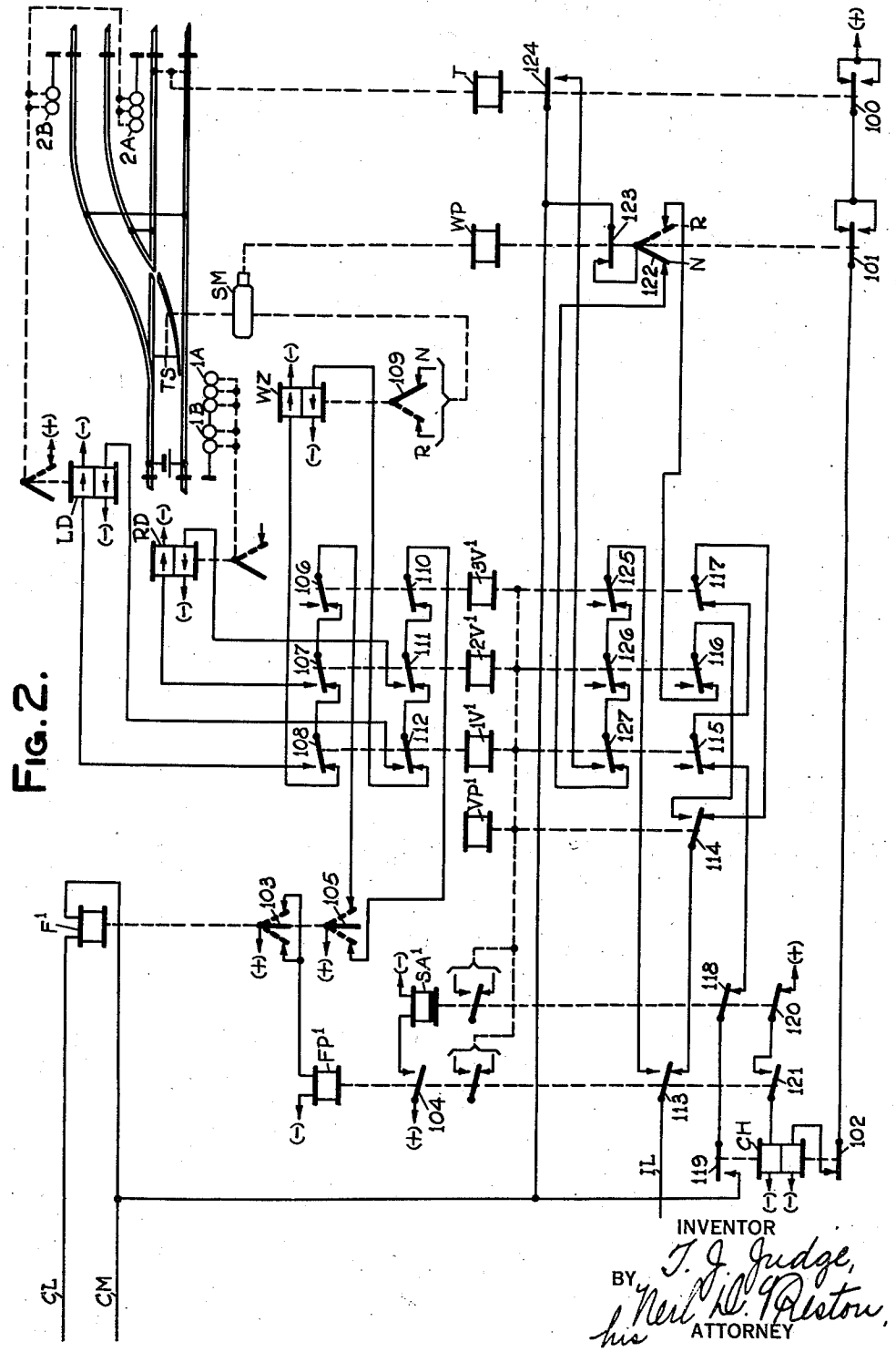


FIG. 2.

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CENTRALIZED TRAFFIC CONTROLLING SYSTEM FOR RAILROADS

Filed Nov. 7, 1934 5 Sheets-Sheet 4

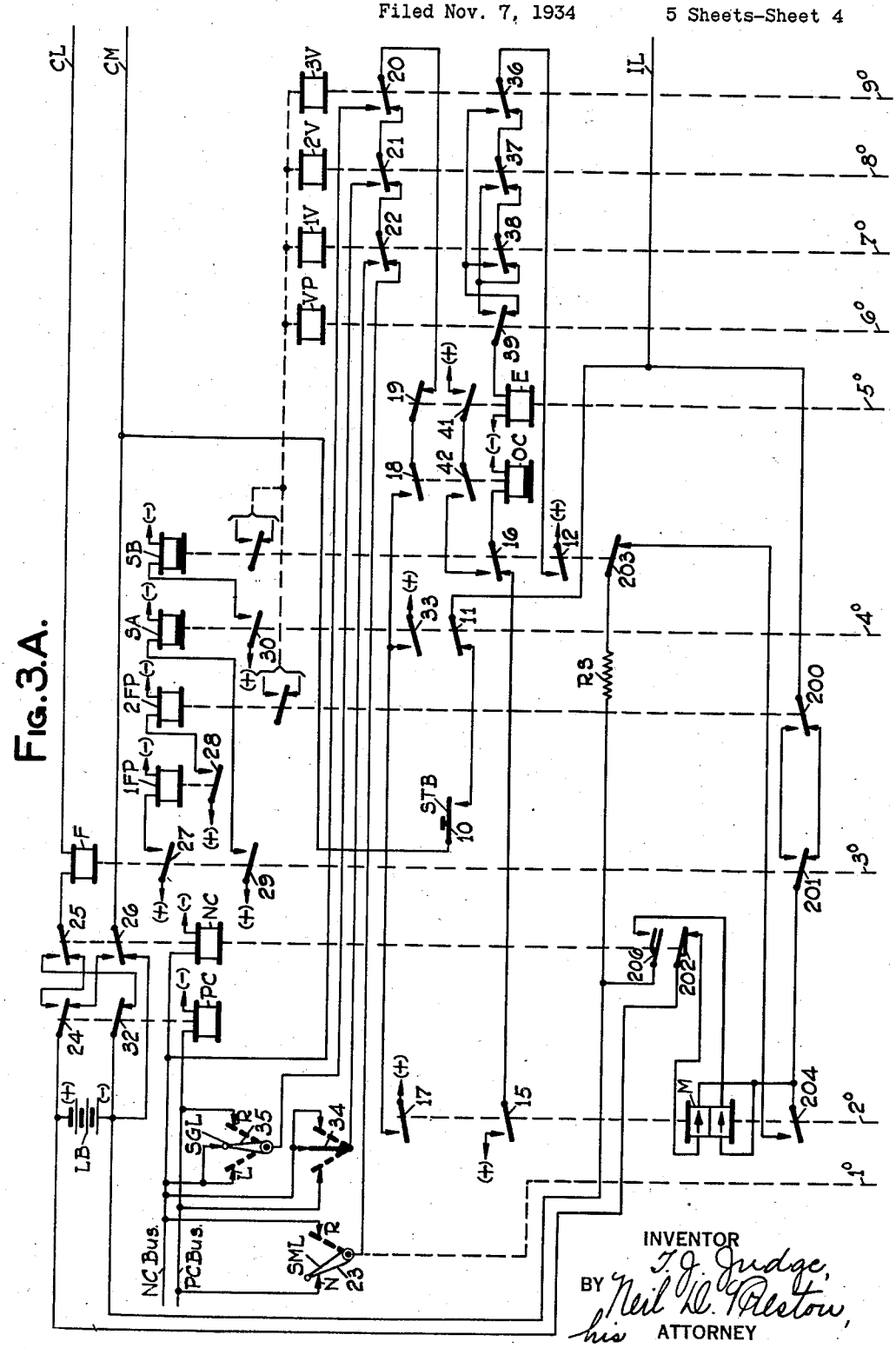


FIG. 3.A.

