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CENTRALIZED TRAFFIC CONTROLLING SYSTEM FOR RAILROADS

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3 Sheets-Sheet 2



INVENTORS
C.S. Bushnell and F.W. Brixner,
BY *Neil H. Preston*
THEIR ATTORNEY

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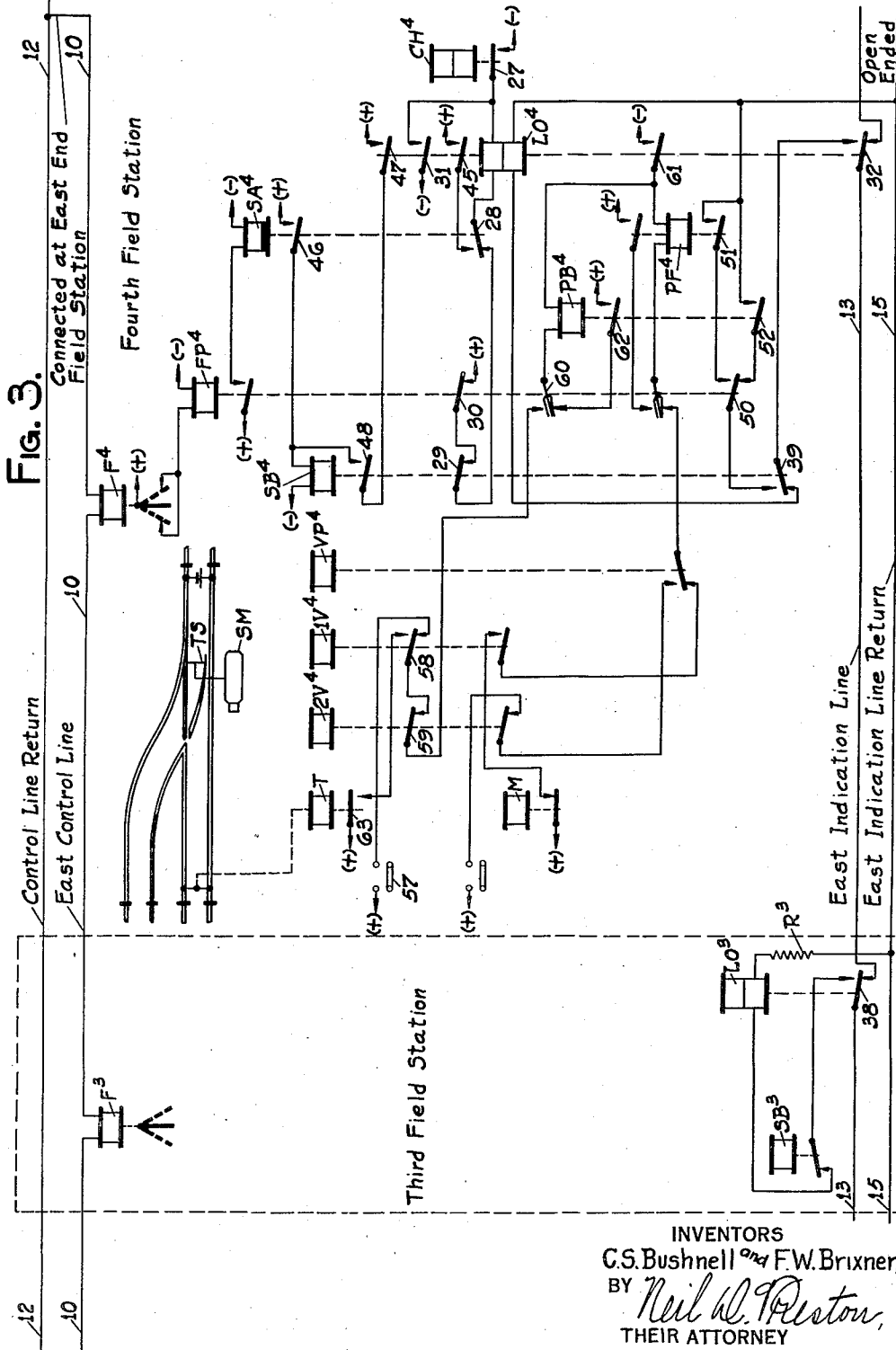
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UNITED STATES PATENT OFFICE

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CENTRALIZED TRAFFIC CONTROLLING
SYSTEM FOR RAILROADS

Charles S. Bushnell and Frederick W. Brixner,
Rochester, N. Y., assignors to General Railway
Signal Company, Rochester, N. Y.

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

5 The present invention contemplates a centralized traffic controlling system in which communication is established between a central control office and a large number of outlying field stations distributed along the railway system by means of a communication system of the station selective coded duplex type. In a communication system of this type, a series of impulses forming a particular code combination is transmitted over a control line circuit interconnecting the control office with the several outlying field stations for the selection of a particular field station and the transmission of controls to that station. Similarly, a series of impulses forming a particular code combination is transmitted over an indication line circuit interconnecting the control office with the outlying field stations for the registration of a particular field station and the transmission of indications from that station. These two circuits, namely, the control line circuit and the indication line circuit, are so interrelated by the selector type apparatus employed that controls and/or indications may be transmitted during any particular cycle of operation.

Where there are a plurality of outlying field stations, it will be apparent that several of these field stations may have new indications ready to be transmitted at the same time, but the system of the present invention provides what is termed a lockout means at each field station, so that only one such station may transmit its code call and indications during any one particular operating cycle with suitable means to restore that station to normal at rest conditions as soon as it has completed its transmitting operation.

40 In a railway system, there are usually certain points or terminals that have more traffic than others, such as division headquarters or a city located in an intermediate point along a particular division of the system. In applying a centralized traffic controlling system to such situations, it becomes expedient to locate the central control office at that point from which the most traffic is to be handled. The present invention particularly provides for such a situation by employing a system arranged so that the control and indication line circuits may extend in a plurality of directions from the central office and still accomplish the proper functioning of the system in the same manner as if the field stations

were all located in one direction from the central office.

In other words, the usual practice has been to provide the field stations in such an order as to be connected in what might be termed a series relationship insofar as the line circuits are concerned when a lock-out system on the indication line circuit is employed. However, the present invention provides a lock-out in the control office between the line circuits extending in the opposite directions which is effective to determine which direction of the indication line circuit is to have control of a particular operating cycle. This is accomplished during the initiating period of the system, and immediately following this period, the particular field station (for that direction which is selected) from among those field stations having indications to transmit is selected in accordance with the usual lock-out means after which the code call and indications are transmitted from that station.

It may be well to note that the control line circuit includes all of the field stations in series irrespective of the diverse directions in which the field stations may extend from the control office.

Other features of the present invention reside in the various circuit arrangements particularly adapted to systems of this type.

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; and various other features, functions and advantages of a system embodying this invention will be in part pointed out and in part apparent as the description thereof progresses.

In describing the invention in detail, reference will be made to the accompanying drawings in which those parts having similar features and functions are designated throughout the several views by like letter reference characters that are generally made distinctive either by reason of distinctive exponents representative of their field station location or by reason of preceding numerals representative of the order of their operation, and in which:—

Figs. 1, 2, and 3, when placed end to end in the order named, illustrate the line circuit arrangements of a system of centralized traffic control embodying the present invention, together with the apparatus and circuit arrangements employed at a typical control office and at a typical field station for accomplishing the functions of the system.

For the purpose of simplifying the illustration and facilitating in the explanation thereof, the various parts and circuits constituting the embodiment of the invention have been shown diagrammatically and certain conventional illustrations have been employed, the drawings having been made more with the purpose of making it easy to understand the principles and mode of operation than with the idea of illustrating the specific construction and arrangement of parts that would be employed in practice. Thus, the various relays and their contacts are illustrated in a conventional manner and symbols are used to indicate connections to the terminals of batteries or other sources of electric current instead of showing all of the wiring connections to these terminals.

The symbols (+) and (—) are employed to indicate the positive and negative terminals respectively of suitable batteries or other 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 designated (CN); and the circuits with which these symbols are used, may have current flowing in one direction or the other depending upon the particular terminal used in combination with the intermediate tap (CN). When alternating current is used in place of direct current, the particular symbols employed represent relative instantaneous polarities.

