

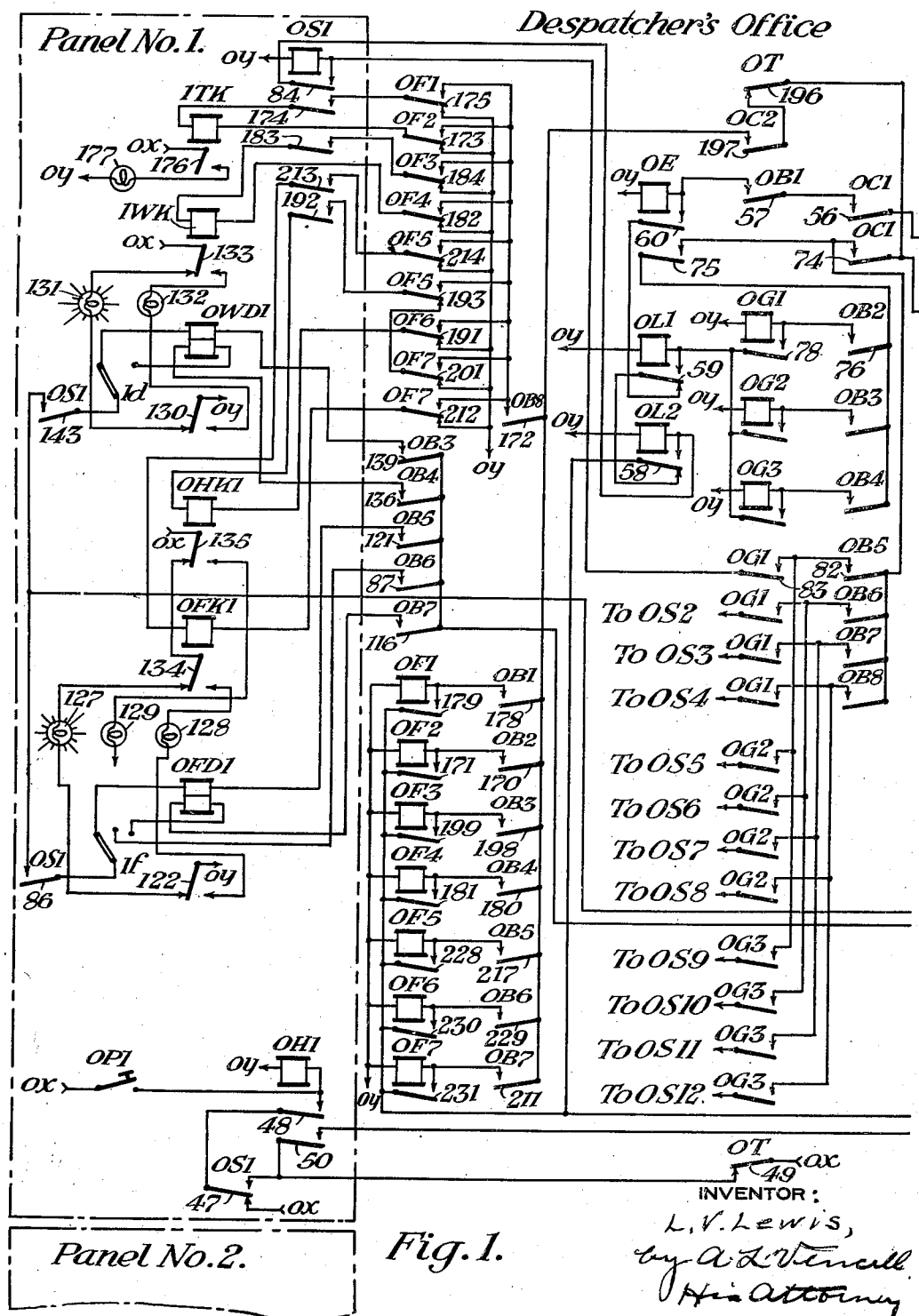
April 16, 1940.

L. V. LEWIS

2,197,130

REMOTE CONTROLLING APPARATUS

Original Filed July 9, 1928 4 Sheets-Sheet 1



April 16, 1940.

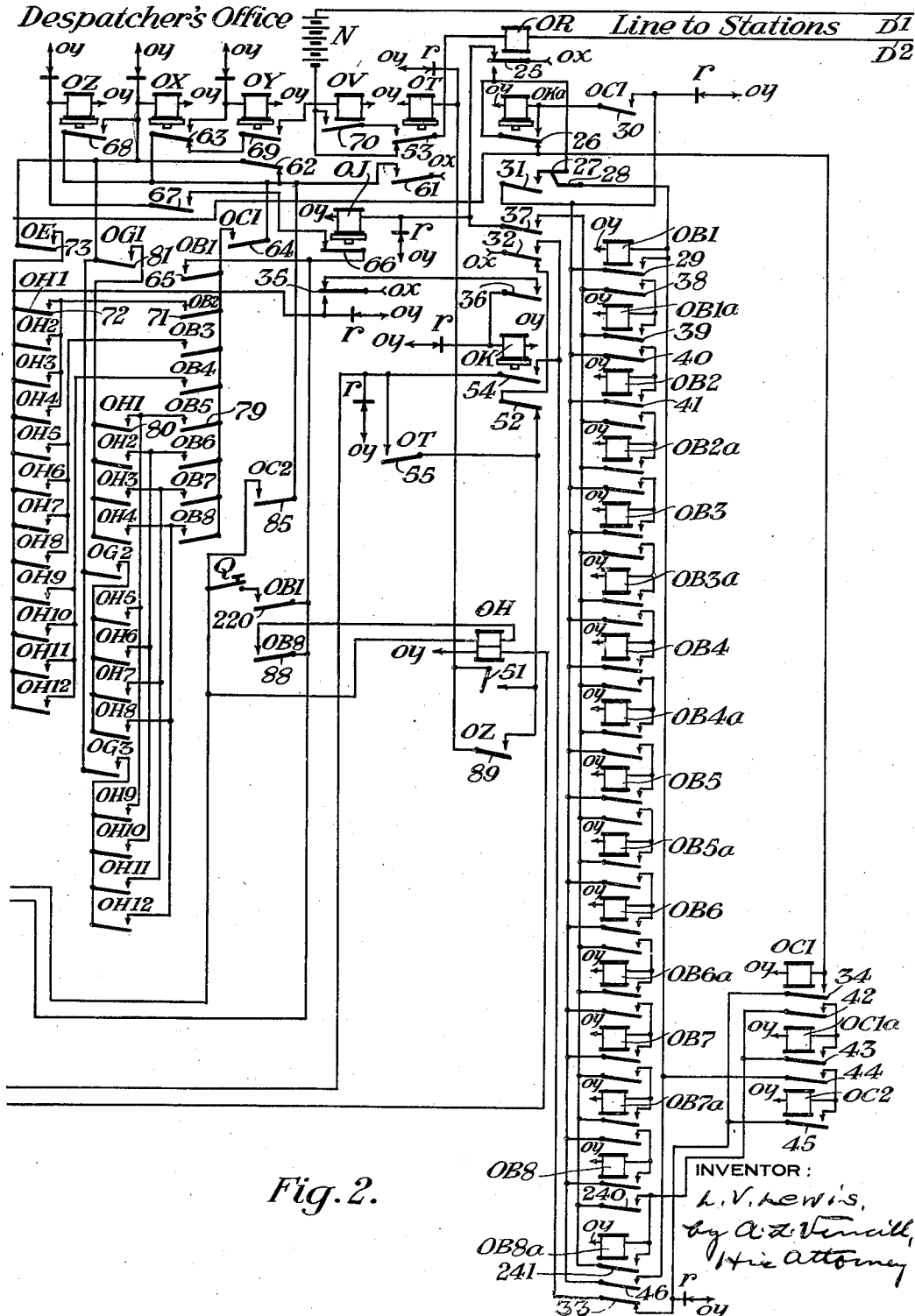
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4 Sheets-Sheet 2



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4 Sheets-Sheet 3

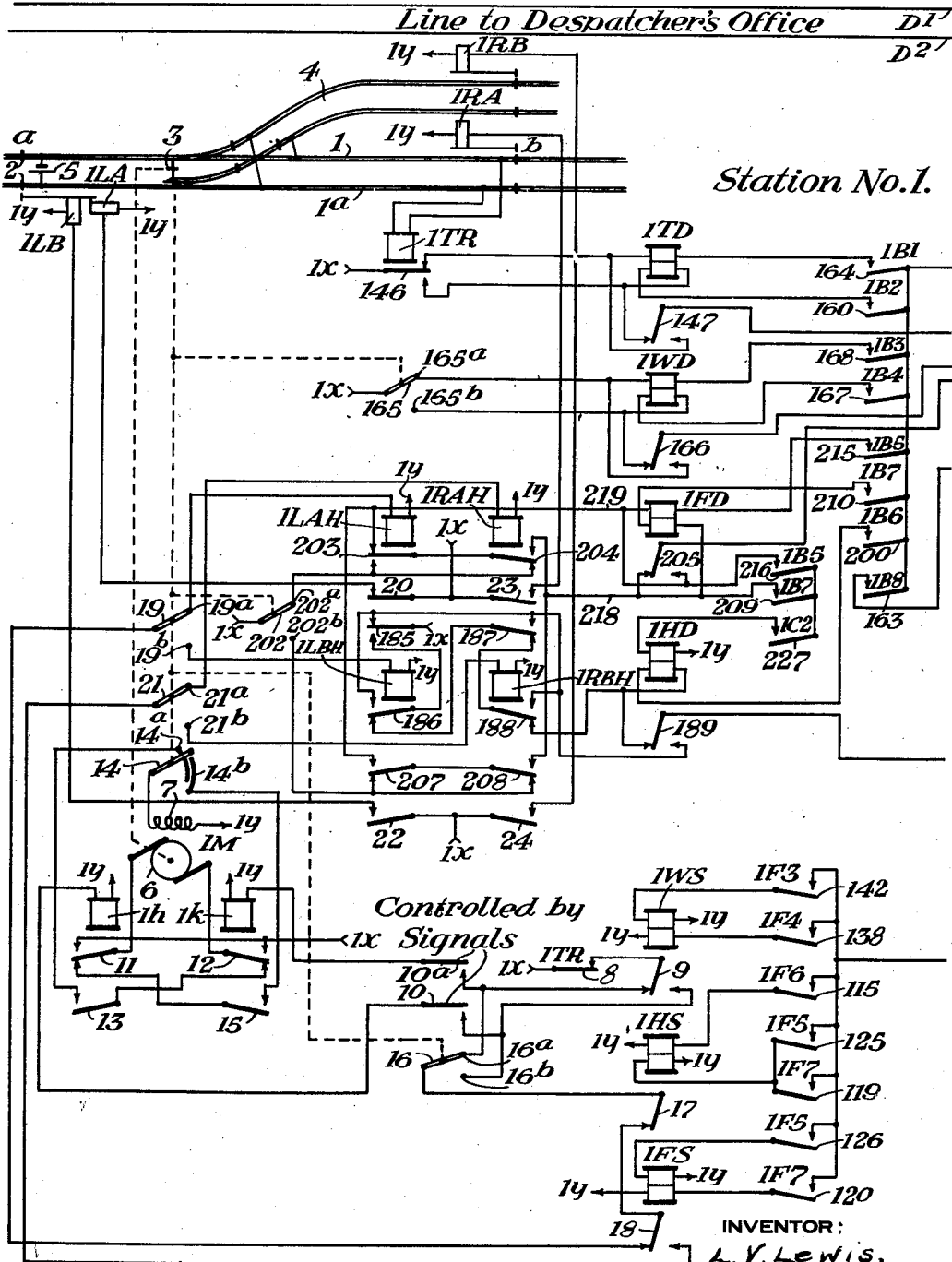


Fig. 3.