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CENTRALIZED TRAFFIC CONTROLLING SYSTEM FOR RAILROADS

Filed Nov. 7, 1934 5 Sheets-Sheet 5

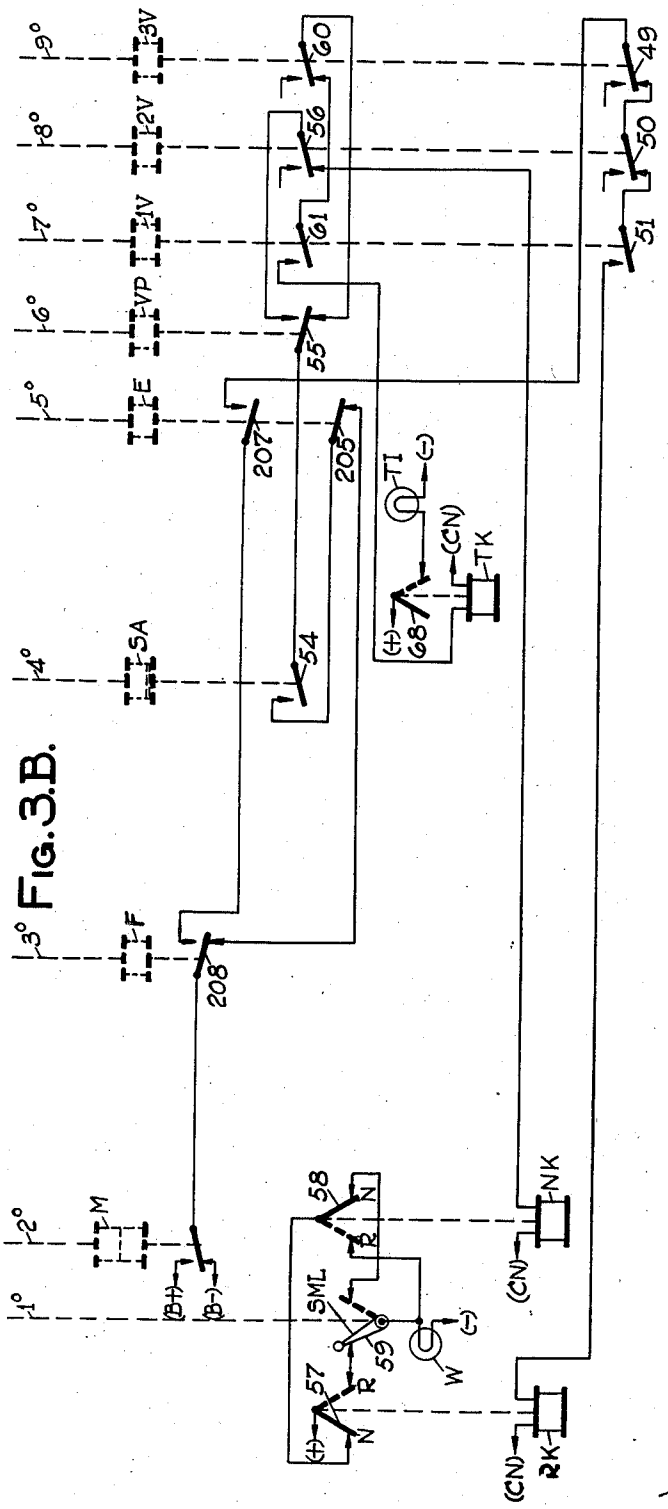


FIG. 3.B.

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Patented Oct. 12, 1937 2,095,703

UNITED STATES PATENT OFFICE

2,095,703

CENTRALIZED TRAFFIC CONTROLLING SYSTEM FOR RAILROADS

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Application November 7, 1934, Serial No. 751,828

8 Claims. (Cl. 177—353)

This invention relates to centralized traffic controlling systems for railroads and it more particularly pertains to the communication part of such systems.

In railroad traffic controlling systems as contemplated by this invention the traffic at an outlying field station is controlled from a control office. The present invention contemplates a system in which the switches and signals at a single station located along a railroad system are placed under the supervision of an operator at the control office. The condition of the switches, signals and various other traffic controlling devices at the location are transmitted to the control office for providing the operator with the information necessary for governing train movements. In a system of this type the switches and signals are associated with such automatic block signalling means as may be necessary under the particular conditions met in practice, in order that the manual control by the operator may be effected in a safe and reliable manner.

It often happens that there are several outlying track switches with their associated signals located adjacent or near each other with the traffic governing devices preferably governed from a central tower of an interlocking plant or other established office. Ordinarily such control would be effected over the usual direct line wire type of system but the present invention provides a selector type system particularly adapted to an installation of this type.

In accordance with the present invention the communication system comprises three line wires extending from the control office to the outlying field station. These three line wires are referred to in this disclosure as the control line CL, the indication line IL and the common line CM. Line CL, in addition to being used for transmitting the controls from the office to the field station, is used to control the synchronous step-by-step operation of the stepping relay banks at both ends of the system. Line IL is used for transmitting indications from the field station to the control office and line CM is the common return conductor for both the control and indication lines.

In this system either control impulses are transmitted from the control office or indication impulses are transmitted from the field station during any particular operating cycle. The control impulses are made distinctive by reason of their polarity for the purpose of transmitting the desired controls. The indication impulses are made distinctive by energizing or not energizing the indication line at a particular step of a cycle for the purpose of transmitting the desired indications.

To accomplish the above the system of the present invention provides a line battery or other suitable source at the control office, with the circuits so arranged that irrespective of the location which is transmitting, the controls or the indications will be transmitted by energizing the control or indication line circuits with current from a single source of current located in the control office. This is an important feature of the present invention since it has been customary to provide separate line batteries for the purpose of transmitting controls and indications over separate circuits between locations.

Since the system is of the coded duplex type it is operated through cycles during each of which transmission of controls and/or the transmission of indications may occur. When controls are transmitted a predetermined number of impulses are applied to the control line circuit for operating the step-by-step mechanisms at both locations through a cycle in synchronism. These impulses are of selected polarities for operating the apparatus at the field station. In other words, the distinctive character (polarity) of the impulses determines the particular controls to be transmitted to the station.

For the transmission of indications a predetermined number of impulses are applied to the control line at the control office for operating the stepping mechanisms through a cycle of operations. During this cycle the distinctive condition (energized or deenergized) of the indication line determines the particular indications to be transmitted to the control office.

Irrespective of whether the control office or the outlying field station is effective to transmit, the duration of the impulses applied to the control line is determined in the control office. Thus the system of the present invention simplifies the timing characteristics of that type of communication system in which an outlying field station is permitted to transmit, due to the fact that the impulses are applied to all cases in the control office and a single source of current is used for impulsing, for the transmission of controls and for the transmission of indications.