Although the present invention may be considered as an adjunct applicable to and usable with any selective type of communication system, it is considered expedient to explain and disclose in a general manner the application of the present invention to a typical selective type communication system, such as shown for example, in the pending application of Thomas J. Judge et al. Ser. No. 640,062 filed October 28, 1932, corresponding to British Patent No. 419,399, to which the present invention has been more particularly adapted. Thus, in considering the structure and mode of operation of the present embodiment, it becomes necessary to explain some of the features of the communication system insofar as material to an understanding of the present invention, reference being made to said prior application for other details of the structure and operation not directly related to the features of the present invention.

Communication system generally.—The general plan of organization of a centralized traffic controlling system embodying the present invention provides a central control office located in a central or intermediate position with regard to the plurality of outlying field stations. As represented in the drawings, the field stations extend to the east and to the west of the control office and are connected thereto by control and indication line circuits.

The control line circuit includes an east control line wire 10 and a west control line wire 11, both of which are connected to the control line return wire 12 at the end stations of their respective directions, so as to make up a series control line circuit extending throughout all of the field stations of the system. This control line circuit includes in the east and west control line wires 10 and 11, a three-position biased-to-neutral line relay F (with suitable exponent) at

the control office and at each of the field stations.

In the control office, positive and negative code sending relays PC and NC having contacts 18, 19, 20, and 21 are provided to determine the polarity of the energy supplied to the control line circuit from a control battery CB for the impulses impressed thereon for each cycle; while an impulsing relay EP has a back contact 22 which is included in the line circuit for periodically opening the circuit to determine the time spaces between the successive impulses of each cycle of operation of the system.

The indication line circuit is provided with an east indication line wire 13, an east indication line return wire 15, a west indication line wire 14, and a west indication line return wire 16. The east and west indication line wires 13 and 14 are normally open ended so that the indication line circuit is normally de-energized, but whenever a field station initiates the system into a cycle of operation, the indication line circuit is completed up to that station and is supplied with energy from an indication battery IB located in the control office.

The east indication line wire 13 normally includes in series therewith the message receiving relay MB in the control office together with a back contact of a direction selecting relay SR; while at the field stations, a back contact of a lockout relay LO (with suitable exponent) at each field station is included therein to determine whether the east indication line wire should pass on to the remaining field stations or be connected to the east indication line return wire 15. On the other hand, the west indication line wire 14 normally includes in series therewith a winding of the direction selecting relay SR and a back contact of the message receiving relay MB in the control office; while at each field station a back contact of the lockout relay LO (with suitable exponent) of that field station is included therein to determine whether the west indication line wire 14 should pass on to the other field stations or be connected to the west indication line return wire 16.

Although the present invention has been specifically illustrated as applied to a system having four line wires interconnecting the several stations, it is to be understood that it may be just as readily applied to a three wire system. For example, it is readily apparent that the control line return wire 12 extending through the several stations may be employed as a common wire with all of the connections made to the east indication line return wire 15 and the west indication line return wire 16 being made to the control line return wire 12. It might also be expedient to use other methods of reducing the number of line wires, such as the superimposing of one circuit upon another by the use of distinctive currents, it being understood that the present invention is intended to be of sufficient scope to include all modified line circuit arrangements.

Each field station except the last field station for each direction, includes suitable resistances, such as resistance R (with suitable exponents) for compensating for the difference in distance between the several field stations and the control office, to thereby maintain the current flow from the indication battery IB within a predetermined range, irrespective of which particular field station is transmitting over the indication line wires.

Control office equipment.—The control office equipment includes besides the apparatus directly

associated with the line circuits, as mentioned above, a quick acting line repeating relay FP together with its repeater relay 2FP. These relays FP and 2FP repeat each energized and each deenergized condition of the line relay P.

A slow acting line repeating relay SA is provided to mark off the cycles of operation by being picked up at the beginning of a series of impulses and by being released at the end of such series.

In order to accomplish this, the relay SA is provided with such slow acting characteristics that it is slow in picking up, thereby requiring a long impulse at the beginning of a series of impulses comprising a cycle of operation, but is provided with relatively slower acting characteristics in releasing so that its contacts are maintained in picked up positions during the time spaces between the successive impulses of the series, until the relay SA has been deenergized for a predetermined period of time at the end of such a series of impulses. Associated with the relay SA is a repeating relay 2SA which is provided with slow acting characteristics similar to those provided for the relay SA.

The impulses placed upon the control line circuit for a cycle of operation, as repeated by the quick acting line repeating relay 2FP, cause the step-by-step operation of a stepping relay bank, illustrated as including stepping relays 1V and 2V together with a half step relay VP. This stepping relay bank is arranged to take one step for each deenergized condition of the control line circuit between the successive impulses of a cycle of operation following the application of the first impulse of the cycle.

An impulse relay EP is associated with the stepping relay bank in order to time space the impulses on the control line circuit. Associated with the impulsing relay is a message circuit dividing relay DV which repeats each deenergized condition of the relay EP during a cycle of operation marked off by the slow acting relay SA.

As previously mentioned, the indication line circuit has associated therewith a message receiving relay MB which is provided for receiving the indication messages over the back branch of the indication line circuit; while a message receiving relay MF is provided for receiving the indication messages over the front branch of the indication line circuit. It will be thus noted, that the present invention has been shown embodied in a system providing for the double capacity transmission of indications.

The control office includes, besides the selector type apparatus, a suitable control machine having a group of control levers for each of the outlying field stations, a miniature track diagram corresponding to the actual track layout in the field, and various indicating lamps or equivalent devices for indicating the condition of the operated devices and the position of trains along the trackway. In other words, the present invention is contemplated as being applied to a complete centralized traffic controlling system, but for convenience, only that part of the control machine to which the present invention is more particularly related has been shown. For example, a miniature track switch *ts* has been shown having a track occupancy indicating lamp OS associated therewith.

Although there has been no apparatus shown for registering a field station, it is assumed that suitable means may be provided, so that following the registration of a station during the first part of an indication cycle on a suitable pilot re-

lay bank, a station relay, such as relay ST, is selected in accordance with the code received, which then renders available for the remaining part of the cycle those indication storing relays associated with the registered station, such as relays IRB and IRF, which are of the two-position magnetic stick type. The relay IRB is controlled in accordance with the condition of the detector track section at its associated field station and controls the track occupancy indicating lamp OS.

The present disclosure omits the illustration of control levers and the usual code determining relay bank for determining which group of control levers is to be selected for the transmission of controls to their associated field station, all of which has been disclosed in the above mentioned application of Thomas J. Judge et al., Ser. No. 640,062 filed October 28, 1932 but it is assumed that the actuation of a suitable starting button, or other means, causes the energization of a control office starting and cycle controlling relay C. This control office starting and cycle controlling relay C is provided to initiate the system into operation whenever it is energized by rendering the code jumpers and control levers for a particular station to be effective to govern the code sending relays PC and NC. The initial energization of one of the code sending relays energizes the control line circuit for applying the first impulse to the control line circuit which impulse, after a predetermined time measured by the picking up of the relays F, FP, 2FP, SA, and 2SA in succession together with the operation of the half step relay and impulsing relay including relay EP, is cut off. During the first deenergized condition of the control line circuit, the first stepping relay is picked up, rendering the next code jumper or control lever effective to position the code sending relays PC and NC for determining the particular character of the next impulse. Various other functions accomplished during a control operation of the system will be explained during the detailed description of the operation of the system.

A field starting and cycle controlling relay FC is picked up in response to the occurrence of a change in indication conditions at one or more field stations, and its energization, when there are no controls to be transmitted, causes the initiation of a cycle of operation for the transmission of indications. Throughout such cycle of operation, the impulses on the control line circuit are all of one character. This is accomplished by allowing the relay FC to directly control the negative code sending relay NC. The energization of the relay NC by the relay FC causes the initial energization of the control line circuit which is repeated by the relays F, FP, 2FP, SA, and 2SA, as previously mentioned, resulting in the operation of the stepping relay bank and the impulsing of the control line circuit, but as the relay NC remains energized throughout the cycle of operation, the impulses are all of negative character.