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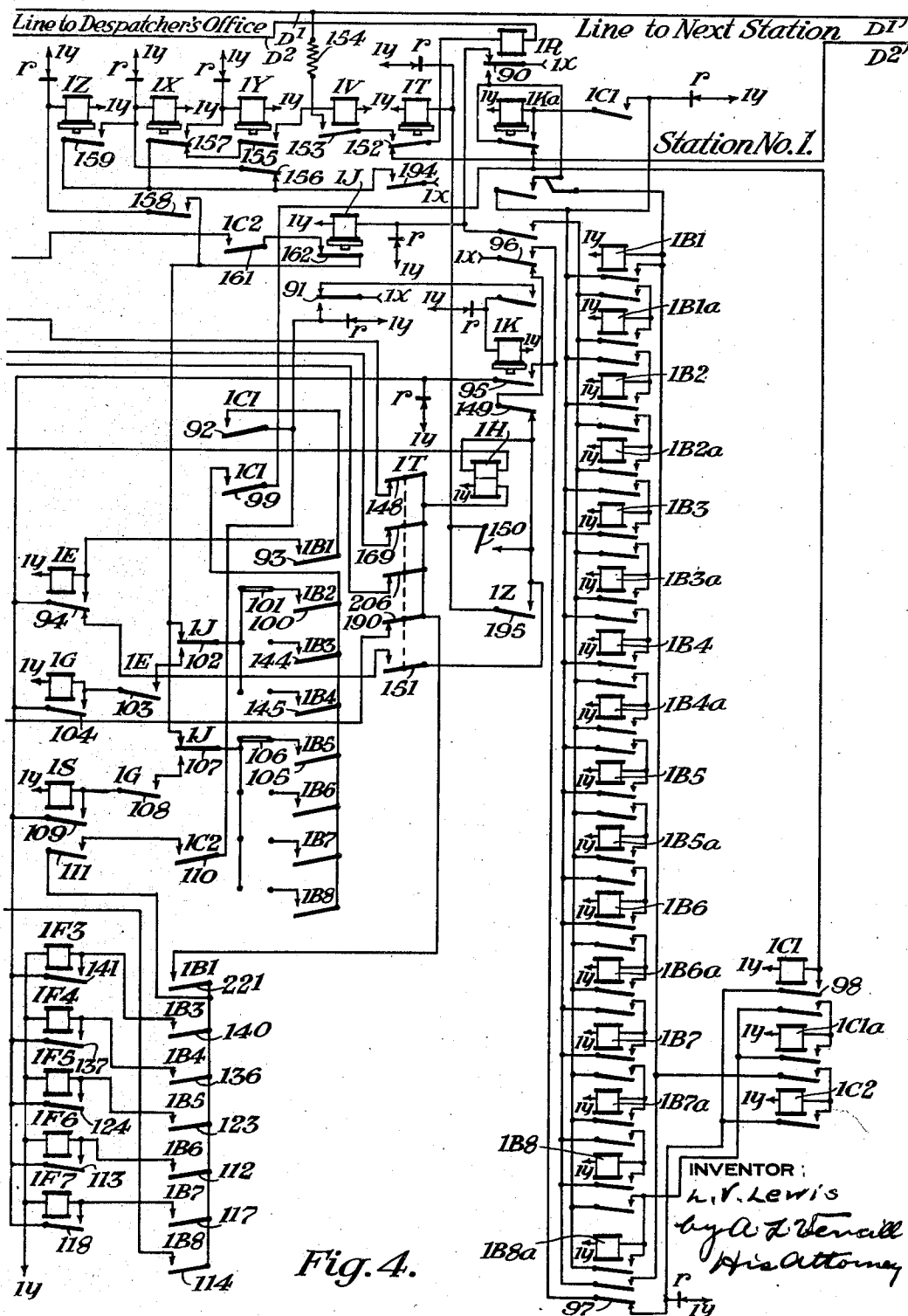
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REMOTE CONTROLLING APPARATUS

Original Filed July 9, 1928

4 Sheets-Sheet 4



UNITED STATES PATENT OFFICE

2,197,130

REMOTE CONTROLLING APPARATUS

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Application July 9, 1928, Serial No. 291,465
Renewed November 14, 1931

135 Claims. (Cl. 246—5)

My invention relates to remote controlling apparatus, and particularly to apparatus of the type adapted for controlling traffic governing devices, such as railway switches and signals, from a remote point, such for example, as a train dispatcher's office, and for also indicating the condition of such devices at said office.

Such systems are customarily identified in the art as centralized traffic control systems.

In systems of this character the traffic governing devices are grouped at field stations distributed along the right of way, and these devices are conveniently controlled by manually operable levers under the control of the operator in the office. These levers may be divided into groups or "panels" corresponding to the field stations with which they are associated, and each such panel may also be provided with lamps or other indicators controlled in accordance with the conditions of the several switches, signals, etc., at the corresponding field station.

It is important that the system by means of which the field devices are controlled from the office and the office indicators are governed from the field station (1) shall have a high degree of reliability, both as to continuity of operation and freedom from accidental or improper actuation, (2) shall require a minimum of apparatus, thereby economizing in cost and size of installation and (3) shall consume a minimum amount of time in its operation thus utilizing most economically the line facilities that connect the office with the field stations and expediting the control of traffic over the railroad on which the system is installed.

In order to accomplish the above and other advantageous objects my invention incorporates a number of novel features all contributing to the achievement of the reliable, cheap and rapidly operating system which is its preferred embodiment herein disclosed.

My invention is applied to a system of the type described in which transmitters, one at the office and one at each station, create codes made up of elements of different characters arranged in patterns. An important feature of my invention is that each code not only selects the particular office panel or field station for which it is intended but also governs each of a plurality of functions (switches, signals, etc., at the field stations or indicators at the office) which are associated with the selected point. To effect this, each code pattern is determined by the apparatus associated with the transmitter, parts of the pattern (function selecting) being deter-

mined by the positions of the operator's levers at the office or the conditions of the devices in the field and parts (station selecting) being determined by apparatus individual to the group of levers or group of devices with which the code originates.

Each receiving equipment includes apparatus selectively responsive to the function selecting parts of the code to govern the plurality of devices or indicators associated with that receiver. Therefore, by my invention an operator at the office by merely transmitting a single code will select any station and control a complete route thereat by positioning a switch and clearing a signal governing traffic movements over the switch; and, conversely, a single code individual to any station will indicate on the appropriate office panel a plurality of changed conditions at the field station—for example, the entrance of a train into a track section and the consequent restoration to stop of a signal at the section entrance.

The code transmitted consists of a series of impulses certain of which are made of a distinctive character different from the other impulses. One feature of my invention is that each impulse of distinctive character of a transmitted code actuates the receiver at the transmitting point, whether office or station, and is there registered just as if the impulse had been received from another transmitting point, and the transmitter is locked to prevent the transmission of the next impulse until this associated registration has taken place.

The impulses are divided into groups and another feature of my invention is that the receiving apparatus at the transmitting station responds to one transmitted impulse of this distinctive character in a group to prevent the transmitter from causing subsequent impulses in the same group to have the distinctive character.

In systems of this character it is necessary to distinguish between codes transmitted from the office and codes transmitted from a field station. In my invention I arbitrarily assign one impulse of each code to this function, and the transmitters cause this impulse to have one character in all control codes originating at the office and to have another character in all indication codes originating at the field stations. In the event that the office and a station start transmission at the same time, the character of this impulse causes the office code to take precedence by locking out the code from the field station. The counting apparatus in the field station receivers

responds to this locking impulse as to the other impulses, but separate devices are actuated at the field station one when the station is transmitting, which allows the transmitting operation to continue, and a different one when the station is receiving, which allows that station to respond to the code and also prevents the transmission of a conflicting code from the receiving station.

Another feature of my invention is the provision for each office panel of a single starting button common to all the levers of a panel for initiating a single code which transmits to the corresponding field station information concerning the position of all the levers. With this arrangement the levers may be manipulated to the positions required without affecting the code equipment, but if the operator desires to control the field devices in accordance with the lever positions, he can do so by a single operation of the starting button on the proper panel. This operation of the starting button initiates operation of the system and automatically governs the devices of the field station into correspondence with the positions of the levers on the office panel.

Another important feature of my invention is the provision of a starting relay and a selecting relay for each office panel together with novel circuits for the control of these relays. Each starting relay is actuated by manipulation of the associated starting button. The starting relay sets the system into operation and is retained in its actuated position until the selecting relay for that panel is operated. The actuated starting relay determines the character of so much of the transmitted code as is necessary to make a station selection, and this selection also operates the selecting relay associated with the actuated starting relay. The selecting relay causes other parts of the code to be governed in accordance with the positions of the panel levers. In case two or more starting relays are actuated at the same time, the several codes corresponding thereto are transmitted sequentially, the order being determined by code superiority.

An important feature of my invention is the restoration of the starting relay by the selecting relay. The circuits are so arranged that if the selecting relay is operated during office receiving it will not restore the starting relay, but if the selecting relay is operated during office transmission the starting relay is automatically restored to its normal condition. This is a distinct advantage because it prevents the undesirable repetition of a code from the office transmitter but allows "storage" of a control code, after momentary manipulation of a starting button, until the system is free to transmit that code.

Another important feature of my invention is the provision of means under the control of the operator for verifying the indications of the devices at any station without changing the position of any such device. This is accomplished by providing, for each field transmitter, a starting circuit which may be selectively closed by the operator. In the particular embodiment illustrated, a distinctive character may be imparted to the code originating at any office panel, and the resulting code will complete a special starting circuit at the station responding to that code, whereupon a single indication code verifying the condition of all the devices at that station will be transmitted to the office.

The control and indication functions of my invention are all accomplished over a single line circuit and it is important to check the condi-

tion of the line circuit at all times. A line relay is included in the line circuit at the office and at each station. A feature of my invention is the provision of two slow acting relays for each line relay, one slow acting relay being energized when the line relay is energized and the other slow acting relay being energized when the line relay is deenergized. With this arrangement the normal intermittent operation of the line relay while a code is on the line results in both slow acting relays being maintained picked up. If the line is steadily open or steadily closed this condition is manifested by the release of one or the other of the slow acting relays.

Another important feature of my invention is the utilization of the slow acting relays mentioned above to control the counting relays used in the receiving and transmitting equipment so as to restore the apparatus to normal in the event of a line failure prior to the completion of a code.

Still other important features of my invention reside in novel circuits for controlling the relays of the transmitter and receiver that count the impulses of the code. For this purpose I provide a series of normally deenergized relays connected in cascade for operation through repeated cycles. The relays of this series are energized and deenergized in sequence. During the first cycle, in combination with a switching contact closed only during that cycle, the counting relays provide a plurality of separate control circuits. At the conclusion of the first cycle all the counting relays are energized and deenergized sequentially through a second similar cycle. During this second cycle in combination with a second switching contact closed only during such second cycle, the counting relays provide additional control circuits. This repeated operation is accomplished with a minimum of apparatus because each relay drops out after its function has been performed, and the repeated cycle operation permits a large number of counting operations with a small number of counting relays.

Another important feature of my invention is the utilization of rectifiers at numerous points throughout the circuits to accomplish vital and valuable results. Certain of these rectifiers are connected across the windings of the counting relays to keep the relays energized for a brief period after the circuits for the relays are opened. This results in a relay which is quick to pick up but slow to release and contributes materially to the uniform and reliable operation of the counting chains. Other rectifiers are connected across the windings of the timing relays which distinguish between code impulses of different characters. In the preferred embodiment of my invention some impulses are short and others are long, and certain of the timing relays and their associated rectifiers are adjusted so that each such relay will release on a long impulse but not on a short impulse. Rectifiers are also employed to retard the release of various other relays so that they will remain picked up for the duration of a code.

As pointed out above, my invention is particularly applicable to systems of centralized traffic control wherein the station devices are railway switches, signals, etc., for the control of traffic along a stretch of railway track. In arrangements of this kind a field station may include a track switch and a complement of railway signals (usually four in number, one for governing train movements from each direction over each of

the two possible routes over the track switch) associated therewith. An important feature of my invention is the provision of means at a station so equipped to position one polar stick relay in response to certain elements of the code for switch control and to position another polar stick relay in response to other elements of the code for signal control. The first mentioned relay puts the signal for the existing route to stop, and then actuates the switch to the required position, and finally signal controlling circuits are closed partly under the control of the switch and its stick relay and partly under the control of the signal relay for clearing the signal for the new route.

During the development of my complete system as herein disclosed, many important features have been devised in addition to those discussed at length above. Some of these additional features are applicable to systems of types quite different from that illustrated in the drawings, and all have advantages which are pointed out at length in the following specification.

In some specific respects the invention of this case is an improvement over the apparatus employed in the system shown in the copending application for Letters Patent of the United States Serial No. 255,375, filed February 18, 1928, by G. W. Baughman for Railway traffic controlling apparatus.

I will describe one form of apparatus embodying my invention, and will then point out the novel features thereof in claims.

In the accompanying drawings, Figs. 1 and 2, when placed end to end with Fig. 1 on the left, form a diagrammatic view illustrating a portion of a train dispatcher's office embodying my invention. Figs. 3 and 4, when placed end to end with Fig. 3 on the left, form a diagrammatic view showing a remote station suitable for cooperation with the apparatus illustrated in Figs. 1 and 2 and also embodying my invention.

Similar reference characters refer to similar parts in each of the several views.

In modern operation of railway systems it is sometimes desirable to control a number of traffic governing devices located at spaced points over a considerable stretch of track from a central point such as a dispatcher's office, and also to indicate at the office the condition of each of these devices. The traffic governing devices are here illustrated as switches and signals, each switch with its corresponding complement of trackway signals being considered as one station and a plurality of stations being controlled from the central office indicated in the drawings on Figs. 1 and 2. The office and all of the stations are connected together by means of a line circuit including two line wires D1 and D2 which extend throughout the system. The line circuit is at times supplied with current from a line battery N located at the office and under normal conditions the line circuit is closed through the back contact of a master relay and the winding of a line relay at each station and at the office. Each master relay is designated by the reference character T with a prefix corresponding to the location, and is energized when sending and de-energized when receiving. Each line relay is designated by the reference character R with a prefix corresponding to the location, and is operated by the code signals both in sending and in receiving.