These characteristic features of the present invention thus briefly stated will be explained more in detail in the following description of one embodiment of the invention. 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.

Figs. 1A and 1B illustrate the apparatus and circuit arrangements provided for a typical control office arranged according to the present invention.

Fig. 2 illustrates the apparatus and circuit arrangements employed at a typical field station for receiving controls and for transmitting indications to and from the field station in accordance with the present invention and adapted to be associated with the apparatus employed in the control office.

Figs. 3 and 3B show a modification of the indication registering circuits in the control office.

Although the present invention has been shown applied to the control of a single switch and its associated signals such as used at one end of a passing siding, it should be understood that the invention is not limited as thus shown but may be extended for any number of desired switches and signals and may readily be applied to all types of track layouts.

In the event that a larger number of switches and signals are located at the field station the system may be extended in any one of several ways. For example, a greater number of steps may be employed to merely duplicate the apparatus illustrated. Or the controls and indications may be divided into several groups, any one group of which could hold communication with the office during any one particular operating cycle as disclosed for example in the pending application of W. D. Hailes et al., Ser. No. 526,674, filed March 31, 1931. It is understood that all such auxiliary features and modifications may be applied to the present invention without in any way limiting or detracting from the scope of the invention.

For the purpose of simplifying the illustrations and facilitating in the explanation, the various parts and circuits have been diagrammatically shown with certain conventional illustrations employed. The drawings have been made more for the purpose of making it easier to understand the principles and method of operation rather than with the idea of illustrating the specific consideration and arrangement of parts that would be employed in practice. For example, the various relays and their contacts are illustrated in a conventional manner and symbols are used to indicate connections to the terminals of batteries or other sources of current instead of showing all the wiring connections to these terminals.

The symbols (+) and (—) are employed to indicate the positive and negative terminals respectively of suitable 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 a suitable battery or other direct current source which has a central or intermediate tap (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 central or intermediate tap (CN).

Control office equipment.—The control office (Figs. 1A and 1B) includes, besides the above mentioned apparatus, a quick acting line relay F of the neutral type which repeats each energization of the control line circuit irrespective of the polarity of such energization. A quick acting line repeating relay 1FP repeats each energization of line relay F and a quick acting line repeating relay 2FP repeats each actuation of relay 1FP.

A slow acting line repeating relay SA of the neutral type is provided with such slow acting characteristics that it does not drop away between the successive energizations of the line repeating relay 2FP. Relay SA is energized at the beginning of a cycle and remains energized until a predetermined time at the end of a cycle. A similar slow acting repeating relay SB repeats the actuation of relay SA and relay SB likewise is picked up at the beginning of a cycle, remains energized throughout the cycle and is dropped after a predetermined interval of time at the end of a cycle.

Positive code sending relay PC and negative code sending relay NC are for the purpose of energizing the control line with positive and negative impulses respectively in accordance with the characteristic code to be transmitted from the control office to the station. Cycle controlling relay OC is picked up at the beginning of either a control cycle or an indication cycle and remains up throughout the succeeding steps of the cycle.

An impulse controlling relay E is jointly controlled by the stepping relays at the various steps of a cycle for applying impulses to the control line circuit by means of the operation of the PC and NC relays.

Associated with the line repeating relays is a bank of stepping relays including relays 1V, 2V and 3V together with an associated half-step repeating relay VP. This bank of relays is for the purpose of marking off the successive steps of each cycle.

Message receiving relays MB and MF are provided to receive the condition of the indication line circuit during the transmission of indications. The conditions of relays MB and MF at the various steps of the cycle are stored during the different periods by suitable indication storing relays such as RK, NK AND TK. Relay MB also serves as a start relay for both control and indication cycles.

The controlling apparatus for the track switch and signals at the illustrated field station comprises a switch machine control lever SML, a signal control lever SGL and a starting button STB. A miniature track switch would ordinarily be provided but in order to simplify the present disclosure this portion of the apparatus has been omitted. Track occupancy lamp TI has been illustrated to indicate how the condition of the illustrated track is indicated in the control office. Likewise switch lamp W is provided to indicate correspondence and lack of correspondence between the switch machine lever and the track switch at the field station.

Field station equipment.—The field station (Fig. 2) includes, besides the above mentioned apparatus, a quick acting line repeating relay F^1 of the polar type which repeats the impulses applied to the control line circuit. Repeating relay FP^1 repeats each actuation of relay F^1 irrespective of the polarity of the impulse which actuates relay F^1. Slow acting relay SA^1 is for a purpose similar to that explained in connection with relay SA in the control office.

The field station includes a stepping relay bank comprising stepping relays $1V^1$, $2V^1$, $3V^1$ and half-step relay VP^1 operating in synchronism

with corresponding relays in the control office.

A track switch TS is operated by a switch machine SM of any suitable type and this switch machine may if desired be provided with various refinements such as a dual control selector to permit local manual operation of the track switch, but since these refinements form no part of the present invention they are omitted from the present drawings.

The position and locked condition of the track switch is repeated by the usual switch repeating relay WP of the polar neutral type. Relay WP is controlled by a suitable polarized circuit (not shown) so that the relay is energized with current of one polarity or the other depending upon the normal or reverse position of the track switch and it is deenergized whenever the track switch is unlocked or in operation.

The signals 1A—1B are provided for governing traffic over the main track and over the turn-out track respectively in an east bound direction. The signals 2A—2B are provided for governing traffic over the main track or over the turn-out track respectively in a west bound direction.

Since the detailed circuits for controlling the switch machine and the signals are immaterial to an understanding of the present invention, this control is only indicated by dotted line connections to the control relays. Switch control relay WZ is for the purpose of controlling the operation of the track switch to its normal and its reverse positions. Signal control relays RD and LD are for controlling signals for directing traffic in a right and a left direction respectively. These control relays are governed from the control office in accordance with selected code combinations. For the purpose of illustrating the manner in which the system is initiated from the field station, a change relay CH has been indicated as being in its normally picked up condition.

It is believed that the nature of the invention, its advantages and characteristics features can best be understood with further description being set forth from the standpoint of operation.

Operation

The general plan of operation of the system contemplated by the present invention may be understood by placing Fig. 2 to the right of Fig. 1A and Fig. 1B below Fig. 1A with correspondingly numbered and lettered lines in alinement. These two drawings illustrate a system having a control office and a field station. A control line wire CL extends from the control office to the field station and at the field station is connected to common return wire CM. Similarly, an indication line wire IL extends from the control office to the field station and is arranged to be selectively connected to the common return wire in various combinations under various operating conditions.

The control line circuit includes a neutral line relay F in the control office and a polarized line relay F^1 at the field station. Energy for the control line circuit is supplied from a line battery LB in the control office with the particular polarity for energizing the control line circuit selected by pole changing contacts located on code sending relays PC and NC. When the code sending relay PC is energized a positive impulse is applied to the control line circuit and when code sending relay NC is energized a negative impulse is applied to the control line circuit. With both code sending relays energized or deenergized the control line circuit is maintained deenergized. Whenever energy is applied to the control line circuit by the code sending relays, the energization of the line is broken up into time spaced impulses by the intermittent operation of relay E, which deenergizes the particular code sending relay which is picked up at that time.