The control office includes various sources of current supply indicated by the symbols previously explained, bus wires, circuit connections, indicator lamps, terminal boards, overload protection and such other devices as may be required for the proper functioning of a complete system contemplated by the present invention.

Field station equipment.—With reference to Figs. 1 and 3 of the drawings, it will be noted that three field stations have been indicated while a fourth field station has been shown somewhat

in detail. This fourth station may be considered as a typical field station, and includes only those devices more particularly required to make plain an understanding of the present invention.

With reference to the fourth field station illustrated in Fig. 3 of the accompanying drawings, a turn-out track is illustrated as connected to the main track by a track switch TS which is operated by a switch machine SM. It is contemplated that this switch machine SM is governed in accordance with a suitable switch machine control lever (not shown) in the control office through the medium of the communication system, as disclosed in the above mentioned application of Thomas J. Judge et al. It is also contemplated that suitable signals are associated with this track switch TS for governing traffic thereover and that such signals are also controlled from the central office.

Associated with the track switch TS is a detector track section having the usual track relay T and a track battery forming a closed circuit type of track circuit.

A signals-at-stop relay M is normally energized when all of the signals governing traffic over the track switch are at stop, but is deenergized when any signal is cleared.

It is assumed that any number of traffic controlling devices may be located at this field station and may have indications to transmit the same as the track relay T and the signals-at-stop relay M, but for convenience in illustration, such additional traffic controlling devices have been omitted. Associated with the traffic controlling devices at the station is a suitable change relay CH which is normally energized, but which is deenergized upon a change in the condition of any of the traffic devices, and is then restored during a cycle of operation upon which its station has been successful in transmitting the new indications, all of which has been shown and described in detail in the Patent No. 1,852,402, dated April 5, 1932 to Darrol F. DeLong, et al.

The communication part of the system at the typical station includes, besides the apparatus already mentioned, a quick acting line repeating relay FP¹, which repeats each energized and each deenergized condition of the line relay F¹ similarly as the relay FP in the control office. Also, a slow acting relay SA⁴ is employed to mark off the cycles of operation by being picked up at the beginning of a cycle of operation and being released at the end of such cycle a predetermined time after the removal of the last impulse of that cycle, in a manner as explained for the relay SA in the control office. Associated with the relay SA⁴ is a quick acting repeating relay SB⁴ provided to cause the positive operation of the system.

The field station includes a bank of stepping relays, including relays 1V⁴ and 2V⁴ together with a half step relay VP⁴, which are controlled as described in the above mentioned application of T. J. Judge et al. and need not be disclosed in detail for an understanding of the present invention.

A lock-out relay LO⁴ is provided at the field station to register when that station is selected for the transmission of its indications from among all other stations having indications ready to transmit.

For the purpose of governing the front and back branches of the indication line circuit when this field station is rendered effective by its lock-out relay LO⁴, pulsing relays PF⁴ and PB⁴ are

provided to operate in accordance with the code jumpers and indication contacts of the station.

It is of course to be understood that the field station includes in practice various other adjuncts and apparatus necessary for a complete system, a description of which is unnecessary for an understanding of the present invention. A station also includes bus wires, circuit connections, terminal boards, overload protection and other devices for the usual communication system employed for controlling traffic controlling devices.

It is believed that the nature of the invention, its advantages and characteristic features can be best understood by setting forth further description from the standpoint of operation.

OPERATION

In general.—The system is normally at rest but may be initiated into a cycle of operation either from the control office or from any of the field stations whenever there are new controls or new indications ready to be transmitted. While the system is at rest, the line circuits are normally deenergized; and similarly, the remaining circuits of the system are arranged to be normally deenergized with a few exceptions.

For example, the change relays CH (with suitable exponents) at the field stations are normally energized, all of which has been pointed out and disclosed in the patent of D. F. DeLong et al., Patent No. 1,852,402, dated April 5, 1932. Also, the track relay T of the detector track section associated with the track TS (see Fig. 3), is normally energized.

If new controls for several different field stations are ready for transmission at substantially the same time, the controls for the several stations are transmitted on separate cycles of operation, one station for each such cycle. Similarly, if several field stations have indications ready for transmission at substantially the same time, the indications are transmitted from such field stations to the control office, one station at a time on separate operating cycles.

It may happen that there are new controls and new indications to be transmitted at the same time, and in such instances controls are transmitted to a selected field station, and simultaneously therewith indications are transmitted from that field station or some other field station during the same cycle of operation.

Irrespective of whether a cycle of operation is to be for the transmission of controls and/or the transmission of indications, a predetermined number of impulses are placed upon the control line circuit to accomplish the step-by-step operation of the stepping relay banks. These impulses placed upon the control line circuit are time spaced, that is, the impulses follow each other at definite time intervals.

When a cycle of operation is initiated for the transmission of controls alone, the characters of the impulses placed upon the control line circuit are determined in accordance with the code call of the station to be selected and in accordance with the controls to be transmitted as set up by the control levers for that station. Similar determination of the characters of the impulses on the control line circuit occurs during a duplex cycle.

On the other hand, during a cycle of operation initiated for the transmission of indications alone, the characters of the impulses placed upon the control line circuit are such as to fail to select

any station, but are employed to merely cause the step-by-step operation of the stepping relay bank at the control office and the stepping relay bank at that particular field station transmitting indications.

In other words, when a cycle of operations is initiated from a field station for the transmission of indications, the control line circuit is impulsed either for the transmission of controls or with a non-selecting code call during which the indication line circuit is pulsed for the transmission of indications. On each step taken by the step-by-step mechanism at the field station which is transmitting, the indication line circuit is either opened or closed in accordance with the indication contacts for that step, that is, one indication contact is effective during the energized condition of the control line circuit, while another indication contact is effective during the deenergized condition of the control line circuit for that step. Such conditions of the front and back branches of the indication line circuit at the field station are transmitted to the control office where they are rendered effective to position the message receiving relays MF and MB of the corresponding branches in the control office. These message receiving relays then store such conditions in suitable indication storing relays or pilot relays, as the case may be, in the period immediately following their positioning over the indication line circuit. These relays MF and MB are positioned alternately on the successive energized and deenergized periods of the control line circuit so that for each period an indication storing relay or pilot relay is being positioned in accordance with the code call or indication transmitted.

For an understanding of the present invention, it is considered unnecessary to consider the manner in which the controls are transmitted from the control office to the field station and the particular distinctions between the transmission of controls and/or indications on separate operating cycles or duplex cycles, as the case may be, for such operation has been set forth in the above mentioned application of Thomas J. Judge et al., Ser. No. 640,062 filed October 28, 1932.

However, it may be pointed out that for the transmission of controls, the control office starting and cycle controlling relay C is picked up which renders the positive and negative code sending relays PC and NC governable by the code jumpers and control contacts for that particular station determined by the code determining relay bank, as indicated by a suitable legend in the drawings (see Fig. 2).

On the other hand, for an indication cycle of operations alone, the relay NC is maintained energized throughout the cycle by reason of the closed back contact 23 of relay C and the front contact 24 of relay FC, so that the impulses of the cycle of operation are all of like character. In other words, for a control cycle alone, or a duplex cycle, the character of the impulses placed on the control line circuit are determined in accordance with the code calls and controls to be transmitted; while for an indication cycle alone when no controls are to be transmitted, the impulses on the control line circuit are all of like characters.

Whenever the system is at rest and one or the other of the cycle controlling relays C or FC is picked up, and either a code sending relay PC or NC is energized, a cycle is initiated by the application of an impulse to the control line circuit

which is repeated at the control office and at all of the field stations by the three-position biased-to-neutral polarized line relays F (with suitable exponents). Irrespective of the particular character of the impulse for this first energized period of the control line circuit, such impulse is repeated by the quick acting line repeating relays FP (with suitable exponents) at the control office and at each field station, which marks the end of the initiating period at each field station. In this connection, it may be noted that the relay 2FP in the control office, which repeats relay FP, provides additional time to compensate for the lag between the field station line repeating relays and the control office line repeating relays.