The control of the various parts is accomplished by means of code signals transmitted over the line circuit including line wires D1 and D2 from the

office or from any station. All code signals are made up of the same number of impulses each of which impulses is produced by opening the line circuit for a relatively short or long interval of time and again closing the line circuit for a short interval. The first impulse in each code is a locking impulse, the function of which will be described hereinafter. Certain of the impulses following the locking impulse in each code are used to select the station, the number of such impulses required for this purpose, depending upon the number of stations to be controlled. In illustrating my invention, I have assumed that twelve stations are to be controlled from the office and with this arrangement seven station selecting impulses are necessary. The next impulses in each code are used to select the particular operations to be performed at the selected station and with the apparatus here illustrated I require seven impulses for this purpose. The last impulse accomplishes the operation of the devices at the selected station, and also restores the apparatus to normal to prepare it for the reception or transmission of additional codes. The equipment also operates in a similar manner to register the condition of the station apparatus on an individual panel at the office.

With the arrangement here illustrated, each code consists of 16 impulses. One feature of my invention is the use of code signals all having the same number of impulses, but certain of which are prolonged to accomplish different purposes as will appear more in detail as the description proceeds.

For purposes of simplicity, I have illustrated only one station complete in the drawings, and have shown only that portion of the office equipment necessary for the control and indication of this one station, but it will of course be understood that the other 11 stations are similar in all respects to station 1 here illustrated, but that the additional equipment required at the office will simply duplicate a portion of the equipment here shown.

Located at station 1 is a stretch of railway track, (Fig. 3), the rails of which are designated by the reference characters 1 and 1^a. These rails are divided, by means of insulated joints 2, to form a track section a—b, which contains a switch 3 of the usual and well known form, communicating with a siding 4. The section a—b is provided with a track circuit comprising a track battery 5 and a track relay 1TR. The rails of siding 4 are connected with the rails of section a—b in the usual manner so that relay 1TR is normally energized but is de-energized when any part of a train occupies section a—b or the portion of siding 4 to the left of point B.

Eastbound traffic over switch 3 is controlled by signals 1LA and 1LB, which as here shown are mounted upon the same mast. Westbound traffic over switch 3 is controlled by signals 1RB and 1RA.

Switch 3 is controlled by a motor 1M which as here shown comprises an armature 6 and a field 7. The motor 1M is controlled in part by two switch relays 1h and 1k and also by a polarized relay 1WS. Assuming that all signals are in the stop position, when relay 1WS is moved to its right-hand or reverse position, current flows from terminal 1x of a source of energy not shown in the drawings, over front contact 8 of track relay 1TR, reverse contact 9 of relay 1WS, contact 10 controlled by the signals at station 1, and winding of relay 1h to terminal 1y of the same source. Relay 1h therefore becomes energized and a circuit is closed

from terminal 1x, over front contact 11 of relay 1h, armature 6 of motor 1M, back contact 12 of relay 1k, front contact 13 of relay 1h, contact 14—14a operated by switch 3, and field 7 of motor 1M to terminal 1y. Contact 14—14a is closed at all times except when the switch occupies its reverse position, and when the circuit just traced is closed, the motor 1M is operated to move the switch to its reverse position. When the switch attains this position, contact 14—14a opens to de-energize the motor 1M.

In similar manner, if relay 1WS becomes energized in its left-hand or normal position, current flows from terminal 1x, over front contact 3 of relay 1TR, normal contact 9 of relay 1WS, contact 10a controlled by the signals at station 1, and winding of relay 1k to terminal 1y. Relay 1k then becomes energized and since relay 1h is then de-energized, a circuit is closed from terminal 1x, over front contact 12 of relay 1k, armature 6 of motor 1M, back contact 11 of relay 1h, front contact 15 of relay 1k, contact 14—14b operated by switch 3, and field 7 of motor 1M to terminal 1y. Contact 14—14b is closed at all times except when switch 3 occupies its normal position, and when the circuit just traced is closed, motor 1M is operated to move the switch toward its normal position in which it is illustrated in the drawings. When the switch attains this position, contact 14—14b opens to de-energize the motor.

Contacts 10 and 10a controlled by signals at station 1 are operated, by means forming no part of my present invention and omitted from the drawings, in such manner that these contacts are closed only when signals 1LB, 1LA, 1RB, and 1RA all indicate stop. Contact 10a is included in the pick-up circuit for relay 1k and contact 10 is included in the pick-up circuit for relay 1h and it follows that the switch cannot be operated in either direction unless all of the associated signals are at stop. Furthermore, if a train is approaching the switch within the limits of section a—b, relay 1TR will be de-energized and under these conditions also it is impossible to operate switch 3, because front contact 3 of track relay 1TR must be closed to energize either relay 1h or 1k.

In practice, contacts 10 and 10a may be so controlled as to prevent operation of relays 1h and 1k when a train occupies either the section to the left of a, or to the right of b, and is approaching section, a—b; this so-called "approach locking" is however omitted from the drawings because it forms no part of my invention and is a feature that is well known in the railway signaling art.

Signal 1LA is controlled by a relay 1LAH, which relay is in turn controlled by relay 1WS and by two other polarized relays 1HS and 1FS. The circuit for relay 1LAH may be traced from terminal 1x, over front contact 3 of relay 1TR, normal contact 9 of relay 1WS, contact 16—16a operated by switch 3, normal contact 17 of relay 1HS, normal contact 18 of relay 1FS, contact 19—19a operated by switch 3, and winding of relay 1LAH, to terminal 1y. This circuit is closed only when relays 1WS, 1HS, and 1FS all occupy their normal positions and when the track relay 1TR is energized and the switch occupies its normal position. When relay 1LAH is energized, current is supplied to the operating mechanism of signal 1LA over front contact 20 of this relay and the signal then indicates proceed. If relay 1WS is energized in the reverse direction, switch 3 will also occupy its reverse position as ex-

plained hereinbefore, and if relays 1HS and 1FS are energized in the normal direction current will then flow from terminal 1x, over front contact 3 of relay 1TR, reverse contact 9 of relay 1WS, contact 16—16b operated by switch 3, normal contact 17 of relay 1HS, normal contact 18 of relay 1FS, contact 19—19b operated by switch 3, and winding of relay 1LBH to terminal 1y. When relay 1LBH is energized, current is supplied to the operating mechanism of signal 1LB, over front contact 22 of relay 1LBH and that signal then indicates proceed.

If, however, relay 1WS is energized in the normal direction so that switch 3 occupies its normal position and if relay 1HS is energized in the normal direction and if relay 1FS is energized in the reverse direction, current flows from terminal 1x, over front contact 3 of relay 1TR, normal contact 9 of relay 1WS, contact 16—16a operated by switch 3, normal contact 17 of relay 1HS, reverse contact 18 of relay 1FS, contact 21—21a operated by switch 3 and winding of relay 1RAH to terminal 1y. When this relay is energized, current is supplied over its front contact 23 to the operating mechanism of signal 1RA which signal then indicates proceed. Finally, if relays 1WS and 1FS are both energized in the reverse direction and if relay 1HS is energized in the normal direction, current flows from terminal 1x, over front contact 3 of relay 1TR, reverse contact 9 of relay 1WS, contact 16—16b operated by switch 3, normal contact 17 of relay 1HS, reverse contact 18 of relay 1FS, contact 21—21b operated by switch 3, and winding of relay 1RBH to terminal 1y, and relay 1RBH therefore becomes energized, to complete at front contact 24 thereon, an operating circuit for signal 1RB, which thereupon indicates proceed.

It should be noted that the energizing circuit for each of the signal control relays 1LAH, 1LBH, 1RAH, and 1RBH includes the normal contact 17 of relay 1HS, so that if this relay is energized in its reverse direction to open normal contact 17, all of the signal control relays will be de-energized, and all of the signals located at station 1 will indicate stop.

In practice, the signals may be "semi-automatic," that is to say, they may be moved only from "stop" to "caution" by the apparatus herein shown and described, and may then move automatically from "caution" to "clear" under control of the track relay of the next section in advance of section a—b in the direction of traffic.

The relays 1WS, 1HS, and 1FS, which control the switch and signals at station 1 are controlled by two manually operable levers 1d and 1f located on a suitable panel at the dispatcher's office as shown in the left hand portion of Fig. 1. It is of course understood that each of the remaining stations, not shown in the drawings, is provided with apparatus similar to that just described at station 1 and the office is provided with a separate panel with corresponding levers for each of the remaining stations. In addition to the two control levers, each such panel is further provided with indication apparatus for giving the operator visual information concerning the condition of the switch and signals and of the detector track section at the corresponding station.

In addition to the polarized relays above described I have employed in this apparatus a number of others, and it is to be understood that each polarized relay is of the permanent magnet stick

type so designed that it will hold its contact firmly closed by the action of its permanent magnet in the absence of electrical energy. Also, I have assumed that each relay is arranged so that when current flows through a winding from terminal *x* to terminal *y* from left to right, the left-hand contact will close, and that when current flows from right to left, the relay will reverse to close the right hand contact.

As was stated above, the code signals delivered to the line circuit are made up of impulses formed by briefly opening the circuit. Each such impulse causes each line relay *R* to become de-energized and when the line circuit is again closed, the line relays again become energized. Each line relay controls a chain of counting relays here shown in Figs. 2 and 4 as sixteen in number and each designated by the reference character *B* with a distinguishing prefix corresponding to the location and a suffix corresponding to its position in the chain. Referring particularly to the apparatus shown on Fig. 2, line relay *OR* controls a chain of counting relays *OB1*, *OB1a*, etc. Each line relay also controls an auxiliary chain of counting relays here shown as three in number, comprising relays *C1*, *C1a*, and *C2*, with prefixes indicating the location, the purpose of which is to enable the "B" relays to be employed more than once, thereby decreasing the total number of counting relays employed. As shown, each "B" relay is used first in combination with relay *C1* and is then used again in combination with relay *C2*. Associated with the counting relays are two slow releasing relays *OKa* and *OK*. The operation of the system depends to some extent upon the times required for the operations of certain relays and for purposes of explanation I have assumed definite values for certain parts, but it should be understood that these values are not essential, but are mentioned only by way of illustration. For example, I have assumed that the release value of relays *OKa* and *OK* are each 0.3 second. A relay *OJ* is controlled by front contact 25 of relay *OR* and has a release time of 0.2 second. Associated also with relay *OR* are three timing relays *OZ*, *OX*, and *OY*, each of which is so adjusted that the sum of its pick-up and release times is approximately 0.1 second. The master relay *OT* also has a release time of 0.1 second. *OV* is a transmitter relay which is comparatively quick acting.

As will be described in detail hereinafter, the normal length of each impulse of each code signal is approximately 0.1 second, and successive impulses are separated by intervals also of substantially 0.1 second during which the line circuit is closed. Under certain conditions, however, some of the impulses may be prolonged so that the line circuit is open for substantially 0.4 second. With these preliminary remarks in mind, I will now describe the operation of the office counting relays in detail in response to the reception of a code signal from a station. The first impulse of the code de-energizes relay *OR*, thereby closing back contact 25 and de-energizing relay *OJ*. It will be remembered that relay *OJ* has a release time of 0.2 second and this relay will therefore hold its front contacts closed for impulses of normal value but will open its front contacts for prolonged impulses exceeding 0.2 second in length. The first de-energization of relay *OR* completes a circuit for the first counting relay *OB1*, over back contact 25 of relay *OR* and contact 27—28 of relay *OKa*, so

that relay *OB1* becomes energized. Furthermore, current flows from terminal *Ox*, over back contact 25 of relay *OR*, back contact 26 of relay *OKa*, and winding of relay *OC1* to terminal *Oy*. Relay *OC1* therefore becomes energized and when this occurs, a circuit is completed from terminal *Ox*, over back contact 25 of relay *OR*, contact 27—28 of relay *OKa*, front contact 29 of relay *OB1*, contact 30 of relay *OC1*, and winding of relay *OKa* to terminal *Oy*. Relay *OKa* therefore becomes energized, whereupon, a stick circuit is completed for this relay over back contact 25 of relay *OR* and front contact 26 of relay *OKa*. At the same time, contact 27—28 opens, but front contact 31 of relay *OKa* is now closed so that relay *OB1* is stuck up over its own front contact 29, front contact 31 of relay *OKa* and back contact 25 of relay *OR*.

Furthermore, relay *OC1* is now stuck up over front contact 32 of relay *OKa*, back contact 33 of relay *OB8a* and front contact 34 of relay *OC1*. The pick-up circuits of relays *OB1* and *OC1* are now open at the back contacts 26 and 28 of relay *OKa*. When relay *OKa* becomes energized, current is supplied to relay *OK*, over front contact 35 of relay *OJ* and front contact 36 of relay *OKa*. It will therefore be plain that the first de-energization of relay *OR* picks up relays *OB1*, *OC1*, *OKa*, and *OK*.

When relay *OR* next becomes energized, the circuit for relay *OKa* is opened, but since relay *OR* is never energized for more than 0.1 second during the reception of a code, relay *OKa* and relay *OK* both remain energized until the code has been completed. Relay *OC1* remains energized over front contact 32 of relay *OKa* but the stick circuit for relay *OB1* is opened at back contact 25 of relay *OR* when the latter relay picks up. Before relay *OB1* releases, a pick-up circuit is closed for relay *OB1a* over front contact 25 of relay *OR*, front contact 37 of relay *OKa*, and front contact 38 of relay *OB1*. Relay *OB1a* therefore picks up and sticks up over its own front contact 39, so that relay *OB1a* remains energized after relay *OB1* releases. When the second impulse of the code is received, relay *OR* again becomes de-energized, whereupon a circuit is closed for relay *OB2* over back contact 25 of relay *OR*, contact 27—31 of relay *OKa* and front contact 40 of relay *OB1a*. Relay *OB2* thereupon becomes energized and sticks up over its own front contact 41. This second de-energization of relay *OR* does not pick up relay *OB1* because the pick-up circuit for the latter relay is open at contact 27—28 of relay *OKa*. Relay *OB1a* releases at the conclusion of a brief interval after the de-energization of relay *OR*. As relay *OR* becomes successively energized and de-energized during the remainder of the code, the counting relays *B* are energized successively. Each of these relays is energized over a front contact of the preceding relay in the chain and sticks up over its own front contact until the next operation of relay *OR*.