The indication line circuit includes message relays in its two branches in the control office and it includes impulsing contacts in the corresponding branches at the field station. Since corresponding branches are selected at the control office and at the field station when the control line circuit is energized (front contacts on the line repeating relays closed) and since corresponding branches are connected in series during the deenergized condition of the control line circuit (back contacts closed on the line repeating relays), these two branches of the indication line circuit at the control office and at the field station are conveniently termed front and back branches. In the office a message relay MB is included in the back branch and a message relay MF is included in the front branch. At the field station the front and back branches are respectively conditioned when the line repeating relay is picked up and dropped away in accordance with the indications to be transmitted. The indication line circuit is supplied with energy from the same line battery LB in the control office that applies energy to the control line circuit.

Both line circuits are normally deenergized for the purpose of rendering the system capable of being initiated by the field station. The field station initiates the system by connecting the indication line wire to the common wire which picks up relay MB. At the control office the system is initiated by picking up relay MB over a local circuit.

It will be observed from the description which follows that indications will be transmitted from the field station to the control office during the same cycle that controls are transmitted from the office to the station. The field station initiating circuit is so arranged that the change relay which initiates the system from the field station will be resensitized at the beginning of a cycle. The effect of this feature is to cause the system to step through a succeeding cycle if during the previous cycle a change has taken place requiring the transmission of indications. In other words, a change in conditions may take place during a cycle after the point associated with this condition on the stepping bank has been passed. In this event, since the change relay is made sensitive at the beginning of the cycle, it will be deenergized to start the system through a succeeding cycle during which this changed indication will be transmitted.

Normal conditions.—As above mentioned the line circuits of the system are normally deenergized. The remaining circuits of the system are arranged to be normally deenergized with a few exceptions. For example, the detector track circuit associated with track switch TS is preferably of the closed circuit type so that track relay T is energized when the track section is unoccupied. Switch repeating relay WP is energized when the switch is in either of its extreme locked positions, with its polar contact positioned to the left with the switch in its normal position and to the right with the switch in its reverse position.

Direction relays RD and LD and switch machine control relay WZ are of the magnetic stick type and although their windings are normally

deenergized the polar contacts remain in the positions to which they were last actuated. Change relay CH is normally energized over a stick circuit extending from (+), front contact 100 of relay T, front contact 101 of relay WP, front contact 102 and lower winding of relay CH, to (−).

Manual starting.—With the system in its normal condition the operator can initiate the system for the transmission of such controls as he may desire. For example, if it is desired to operate track switch TS or to govern signals 1A—1B and 2A—2B the control levers SML and SGL in the office are properly positioned, after which starting button STB is actuated.

It will be noted that the operator may move the control levers to different positions without transmitting controls until such time that button STB is actuated. Such an arrangement is to be considered as merely one embodiment of the present invention since the system might readily be arranged to be initiated upon the actuation of one or more of the control levers in the manner shown, for example, in the Preston application, Ser. No. 573,079, filed November 5, 1931, corresponding to British Pat. No. 406,418 and French Pat. No. 745,343.

The actuation of starting button STB with the system at rest causes the energization of relay MB over a circuit extending from (+), contact 10 of button STB, back contact 11 of relay SA and upper winding of relay MB, to (−). Relay MB closes a stick circuit for itself extending from (+), back contact 12 of relay SB, back contact 13 of relay E, front contact 14 and upper winding of relay MB, to (−). The operation of relay MB closes a circuit for picking up relay OC which extends from (+), front contact 15 of relay MB, back contact 16 of relay SB and winding of relay OC, to (−).

The operation of relay OC closes a circuit for picking up relay PC which extends from (+), front contact 17 of relay MB, front contact 18 of relay OC, back contact 19 of relay E, back contacts 20, 21 and 22 of relays 3V, 2V and 1V respectively, contact 23 of lever SML in its left hand position, PC bus and winding of relay PC, to (−). This applies an initial positive impulse to the control line over a circuit extending from the (+) terminal of battery LB, front contact 24 of relay PC, back contact 25 of relay NC, winding of relay F, line conductor CL, winding of relay F^1, common conductor CM and back contact 26 of relay NC to the (−) terminal of battery LB.

This energization of the control line circuit energizes relays F and F^1 and since the impulse is positive, relay F^1 positions its polar contacts to the right. Relay F closes a circuit for picking up relay 1FP which extends from (+), front contact 27 of relay F and winding of relay 1FP, to (−). Relay 1FP closes a circuit for picking up relay 2FP which extends from (+), front contact 28 of relay 1FP and winding of relay 2FP, to (−). The operation of relay F also closes a pick up circuit for relay SA extending from (+), front contact 29 of relay F and winding of relay SA to (−). Relay SA closes a pick up circuit for relay SB extending from (+), front contact 30 of relay SA and winding of relay SB, to (−).

At the field station the operation of relay F^1 closes a circuit for picking up relay FP^1 which extends from (+), contact 103 of relay F^1 in its right hand dotted position and winding of relay FP^1, to (−). Relay FP^1 closes a circuit for picking up relay SA^1 which extends from (+), front contact 104 of relay FP^1, and winding of relay SA^1, to (−).

Referring to the control office the picking up of front contact 31 of relay SA before the opening of back contact 12 of relay SB maintains energy on the stick circuit of relay MB. The picking up of back contact 11 of relay SA opens the circuit leading to button STB so that any further operation of this button is ineffective to control relay MB.

Polarity selection of stepping impulses.—When the system is initiated by the energization of relay OC, above explained, the impulses placed upon the line circuit for the succeeding cycle of operations are of polarities determined by the positions of the switch machine and signal levers, which levers select the code determining relays. As above mentioned with lever SML in its normal position relay PC is picked up to apply a (+) impulse to the line circuit. If lever SML is in its reverse position then the above traced circuit through back contact 22 of relay 1V extends through contact 23 of lever SML in its reverse position and the NC bus to relay NC. The picking up of relay NC causes a (−) impulse to be applied to the control line over a circuit extending from the (−) terminal of battery LB, back contact 32 of relay PC, front contact 25 of relay NC, winding of relay F, conductor CL, winding of relay F^1, conductor CM, front contact 26 of relay NC and back contact 24 of relay PC to the (+) terminal of battery LB.

This energization of the control line circuit is repeated by relays F and F^1, but with a (−) impulse applied to this line circuit relay F^1 actuates its polar contacts to the left. Contact 103 of relay F^1 is effective to pick up relay FP^1 in both its right or left hand positions.

It will now be assumed that the application of the first impulse to the control line circuit results in the picking up of relay VP in the office and relay VP^1 at the station. The picking up of relay VP at the office effects the picking up of relay E, as will be later described, to deenergize the control line circuit and the deenergization of this line circuit causes relay 1V to be picked up. Contact 22 of relay 1V then extends the circuit from (+), front contact 33 of relay SA to contact 34 of the signal lever.

With the signal lever in its stop position as shown this circuit is extended through the NC bus and the winding of relay NC, to (−), thus applying a (−) impulse to the control line on the second step. It will be apparent that if signal lever SGL is in its right hand position, contact 34 causes relay NC to be picked up so that this impulse is likewise of (−) polarity. With lever SGL in its left hand position the above described circuit is extended by way of the PC bus to relay PC for making the impulse positive in character.

When relay 2V is picked up following the second impulse, contact 21 shifts the circuit to contact 35 of lever SGL and with this lever in its stop or left position, relay NC is energized to apply a (−) impulse to the line on the next step. With contact 35 in its right hand position then relay PC is picked up to apply a (+) impulse to the control line on this step.