After the first impulse has been placed upon the control line circuit for a predetermined period of time the relays SA (with suitable exponents) at the control office and at each field station are picked up which marks the end of the lock-out period at each field station. After a time the relay 2SA in the control office (see Fig. 2) picks up which then allows the relays VP and EP to successively respond to thereby mark the end of the first energized period on the control line circuit. The relay 2SA is in part provided to give additional time after the response of the relay SA in order to provide for any variation in time periods during which the relay SA (with suitable exponents) at the several field stations may pick up.

The picking up of the relay EP in the control office marks the end of the first energized period, thereby causing the first deenergized period for the cycle to be impressed upon the control line circuit. This first deenergized period of the control line circuit is repeated by the relays FP and 2FP to cause the operation of the first stepping relay IV in the control office, but the relays SA and 2SA do not drop away as their slow acting characteristics provide that their contacts are maintained in energized positions between successive impulses applied to the control line circuit. The response of the relay IV in the control office deenergizes the impulsing relay EP so that the closure of its back contact may apply the next impulse (second) having a character determined by the code sending relays PC and NC, which are positioned during the first deenergized period of the control line circuit.

The second impulse or second energized period of the control line circuit causes the response of the half step relay VP in the control office following the response of the relay 2FP to such energized period. The response of the relay VP again causes the energization of the relay EP marking the end of the second energized period. During the second deenergized period of the control line circuit, the second stepping relay 2V in the control office is picked up and at the same time the code sending relays PC and NC are positioned providing of course that controls are being transmitted. The response of the relay 2V deenergizes the relay EP, and the third impulse is applied to the control line circuit.

The impulsing operation of the control line circuit and the step-by-step operation of the stepping relay bank in the control office may continue for as many steps as may be required for the chosen capacity of the system.

Similar step-by-step operation of the stepping relay bank at the field station takes place in response to the impulsing of the control line circuit. However, the stepping relay banks at the field station preferably respond only when they

have the possibility of being selected for the reception of controls or when they are transmitting indications. In other words, the operation of the stepping relay bank at the field station is made dependent upon station selection either for the reception of controls or for the transmission of indications. Such optional features are immaterial to an understanding of the present invention and may be had by reference to the above mentioned application of T. J. Judge et al., Ser. No. 640,062 filed October 28, 1932. It is considered sufficient to know that the stepping relay bank at a field station operates each time its lock-out relay LO (with suitable exponent) is energized following the lock-out period marked off by the picking up of the relay SA (with suitable exponent) at the station. After the predetermined number of impulses comprising a cycle of operation has been applied to the control line circuit and all of the stepping relays in the control office have been picked up in succession, the relay EP is picked up and is maintained energized until all of the relays of the system have returned to their normal positions after which the relay EP is deenergized and the system continues to be in a condition of rest until again initiated. In other words, after the last impulse has been applied to the control line circuit, the control line circuit is maintained deenergized for a period of time sufficient to allow the relays SA (with suitable exponents) at the control office and at all field stations to drop away, which causes all of the stepping relays to be released as well as various other relays which have been picked up during the cycle of operation. After a certain added period of time measured by the releasing period of the relay 2SA in the control office, the relay EP is released and the system is then in a normal at rest condition.

It is believed that sufficient general information has been given with regard to the operation of the system as a whole, so that the specific operation with regard to the transmission of indications and the interlock between the opposite directions to prevent more than one field station from transmitting indications at the same time will be considered. In considering such detailed operation, the functioning of the system with regard to the transmission of indications from a single field station location will be given with more particular reference to the fourth field station illustrated in Fig. 3 of the drawings. Following such description, the interlock between field stations which allows only one field station for any one extension of the indication line circuit to transmit at the same time will be considered, after which the interlock between the opposite extensions of the indication line circuit will be pointed out.

Transmission of indications.—The selection of field stations for outgoing controls and the transmission of controls to a selected station is accomplished, as briefly mentioned above, over the control line circuit; while the transmission of indications is accomplished over the message or indication line circuit following the proper registration of a particular field station.

To consider the transmission of indications from a particular field station, we will assume that the system is in a condition of rest and is automatically initiated when a train enters the detector track section associated with the track switch TS, thereby causing the deenergization of the track relay T followed by the release of the change relay CH⁴. Of course, similar initiation

of the system would occur when a train passed off the detector track section picking up the track relay T, as the change relay CH⁴ would likewise at such a time be released. It is also to be understood that a large number of traffic governing devices may also cause the release of the change relay CH⁴, but for convenience and simplicity the specific control of the change relay has been omitted.

In any case, the deenergization or release of the relay CH⁴ closes a pick-up circuit for the lock-out relay LO⁴ from (+), through a circuit including back contact 30 of relay FP⁴, back contact 29 of relay SB⁴, back contact 28 of relay SA⁴, upper winding of LO⁴, back contact 27 of relay CH⁴, to (—).

The response of the relay LO⁴ closes its stick circuit from (+), through a circuit including back contact 30 of relay FP⁴, back contact 29 of relay SB⁴, back contact 28 of relay SA⁴, upper winding of relay LO⁴, front contact 31 of relay LO⁴, to (—).

The closure of front contact 32 of relay LO⁴ closes the indication line circuit to energize the message receiving relay MB in the control office which in turn closes a pick-up circuit for the field starting and cycle controlling relay FC. For example, this energizing circuit for the relay MB is closed from the positive terminal of the indication battery IB (see Fig. 2) through a circuit including the back contact 35 of relay DV, lower winding of message receiving relay MB, back contact 36 of relay 2SA, back contact 37 of selecting relay SR, east indication line wire 13 to the third field station, back contact 38 of lock-out relay LO³ at the third field station, through the east indication line wire 13 to the fourth field station, front contact 32 of lock-out relay LO⁴ at the fourth field station, back contact 39 of relay SB⁴, lower winding of relay LO⁴ to the east indication line return wire 15 and thence to the negative terminal of the indication battery IB in the control office.

It will be noted that the contacts 40 and 41 of the relays FP and 2FP in the control office provide a shunt circuit for the back contact 36 of the relay 2SA for energizing the lower winding of the relay MB from the field station, but these contacts are opened at the beginning of a cycle of operation thereby requiring the back contact 36 of the relay 2SA to make up the line circuit for the relay MB for a sufficient period of time to insure the selection of a lock-out relay during the lock-out period, as presently to be described. In other words, the back contact 36 of the relay 2SA may be considered as the contact properly included in the indication line circuit above pointed out.

The response of the message receiving relay MB in the control office closes a pick-up circuit for the field starting and cycle controlling relay FC from (+), through a circuit including front contact 42 of relay MB, back contact 43 of relay 2SA, lower winding of relay FC, to (—).

The picking up of the contacts of the field starting and cycle controlling relay FC prepares its stick circuit at front contact 44 and also closes an energizing circuit for the negative code sending relay NC from (+), through a circuit including back contact 23 of relay C, front contact 24 of relay FC, bus wire 25, windings of relay NC, to (—).

This energization of the negative code sending relay NC actuates its contacts 18 and 19, to thereby energize the control line circuit with a negative

impulse. For example, this energizing circuit is closed from the positive terminal of the control battery CB, through a circuit including front contact 18 of relay NC, back contact 20 of relay PC, through the west control line wire 11 to the second field station, windings of relay F², through the west control line wire 11 to the first field station, windings of relay F¹, to the control line return wire 12 and thence through the several field stations and the control office to the fourth field station, windings of relay F⁴ at the fourth field station, through the east control line wire 10 to the third field station, windings of relay F³ at the third field station, through the east control line wire 10 to the control office, windings of the relay F at the control office, back contact 22 of relay EP, back contact 21 of relay PC, front contact 19 of relay NC to the negative terminal of the control battery CB. This energization of the control line circuit causes the polar contacts of the line relays F (with suitable exponents), to be actuated to left hand dotted line positions.

The energization of the line relays is repeated by their respective line repeating relays FP (with suitable exponents) which marks the end of the initiating period after which no lock-out-relay LO (with suitable exponent) can be picked up, as the pick-up circuits of all lock-out relays are opened at back contacts of the line repeating relays. For example, the response of the relay FP⁴ opens the pick-up circuit of the lock-out relay LO⁴ at back contact 30.