When the 8th impulse is received, relay *OB8* becomes energized and when relay *OR* next becomes energized, relay *OB8a* picks up. When this happens, the stick circuit for relay *OC1* is interrupted, but before relay *OC1* opens its front contacts a pick-up circuit is closed for relay *OC1a*, which pick-up circuit may be traced from terminal *Ox*, over front contact 25 of relay *OR*, front contact 37 of relay *OKa*, front contact 240 of relay *OB8*, front contact 42 of relay *OC1*, and winding of relay *OC1a* to terminal *Oy*. Relay

OC1a therefore becomes energized at the same time as relay OB8a, and relay OC1a sticks up over a circuit including its own front contact 43, front contact 241 of relay OB8a, front contact 37 of relay OKa, and front contact 25 of relay OR. Relay OC1 becomes de-energized soon after relay OB8a picks up, and when relay OR next becomes de-energized, relays OB8a and OC1a become de-energized. Current now flows from terminal Oz, through back contact 25 of relay OR, contact 27—31 of relay OKa, front contact 46 of relay OB8a, front contact 44 of relay OC1a, and winding of relay OC2, to terminal Oy. Relay OC2 is therefore energized and is subsequently stuck up over its own front contact 45 and back contact 33 of relay OB8a. Furthermore, when relay OR became de-energized, a circuit was completed for relay OB1 from terminal Oz, through back contact 25 of relay OR, contact 27—31 of relay OKa, front contact 46 of relay OB8a, and winding of relay OB1 to terminal Oy. This pick-up circuit opens, of course, as soon as relay OB8a releases, but relay OB1 is thereafter held in its energized condition over the stick circuit previously traced for this relay. As the succeeding impulses of the code are received, relays OB1a, OB2, OB2a, etc., are energized successively. It will be plain, therefore, that during the reception or transmission of a code of sixteen impulses, the counting relays B are energized successively through two complete cycles, relay OC1 being energized during the first cycle of operation of the counting relays, and relay OC2 being energized during the second cycle of operation of the counting relays. At the conclusion of the code, relay OR becomes energized and remains in this condition. Relay OKa is therefore de-energized and at the expiration of 0.3 second, this relay releases. Relays OB8a and OC2 release almost immediately, and relay OK releases at the end of 0.3 second following the release of relay OKa.

It will be noted that since the release time of relay OJ is 0.2 second, this relay will remain energized during the intervals that relay OR is de-energized as long as these intervals do not exceed 0.2 second. When a prolonged impulse is received, however, that is, when relay OR becomes de-energized, for more than 0.2 second, relay OJ opens, and remains open until relay OR is again energized. The function of relay OJ will be described hereinafter.

It should also be pointed out that if relay OR remains energized during the reception of a code for a longer time than the release time of relay OKa, the latter relay will become de-energized, thereby opening relay OK and also de-energizing relay OC1 or relay OC2 and whichever one of the counting relays may then be energized. This operation restores the counting chain to its original condition and prevents improper operation of a function due to an incorrect code or accidental interruptions in the line circuit. The operation of the counting relays at each station in response to operation of the associated line relay R is similar to the operation just described and will be understood from the foregoing without further explanation.

In explaining the operation of the apparatus I will assume that all parts occupy the positions in which they are illustrated in the drawings and that the operator wishes to restore signal 1LA at station 1 to the stop position, from the proceed position in which it is illustrated in the drawings. To accomplish this result the operator moves signal control lever 1f on panel num-

ber 1 to its middle position (see Fig. 1), and then closes push button OP1. The operation of the push button OP1 closes a pick-up circuit for relay OH1 which will be obvious from the drawings, and this relay sticks up over back contact 47 of a panel relay OS1, and front contact 48 of relay OH1. The push button OP1 may then be released without de-energizing relay OH1. When relay OH1 becomes energized, current flows from terminal Oz, through back contact 49 of relay OT, front contact 58 of relay OH1, and the lower winding of a polarized starting relay OH, (Fig. 2) to terminal Oy. Relay OH therefore becomes energized in the reverse direction and swings its armature to the right to close contact 51. Current then flows from terminal Oz, over back contact 32 of relay OKa, back contact 52 of relay OK, reverse contact 51 of relay OH and winding of relay OT to terminal Oy. Relay OT therefore becomes energized and opens the line circuit including line wires D1 and D2 at back contact 53 of this relay. Relay OR therefore becomes de-energized, picking up relay OB1, OC1, OKa, and OK as described hereinbefore. When relay OKa first becomes energized, the pick-up circuit previously traced for relay OT is interrupted, but relay OT has a release time of 0.1 second and before this relay opens, a stick circuit is closed from terminal Oz, over front contact 32 of relay OKa, front contact 54 of relay OK, front contact 55 of relay OT, reverse contact 51 of relay OH, and winding of relay OT to terminal Oy. Relay OT therefore remains energized as long as OKa and OK are energized, that is, until the completion of the code.

When relay OR became de-energized and picked up relays OB1 and OC1, a pick-up circuit was completed for relay OE, which may be traced from terminal Oz, over back contact 25 of relay OR, (Fig. 2) back contact 28 of relay OKa, front contact 56 (see Fig. 1) of relay OC1, front contact 57 of relay OB1, and winding of relay OE, to terminal Oy. Relay OE therefore became energized, and is stuck up by current which flows from terminal Oz, (Fig. 2) over front contact 32 of relay OKa, front contact 54 of relay OK, back contact 53 of relay OL2, (Fig. 1) back contact 59 of relay OLL, and front contact 60 of relay OE.

When relay OT became energized, the closing of front contact 61 thereon completed a pick-up circuit for relay OX, (Fig. 2) which may be traced from terminal Oz, over front contact 61 of relay OT, back contact 62 of relay OY, and winding of relay OX to terminal Oy. Relay OX is therefore energized and current is supplied to relay OY over front contact 61 of relay OT and front contact 63 of relay OX. When relay OX becomes energized, front contact 67 closes and current then flows from terminal Oz, over front contact 61 of relay OT, front contact 64 of relay OC1, front contact 65 of relay OB1, front contact 66 of relay OJ, front contact 67 of relay OX, and winding of relay OZ to terminal Oy. Relay OZ therefore becomes energized and an additional circuit is completed for relay OX, from terminal Oz, over front contact 61 of relay OT, front contact 68 of relay OZ, and winding of relay OX to terminal Oy. The opening of back contact 62 of relay OY interrupted the pick-up circuit for relay OX, but this relay is now held in its energized condition over the additional circuit just traced. Since relay OT is now energized and OV de-energized, the line circuit is held open until relay OJ opens, which will occur at the expiration of 0.2 second after the operation of relay

OR. When relay OJ releases, it breaks the circuit for relay OZ and at the expiration of 0.1 second, relay Z releases. The circuit is then broken for relay OX, and at the expiration of a further time interval of 0.1 second relay OX releases to close its back contact 63. When this occurs, current flows from terminal O_x, over front contact 61 of relay OT, back contact 63 of relay OX, front contact 69 of relay OY, and winding of relay OV to terminal O_y. Relay OV therefore becomes energized and closes the line circuit through front contact 70 of relay OV and front contact 53 of relay OT. Relay OR then again becomes energized, but it should be noted that the line circuit has been held open during the first impulse for a time interval equal to the sum of the release times of relays OJ, OZ, and OX. The length of the first impulse is, then, approximately 0.4 second.

The energization of relay OR at the conclusion of this long impulse, of course, picks up relay OB1a. Furthermore, relay OV remains energized only during the holding time of relay OY. When relay OY releases, the opening of front contact 69 of this relay breaks the circuit for relay OV, which immediately releases to again interrupt the line circuit. This initiates the second impulse, de-energizing relay OR and picking up relay OB2. When relay OY becomes de-energized, the pick-up circuit for relay OX is again closed and this relay becomes energized. Relay OY is then picked up over front contact 63 of relay OX, and front contact 61 of relay OT. The opening of back contact 62 of relay OY interrupts the pick-up circuit for relay OX, but relay OX is now held up over a holding circuit which may be traced from terminal O_x, (Fig. 2), over front contact 61 of relay OT, front contact 64 of relay OCI, front contact 71 of relay OB2, front contact 72 of relay OH1 on panel number 1, front contact 73 of relay OE, and winding of relay OX to terminal O_y. Since relay OR is now de-energized, relay OJ is also de-energized, and releases after 0.2 second. When back contact 35 of relay OJ closes, current flows from terminal O_x, over back contact 35 of relay OJ, front contact 74 of relay OCI, (Fig. 1) front contact 75 of relay OE, front contact 76 of relay OB2 and winding of a group selector relay OG1, to terminal O_y. Relay OG1 therefore becomes energized, and current then flows over the circuit just traced, as far as front contact 76 of relay OB2, and thence over front contact 78 of relay OG1 and winding of relay OL1 to terminal O_y. Relay OL1, therefore, also becomes energized, interrupting the stick circuit previously traced for relay OE. Relay OE therefore releases and relays OG1 and OL1 are held energized over stick circuits including their own front contacts, back contact 58 of relay OL2, front contact 54 of relay OK and front contact 32 of relay OKa. The opening of front contact 73 (Fig. 2) of relay OE breaks the holding circuit for relay OX and this relay therefore releases to close back contact 63 and complete the circuit for relay OV. It will therefore be seen that the line circuit has been opened during the second impulse for a time interval equal to the release time of relay OJ plus the pick-up times of relays OG1 and OL1, plus the release time of relay OE, and the release time of relay OX and pick-up time of relay OV. With relays of the type here described, this total time is approximately the equivalent of the prolonged first impulse, or 0.4 second.

When relay OV becomes energized, relay OR picks up and energizes relay OB2a. Further-

more, the opening of relay OX de-energizes relay OY and, after 0.1 second, this relay opens to again complete the circuit for relay OX. When relay OX picks up, relay OY becomes energized, thereby breaking the circuit for relay OX. Under these conditions, there is no holding circuit for relay OX, because relay OE is now de-energized so that its front contact 73 is open, and relay OX therefore becomes de-energized. When this relay closes its back contact 63, relay OV becomes energized to close the line circuit and pick-up relay OB3a. It will be seen therefore that the third impulse is not prolonged but is equal to the pick-up time of relay OV, plus the pick-up of relay OX, plus the release time of relay OY.

The pumping operation of relays OX and OY continues, and relay OV operates periodically to open and close the line circuit, and causes the repeated operation of relay OR in the manner described until the 5th impulse has been transmitted to the line circuit. At the beginning of the 5th impulse, relay OB5 is picked up and a holding circuit is then closed for relay OX which may be traced from terminal O_x, over front contact 61 of relay OT, front contact 64 of relay OCI, front contact 79 of relay OB5, front contact 80 of relay OH1 on panel number 1, front contact 81 of relay OG1, and winding of relay OX to terminal O_y. Relay OX is therefore held energized to prevent energization of relay OV until relay OG1 becomes de-energized. This takes place in the following manner: The opening of the line circuit for the 5th impulse opens relay OR and de-energizes relay OJ, and at the conclusion of its holding time relay OJ drops to close its back contact 35. The closing of this contact completes a circuit from terminal O_x, over back contact 35 of relay OJ, front contact 74 (Fig. 1) of relay OCI, front contact 75 of relay OE, front contact 76 of relay OB5, front contact 78 of relay OG1, and winding of the panel selector relay OS1 to terminal O_y. Relay OS1 therefore picks up, and current flows over the circuit just traced as far as front contact 83 of relay OG1, and thence over front contact 84 of relay OS1, and winding of relay OL2 to terminal O_y. Relay OL2 therefore becomes energized to open its back contact 53 and break the stick circuits previously described for relays OG1 and OL1. Relay OG1 therefore becomes de-energized, breaking the pick-up circuits just traced for relays OS1 and OL2, but relay OL2 is now stuck up over its own front contact 58, front contact 54 of relay OK, and front contact 32 of relay OKa. Furthermore, relay OS1 is now stuck up over its own front contact 84, front contact 58 of relay OL2, front contact 54 of relay OK, and front contact 32 of relay OKa, and relay OS1 breaks the holding circuit for relay OH1 so that this relay now becomes de-energized and its contact 50 opens to de-energize polarized starting relay OH. Contact 51 of the latter relay remains closed until relay OH is reversed at the end of the code signal as will be described hereinafter. The opening of front contact 81 of relay OG1 breaks the holding circuit for relay OX, and, after the release interval of this relay has elapsed, the back contact 63 of relay OX closes, picking up relay OV to terminate the 5th impulse by re-establishing the line circuit. It will be seen, therefore, that the 5th impulse is prolonged to have the same length as the second impulse. The pumping operation of relays OX and OY then continues.