Impulsing the line.—As above mentioned it will be assumed that relay VP is picked up on the first impulse applied to the control line circuit. This closes a circuit for picking up relay E which extends from (+), front contact 12 of relay SB, back contacts 36, 37 and 38 of relays 3V, 2V and 1V respectively, front contact 39 of relay VP and

winding of relay E, to (—). The picking up of relay E opens (at back contact 19) the circuit of the particular code sending relay which was selected. The dropping of the code sending relay (relay PC in the assumed example) deenergizes the control line circuit at contact 24 of relay PC. In the event that relay NC is picked up then the dropping of contacts 25 and 26 of this relay deenergizes the control line circuit.

The deenergization of the control line is repeated by the dropping of relays F, 1FP and 2FP in sequence. This effects the picking up of relay 1V, which in turn deenergizes relay E by the picking up of back contact 38 of relay 1V. Relay E drops and when the next selected code sending relay is picked up the control line is again energized, resulting in relays F, 1FP and 2FP being picked up in sequence.

The picking up of relay 2FP causes relay VP to drop which closes a pick up circuit for relay E extending from (+), front contact 12 of relay SB, back contacts 36 and 37 of relays 3V and 2V respectively, front contact 38 of relay 1V, back contact 39 of relay VP and winding of relay E, to (—). The picking up of relay E drops the code sending relay as before which deenergizes the control line circuit for dropping relays F, 1FP and 2FP in sequence. The dropping of relay 2FP picks up relay 2V which opens the circuit of relay E at back contact 37. Relay E drops and the selected code sending relay is picked up for again energizing the control line circuit.

Relays F, 1FP and 2FP are now picked up in sequence and the picking up of relay 2FP causes relay VP to be picked up which closes a circuit for picking up relay E extending from (+), front contact 12 of relay SB, back contact 36 of relay 3V, front contact 37 of relay 2V, front contact 39 of relay VP, and winding of relay E, to (—).

The picking up of relay E drops the selecting code sending relay which deenergizes the line circuit for dropping relays F, 1FP and 2FP in sequence. The dropping of relay 2FP picks up relay 3V which deenergizes relay E at back contact 36.

The dropping of relay E closes the circuit for picking up the selected code sending relay, after which the line is again energized for picking up relays F, 1FP and 2FP in sequence. The picking up of relay 2FP drops relay VP which in turn closes a circuit for picking up relay E extending from (+), front contact 12 of relay SB, front contact 36 of relay 3V, back contact 39 of relay VP and winding of relay E, to (—).

The picking up of relay E deenergies the selected code sending relay which drops to deenergize the line for dropping relays F, 1FP and 2FP in sequence.

Since there are no additional stepping relays in the present embodiment, relay E remains energized resulting in the deenergization of the control line circuit for a comparatively long interval of time. This has the effect of keeping relay F deenergized for a period of time sufficient to drop relays SA and SB in sequence.

The dropping of relay SB deenergizes the circuit of relay E at front contact 12. The dropping of relay SB also deenergizes the stick circuits of the stepping relays so that they are all restored to normal.

Relay MB, which was picked up to initiate the cycle, is dropped during the first deenergized period of the line circuit by the dropping of contact 40 of relay 2FP. The picking up of relay E to mark the beginning of the first deenergized or "off" period of the line circuit opened the stick circuit of relay MB at its back contact 13, but since relay 2FP was picked up at this time the stick circuit was maintained energized at front contact 40 of relay 2FP. However, during the first "off" period relay E being up with its back contact 13 open when relay 2FP is dropped to open front contact 40, the stick circuit of relay MB is deenergized and this relay is released.

Relay OC is maintained energized throughout the cycle over a circuit extending from (+), front contact 41 of relay E, front contact 42 of relay OC, front contact 16 of relay SB and winding of relay OC to (—). At the end of the cycle the dropping of relay SB opens (at its front contact 16) the circuit of relay OC and this relay is deenergized.

Stepping relay bank.—The detailed circuits of the stepping relays in the control office and at the field station have not been shown since these relays may be operated at the various steps of the cycle in any well known manner. Those at the office and at the field station operate in synchronism and the detailed circuits may be such as shown in the Pat. No. 2,058,824 dated October 27, 1936, granted to W. T. Powell. In this prior patent the stepping line is normally deenergized and the VP relay is picked up on the first energized period, dropped on the second energized period, picked up on the third energized period, dropped on the fourth energized period, etc., with the stepping relays being picked up in rotation during the succeeding deenergized periods. The present embodiment contemplates a similar operation of the stepping relay bank and in order to keep the drawings as simple as possible the control of the stepping relay banks has been merely indicated by dotted line connections extending from the FP and slow acting relays to the stepping relays.

Transmission of controls.—With the switch machine and the signal control levers in the positions shown in Fig. 1A the control line circuit is energized with a combination of impulses comprising (+) (—) (—) (—). This is because contact 23 of lever SML selects relay PC for making the first impulse (+) and contacts 34 and 35 of lever SGL select relay NC for making the second and third impulses (—), while front contact 20 of relay 3V connects directly to relay NC for making the fourth impulse (—). It will be understood in this connection that front contact 20 may selectively connect to relays PC and NC through contacts of other controlling devices for providing a selection of impulses on this step if desired.

The first (+) impulse positions relay F^1 to the right which closes a circuit for energizing relay WZ extending from (+), contact 105 of relay F^1 in its right hand dotted position, back contacts 106, 107 and 108 of relays $3V^1$, $2V^1$ and $1V^1$ respectively and upper winding of relay WZ, to (—). This polarity of energization actuates contact 109 of relay WZ to the right for causing switch machine SM to actuate the track switch to its normal position.

In the event that the first impulse is (—), then relay WZ is energized through its lower winding for reversing the position of contact 109, over a circuit extending through contact 105 of relay F^1 in its left hand dotted position, back contacts 110, 111 and 112 of relays $3V^1$, $2V^1$ and $1V^1$ respectively and lower winding of relay WZ, to (—). Relay WZ in this position causes the track switch to be actuated to its reverse position.

The second impulse being (—), actuates relay F^1 to the left for closing a circuit through the lower winding of relay LD which extends from (+), contact 105 of relay F^1 in its left hand dotted position, back contacts 110 and 111 of relays $3V^1$ and $2V^1$ respectively, front contact 112 of relay $1V^1$, and lower winding of relay LD, to (—).

The third impulse being (—), relay F^1 is again actuated to the left which closes a circuit through front contact 111 of relay $2V^1$ and the lower winding of relay RD, to (—).

With relays LD and RD actuated to the left no signals are cleared which repeats the position of the signal control lever in the control office, that is, all signals at stop.

From the above description of the operation of relay WZ it will be readily apparent that relays LD and RD may be selectively actuated to the right for clearing their associated signals in response to the right hand or left hand positions of lever SGL in the control office. It will also be apparent that the use of the fourth impulse for selectively actuating the line circuit would mean that front contacts 106 and 110 of relay $3V^1$ would be connected to a control relay to be selectively actuated by this impulse.

Automatic start.—A change in the indication conditions at the field station may include a change in the condition of the detector track section, a change in the condition of the track switch or any one of several other devices, but as typical of such change only the track and switch repeating relays have been shown controlling the change relay.

For example, the movement of either the track relay contact 100 or the switch repeating contact 101 from one position to the other momentarily opens the stick circuit of relay CH causing this relay to be deenergized.