However, during the lock-out period, that is, during the time subsequent to the picking up of the line repeating relays FP (with suitable exponents) and prior to the response of the slow acting line repeating relays SA (with suitable exponents), the particular lock-out relay closest to the control office on its respective extension of the indication line circuit is maintained energized over the indication line circuit, as previously traced. For example, subsequent to the picking up of the relay FP⁴ and prior to the response of the relay SA⁴, the lock-out relay LO⁴ is maintained energized over the indication line circuit including at the station its front contact 32 and the back contact 39 of relay SB⁴.

After the predetermined time measured off by the picking up of the relay SA⁴, a stick circuit is closed for the relay LO⁴ from (+), through a circuit including front contact 45 of relay LO⁴, front contact 28 of relay SA⁴, upper winding of relay LO⁴, front contact 31 of relay LO⁴, to (-).

The picking up of the relay SA⁴ closes a pick-up circuit for the relay SB⁴ from (+), through a circuit including front contact 46 of relay SA⁴, windings of relay SB⁴, to (-). With the relay LO⁴ picked up, a stick circuit is closed for the relay SB⁴ from (+), through a circuit including front contact 47 of relay LO⁴, front contact 48 of relay SB⁴, windings of relay SB⁴, to (-).

The picking up of the relay SB⁴ connects the east indication line wire 13 through front contact 32 of relay LO⁴ and front contact 39 of relay SB⁴ to the control of the contact 50 of relay FP⁴ and the contacts 51 and 52 of the pulsing relays PF⁴ and PB⁴ respectively. However, at this time the pulsing relays PF⁴ and PB⁴ are both deenergized so that the indication line circuit is opened.

In the control office, as previously mentioned, the energizing circuit for the relay MB is maintained through back contact 36 of relay 2SA until after the response of the relay SB⁴ at the field station. In other words, the relay MB is maintained energized over the indication line circuit

by the relays LO⁴ and SB⁴ until after the response of the relay SA in the control office, so that the relay FC is insured of being maintained energized by reason of the closure of its stick circuit prior to the opening of its pick-up circuit. For example, its stick circuit is closed upon the response of relay SA from (+), through a circuit including front contact 53 of relay SA, front contact 44 of relay FC, upper winding of relay FC, to (-).

At the time of the closure of the stick circuit for the relay FC, an energizing circuit is closed for the relay DV from (+), through a circuit including front contact 53 of relay SA, back contact 45 of relay EP, windings of relay DV, to (-). The response of the relay DV may be assumed to be at substantially the same time as the response of the relay SB⁴ at the field station, so that the circuit for the relay MB is opened at the control office and the field station practically at the same time. If the relay DV should happen to pick up prior to the relay SB⁴ at the field station, and the relay MF should happen to be momentarily energized enough to momentarily pick its contacts up, it is not stuck up through its stick circuit at this time as the relay EP is deenergized and the relay 2FP is picked up. Also, if such a change in the position of the relay MF occurs at this time, it has no effect as the relay FP is picked up which opens its executing or storing circuit at back contact 55.

Following the response of the relay 2SA to the first impulse upon the control line circuit, the relay VP is actuated to its picked-up position causing the relay EP to be picked up. The energization of the relay EP opens the control line circuit for the first deenergized period. The opening of the back contact 45 of relay EP also deenergizes the relay DV. The opening of the control line circuit is repeated at the control office and at the field stations by the relays EP (with suitable exponents).

The remaining impulses of the cycle are placed upon the control line circuit at time spaced intervals, as previously described, it being understood that with an indication cycle alone, the field starting and cycle controlling relay FC is picked up, so that all of the impulses of the cycle are of negative character.

We may now consider how the pulsing relays PB⁴ and PF⁴ are positioned at the field station and govern the indication line circuit.

During the first energized period of the control line circuit, the pulsing relay PB⁴ is positioned in accordance with the code jumper 57 at the field station. If the code jumper 57 is in an upper contacting position, the relay PB⁴ is energized, but if the code jumper is in a lower open position, then the relay PB⁴ is left deenergized. For example, with the code jumper in a closed position, a circuit is closed for the relay PB⁴ from (+), through a circuit including code jumper 57, back contact 58 of relay 1V⁴, back contact 59 of relay 2V⁴, front contact 60 of relay FP⁴, windings of relay PB⁴, front contact 61 of relay LO⁴, to (-).

If the relay PB⁴ is picked up by reason of the code jumper 57 being in a closed position during the first energized period, then it is maintained energized during the following deenergized period of the control line circuit by reason of a stick circuit closed from (+), through the front contact 62 of the relay PB⁴, back contact 60 of relay FP⁴, windings of relay PB⁴, front contact 61 of relay LO⁴, to (-). If, however, the relay PB⁴ is left deenergized during the first energized period of the control line circuit, then it is left deenergized

during the following deenergized period of the control line circuit. It is noted that the control of the relay PB⁴ can be shifted from its pick-up circuit to its stick circuit without interruption of its energization by reason of the make-before-break contact 60.

In a similar manner, the relay PB⁴ is positioned on each energized period of the control line circuit in accordance with its respective code jumper or indication contact for that period as selected by the stepping relays, with each such condition thus established on the energized period being maintained for the immediately following deenergized period.

For example, during the first deenergized period of the control line circuit, the first stepping relay IV⁴ is picked up so that during the second energized period on the control line circuit, the relay PB⁴ is positioned in accordance with the energized or deenergized position of the track relay T. If the track relay T is energized, then the relay PB⁴ is left deenergized; but if the track relay T is deenergized, the pulsing relay PB⁴ is energized by a circuit closed from (+), through a circuit including back contact 63 of relay T, front contact 53 of relay IV⁴, back contact 59 of relay 2V⁴, front contact 60 of relay FP⁴, windings of relay PB⁴, front contact 61 of relay LO³, to (-). If the relay PB⁴ is not picked up, it remains deenergized during the following deenergized period (second); but if it is picked up during the second energized period, then it is maintained energized during the following deenergized period (second) by reason of its stick circuit previously pointed out.

Similar control is provided for the pulsing relay PF⁴ with the exception that it is positioned during the deenergized conditions of the control line circuit, and the positions thus established are maintained during their immediately following energized periods of the control line circuit.

As pointed out above, the pulsing relays PB⁴ and PF⁴ are ineffective to govern the indication line circuit during the first energized period of the control line circuit. This is because the relay FP⁴ is picked up routing the indication line circuit through the contact 51 of relay PF⁴, but this contact can not be closed nor is the relay PF⁴ positioned in accordance with any code jumper until the first deenergized period.

Thus, relay MF in the control office is not positioned during the first energized period on the control line circuit. However, the relay PB⁴ is being positioned during the first energized period, so as to be effective to govern the indication line circuit on the first deenergized condition of the control line circuit and thereby position the message receiving relay MB. For example, if the relay PB⁴ is deenergized, the relay MB remains deenergized; but if the relay PB⁴ is picked up by reason of the closed position of the code jumper 51, the relay MB is energized through a circuit closed from the positive terminal of the indication battery IB through a circuit including back contact 35 of relay DV, lower winding of relay MB, back contact 40 of the relay FP, back contact 41 of the relay 2FP, back contact 37 of the selecting relay SR, through the east indication line wire 13 to the third field station, back contact 38 of relay LO³ at the third field station, through east indication line wire 13 to the fourth field station, front contact 32 of relay LO⁴ at the fourth field station, front contact 39 of relay SB⁴, back contact 50 of relay FP⁴, front contact 52 of relay PB⁴, through the east indication line return

wire 15 to the negative terminal of the indication battery IB in the control office.