At the conclusion of the 8th impulse, relays

OB8a and OC1a become energized as described hereinbefore. The 9th impulse therefore energizes relays OB1 and OC2, the latter relay remaining energized during subsequent impulses delivered to the line. Relay OB1 releases after relay OR becomes energized at the end of the 9th impulse. As the transmission of the code continues, due to operation of relays OX, OY, and OB, the counting relays OB are successively energized until the 11th impulse is delivered to the line circuit. The transmission of this impulse to the line circuit results in the energization of relay OB3 and since relays OC2 and OS1 are now energized, current flows from terminal Oz, over front contact 51 of master relay OT, front contact 25 of relay OC2, front contact 143 of relay OS1, lever 1d in its left-hand position, upper winding of relay OWD1, front contact 139 of relay OB3, front contact 66 of relay OJ, front contact 67 of relay OX, and winding of relay OZ to terminal Oy. Relay OZ therefore picks up and completes the additional circuit for relay OX, over front contact 63 of relay OZ, and front contact 61 of relay OT. Relay OX is therefore held energized to prolong the 11th impulse until relay OZ becomes de-energized. Since relay OR is now de-energized, relay OJ is also de-energized, and after 0.2 second front contact 66 of relay OJ opens to de-energize relay OZ. After 0.1 second, relay OZ opens to de-energize relay OX, and 0.1 second later back contact 63 of relay OX closes to complete the pick-up circuit for relay OV, thereby re-establishing the line circuit and terminating the 11th impulse. It will be seen, however, that the 11th impulse has been prolonged to 0.4 second to transmit as the 11th element of the code a signal indicating that lever 1d is in its left-hand position. The repeated operation of relays OX and OY then continues, and short impulses are transmitted until the 14th impulse is reached, when the energization of relay OB6 permits current to flow from terminal Oz, front contact 61 of relay OT, front contact 25 of relay OC2, front contact 86 of relay OS1, lever 1f in its middle position, front contact 87 of relay OB6, front contact 66 of relay OJ, front contact 67 of relay OX and winding of relay OZ to terminal Oy. Relay OZ therefore picks up to prolong the 14th impulse in a manner similar to that just described for the 11th impulse.

Subsequent impulses in the code are short, until the final or 16th impulse is transmitted to the line, this last impulse being prolonged to form the "delivery" impulse of the code as follows: The commencement of the 16th impulse de-energizes relay OR and picks up relay OB2. A circuit is therefore completed from terminal Oz, front contact 61 of relay OT, front contact 35 of relay OC2, (Fig. 2) upper winding of starting relay OH, front contact 23 of relay OB2, front contact 66 of relay OJ, front contact 67 of relay OX, and winding of relay OZ to terminal Oy. When this circuit is closed, relay OZ is energized to complete the holding circuit for relay OX and prolong the 16th impulse. Furthermore, current delivered to this circuit restores the starting relay OH to its normal position, thereby opening reverse contact 51 of this relay. The opening of reverse contact 51 of relay OH interrupts the stick circuit previously traced for relay OT, but this relay is now held in its energized condition by virtue of a branch including front contact 39 of relay OZ, now closed around contact 51 of relay OH. Since relay OZ is energized, therefore, relay OT remains energized. When relay

OJ opens its front contact 53 at the conclusion of its holding interval it de-energizes relay OZ. Front contact 39 of relay OZ therefore breaks the stick circuit for relay OT, whereupon relay OT becomes de-energized to close the normal line circuit over its back contact 53. It will be seen, however, that the line circuit has been held open during the 16th impulse for a time interval equal to the sum of the holding times of relays OJ, OZ, and OT so that the final impulse is a long impulse of the same length as the other long impulses. Relay OR now remains energized, so that after 0.3 second relay OKa becomes de-energized. The counting relays B and relay C, and in fact, all relays except OR, OJ, and OK are now de-energized to return the apparatus to its normal position so that after 0.3 second the apparatus is in condition to receive code from a station. The de-energization of relay OKa de-energizes relay OK so that 0.3 second later it closes its back contact to prepare the pick-up circuit for relay OT. This circuit is now open at contact 51 of relay OH, and the apparatus is in a condition to send a control code as soon as contact 51 is again closed. This time interval between the release of relays Ka and K at each station insures that all stations are in condition to receive before any station starts to send.

In the foregoing explanation I have described the operation of the apparatus at the office during the transmission of a control code to the line wires and it will be seen that this code consists of 16 impulses, the 1st, 2nd, 5th, 11th, 14th, and 16th of which are approximately 0.4 second in length while the remaining impulses are approximately 0.1 second in length.

I will now describe the operation of the apparatus at station No. 1 in response to the control code thus supplied to the line circuit. It should be borne in mind that the operation of the apparatus at the remaining stations is similar in all respects to the operation of the apparatus at station 1 except that the several stations are selectively responsive to the location in the code signal of the 2nd and 3rd long impulses, and only station 1 will be responsive to the particular code signal just described.

Referring now to the equipment illustrated on Figs 3 and 4 and located at station No. 1, the first impulse of the code signal transmitted from the office deenergizes relay 1R, to close back contact 90 and pick-up relays 1B1, 1C1, 1Ka, and 1K, each of these relays remaining in its energized condition by virtue of stick circuits similar to those already described in connection with Figs. 1 and 2. Furthermore, this de-energization of relay 1R de-energizes relay 1J. It will be remembered that the first impulse of the code sent from the office is long, so that at the expiration of the holding interval of 0.2 second of relay 1J, this relay releases, thereby closing back contact 91 and completing a circuit from terminal 1x, over back contact 91 of relay 1J, front contact 92 of relay 1C1, front contact 93 of relay 1B1, and winding of a lock out relay 1E to terminal 1y. Relay 1E is subsequently held in its energized condition by virtue of a stick circuit which includes the front contact 94 of relay 1E, front contact 95 of relay 1K and front contact 96 of relay 1Ka. During the interval between the 1st and 2nd impulses, relay 1R is energized so that relay 1J again picks up, and relay 1B1a picks up, and relay 1B1 releases. During the second impulse, relay 1R is again de-energized, picking up relay 1B2 and releasing relay 1B1a. 76

It will be remembered that the second impulse is also long, so that at the conclusion of the holding interval of relay IJ, that relay closes its back contacts, and current then flows from terminal 1x, over front contact 96 of relay IKA, back contact 97 of relay IB8a, front contact 98 of relay IC1, front contact 99 of relay IC1, front contact 100 of relay IB2, jumper 101, back contact 102 of relay IJ, front contact 103 of relay IE, and winding of the group selector relay IG to terminal 1y. When relay IR next becomes energized, relay IJ picks up and relay IB2a also picks up, but relay IB2 becomes de-energized. As a result, the pick-up circuit just traced for relay IG is open, but this relay is now held energized over a stick circuit including its own front contact 104, front contact 95 of relay IK, and front contact 96 of relay IKA. The third and fourth impulses are short and relay IJ therefore remains energized while these impulses are being received, and when the 5th impulse is received, relay IB5 will be energized. Since the 5th impulse is long, relay IJ opens at the conclusion of 0.2 second and a circuit is then completed for the station selector relay IS which may be traced from terminal 1x, over front contact 96 of relay IKA, back contact 97 of relay IB8a, front contact 98 of relay IC1, front contact 99 of relay IC1, front contact 105 of relay IB5, jumper 106, back contact 107 of relay IJ, front contact 108 of relay IG and winding of relay IS to terminal 1y. At the conclusion of the 5th impulse, relay IR picks up to energize relay IJ and continue the successive operation of the counting relays and the pick-up circuit just traced for relay IS is then open, but this relay remains energized, its stick circuit being closed over its own front contact 109, front contact 95 of relay IKA and front contact 96 of relay IK. Subsequent impulses in the code are short until the 11th impulse. It should be noted that the beginning of the 9th impulse will find relay IB8a picked up and will also find relay IC1a picked up. The 9th impulse, therefore energizes relays IB1 and IC2 and de-energizes relays IB8a and IC1a. When the 11th impulse is received, relay IB3 will become energized and since this impulse is long, relay IJ will become de-energized at the end of 0.2 second to close a circuit from terminal 1x, over back contact 91 of relay IJ, front contact 110 of relay IC2, front contact 111 of relay IS, front contact 140 of relay IB3, and winding of register relay IF3 to terminal 1y. Relay IF3 is subsequently held up by a stick circuit including its own front contact 141, front contact 95 of relay IK, and front contact 96 of relay IKA. The 12th and 13th impulses are short so that IJ does not close its back contact and therefore relays IF4 and IF5 are not operated. The 14th impulse is long however, and results in picking up register relay IF6 over contact 112 of relay IB6 and this relay then sticks up over its own front contact 113 in a manner similar to that just described for relay IF3. During the 15th impulse, which is short, relay IJ is not de-energized long enough to close its back contact. When the 16th impulse is received, however, relay IB8 picks up, closing its delivery contact 114, and since this 16th impulse is long, relay IJ closes its back contact 91. An operating, or "totalizing" impulse is then delivered to relay IWS, (Fig. 3) over a circuit which passes from terminal 1x, over back contact 91 of relay IJ, (Fig. 2) front contact 110 of relay IC2, front contact 111 of relay IS, front contact 114

of relay IB8, front contact 142 of relay IF3 and the upper winding of relay IWS to terminal 1y. This impulse tends to move contact 9 of IWS to the left, but since this contact is already in that position, no change results. A branch of the same circuit also delivers an operating impulse to relay IHS, from front contact 114 of relay IB8, front contact 115 of relay IF6 and the upper winding of relay IHS to terminal 1y. Relay IHS is therefore energized in the reverse direction, to open the normal contact 17. The interruption of this contact breaks the circuit for relay ILAH which thereupon becomes de-energized to open, at front contact 20, the operating circuit for signal 1LA, to put this signal to its stop position. It should be pointed out that had any of the other signals been indicating proceed, the reversal of relay IHS would have put such signal to the stop position. If, due to line trouble or other causes, the total number of impulses received at station 1 is greater or less than 16, the delivery impulse will be received by some counting relay other than IB8, and polarized relays IWS and IHS will not be actuated. This feature provides a large measure of protection against imperfect line signals. At the conclusion of the 16th and last impulse of the code, relays IR and IJ become energized and all other relays become de-energized, but relay IHS remains in its reverse position.

I will next assume that the operator, instead of moving signal control lever 1f to its middle position to set the signals at station No. 1 at stop, wishes to clear the westbound signal at this station. He accomplishes this result by moving lever 1f to its right-hand position, and closing the starting push button OP1. The apparatus at the office is then set into operation to send a code in the same manner as already described with the exception that the 15th impulse is now prolonged instead of the 14th impulse. This change is accomplished in the following manner: As was pointed out hereinbefore, when lever 1f is in the middle position, relay OZ becomes energized during the 14th impulse to prolong this impulse, the circuit for relay OZ including front contact 87 of relay OB6 and lever 1f in its middle position. Since lever 1f now occupies its right-hand position, this circuit is open and the 14th impulse is short. During the 15th impulse, however, relay OB1 is energized and a circuit is completed for relay OZ, which may be traced from terminal OX, over front contact 61 of relay OT, front contact 85 of relay OC2, front contact 86 of relay OSI, lever 1f in its right-hand position, lower winding of relay OFD1, front contact 116 of relay OB1, front contact 66 of relay OJ, front contact 67 of relay OX, and winding of relay OZ to terminal OY. Relay OZ is therefore energized, and it will be plain that the 15th impulse has been prolonged. It will be seen, therefore, that the code now transmitted to the line circuit consists of 16 impulses, the 1st, 2nd, 5th, 11th, 15th, and 16th, of which are long impulses while the remaining impulses are short impulses.

It should be noted that current supplied to relay OZ during the 15th impulse energizes relay OFD1, and swings contact 122 of this relay to its reverse position. This breaks the circuit of the signal indication lamp 127, which when lighted indicates that the eastbound signal at station 1 is "clear", and thus informs the operator that the code to reverse the traffic direction has been sent. Contact 122 in reverse position connects lamp 128 to terminal OY, preparing a circuit so that the

signal indication lamp 123 may be lighted as soon as relay OFK1 is reversed by a return indication showing that the signal at station 1 has cleared for westbound traffic.

- Referring now to the apparatus at station No. 1, the code signal just described will actuate the apparatus at this station in the manner already explained, except that register relays 1F3 and 1F7 will be energized instead of 1F3 and 1F6.
- This takes place as follows: During the 15th impulse, relay 1B7 is energized and since this impulse is long, relay 1J releases and a circuit is completed from terminal 1z, over back contact 91 of relay 1J, front contact 110 of relay 1C2, front contact 111 of relay 1S, front contact 117 of relay 1B7, and winding of relay 1F7 to terminal 1y. Relay 1F7 therefore picks up and sticks up over a circuit including its own front contact 113, front contact 95 of relay 1K and front contact 98 of relay 1Ka. When the 16th impulse is received, relay 1B8 is energized and since this impulse is long, relay 1J releases and current flows from terminal 1z, over back contact 91 of relay 1J, front contact 110 of relay 1C2, front contact 111 of relay 1S, front contact 114 of relay 1B8, front contact 142 of relay 1F3 and the upper winding of relay 1WS to terminal 1y, tending to move contact 9 to the left; also from front contact 114 of relay 1B8 over front contact 119 of relay 1F7, lower winding of relay 1HS to move its contact 17 to the left, if not already in that position; and also from front contact 114 of relay 1B8 over front contact 120 of relay 1F7 and the lower winding of relay 1FS to move its contact 18 to the right. This operation of relays 1HS and 1FS de-energizes relay 1LAH, if that relay happens to be energized, and also completes the circuit for relay 1RAH. Relay 1RAH therefore becomes energized and completes at front contact 23 thereon the operating circuit for signal 1RA which signal then indicates proceed.