The deenergization of relay CH closes a circuit for picking up relay MB in the control office, which circuit extends from the (+) terminal of battery LB, lower winding of relay MB, back contacts 43 and 44 of relays PC and NC, back contacts 45 and 46 of relays 1FP and 2FP, line conductor IL, back contact 113 of relay FP^1, back contact 114 of relay VP^1, back contacts 117 and 115 of relays $3V^1$ and $1V^1$, back contact 118 of relay SA^1, back contact 119 of relay CH, conductor CM and back contact 26 of relay NC to the (—) terminal of battery LB.

The picking up of relay MB closes the previously described stick circuit for this relay and also closes the pick up circuit for relay OC. This initiates the system into a cycle of operations, as before, and the stepping relay banks in the control office and at the field station step through the cycle in the same manner previously mentioned.

During this cycle, controls are transmitted in accordance with the position of the control levers and indications are transmitted in accordance with the conditions of the indication transmitting contacts at the field station.

Transmission of indications.—Each time a cycle is initiated, relay CH at the field station is energized when relay FP^1 is picked up and before relay SA^1 is picked up. This circuit extends from (+), back contact 120 of relay SA^1, front contact 121 of relay FP^1, and upper winding of relay CH, to (—). Thus relay CH is made sensitive at the beginning of each cycle to a change in indication conditions requiring another cycle of operations.

It will now be assumed that track switch TS is actuated to its reverse position during a control cycle in response to the actuation of lever SML to its reverse position. The change-over of contact 101 of relay WP from its front to its back point, during the time that relay WP is deenergized when the switch machine is in operation, drops relay CH for initiating the cycle as above described.

Relay WP actuates its polar contact 122 to the right when the track switch is in its reverse locked position. The stepping relay banks in the office and at the station are stepped through a cycle of operations as previously described.

The indication that the switch is in its unlocked position is transmitted due to front contact 123 of relay WP being open. With this contact open the indication line conductor IL is not energized during the first two impulses of the cycle because of the open contact 123.

With conductor IL deenergized, relay MB will not be picked up (after it is dropped during the first "off" period as previously described) so that an executing circuit is closed for actuating relay RK to the left which extends from (B—), back contact 47 of relay MB, front contact 48 of relay 1FP, back contacts 49 and 50 of relays 3V and 2V respectively, front contact 51 of relay 1V and winding of relay RK, to (CN). This is conveniently referred to as an "on" indication since the control line is energized for picking up relay 1FP and closing its front contact 48.

Relay MF is likewise not energized so that an "off" indication is executed which actuates relay NK to the left when relay 1FP is deenergized. This circuit extends from (B—), back contact 52 of relay MF, back contact 53 of relay 1FP, front contact 54 of relay SA, front contact 55 of relay VP, back contact 56 of relay 2V and winding of relay NK, to (CN).

With the contacts of relays RK and NK in their left hand positions a circuit is closed for lighting lamp W extending from (+), contact 57 of relay RK in its left hand position, contact 58 of relay NK in its left hand dotted position and lamp W, to (—). This is an indication to the operator that the switch at the station is in its unlocked condition.

When the switch reaches its reverse locked position, relay WP is energized so that the switching of its contact 101 from a back to a front point again deenergizes relay CH to initiate another cycle of operations.

Before describing the transmission of indications for this cycle it will be pointed out that lamp W is lighted when lever SML is actuated to its reverse position, out of correspondence with the position of the switch at the station as repeated by relays RK and NK. Relay RK has its contact 57 actuated to the left as an indication that the switch is in its normal position and relay NK has its contact 58 actuated to the right as an indication that the switch is in its normal position. When contact 59 of lever SML is actuated to its right hand dotted position a circuit is closed for lighting lamp W which extends from (+), contact 57 of relay RK in its left hand position, contact 58 of relay NK in its right hand position, contact 59 of lever SML in its right hand dotted position and the lamp W, to (—). The lighting of this lamp is an indication to the operator that the switch at the remote station is not in correspondence with the lever in the office.

When the switch reaches its reverse position, relay WP repeats this condition by actuating its

polar contact 122 to its right hand dotted position. Relay MB in the office is not deenergized during the first "off" period under this condition when relay 2FP opens the stick circuit of relay MB at front contact 40. This is because an energizing circuit is completed through the lower winding of relay MB over the indication line. This circuit extends from the (+) terminal of battery LB, lower winding of relay MB, back contacts 43 and 44 of relays PC and NC respectively, back contacts 45 and 46 of relays 1FP and 2FP respectively, line conductor IL, back contact 113 of relay FP1, front contact 114 of relay VP1, back contact 116 of relay 2V1, contact 122 of relay WP in its right hand dotted position, front contact 123 of relay WP, conductor CM and back contact 26 of relay NC to the (—) terminal of battery LB.

Relay MB is thus maintained energized by way of its lower winding until relay E drops to close the stick circuit for relay MB at back contact 13. This condition is executed for actuating relay RK to its reverse position when relay 1FP picks up, over a circuit extending from (B+), front contact 47 of relay MB, front contact 48 of relay 1FP, back contacts 49 and 50 of relays 3V and 2V respectively, front contact 51 of relay 1V and winding of relay RK, to (CN).

Since lever contact 59 is to the right there is no energy applied to lamp W through contact 57 in its right hand dotted position, so that this lamp is extinguished as an indication that correspondence exists between lever SML and the track switch.

There is no circuit closed under this condition for actuating relay MF and when this indication is executed by the dropping of relay 1FP, a circuit is closed for actuating relay NK to the left (reverse) extending from (B—), back contact 52 of relay MF, back contact 53 of relay 1FP, front contact 54 of relay SA, front contact 55 of relay VP, back contact 56 of relay 2V and winding of relay NK, to (CN). This positions contact 58 of relay NK to the left which is ineffective to control signal lamp W because contact 57 of relay RK is positioned to the right.

Since it is assumed that track relay T is energized, the indication line is not energized when the next step is taken because of open contact 124 of relay T. This results in relay MF being deenergized during the next step so that relay TK is conditioned for actuating its polar contact to the left over a circuit extending from (B—), back contacts 52 and 53 of relays MF and 1FP respectively, front contact 54 of relay SA, back contact 55 of relay VP, back contact 60 of relay 3V, front contact 61 of relay 1V and winding of relay TK to (CN).

In the event that relay T is deenergized during this step, then relay MF would be picked up over a circuit through the lower winding of relay MF selected in accordance with the particular code sending relay PC or NC which is energized. If relay PC is energized then the circuit for energizing the circuit including the lower winding of relay MF extends from the (+) terminal of battery LB, front contact 62 of relay PC, lower winding of relay MF, front contact 63 of relay PC, back contact 64 of relay NC, front contact 65 of relay 1FP, front contact 46 of relay 2FP, conductor IL, front contact 113 of relay FP1, back contacts 125 and 126 of relays 3V1 and 2V1 respectively, front contact 127 of relay 1V1, back contact 124 of relay T, conductor CM and back contact 26 of relay NC to the (—) terminal of battery LB.

In the event that relay NC is picked up instead of relay PC, then a circuit is effective now traced from the (—) terminal of battery LB, front contact 66 of relay NC, back contact 63 of relay PC, lower winding of relay MF, back contact 62 of relay PC, front contact 64 of relay NC, front contact 65 of relay 1FP, front contact 46 of relay 2FP, conductor IL, front contact 113 of relay FP1, back contacts 125 and 126 of relays 3V1 and 2V1 respectively, front contact 127 of relay 1V1, back contact 124 of relay T, conductor CM, front contact 26 of relay NC and back contact 24 of relay PC to the (+) terminal of battery LB.