If the message receiving relay MB is not picked up on the first deenergized period of the control line circuit, then it remains deenergized during the following energized period (second) of the control line circuit; but if the message receiving relay MB is picked up on the first deenergized period of the control line circuit, then it is maintained energized during the second energized period of the control line circuit by reason of a stick circuit closed from (+), through a circuit including back contact 64 of relay EP, front contact 65 of relay MB, upper winding of relay MB, to (-). This stick circuit is closed prior to the picking up of the relay DV and the resulting opening of the governing circuit for the relay MB. Upon the energization of the relay 2FP, a multiple stick circuit is closed from (+), through a circuit including front contact 66 of relay 2FP, front contact 65 of relay MB, upper winding of relay MB, to (-). In other words, the stick circuit for the relay MB is initially closed by the back contact 64 of the relay EP and is finally opened by the front contact 66 of the relay 2FP. This is to insure that the relay MB is held energized during the proper periods of time.

It will be readily apparent that the relay MB may be positioned on each deenergized period of the control line circuit and will be held in such position through the following energized period.

During each energized period of the control line circuit beginning with the second, the position of the relay MB, as determined by the indication message received, is executed or stored by reason of the closure of front contact 67 of relay FP. During the second energized period of the control line circuit, the position of the relay MB is executed to a suitable pilot relay (not shown), it being assumed that this is accomplished in the usual way. After a sufficient number of code calls have been established, a station registering relay ST is picked up after which the indications are registered.

For example, if the track relay T is energized, then the relay PB⁴ will be left deenergized on the second energized period and second deenergized period of the control line circuit, so that the relay MB is left deenergized on the second deenergized period and third energized period. Then, during the third energized period, negative potential is therefore applied to the indication storing relay IRB. On the other hand, it will be apparent that if the track relay T is deenergized, that the relays PB⁴ and MB will be picked up during their respective periods, so that positive potential is applied to the relay IRB.

For example, the execution or storing circuit for the relay IRB is closed during the third energized period of the control line circuit from either (B+) or (B-), depending upon the energized or deenergized position of contact 68 of the relay MB respectively, through a circuit including front contact 67 of relay FP, front contact 69 of the relay 2V, front contact 70 of the relay ST, windings of the relay IRB, to (CN). The application of negative potential to the relay IRB in accordance with the energized position of the track relay T causes its contact 71 to be actuated to a left hand position; while the application of positive potential to the relay IRB in response to the deenergized position of the track relay T causes its contact 71 to be actuated to a right hand position. When con-

tact 71 of relay IRB is in a right hand position, an obvious energizing circuit is closed for the track occupancy indicating lamp OS advising the operator in the control office that a train is present on the detector track section associated with the track switch TS.

It will be readily understood that the relay MF may be similarly positioned during each energized period of the control line circuit beginning with the second, in accordance with the position of the relay PF⁴ and that such positions will be maintained through the immediately following deenergized period, at which time the messages then stored will be executed to the indication storing relays or the pilot relays as the case may be.

Further operation of the system for the transmission of indications may be understood by analogy to the description already given, or reference may be made to the pending application of T. J. Judge et al., Ser. No. 640,062 filed October 28, 1932, for features not directly associated with the present invention.

After the last impulse has been applied to the control line circuit and then removed, the SA relays (with suitable exponents) drop away as previously explained for the end of a cycle of operation. Also, the stick circuit for the relay LO⁴ is opened by reason of the open front contact 28 of relay SA⁴. The dropping away of the contacts of the relay LO⁴ opens the stick circuit for the relay SB⁴ and the field station is returned to its normal condition. Some time during the cycle of operation after the relay LO⁴ is selected during the lock-out period, the change relay CH⁴ is returned to normal energized condition through suitable means disclosed in the prior application of T. J. Judge et al., above mentioned, the details of which are immaterial for an understanding of the present invention.

In the control office, the relays return to normal conditions, as previously mentioned, the relay FC being deenergized by reason of the opening of front contact 53 of the relay SA.

Interlock between field stations.—It will be apparent that when the third and fourth field stations have indications ready to transmit at the same time, that the relays LO³ and LO⁴ will be picked up at the same time. However, as the east indication line wire 13 is routed through the lower winding of the lockout relay LO³ by contact 38 in such a case, the relay LO⁴ cannot be maintained energized over the indication line circuit during the lock-out period after its pick-up circuit is opened by the opening of back contact 30 of relay FP⁴. In other words, during the lockout period, preference is given to that station nearest the control office having its lock-out relay LO (with suitable exponent) picked up.

Field starting from west extension of line circuits.—It is considered unnecessary to describe the detailed operation of the initiation of the system and the transmission of indications from a west end field station, but to merely point out the difference in the operation in the control office for accomplishing such initiation before considering the condition where a field station on both ends of the system may endeavor to transmit at the same time.

For example, it is evident that the energization of a lock-out relay LO (with suitable exponent) on the west end creates a closed indication line circuit similar as explained for the picking up of the lock-out relay LO⁴ on the east end of the system, with the exception that the closure of

the indication line circuit from the west end, first energizes the direction selecting relay SR before energizing the message receiving relay MB.

More specifically, assuming that the lock-out relay LO³ is picked up with the system otherwise at rest, an energizing circuit for the relay SR is closed from the positive terminal of the indication battery IB through a circuit including back contact 72 of relay MB, back contact 73 of relay 2SA, lower winding of relay SR, west indication line wire 14 to the second field station, front contact 74 of relay LO³, back contact 75 of relay SB², lower winding of relay LO², compensating resistance R², through the west indication line return wire 16 to the control office and the negative terminal of the indication battery IB.

This energization of the relay SR causes its contacts to be picked up, which closes its stick circuit from (+), through a circuit including back contact 76 of relay 2SA, front contact 77 of relay SR, upper winding of relay SR, to (—). This stick circuit is maintained closed upon the picking up of the relay 2SA by reason of the multiple contact 78 of relay SA which connects positive energy to the stick circuit, as will be readily apparent.

The picking up of the relay SR closes a local energizing circuit for the message receiving relay MB from (+), through back contact 79 of relay 2SA, front contact 80 of relay SR, upper winding of relay MB, to (—). This energization of the relay MB effects the energization of the field starting and cycle controlling relay FC in a manner previously pointed out.

It is noted that the response of the relay SR in opening back contact 37 and in closing front contact 37, disconnects the east indication line wire 13 and connects the west indication line wire 14 to the control office message receiving relays, connects the relay MB through its lower winding in multiple with the relay SR so that the relay MB would probably pick up, if the voltage supplied by the indication battery IB were properly chosen.

However, it is evident that the relays MB and SR when connected in multiple, will each receive half of the indication line current, which would tend to energize the relay MB and which would tend to deenergize the relay SR, but the relay SR is maintained energized through its stick circuit and the relay MB is energized through a local circuit so that the proper operation is obtained irrespective of the multiple combination. This provides that the same indication currents are employed for all combinations of circumstances throughout the operation of the system.

It is also noted, that the pick-up circuit for the relay SR is disconnected from the west indication line wire 14 upon the response of the relay 2SA by reason of the open back contact 73. Also, the local energizing circuit for the relay MB is maintained open throughout the cycle of operation by reason of open back contact 79 of relay 2SA.

It is believed that further operation will be readily apparent as the indication impulses are transmitted over the west indication line wire 14 in a similar manner as explained for transmission over the east indication line wire 13.

Interlock between east and west extensions.—Let us now assume that lock-out relays LO (with suitable exponents) are picked up at a station on both the east and west extensions of the system at the same time. Under such conditions,

the energizing circuit for the relay MB is closed over the east indication line wire 13, as pointed out, including back contact 37 of relay SR; while at the same time the energizing circuit for the relay SR is closed over the west indication line wire 14 including the back contact 72 of relay MB.

Assuming that the relays MB and SR have operating times substantially identical, the relays MB and SR will assume picked up positions at the same instant. As the relay SR has a stick circuit, it will remain picked up and the west indication line wire 14 will be connected to the relay MB, which will be insured of being picked up by reason of its local circuit. In other words, where the east and west extensions have changes occurring at the same instant, preference is given to the west extension.

It is readily apparent that if a lock-out relay LO (with suitable exponent) is energized first on the west extension, then the relay SR will pick up first in spite of any lock-out relay that may pick up on the east extension. Similarly, if a change occurs by the picking up of a lock-out relay LO (with suitable exponent) on the east extension, the relay MB will be picked up opening back contact 72 and preventing the picking up of the relay SR by a lock-out relay LO (with suitable exponent) on the west extension, so that preference is given to the east extension in such a case.