- I will next assume that the signal control lever 1f has been moved to either its middle or right-hand positions to send out a corresponding code as already described and that the operator then restores the lever 1f to its normal position in which it is shown in the drawings, and then operates the push button OP1, to transmit to the line circuit a code which will clear the eastbound signal at station No. 1. When the push button OP1 is operated the apparatus at the office is actuated to transmit to the line circuit a code similar to those previously described, except that in this case the long impulses will be the 1st, 2nd, 5th, 11th, 13th, and 16th. Since lever 1f now occupies its left-hand position, a circuit will be closed for relay OZ during the 13th impulse when relay OB5 is energized; which circuit passes from terminal OZ, over front contact 61 of relay OT, front contact 85 of relay OC2, front contact 86 of relay OS1, lever 1f in its left-hand position, upper winding of relay OFD1, front contact 121 of relay OB5, front contact 86 of relay OJ, front contact 67 of relay OX, and winding of relay OZ to terminal Oy. Relay OZ therefore becomes energized to hold relay OX energized and prolong the 13th impulse. Since the circuit just traced includes the operating winding of relay OFD1, this relay is energized in its normal direction to close normal contact 122, and prepare the circuit for lighting lamp 127 upon the receipt of a normal indication, as will be explained in detail hereinafter. Had the signal control lever 1f occupied its right-hand position previous to its last change, with lamp 128 energized, this operation of relay OFD1 would

have extinguished lamp 128. With lever 1f in its left-hand position, the 14th and 15th impulses are both short but the 16th impulse is long, as before.

- The code transmitted to the line circuit under the conditions just described, selects the equipment at station No. 1 in the manner already described to pick up relays 1E, 1F, and 1G. During the 11th impulse register relay 1F3 is picked up over contact 140 of relay 1B3 as already described. During the 13th impulse, relay 1B5 is, of course, energized, and at this time, relay 1C2 is also energized. Since the 13th impulse is long, relay 1J releases and current then flows from terminal 1z, over back contact 91 of relay 1J, front contact 110 of relay 1C2, front contact 111 of relay 1S, front contact 123 of relay 1B5, and winding of relay 1F5 to terminal 1y. Relay 1F5 therefore becomes energized, and sticks up over a circuit including its own front contact 124, front contact 95 of relay 1K, and front contact 96 of relay 1Ka. Since the 14th and 15th impulses are short, relays 1F6 and 1F7 remain de-energized. When the 16th impulse is received, relay 1B8 is energized and since this impulse is long, the "delivery" circuit is closed and current flows from terminal 1z, over back contact 91 of relay 1J, front contact 110 of relay 1C2, front contact 111 of relay 1S, front contact 114 of relay 1B8, front contact 42 of relay 1F3, and the upper winding of relay 1WS to terminal 1y. Relay 1WS thus receives an impulse tending to move contact 9 to the left. A branch is closed for the circuit just traced from front contact 14 of relay 1B8, over contact 125 of relay 1F5 and the lower winding of relay 1HS to terminal 1y, to move contact 17 to the left, if not already in that position and a second branch circuit is closed from front contact 114 of relay 1B8 over contact 126 of relay 1F5 upper winding of relay 1FS to terminal 1y to cause contact 18 to move to the left. This operation of relays 1HS and 1FS closes, at contacts 17 and 18, the circuit for relay 1LAH and energizes this relay to clear signal 1LA.
- I will next assume that with the apparatus in the condition in which it is illustrated in the drawings, the operator moves switch control lever 1d on panel No. 1 at the office to its right-hand position to reverse switch 3 at station No. 1. He then closes push button OP1, whereupon the apparatus is actuated to transmit to the line circuit a code similar to those previously discussed but having the 12th impulse prolonged, the long impulses in this case being the 1st, 2nd, 5th, 12th, 13th, and 16th. This is accomplished in the following manner: When the 12th impulse commences, relay OB4 is energized, and a circuit is then completed for relay OZ, from terminal OZ, over front contact 61 of relay OT, front contact 85 of relay OC2, front contact 143 of relay OS1, lever 1d in its right-hand position, lower winding of relay OWD1, front contact 136 of relay OB4, front contact 66 of relay OJ, front contact 67 of relay OX, and winding of relay OZ to terminal Oy. Relay OZ therefore becomes energized to prolong the 12th impulse. Current supplied to the circuit just traced for relay OZ also energizes relay OWD1 in its reverse direction, thereby opening at normal contact 130 thereon, the circuit for the "normal" switch indication lamp 131. This lamp is therefore extinguished and informs the operator that a code has been sent to reverse the switch. Reverse contact 130 is closed to connect the "reverse" switch indication lamp 132 to terminal Oy, preparing a circuit so

that lamp 132 may be lighted when a reverse switch indication is received. When the code just described is received at station No. 1, relays 1E, 1G, and 1S are energized as before, and when the 12th impulse is received, relay 1B4 will be energized. Since the 12th impulse is long, relay 1J becomes de-energized and picks up relay 1F4 over a circuit which may be traced from terminal 1x, over back contact 91 of relay 1J, front contact 110 of relay 1C2, front contact 111 of relay 1S, front contact 168 of relay 1B4 and winding of relay 1F4 to terminal 1y. Register relay 1F4 therefore becomes energized and sticks up over its own front contact 131, front contact 95 of relay 1K and front contact 96 of relay 1Ka. When the 13th impulse is received, register relay 1F5 picks up as already described, and when the 16th impulse is received, the operating circuit is closed from terminal 1x, over back contact 91 of relay 1J, front contact 110 of relay 1C2, front contact 111 of relay 1S, front contact 114 of relay 1B8, front contact 138 of relay 1F4, and the lower winding of relay 1WS to terminal 1y. Relay 1WS therefore becomes energized in the reverse direction to swing contact 9 to the right. Furthermore, a branch is closed for the operating circuit over contact 115 of relay 1F5 to energize relay 1HS in the reverse direction, tending to close contact 17. Another branch for the operating circuit is also closed over contact 126 of relay 1F5 energizing relay 1FS in the reverse direction and tending to swing contact 18 to the left; but it has been assumed that contacts 17 and 18 are already to the left, so no movement of these contacts takes place. It should be observed that the reversal of relay 1WS breaks the circuit previously existing for relay 1LAH. The opening of front contact 20 of relay 1LAH restores signal 1LA to the stop position, and when the signals at station No. 1 all indicate stop, contacts 10 and 10a controlled by these signals are both closed. Current then flows over reverse contact 9 of relay 1WS to energize relay 1I, and motor 1M is operated to move switch 3 to its reverse position. When the switch attains its full reverse position, the opening of front contact 14—14a de-energizes motor 1M. Furthermore, this operation of the switch 3 opens contact 16—16a and closes contact 16—16b. A circuit is then completed for relay 1LBH and this relay becomes energized to close the operating circuit for signal 1LB. It should be observed that the transmission of a code for reversing the switch and clearing the signal for the traffic direction previously existing first puts all signals to stop, then reverses the switch, and finally clears the signal which corresponds to the new switch position and to the traffic direction.

I will next assume that the operator wishes to restore switch 3 at station No. 1 to its normal position, with traffic direction unchanged. He accomplishes this result by restoring lever 1d on panel No. 1 to its normal position, and operating push button OPI. The code now transmitted from the office has the 1st, 2nd, 5th, 11th, 13th, and 16th impulses prolonged, which code has already been described. Relay OWD1 will be restored to normal, during the transmission of this code, thereby extinguishing reverse switch indication lamp 132 had this lamp been previously lighted, and preparing the circuit of lamp 131 for the receipt of a normal switch indication.

When the code just described is received at station No. 1, the 11th impulse will pick up register relay 1F3 so that the final operating impulse will

restore relay 1WS to normal to close reverse contact 9. This operation of relay 1WS de-energizes relay 1LBH and puts signal 1LB at station No. 1 at stop. Contacts 10 and 10a then close and a circuit is completed over normal contact 9 of relay 1WS for relay 1I. This relay therefore becomes energized and motor 1M is operated to move the switch 3 to its normal position. When the switch attains its normal position contact 14—14b opens to de-energize motor 1M, and contact 16—16a closes to complete the circuit for relay 1LAH. Signal 1LA is therefore cleared and contacts 10 and 14 then open to prevent further operation of motor 1M until all signals at station Number 1 have been restored to the stop position.

In all of the preceding discussion, I have considered only the transmission of control codes from the office to station No. 1 and it will be seen that each of these codes have the first impulse long and also the 2nd and 5th impulses long to pick-up the group and station selector relays 1G and 1S at station No. 1. It will be plain from an examination of Fig. 4 that relay 1G is energized by a long second impulse in the code because jumper 101 connects back contact 102 of relay 1J with front contact 100 of relay 1B2. Had jumper 101 been adjusted to connect contact 102 of relay 1J with front contact 144 of relay 1B3, it would have been necessary to prolong the 3rd impulse in order to pick up relay 1G. Similarly had it been adjusted to connect contact 102 of relay 1J with contact 145 of relay 1B4, relay 1G could be energized only if the 4th impulse of the code were long. Furthermore, by proper adjustment of jumper 106, the apparatus could be arranged to pick up relay 1S on codes having the 6th, 7th, or 8th impulses long instead of the 5th as shown in the drawings, by connecting 106 to the corresponding contact of 1B6, 1B7, or 1B8 instead of to contact 105 of 1B5. It is apparent from the foregoing that the apparatus at the station can be adjusted to respond to any one of twelve different combinations of long impulses in the code and that each station will be selected only by the code having the proper impulses prolonged. Since none of the functions at a station can be actuated until the station selector relay at that station, corresponding to relay 1S at station No. 1 has been energized, it follows that the station will be unaffected by any code except the one which is intended for that station, and of course, in practice, the jumpers 101 and 106 at each of the twelve stations are adjusted so that each station will respond to a different code.

If a code is to be sent from the office for controlling apparatus at a station other than station No. 1, it will be accomplished by operating apparatus associated with the panel corresponding to such station in the same manner as already described in connection with panel No. 1, the office equipment including a set of twelve panels when there are twelve stations to be controlled. It will be seen that relay OH1 determines when energized that the 2nd and 5th impulses of the code will be prolonged. If, however, the individual starting relay H for a different panel is energized, other impulses are prolonged to select the corresponding stations. The selection at the office between impulses is accomplished by the group of contacts illustrated at the left-hand edge of Fig. 2, where I have shown contacts for twelve individual starting relays OH1 to OH12 inclusive, one of which relays is associated with each of the twelve panels of the office equipment. Each of these relays controls the selection of its own

panel and station in a manner similar to that described for the selection of panel No. 1 and station No. 1 by the operation of relay OH1.

The apparatus is also arranged to transmit from each station indication codes similar to the codes used for the control of apparatus at the station, for operating indication means at the office in response to any change in the condition of the apparatus located at the station. In explaining this feature of my invention, I will first assume that with the parts occupying the positions in which they are illustrated in the drawings, a train enters section *a-b* at station No. 1 and causes relay 1TR, (Fig. 3) to become deenergized. When back contact 146 of this relay closes, current flows from terminal 1x, through back contact 146 of relay 1TR, normal contact 147 of relay 1TD, back contact 148 of relay 1T, (Fig. 4) and the lower winding of starting relay 1H to terminal 1y. Relay 1H therefore becomes energized in the reverse direction to close contact 150. A pick-up circuit is then closed for master relay 1T, which may be traced from terminal 1x, over back contact 96 of relay 1Ka, back contact 149 of relay 1K, reverse contact 150 of relay 1H, and winding of relay 1T to terminal 1y. When this circuit is closed, relay 1T becomes energized and this relay remains energized until a complete code has been sent. The energization of relay 1T opens its back contact 152, thereby interrupting the portion of the line circuit extending to all stations beyond station 1, so that all line relays R at these stations are de-energized. Furthermore, the portion of the line circuit extending from the transmitting station to the office is open at contact 153 of transmitter relay 1V, and this opening of the line circuit de-energizes relay 1R at the station and relay OR at the office, and also the R relays of any stations located between the sending station and the office. The de-energization of relay 1R at station No. 1 picks up relays 1B1, 1C1, 1Ka, and 1K as will be readily understood without further explanation. Relays 1Kz and 1K remain energized until the code has been completed. It will be plain that the energization of the two relays last mentioned interrupts the pick-up circuit just traced for relay 1T, but this relay is now held energized over a stick circuit including front contact 96 of relay 1Ka, front contact 95 of relay 1K, back contact 94 of relay 1E, front contact 151 of relay 1T and reverse contact 150 of relay 1H.