It will be apparent that contacts 62, 63, 64 and 66 of relays PC and NC are for the purpose of energizing the pick up (lower) winding of relay MF always in the same direction so that it will be maintained energized when its stick circuit is completed.

When relay MF is picked up it is stuck up over a circuit extending from (+), front contact 31 of relay SA, front contact 13 of relay E, front contact 67 and upper winding of relay MF, to (—). When relay 2FP drops it energizes this stick circuit at back contact 40 so that relay MF is not dropped when relay E opens its front contact 13.

This condition is executed when relay 1V is picked up and since it is assumed that the track section is occupied, the picking up and sticking of relay MF closes a circuit for actuating relay TK to the right extending from (B+), front contact 52 of relay MF, back contact 53 of relay 1FP, front contact 54 of relay SA, back contact 55 of relay VP, back contact 60 of relay 3V, front contact 61 of relay 1V and winding of relay TK to (CN). The actuation of contact 68 of relay TK to the right closes an obvious circuit for lighting lamp TI to indicate to the operator that the track section is occupied.

After this indication has been executed relay MF is dropped when relay 2FP picks up its contact 40, since at this time relay E is down so that front contact 13 is open and back contact 40 is open to deenergize the stick circuit of relay MF.

Relays MB and MF may thus be conditioned at other steps of the cycle in a similar manner for transmitting other indications from the field station to the control office.

When the system has taken the last step the line circuit is maintained deenergized for a sufficient period of time to drop the slow acting relays in the same manner previously described in connection with a control cycle. It is to be understood that, although lamps have been selected for advising the operator of the conditions at the field station, other suitable indicator means such as audible signals, miniature movable track switch points, or the like, may be employed as desired.

Modification.—The modification shown in Figs. 3A and 3B contemplates the use of a single message relay M in place of the two message relays MB and MF of Figs. 1A and 1B. The reference characters in Figs. 3A and 3B are the same for those devices which correspond to the devices of Figs. 1A and 1B, and only those relays and contacts which are characteristic of this modification have been given distinctive reference characters. It is also to be understood that this modification, or control office arrangement, is to be employed with the field station apparatus disclosed in Fig. 2 in a similar manner as described in connection with Figs. 1A and 1B.

Relay M is picked up to initiate a cycle from

the field station when energy is applied to conductor IL in the same manner as described in connection with Fig. 2. Current flows from the (—) terminal of battery LB, through back contact 26 of relay NC, over conductor CM, through back contacts 119, 118, 115, 117, 114 and 113 of relays CH, SA1, 1V1, 3V1, VP1 and FP1 respectively, conductor IL, through back contacts 200 and 201 of relays 2FP and F respectively, upper winding of relay M and back contact 202 of relay NC to the (+) terminal of battery LB. Relay M is stuck up over a circuit extending from the (+) terminal of battery LB, back contact 202 of relay NC, upper winding of relay M, front contact 204 of relay M, back contact 203 of relay SB and resistance RS, to the (—) terminal of battery LB. This stick circuit maintains relay M energized until the picking up of relay SB, after which it is dropped ready for the first indication circuit.

During succeeding steps of the cycle the indication line conductor IL is conditioned during the "on" periods at the field station by energizing or deenergizing this conductor. If it is energized with relay PC picked up, relay M is picked up over a circuit extending from the (+) terminal of battery LB, back contact 202 of relay NC, upper winding of relay M, front contacts 201 and 200 of relays F and 2FP respectively, conductor IL, front contact 113 of relay FP1, through the channel selecting contacts of the stepping relays, through the contact of the relay which connects conductor IL to conductor CM (such as back contact 124 of relay T) and over conductor CM to the (—) terminal of battery LB by way of back contact 26 of relay NC.

If relay NC is picked up at this particular step, then the circuit extends from the (+) terminal of battery LB, back contact 24 of relay PC (see Fig. 1A), front contact 26 of relay NC, conductor CM and through the selecting contacts at the field station, through front contact 113 of relay FP1, conductor IL, front contacts 200 and 201 of relays 2FP and F respectively, lower winding of relay M and front contact 206 of relay NC to the (—) terminal of battery LB. In the event that conductor IL is not energized at this particular step relay M will remain deenergized. This provides a choice of two "on" indication conditions which are executed when relay E picks up and closes its front contact 207 and before relay F is dropped to open its front contact 208.

The choice of two "off" indications is provided by energizing or not energizing conductor IL during the "off" periods when the line and line repeating relays are deenergized. For example, if conductor IL is energized during a particular "off" period the circuit for energizing relay M extends through back contacts 200 and 201 of relays 2FP and F respectively and through the upper winding of relay M to the (+) terminal of battery LB by way of back contact 202 of relay NC. It will be obvious that since this is an "off" period, relays NC and PC will be deenergized so that the (+) terminal of battery LB is connected to one terminal of the upper winding of relay M through back contact 202 of relay NC. The (—) terminal of battery LB is connected to the other terminal of the upper winding of relay M through back contact 26 of relay NC, by way of conductor CM to the station, conductor IL back to the office and over back contacts 200 and 201 of relays 2FP and F. In the event that conductor IL is deenergized during a particular "off" period then of course relay M remains down. This gives a choice of two "off" indications which are executed by way of back contact 208 of relay F and back contact 205 of relay E just before the start of the next succeeding "on" period.

It is to be understood that the modification of Figs. 3A and 3B may or may not be used in place of Figs. 1A and 1B and that only a single line battery is used in either case. Although the times during which the indication conditions are executed by energizing the indication channel circuits may not be as long when the modification of Figs. 3A and 3B is used, it will be apparent that sufficient time is obtained to operate a fast acting magnetic stick type relay and that a saving in apparatus is realized.

Having thus described a centralized traffic controlling system as one specific embodiment of the present invention it is desired to be understood that the form is selected to facilitate in the disclosure of the invention rather than to limit the number of forms which it may assume. It is further to be 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, a plurality of locations including a control office and a field station, means for synchronously marking off a series of successive time spaced impulse periods at said locations, an indication line circuit connecting said locations, an impulse repeating relay, a message receiving relay, means causing said indication line circuit to be impulsed by said impulse repeating relay during impulse periods and means causing said indication line circuit to be impulsed by said impulse repeating relay during time space periods whereby messages are transmitted over said indication line circuit, means inserting said message receiving relay in said indication line circuit during said impulse periods, means inserting said message receiving relay in said indication line circuit during said time space periods, and means controlled by said message receiving relay for registering messages transmitted by the impulsing of said indication line circuit.

2. In a remote control system, a plurality of locations including a control office and a field station, a source of current at one of said locations, means for synchronously marking off a series of successive time spaced impulse periods at said locations, an indication line circuit connecting said locations, an impulse repeating relay, a message receiving relay, means including said source of current for causing said indication line circuit to be impulsed by said impulse repeating relay during impulse periods and means including said source of current for causing said indication line circuit to be impulsed by said impulse repeating relay during time space periods whereby messages are transmitted over said indication line circuit, means inserting said message receiving relay in said indication line circuit during said impulse periods, means inserting said message receiving relay in said indication line circuit during said time space periods, and means controlled by said message receiving relay for registering messages transmitted by the impulsing of said indication line circuit.