From the above description it is apparent that the interlock between the east and west extensions occurs prior to the picking up of the relay FC, so that preference is established between the east and west extensions during what may be termed the initiating period, which exists prior to and up to the picking up of the relays FP (with suitable exponents) at the several field stations. If lock-out relays are picked up on both extensions at the same time, only the lock-out relay closest to the control office on that extension which has been given preference will be maintained during the lock-out period following the picking up of the relays FP (with suitable exponents). In other words, that particular indication line which is connected to the control office by reason of its preference receives energy to select a lock-out relay during the lock-out period. All other lock-out relays are dropped out.

SUMMARY

A system has thus been shown and described which is of the coded duplex type provided with an indication line circuit that employs the lock-out method of providing superiority between field stations for the transmission of indications. The present invention provides a system of this character in which the control office may be located at an intermediate point in the system without in any way hindering the usual functioning of the lock-out operation between stations.

The control office may be located at any intermediate point, as it is immaterial insofar as the preference between the two extensions of the system is concerned, as such preference is determined before the preference between the stations is established. The indication line circuit employs compensating resistors at the several field stations to determine the proper line current in the indication line circuit with respect to their distance from the control office.

This method of locating a control office in the center of a geographic lock-out on a line circuit may be adapted to any type of system and still

be within the scope of the invention, it being understood that it is applied to the type of system disclosed in the above mentioned case of T. J. Judge et al., Ser. No. 640,062 filed October 28, 1932, only for the purposes of explanation, and in no way should it be understood that the present invention is limited to the use with a duplex type of system, or with a system providing the double capacity transmission of indications.

It should be noted in connection with the registration of field stations in the control office that a number of station registering codes must be employed equal to the total number of field stations of the system. In other words, each field station must be given a distinctive code call irrespective of the fact that preference is given between the east and west extensions of the system with respect to the order of transmission. The specific code calls which may be assigned and the particular manner in which code calls may be arranged has not been disclosed in detail in the present disclosure, it being understood that code systems are well known to those skilled in the art and have been explained and disclosed in various prior applications.

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

What we claim is:—

1. In a remote control system, a control office, a plurality of field stations, a control line circuit connecting the control office with said field stations, one indication line circuit connecting the control office with a part of the field stations, another indication line circuit connecting the control office with another part of the field stations, means causing a series of impulses to be applied to said control line circuit when either or both of said indication line circuits is energized, control line circuit repeating relays marking the end of an initiating period upon the repeating of the first impulse of said series, slow acting control line circuit repeating relays marking the end of the lock-out period upon repeating the first impulse of said series, means in the control office effective during the initiating period to determine which indication line circuit is to be employed, and means at each field station effective during the lock-out period to select that field station nearest the control office on that particular indication line circuit which is selected during said initiating period, whereby only one field station is in communication with the control office during any one series of impulses on the control line circuit.

2. In a remote control system, a plurality of field stations, a control line circuit connecting the control office with the field stations, one indication line circuit connecting the control office with a part of the field stations, another indication line circuit connecting the control office with another part of the field stations, impulsing means for applying a series of impulses to said control line circuit, lock-out relay means at each field station for closing the indication line circuit

connecting that station with the control office, a change storing means at each field station for initially rendering effective its corresponding lock-out relay means when a change in indication conditions occurs, a neutral relay in the control office for each indication line circuit, a pick-up circuit for each of said neutral relays including a back contact of the other of said neutral relays and its own indication line circuit, a stick circuit for only one of said neutral relays which is capable of being closed prior and during the first impulse, means initiating said impulsing means when either one or both of said neutral relays is picked up, means including said neutral relays for rendering effective one or the other of said indication line circuits, and means selecting a particular lock-out means at a particular field station connected by the particular indication line circuit rendered effective, said means being effective only during the first impulse of a series.

3. In a remote control system having a control office with two separate incoming line circuits which may simultaneously have indications to be received but where there is only one indication receiving apparatus in the control office, means for interlocking the two line circuits to connect only one of the line circuits to the indication receiving apparatus at a time in the event of simultaneous energization of the line circuits comprising; two neutral relays, one for each line circuit; a pick-up circuit for each of said neutral relays, the pick-up circuit for a particular relay including a back contact of the other relay and its own respective line circuit; a stick circuit for a first one of said relays; means controlled by said first relay for rendering said line circuits incapable of simultaneous energization; means for allowing the closure of said stick circuit while the two line circuits are capable of simultaneous energization; means rendering one or the other of the two line circuits connected to the indication receiving apparatus effective depending upon the condition of said two neutral relays; whereby a predetermined preference is given to a particular one of the line circuits in the event of simultaneous energization of said line circuits when indications are ready simultaneously on both line circuits.

4. In combination, a control office, a plurality of field stations, a code transmitter at each field station, a code receiver at said control office, one line circuit connecting one part of said field stations with said control office, another line circuit connecting the other part of said field stations with said control office, means connecting said one or said another line circuit with said code receiver depending upon which of said line circuits is first energized by one of its code transmitters, means controlled by the code transmitter at each station for transmitting codes over its associated line circuit, means including said code receiver for receiving said codes, and said means invariably causing connection of said one line circuit with said code receiver when said line circuits are simultaneously energized by said code transmitters.

5. In combination, a control office, a plurality of field stations, a code transmitter at each field station, a code receiver at said control office, one line circuit connecting one part of said field stations with said control office, another line circuit connecting the other part of said field stations with said control office, relay means connecting said one or said another line circuit with said code receiver depending upon whether said relay

means is energized or deenergized, means rendering one of said code transmitters effective to transmit codes on said line circuit and said means energizing said relay means when a station among said one part of said stations is actuated and the corresponding line circuit is connected to the code receiver, means rendering one of said code transmitters effective to transmit codes on another line circuit when a station on another part of said line circuit is actuated and the corresponding line circuit is connected to said code receiver, means maintaining said relay means energized when once energized until said one line circuit becomes deenergized at the end of a code transmitted thereafter, and means maintaining said relay means dropped away when a code transmitter has been rendered effective on said another line circuit until said another line circuit becomes deenergized at the end of a code transmitted thereafter, whereby priority is given to said one line circuit in the event of simultaneous actuation of different code transmitters for the two line circuits.

6. In a remote control system, a control office, a plurality of field stations, a control line circuit connecting the control office with said field stations, one indication line circuit connecting the control office with one part of said field stations, another indication line circuit connecting the control office with another part of said field stations, means causing a series of impulses to be applied to said control line circuit when either or both of said indication line circuits is energized, control line circuit repeating relays marking the end of an initiating period upon the repeating of the first impulse of said series, slow acting control line circuit repeating relays marking the end of the lock-out period upon repeating the first impulse of said series, means in the control office effective during the initiating period to determine which indication line circuit is to be employed, and means at each field station effective during the lock-out period to select a particular field station on a particular indication line circuit which is selected during said initiating period to allow that field station to transmit indications during said series of impulses on said control line circuit, whereby only one field station is in communication with the control office during any one series of impulses on said control line circuit.

7. In a remote control system, a control office, a plurality of field stations, a control line circuit connecting the control office with said field stations, one indication line circuit connecting the control office with one part of said field stations, another indication line circuit connecting the control office with another part of said field stations, means causing a series of impulses to be applied to said control line circuit when either or both of said indication line circuits is energized, control line circuit repeating relays marking the end of an initiating period upon the repeating of the first impulse of said series, slow acting control line circuit repeating relays marking the end of the lock-out period upon repeating the first impulse of said series, means in the control office effective during the initiating period to automatically determine which indication line circuit is to be selected, means at each field station effective when that field station has indications to transmit to energize its said indication line circuit to the end of said lock-out period, means at each field station effective during the lock-out period to select a particular field

station on a particular indication line circuit which is selected during said initiating period to allow that field station to transmit indications during said series of impulses on said control line circuit, and means at each field station rendered effective when that field station is selected to transmit indications over its said indication line circuit, whereby only one field station is in communication with the control office during any one series of impulses on said control line circuit.