When relay 1T picked up, relay 1X was energized over back contact 156 of relay 1Y and front contact 194 of relay 1T. When relay 1X becomes energized, relay 1Y is picked up, over front contact 157 of relay 1X and front contact 194 of relay 1T. The energization of relay 1Y breaks the circuit for relay 1X and after a time interval, relay 1X opens. When this happens, relay 1V is energized over front contact 155 of relay 1Y, back contact 157 of relay 1X and front contact 194 of relay 1T. Relay 1V therefore becomes energized to close the line circuit at station 1 through relay 1R and an impedance 154. Relay 1R then becomes energized, picking up relay 1B1a and deenergizing relay 1B1. The time characteristics of the relays at each station are similar to those of the corresponding relays at the office, and it will be seen therefore that this first impulse of the code is a short impulse.

At the conclusion of the holding time of relay 1Y this relay releases to de-energize relay 1V to form the second impulse of the code. Relay 1R then becomes de-energized and picks up relay 1B2. A circuit is then completed for relay 1Z,

from terminal 1x, through front contact 96 of relay 1Ka, back contact 97 of relay 1B2a, front contact 98 of relay 1C1, front contact 99 of relay 1C1, front contact 100 of relay 1B2, jumper 101, front contact 102 of relay 1J, front contact 158 of relay 1X, and winding of relay 1Z to terminal 1y. Relay 1Z, therefore, becomes energized and holds relay 1X energized over front contact 159 of relay 1Z. Relay 1V is therefore held deenergized. At the conclusion of the holding interval of relay 1J, this relay releases, thereby opening front contact 102 thereon and interrupting the circuit just traced for relay 1Z. After a time interval, relay 1Z releases, de-energizing relay 1X. After another time interval, relay 1X releases to energize relay 1V and conclude the second impulse. It will be seen, therefore, that the second impulse of the code is a long impulse.

The repeated operation of relays 1X and 1Y, thereafter continues, transmitting short impulses to the line circuit until the 5th impulse has been initiated. At this time, relay 1B5 is energized and a circuit is completed for relay 1Z from terminal 1x, over front contact 96 of relay 1Ka, back contact 97 of relay 1B2a, front contact 98 of relay 1C1, front contact 99 of relay 1C1, front contact 105 of relay 1B5, jumper 106, front contact 107 of relay 1J, front contact 158 of relay 1X, and winding of relay 1Z to terminal 1y. Relay 1X is therefore held energized to prolong the 5th impulse. After a time interval, relay 1J releases, thereby interrupting the circuit for relay 1Z, which releases to de-energize relay 1X to pick up relay 1V. It will be seen that the 5th impulse is a long impulse and the 6th, 7th, and 8th impulses are short. It should be noted that the de-energization of track relay 1TR, which set the code transmitter into operation, opens contact 8 and thus de-energizes relay 1LAH. This opens contact 20 to put signal 1LA to stop, so that both the signal and the track relay will be out of step with the corresponding indicators at the office, until the 9th to 16th impulses of the return indication code have been completed. During the time interval following the 8th impulse, relays 1B3a, and 1C1a are energized and when the 9th impulse is transmitted, relays 1B1 and 1C2 become energized as described in connection with the corresponding relays at the office. The 9th impulse is short but when the 10th impulse is transmitted, relay 1B2 is energized and a circuit for relay 1Z is then closed from terminal 1x, through back contact 146 of relay 1TR, the lower winding of relay 1TD, contact 100 of relay 1B2, contact 161 of relay 1C2, contact 162 of relay 1J, contact 158 of relay 1X, and winding of relay 1Z to terminal 1y, to pick up relay 1Z to prolong the 10th impulse. Furthermore relay 1TD becomes energized in the reverse direction to close reverse contact 147, thereby preparing a circuit to start the transmitter when track relay 1TR again picks up.

During the 11th impulse, a circuit for relay 1Z is closed from terminal 1x, over contact 165-165a, closed when switch 3 is normal, thence through upper winding of relay 1WD, front contact 168 of relay 1B3, front contact 161 of relay 1C2, front contact 162 of relay 1J, front contact 158 of relay 1Z, and winding of relay 1Z to terminal 1y. Current in this circuit picks up relay 1Z to prolong the 11th impulse, and flows through relay 1WD in such direction as to tend to move contact 166 to the left. The 12th and 13th impulses are short.

During the 14th impulse, a circuit for relay 1Z is closed from terminal 1x, through back contact 97

185 of relay 1LAH, back contact 186 of relay 1LBH, back contact 187 of relay 1RAH, back contact 188 of relay 1RBH, lower winding of relay 1HD, front contact 200 of relay 1B6, front contact 161 of relay 1C2, front contact 162 of relay 1J, front contact 158 of relay 1X, and winding of relay 1Z to terminal 1y. Current in this circuit picks up relay 1Z to prolong the 14th impulse, and flows through the lower winding of relay 1HD in such direction as to close right-hand contact 189. This prepares a circuit to start the transmitter when any one of the four signal relays 1LAH, 1LBH, 1RAH, or 1RBH is again energized.

The 15th impulse is short, but the 16th impulse is, of course, a long impulse. During the 16th impulse, the circuit for relay 1Z is from terminal 1x, over front contact 96 of relay 1Ka, front contact 95 of relay 1K, back contact 94 of relay 1E, front contact 151 of relay 1T, upper winding of relay 1H, front contact 163 of relay 1B8, front contact 161 of relay 1C2, front contact 162 of relay 1J, front contact 158 of relay 1X, and winding of relay 1Z to terminal 1y. As a result of the current supplied to this circuit, relay 1Z is held energized to prolong the 16th and last impulse of the code. Furthermore, the current in the circuit just traced energizes relay 1H in its normal direction, thereby opening reverse contact 150. The opening of this contact interrupts the stick circuit for master relay 1T, but since relay 1Z is now energized, a branch is closed around contact 150 of relay 1H, through front contact 195 of relay 1Z. Relay 1T therefore remains energized after relay 1H has been restored to its normal condition. When relay 1J releases, relay 1Z becomes de-energized and after a time interval, this relay opens its front contact 195. The master relay 1T is then de-energized and after a further time interval, this relay releases to stop the transmission, closing its back contact 152 to restore the line circuit and complete the last impulse of the code, following which relays 1Ka and 1K become de-energized to restore the apparatus to normal.

It will be seen from the foregoing that the code transmitted to the line circuit from a station consists of 16 impulses similar to those transmitted from the office, except that the first impulse of the code transmitted from a station to the office is a short impulse while the code transmitted from the office to the station has its first impulse a long impulse. In the particular code described, the long impulses are the 2nd, 5th, 10th, 11th, 14th, and 16th.

The code transmitted to the line by the apparatus at station No. 1 operates the apparatus at the office in the following manner:

Line relay OR at the office is, of course, energized when the line circuit is closed, but is de-energized during each impulse, or open circuit interval of the code transmitted from station No. 1. This operation of relay OR energizes the counting relays OB1, OB1a, etc., consecutively in the manner previously described. The first time relay OR becomes de-energized, relays OB1, OC1, OKa, and OK become energized. This first impulse is short, but during this impulse, relay OE (Fig. 1) is energized, over a circuit which passes from terminal Ox, over back contact 25 of relay OR (Fig. 2) back contact 26 of relay OKa, front contact 56 of relay OC1, front contact 57 of relay OB1, and winding of relay OE to terminal Oy. When relay OE picks up, it sticks up over its own front contact 60, back contact 59 of relay OL1, back contact 58

of relay OL2, front contact 54 of relay OK, and front contact 32 of relay OKa. During the second impulse, relay OB2 is energized and since this impulse is long, relay OJ releases, and current then flows from terminal Ox, over back contact 35 of relay OJ, front contact 74 of relay OC1, front contact 75 of relay OE, front contact 76 of relay OB2, and winding of relay OG1 to terminal Oy. Relay OG1 then picks up, and current flows over the circuit just traced for this relay as far as front contact 76 of relay OB2, and thence over front contact 78 of relay OG1, and winding of relay OL1 to terminal Oy. Relay OL1 therefore picks up, breaking the stick circuit for relay OE and allowing relay OE to release, but relays OG1 and OL1 stick up over their own front contacts, back contact 58 of relay OL2, front contact 54 of relay OK and front contact 32 of relay OKa. The third and fourth impulses are short, but when the 5th impulse is received, relay OB5 is energized, and since this impulse is long, relay OJ releases, and current flows from terminal Ox, over back contact 35 of relay OJ, front contact 74 of relay OC1, front contact 82 of relay OB5, front contact 83 of relay OG1, and winding of relay OS1 to terminal Oy. Relay OS1 then becomes energized and current flows over the circuit just traced for this relay as far as front contact 83 of relay OG1, and thence over front contact 84 of relay OS1 and the winding of relay OL2 to terminal Oy. Relay OL2 then picks up, breaking the stick circuit for relay OL1 so that OL1 and OG1 drop, and completing a stick circuit for relay OL2 over its own front contact 58, front contact 54 of relay OK, and front contact 32 of relay OKa. Relay OS1 is also stuck up over a circuit including its own front contact 84, front contact 58 of relay OL2, front contact 54 of relay OK, and front contact 32 of relay OKa. The circuits for relays OL1, OL2, OG1, and OS1 are similar to the circuits previously described for these relays in connection with the transmission of a code from the office and will be readily understood without tracing these circuits in further detail. The next long impulse in the code is the 10th impulse and when this impulse is received, relay OB2 is energized. During this impulse, relay OJ releases, and since relay OC2 is now picked up, current flows from terminal Ox, through back contact 35 of relay OJ, back contact 196 of relay OT, front contact 197 of relay OC2, contact 170 of relay OB2, and winding of relay OF2 to terminal Oy. As a result, relay OF2 picks up and sticks over its own front contact 171, front contact 54 of relay OK and front contact 32 of relay OKa.

During the 11th impulse, which is long, relay OF3 picks up over front contact 198 of relay OB3, and sticks over its own front contact 199. The 12th and 13th impulses are short so that relays OF4 and OF5 do not pick up.

During the 14th impulse, which is long, relay OF6 picks up over front contact 229 of relay OB6, and sticks over its own front contact 230. The 15th impulse is short so that relay OF7 does not pick up. During the 16th impulse, which is long, the operating circuit is closed from terminal Ox, back contact 35 of relay OJ, back contact 196 of relay OT, front contact 197 of relay OC2, front contact 172 of relay OB8, and from this point one branch is completed over front contact 173 of relay OF2, winding of relay 1TK, front contact 174 of relay OS1 and back contact 175 of relay OF1 to terminal Oy. Cur-

rent over this branch reverses relay **ITK**, closing contact **176** and lighting lamp **177** to indicate "track occupied."

A second branch of the operating circuit is completed from front contact **172** of relay **OB3**, over front contact **184** of relay **OF3**, front contact **193** of relay **OS1**, winding of relay **1WK**, and back contact **182** of relay **OF4** to terminal **Oy**. Current over this branch tends to move contact **133** to the left thus verifying its correct position.

A third branch of the operating circuit is completed from front contact **172** of relay **OB3**, over front contact **191** of relay **OF6**, winding of relay **OHK1**, contact **192** of relay **OS1**, back contact **193** of relay **OF5** and back contact **201** of relay **OF7** to terminal **Oy**. Current over this branch causes contact **135** of relay **OHK1** to move to the right to open the circuit for lamps **127** and **128** and to close the circuit for lamp **129**, thus lighting lamp **129** to indicate that the signals are at "stop."

When the code signal is completed, relays **OR** and **OJ** pick up and remain energized, and all other relays become de-energized, restoring the apparatus to normal. On panel No. 1, lamps **177**, **131**, and **129** will now remain lighted until a new code signal is received from station No. 1.

Returning now to station No. 1, we will assume that the train moves out of section **a—b**, so that track relay **1TR** picks up. The closing of front contact **3** of this relay picks up relay **1LAH** to again clear the signal **1A**. A starting circuit is now closed from terminal **1x**, over front contact **146** of relay **1TR**, reverse contact **147** of relay **1TD**, back contact **148** of relay **1T** and lower winding of relay **1H** to terminal **1y**. The starting relay **1H** is therefore energized in the reverse direction and the equipment at station No. 1 is actuated to transmit a code to the line circuit in a manner similar to that already described in connection with the operation of the apparatus in response to the entrance of a train into section **a—b**, with the difference, however, that the 9th, 11th, and 13th will be long impulses instead of the 10th, 11th, and 14th. During the 9th impulse of this code, relays **1B1** and **1C2** are energized and a circuit for relay **1Z** is then closed from terminal **1z**, over front contact **146** of relay **1TR**, the upper winding of relay **1TD**, front contact **164** of relay **1B1**, front contact **161** of relay **1C2**, front contact **162** of relay **1J**, front contact **158** of relay **1X**, and winding of relay **1Z**, to terminal **1y**. Relay **1Z** therefore picks up to prolong the 9th impulse, and relay **1TD** is energized, so as to move contact **147** to the left. The 10th impulse will be short, the 11th impulse will be long, as already described, and the 12th impulse will be short. During the 13th impulse, a circuit for relay **1Z** is closed from terminal **1x**, through contact **202—202a** closed when switch **3** is normal, back contact **204** of relay **1RAH**, front contact **203** of relay **1LAH**, to wire **219**. From this point one branch continues through upper winding of relay **1FD**, front contact **215** of relay **1B5**, front contact **161** of relay **1C2**, front contact **162** of relay **1J**, front contact **158** of relay **1Z**, and winding of relay **1Z** to terminal **1y**. Current in this branch circuit picks up relay **1Z** to prolong the 13th impulse, and flows through the upper winding of relay **1FD** tending to move contact **235** to the left, but under the assumed conditions this contact is already in that position. This prepares a circuit to start the transmitter if the traffic direction is reversed to pick up re-

lay **1RAH** or relay **1RBH**. A second branch of the circuit extends from wire **219** through front contact **216** of relay **1B5**, and the upper winding of relay **1HD** to terminal **1y**. Current in this branch causes contact **189** of relay **1HD** to move to the left, to prepare a circuit to start the transmitter when all the signal relays become de-energized.