3. In a remote control system; a plurality of locations including a control office and a field station; a stepping line circuit and an indication line circuit connecting the control office and the

field station, said line circuits having a common return line wire; a source of current at said control office; impulsing means at said control office for marking off a series of positive and negative time spaced impulses on said stepping circuit, said stepping circuit receiving energy for such impulses from said source of current; an impulse repeating relay; step-by-step means at the field station operated one step at a time in response to said series of impulses on said stepping circuit as repeated by said impulse repeating relay; means governed by said step-by-step means for selectively opening or closing said indication line circuit during each impulse period and during each time space period marked off on said stepping circuit by said impulse repeating relay, whereby said indication line circuit is impulsed and messages are transmitted over said indication line circuit, said indication line circuit receiving energy for such impulses from said source of current; another impulse repeating relay at the office; a first message receiving relay and a second message receiving relay at the office; means including said impulsing means and said another impulse repeating relay for reversibly inserting said first message receiving relay and said source of current in said indication line circuit during the impulse periods on said stepping circuit depending upon the polarity of the impulses on said stepping circuit and always inserting said second message receiving relay and said source of current in said indication line circuit in the same manner during said time spaced periods on said stepping line circuits, whereby said common return line wire always acts as the return path for both said line circuits; stick circuit means for said message receiving relays always having current flowing in the same direction when energized; and means controlled by said message receiving relays for registering messages transmitted by the selective impulsing of said indication line circuit.

4. In a remote control system; a control line circuit and an indication line circuit connecting a control office and a field station, said line circuits having a common return line wire; a source of energy; a code transmitting means for impressing a series of positive and/or negative time spaced impulses on said control line circuit from said source of energy; means at the field station responsive to said control impulses for receiving messages from the control office; means at the field station responsive to the impulses on said control line circuit for causing said indication line circuit to be selectively impulsed in accordance with indication conditions at the field station; a message receiving relay at the control office; means controlled by said code transmitting means for reversibly connecting said message receiving relay and said source of energy in said indication line circuit, whereby said common return line always acts as the return path for the current of both said line circuits; stick circuit means for said message receiving relays always having current flowing in the same direction when energized; and means controlled by said message receiving relay in accordance with the impulses on said indication line circuit, whereby messages are received from the field station.

5. In a remote control system; a control line circuit and an indication line circuit connecting a control office and a field station, said line circuits having a common return line wire; a single source of energy in the control office; two code sending relays in the control office, one for applying a positive impulse, when picked up, and the other for applying a negative impulse, when picked up, from said source to said control line circuit; means for selectively and intermittently controlling said two code sending relays in accordance with a control message to be transmitted, whereby a series of time spaced positive and/or negative control impulses are placed on said control line circuit; means at the field station responsive to said control impulses for receiving messages from the control office; means responsive to the impulses on said control line circuit for governing the distinctive impulsing of said indication line circuit in accordance with indication conditions at the field station both during the impulse periods and the time space periods on said control line circuit; two message receiving relays at the control office; means controlled by said two code sending relays for reversibly connecting said source of current and one of said message receiving relays into said indication line circuit during the impulse period on said control line circuit in accordance with the character of that impulse, and for connecting said other message relay into said indication line circuit during the time space periods on said stepping circuit; stick circuits for said message receiving relays for maintaining said relays picked up until the end of the time periods next succeeding the time periods upon which they are respectively picked up, said stick circuits always having current flowing in the same direction; and means distinctively controlled by said indication impulses as repeated by said message receiving relays, whereby indication messages are received from the field station.

6. In a remote control system; a control line wire and an indication line wire connecting a control office and a field station, said line wires included respectively in a control line circuit and an indication line circuit having a common return line wire; a single battery source in the control office; two code sending relays in the control office, one for applying a positive impulse, when picked up, and the other for applying a negative impulse, when picked up, from said battery source to said control line circuit; means for selectively and intermittently controlling said two code sending relays in accordance with control messages to be transmitted, whereby different series of time spaced positive and/or negative control impulses are impressed on said control line circuit; code responsive means at the field station responsive to said control impulses for receiving messages from the control office; code transmitting means at the field station governed in part by said code receiving means at the field station and in part in accordance with indication conditions at the field station for distinctively impulsing said indication line circuit in accordance with indication messages to be transmitted both during the impulse periods and the time space periods on said control line circuit; two message receiving relays at the control office; means controlled by said two code sending relays for reversibly connecting said battery source and one of said message receiving relays in said indication line circuit so as to apply positive or negative potential to said indication line circuit during each impulse period on said control line circuit depending upon whether the impulse for that period on the control line circuit is positive or negative in character respectively, and for connecting said battery source and said other message receiving relay into said indication line cir-

cuit always in the same manner during the time space periods on said stepping line circuit; an impulse repeating relay in said control office for repeating each impulse on said control line circuit irrespective of its polarity; stick circuits for each of said message receiving relays, said stick circuits being governed in part by said impulse repeating relay and always having current flowing in the same direction; and means distinctively controlled by said indication impulses as repeated by said message receiving relay, whereby said indication messages are received from the field station.

7. In a remote control system; a control line circuit and an indication line circuit connecting a control office and a field station, said line circuits having a common return line wire; a source of energy in the control office; a code transmitting means at the control office for impressing a series of postive and/or negative time spaced impulses on said control line circuit from said source of energy; means at the field station responsive to said control impulses for receiving messages from the control office; transmitting means at the field station responsive to the impulses on said control line circuit for causing said indication line circuit to be selectively impulses in accordance with the indication conditions at the field station; a message receiving relay at the control office; means controlled by said code transmitting means at the control office for reversibly connecting said message receiving relay and said source of energy in said indication line circuit, whereby said common return line wire always acts as the return path for the current of both said line circuits, and whereby the current always flows through said message receiving relay in the same direction; a stick circuit for said message receiving relay always energized with current flowing in the same direction during each time space period on said control line circuit providing said message receiving relay has been energized during the preceding impulse period; and means controlled by said message receiving relay during each time spaced period in accordance with the impulses received over said indication line circuit, whereby indications are transmitted from the field station to the control office.

8. In a remote control system; a plurality of locations including a control office and a field station; a stepping line circuit and an indication line circuit connecting the control office and the field station, said line circuits having a common return line wire; a source of current at said control office; impulsing means at said control office for marking off a series of time spaced impulses on said steppping line circuit, said stepping line circuit receiving energy for said impulses from said source of current; an impulse repeating relay; step-by-step means at the field station operated one step at a time in response to said series of impulses on said stepping line circuit as repeated by said impulse repeating relay; means governed by said step-by-step means for selectively opening or closing said indication line circuit during each impulse period and during each time space period marked off on said stepping line circuit by said impulse repeating relay; whereby said indication line circuit is impulsed and messages are transmitted over said indication line circuit, said indication line circuit receiving energy for such impulses from said source of current in said control office; another impulse repeating relay at the office; a single message receiving relay at the office; means including said impulsing means and said another impulse repeating relay for inserting said message receiving relay and said source of current in one relationship in said indication line circuit during each time space period and during each impulse of one polarity but reversibly inserting said message relay in said indication line circuit during each impulse of the opposite polarity, whereby said message receiving relay is always energized with current flow in the same direction irrespective of the polarity of the impulses impressed upon said stepping line circuit, and whereby said message receiving relay is responsive to the messages transmitted over said indication line circuit; and means controlled by said message receiving relay for registering the messages transmitted by the selective opening and closing of said indication line circuit during each time space and each impulse period of the series.

THOMAS J. JUDGE.