8. In a remote control system, a control office, a plurality of field stations, a control line circuit connecting the control office with said field stations, one indication line circuit connecting the control office with one part of said field stations, another indication line circuit connecting the control office with another part of said field stations, means causing a series of impulses to be applied to said control line circuit when either or both of said indication line circuits is energized, control line circuit repeating relays marking the end of an initiating period upon the repeating of the first impulse of said series, slow acting control line circuit repeating relays marking the end of the lock-out period upon the repeating of the first impulse of said series, indication registering means in said control office, means in the control office responsive to the initial energization of each of said line circuits to connect that indication line circuit to said indication registering means but said means being effective to give priority to a particular one of said line circuits in the event of simultaneous initial energization of said indication line circuits, and means at each field station effective during the lock-out period to select a particular field station on a particular indication line circuit which is selected during said initiating period to allow that field station to transmit indications during said series of impulses on said control line circuit, whereby only one field station is in communication with the control office over one of said indication line circuits during any one series of impulses on said control line circuit.

9. In a remote control system, a control office, a plurality of field stations divided into a plurality of groups, a plurality of line circuits connecting said office with each group of said stations, means including one of said line circuits for transmitting messages from said office to any one of said stations, means jointly controlled over said one line circuit and another line circuit to which a first one of said groups is connected for transmitting messages from any station in said first group to said office, means jointly controlled over said one line circuit and another line circuit to which a second one of said groups is connected for transmitting messages from any station in said second group to said office, means for determining the sequential order of transmission between said groups to said office, and means for determining the sequential order of transmission between stations in each group to said office.

10. In a remote control system, a control office, a plurality of field stations divided into a plurality of groups, a plurality of line circuits connecting said office with each group of said stations, means including one of said line circuits for transmitting messages from said office to any one of said stations, means jointly controlled over said one line circuit and another line circuit to which a first one of said groups is connected for transmitting messages from any station in said first group to said office, means jointly controlled

over said one line circuit and another line circuit to which a second one of said groups is connected for transmitting messages from any station in said second group to said office, means for giving a predetermined priority of transmission between said groups for transmitting messages to said office, and means for giving a predetermined priority of transmission between stations in each group for transmitting messages to said office.

11. In a remote control system, a control office and a plurality of field stations connected by a control line circuit, a first indication line circuit connecting said office with a first portion of said stations, a second indication line circuit connecting said office with a second portion of said stations, means including the associated indication line circuit at each station for initiating the transmission of impulses over said control line circuit, a sequence determining device in said office, means controlled over said indication line circuits and including said sequence determining device for registering whether one of said first portion of stations or one of said second portion of stations initiates said transmission of impulses, a code transmitter at each of said stations, means controlled by said code transmitters for transmitting messages from the associated station to said office, and means including the indication line at the associated stations for allowing only one of said stations to transmit messages to said office at any one time.

12. In a remote control system, a control office, a plurality of field stations divided into a plurality of groups, a plurality of line circuits connecting said office with each group of said stations, means including one of said line circuits for transmitting messages from said office to any one of said stations, means jointly controlled over said one line circuit and another line circuit to which a first one of said groups is connected for transmitting messages from any station in said first group to said office, means jointly controlled over said one line circuit and another line circuit to which a second one of said groups is connected for transmitting messages from any station in said second group to said office, means for determining the sequential order of transmission between said groups to said office, means for determining the sequential order of transmission between stations in each group to said office, and means for preventing more than one station obtaining access to said line circuits at any one time for the transmission of messages.

13. In a remote control system, a control office, a message receiving device and a message transmitting device in said office, a control circuit connectible to said transmitting device, means including said transmitting device for transmitting control messages over said control circuit, a control receiver for receiving said control messages, a plurality of message circuits selectively connectible to said receiving device, means controlled over said message circuits for selectively connecting said message circuits to said receiving device, means cooperating with said control receiver and controlled over said message circuits for transmitting indication messages to said receiving device, and means controlled over said control circuit for transmitting control messages from said transmitting device to said control receiver concomitantly with the transmission of indication messages to said receiving device.

14. In a remote control system, a control office and a plurality of field stations connected by a

control line circuit, a first indication line circuit connecting said office with a first portion of said stations, a second indication line circuit connecting said office with a second portion of said stations, means including the associated indication line circuit at each station for initiating the transmission of impulses over said control line circuit, a sequence determining device in said office, means controlled over said indication line circuits and including said sequence determining device for registering whether one of said first portions of stations or whether one of said second portions of stations initiates said transmission of impulses, a code transmitter at each of said stations, means controlled by said code transmitter for transmitting messages from the associated station to said office, means including the indication line at the associated stations for allowing only one of said stations to transmit messages to said office at any one time, and means responsive to the initiation of said impulse transmission for continuing the transmission of a predetermined number of impulses over said control line circuit.

15. In a remote control system, a control office, a plurality of field stations divided into a plurality of groups, a common control line circuit connecting the stations of said groups with said office, a separate indication line circuit connecting the stations of each group with said office, means for applying control impulses to said control line circuit, means controlled by said control impulses for transmitting control messages between said office and said stations, control receiving means at each of said stations for receiving said control impulses, means including the control receiving means at each station for transmitting indication messages to said office over the particular indication line circuit with which the transmitting station is associated, means in said office determining the sequence between groups of stations for transmitting, means determining the sequence between stations in any one group of stations for transmitting whereby only one of said plurality of stations is permitted to transmit at any one time, a single message register in said office, and means including said message register for registering said indication messages.

16. In a remote control system, a control office, a plurality of field stations divided into a plurality of groups, a common control line circuit connecting the stations of said groups with said office, a separate indication line circuit connecting the stations of each group with said office, means for applying control impulses to said control line circuit, means controlled by said control impulses for transmitting control messages between said office and said stations, control receiving means at each of said stations for receiving said control impulses, means including the control receiving means at each station for transmitting indication messages to said office over the particular indication line circuit with which the transmitting station is associated, means giving a predetermined priority between groups of stations for transmitting, means giving a predetermined priority between stations in any one group of stations for transmitting whereby only one of said plurality of stations is permitted to transmit at

any one time, a single message register in said office, means including said message register for registering said indication messages, and means for effecting contemporaneous two-way transmission over said control line circuit and either one of said indication line circuits.

17. In a remote control system, a control office, a plurality of field stations divided into a plurality of groups, a common control line circuit connecting the stations of said groups with said office, a separate indication line circuit connecting the stations of each group with said office, means for applying control impulses to said control line circuit, means controlled by said control impulses for transmitting control messages between said office and said stations, control receiving means at each of said stations for receiving said control impulses, means including the control receiving means at each station for transmitting indication messages to said office over the particular indication line with which the transmitting station is associated concomitantly with the transmission of control messages from said office to any station in any one of said groups, means for determining the sequential order of transmission between said groups to said office, and means for determining the sequential order of transmission between stations in each group to said office.

18. In a remote control system, a control office, a plurality of field stations divided into a plurality of groups, a common control line circuit connecting the stations of said groups with said office, a separate indication line circuit connecting the stations of each group with said office, means for applying control impulses to said control line circuit, means controlled by said control impulses for transmitting control messages between said office and said stations, control receiving means at each of said stations for receiving said control impulses, means including the control receiving means at each station for transmitting indication messages to said office over the particular indication line with which the transmitting station is associated concomitantly with the transmission of control messages from said office to any station in any one of said groups, and means for determining the sequential order of transmission between said groups to said office.

19. In a remote control system, a control office, a plurality of field stations divided into a plurality of groups, a common control line circuit connecting the stations of said groups with said office, a separate indication line circuit connecting the stations of each group with said office, means for applying control impulses to said control line circuit, means controlled by said control impulses for transmitting control messages between said office and said stations, control receiving means at each of said stations for receiving said control impulses, and means including the control receiving means at each station for transmitting indication messages to said office over the particular indication line with which the transmitting station is associated concomitantly with the transmission of control messages from said office to any station in any one of said groups.

CHARLES S. BUSHNELL.
FREDERICK W. BRIKNER.