The 14th and 15th impulses are short, and the operation during the 16th impulse is as already described. In the code just described therefore, the long impulses will be the 2nd, 5th, 9th, 11th, 13th, and 16th.

The operation of the office equipment in response to the code just described for an unoccupied track section is similar to the operation in receiving an indication of an occupied track section, except that the 9th, 11th, and 13th will be long impulses instead of the 10th, 11th, and 14th impulses. During the 9th impulse, relay **OF1** picks up over front contact **178** of relay **OB1**, and sticks over its own front contact **179**. The 10th impulse is short so that relay **OF2** does not pick up. During the 11th impulse relay **OF3** picks up and sticks as already described, and the 12th impulse is short so that relay **OF4** does not pick up. During the 13th impulse, relay **OF5** picks up over front contact **217** of relay **OB5**, and sticks over its own contact **228**. The 14th and 15th impulses are short so that relays **OF6** and **OF7** do not pick up.

During the 16th impulse, the operating circuit is closed from terminal **Ox** over contacts **35**, **196**, **197**, **172** as already described, one branch continuing over front contact **175** of relay **OF4**, contact **174** of relay **OS1**, winding of relay **1TK**, and back contact **173** of relay **OF2** to terminal **Oy**. Current over this branch restores relay **1TK** to normal, opening contact **176** to extinguish lamp **177** and thereby indicating "track unoccupied."

The second branch of the operating circuit energizes relay **1WK** to the left, as already described, to insure that lamp **131** is lighted, and a third branch is completed over front contact **193** of relay **OF5**, front contact **192** of relay **OS1**, winding of relay **OHK1**, back contact **191** of relay **OF6** to terminal **Oy**. Current over this branch energizes relay **OHK1** to move contact **135** to the left. A fourth branch of the operating circuit is completed over front contact **214** of relay **OF5**, front contact **213** of relay **OS1**, winding of relay **OFK1**, and back contact **212** of relay **OF7** to terminal **Oy**. Current over this branch energizes relay **OFK1** tending to move contact **134** to the left, but this contact was assumed to be in that position. Thus lamp **129** is extinguished and lamp **127** lighted to indicate that an eastbound signal is clear, and since lamp **131** is lighted showing that the switch is normal, this is known to be signal **1LA** and not **1LB**.

I will next assume that the operator reverses lever **1d** to reverse switch **3**. It has been shown that the code signal in response to this movement results at station No. 1 in moving contact **9** of relay **1WS** from left to right, but contacts **17** and **18** of relays **1HS** and **1FS** will remain closed to the left. This opens the circuit of signal relay **1LAH** at contact **9**, because relay **1WS** is now in disagreement with the switch position, and signal **1LA** is put to stop. One result of this operation is to cause the transmission to the office of a return indication code indicating this change of conditions at the station. A second result is to close back contact **10**, thereby completing the circuit to reverse switch **3**.

When switch 3 is reversed and locked, one result is to close a transmitter starting circuit from terminal 1x over contact 165—165b, back contact 166 of relay 1WD, back contact 169 of relay 1T and lower winding of relay 1H. Contact 150 then closes to start the transmitter in the manner previously described. Furthermore the signal now moves to proceed, the circuit being from terminal 1x, over front contact 8 of relay 1TR, reverse contact 9 of relay 1WS, contact 16—16b, normal contact 17 of relay 1HS, left hand contact 18 of relay 1FS, contact 19—19b, and winding of relay 1LBH, which thus picks up to clear signal 1LB. This return indication code signal will therefore have its 9th impulse long, the circuit for relay 1Z being closed from terminal 1x, over front contact 146 of relay 1TR and contact 164 of relay 1BI, as described hereinbefore. The 10th and 11th impulses will be short, but the 12th will be long, the circuit for relay 1Z being closed from terminal 1x, over contact 165—165b, lower winding of 1WD, front contact 167 of relay 1B4, front contact 161 of relay 1C2, front contact 162 of relay 1J, front contact 158 of relay 1x, and winding of relay 1Z to terminal 1y. When the 12th impulse is transmitted, current in this circuit will energize relay 1WD to move contact 166 to the left, thus opening the starting circuit to prevent repetition of the code. Since signal 1LBH is now clear, the 13th impulse will be long and the 14th and 15th impulses will be short. The circuit for 1Z to prolong the 13th impulse is from terminal 1x, over contact 202—202b, back contact 208 of relay 1RBH, front contact 207 of relay 1LBH, wire 219, upper winding of 1FD, contact 215 of relay 1B5, and thence through contacts 161, 162, and 158 to relay 1Z. Current in this circuit tends to move contact 205 of relay 1FD to the left, to prepare a starting circuit in case traffic direction is reversed. The circuit just traced is provided with a branch which passes from wire 219, through front contact 216 of relay 1B5, contact 227 of relay 1C2, upper winding of relay 1HD to terminal 1y to move contact 189 to the left, provided it had been moved to the right by a preceding code transmission. This prepares a starting circuit available in the event that signal 1LB goes to stop. This code is completed by a 16th long impulse in the usual manner.

When the last mentioned code is received at the office, since the 9th, 12th, and 13th impulses are long, relays OF1, OF4, and OF5 will be picked up. The pick up circuit for relay OF4 is similar to the corresponding circuit for relays OF1 and OF5 previously described and includes front contact 180 of relay OB4. Relay OF4 sticks up over its own contact 228.

During the 16th impulse the operating circuit is closed from terminal Ox, over contacts 35, 196, 197, 172, one branch energizing relay 1TK as already described, and a second branch being closed over front contact 182 of relay OF4, winding of relay 1WK, contact 183 of relay OSI, back contact 184 of relay OF3 to terminal Oy. Current in this branch reverses relay 1WK to close right-hand contact 133, and since relay OWD1 has been reversed in transmitting the control code from the office, this completes a circuit to light reverse switch indication lamp 132 over contacts 133 and 130. Relays OHK1 and OFK1 are also energized to the left as in a previously described code, to light lamp 127, thereby showing that an eastbound signal is

clear, and since lamp 132 is lighted, this is known to be signal 1LB and not signal 1LA.

I will next assume that the operator returns lever 1d to normal, and transmits a code to station No. 1 to restore switch 3 to normal. This code will have its 1st, 2nd, 5th, 11th, 13th, and 16th impulses long and has already been described. The previous code resulted in the reversal of relay 1WD, and therefore when switch 3 is restored to normal, a starting circuit is completed from terminal 1x, over contact 165—165a, reverse contact 166 of relay 1WD, back contact 169 of relay 1T, and the lower winding of relay 1H, to start the transmission of a return indication code which will be the same as that previously described as the result of a train leaving section a—b, the long impulses in this code being the 2nd, 5th, 9th, 11th, 13th, and 16th.

At the office, this code restores relay 1WK to normal, and since relay OWD1 has been restored to normal by the control code impulse sent out, normal indication lamp 131 will be lighted.

It has been shown that the operation of the switch involves the transmission of two return indication codes, first that the signal has been put to stop, and second, that the switch has completed its movement and the signal has cleared, or is at stop, as the case may be. However, in case the line is busy or occupied by the transmission of other code during the 20 or 30 seconds usually required for the switch to operate, and all operations are completed at the station before the line is available, it is evident that but a single return code will be transmitted, thus economizing in the use of the line.

I will now assume that the operator has sent a code to put the signals at station No. 1 at stop by reversing relay 1HS to open contact 17. This closes a starting circuit from terminal 1x over back contacts 185, 186, 187, and 188 of the four signal relays, left-hand contact 189 of relay 1HD, back contact 190 of relay 1T, and the lower winding of relay 1H, to terminal 1y. Relay 1H then reverses to start the transmission of a code from station No. 1, in which code the 2nd, 5th, 9th, 11th, 14th, and 16th impulses will be long. When the 14th impulse of this code is transmitted, a circuit is closed for relay 1Z from terminal 1x, over back contacts 185, 186, 187, and 188 of the signal relays, through the lower winding of relay 1HD, front contact 200 of relay 1B6, contacts 161, 162, and 158, and winding of relay 1Z to terminal 1y. Relay 1Z is then held up to prolong the 14th impulse, and relay 1HD is energized in the reverse direction to close its right-hand contact 189, thereby preparing a starting circuit available when any one of the four signal relays becomes energized.

At the office, the 14th impulse of this code will pick up relay OF6 over contact 229 of relay OB6, and this relay will stick up over its own contact 230, the remainder of the selection being as previously described so that relays OF1, and OF3 are also picked up. During the 16th impulse one branch of the operating circuit is closed from terminal Ox, over back contact 35 of relay OJ, back contact 196 of relay OT, front contact 197 of relay OC2, front contact 172 of relay OB8, front contact 191 of relay OF6, winding of relay OHK1, front contact 192 of relay OSI, back contacts 193, and back contact 201 of relay OF7, to terminal Oy. Relay OHK1 is thereby reversed to close right-hand contact 135. Lamp 129 then is lighted to indicate to the operator that all of

the signals at station No. 1 occupy their stop positions.

With lever 1f on panel No. 1 at the office in its middle position, and with all of the signals at station No. 1 at stop, I will next assume that the operator moves lever 1f to its right-hand position and operates the starting push button OP1 to clear a westbound signal. As shown in the drawing, switch 3 occupies its normal position and when this code is received at the station, relay 1RAH becomes energized. A starting circuit is then closed from terminal 1x, over contact 202-202a, back contact 203 of relay 1LAH, front contact 204 of relay 1RAH, wire 218, normal contact 205 of relay 1FD, back contact 206 of relay 1T, and the lower winding of relay 1H to terminal 1y. Had switch 3 been reversed, relay 1RBH would have been energized and the starting circuit would have been closed over contact 202-202b, back contact 207 of relay 1LBH, front contact 208 of relay 1RBH, to wire 218. In case the last preceding clear signal had been a westbound signal, relay 1FD would have been reversed and the above starting circuit would be open at left-hand contact 205. In this case the transmission is started over a circuit that is completed from terminal 1x, through contact 185 of relay 1LAH to right hand contact 189 of relay 1HD and contact 190 of relay 1T. This circuit is closed if the preceding transmission included the indication of a stop signal. The transmission of the code indicating that a westbound signal is clear opens both the aforesaid starting circuits to prevent repetition. This is accomplished by reversing relay 1FD by current in the circuit from wire 218 lower winding of relay 1FD, and contact 210 of relay 1B7 and thence through relay 1Z to terminal 1y, and by restoring relay 1HD to normal by current in the circuit from wire 218, contact 209 of relay 1B7, contact 227 of relay 1C2, upper winding of relay 1HD to terminal 1y. This return indication code will have long 2nd, 5th, 9th, 11th, 15th, and 16th impulses. At the office the 15th impulse will pick up relay OF7 over contact 211 of relay OB7, and relay OF7 sticks up over its own contact 231. Relays OF1 and OF3 are also energized as previously described. During the 16th or operating impulse a branch will be closed for the operating circuit from front contact 212 of relay OF7 through the winding of relay OFK1, front contact 213 of relay OS1, back contact 214 of relay OF5 to terminal Oy, and a second branch circuit will be closed from front contact 201 of relay OF7, through back contact 193 of relay OF5, front contact 192 of relay OS1, winding of relay OHK1, and back contact 191 of relay OF6 to terminal Oy. Current through these two branch circuits causes contact 135 of relay OHK1 to move to the left and contact 134 of relay OFK1 to move to the right, and since contact 122 of relay OFD1 occupies the right hand position as the result of transmission of the preceding operating code, the circuit of lamp 128 is closed to light lamp 128 and indicate that a westbound signal is clear. Since normal switch indication lamp 131 is also lighted, this is known to be signal 1RA and not 1RB. I will now assume that the operator wishes to change the set-up at station No. 1 from an eastbound main line move as shown in Fig. 3 to a westbound move from the siding to the main line. He then reverses both levers 1d and 1f and operates push button OP1, and sends a code having the 1st, 2nd, 5th, 12th, 15th, and 16th impulses long.

At station No. 1, this code not only causes the reversal of relay 1WS, which puts signal 1LA at stop and reverses the switch, but also causes relay 1FS to reverse, so that when the signal circuit is closed at the completion of the operation of the switch, signal 1RB clears instead of 1LA. This causes the transmission of a return indication code whose long impulses are the 2nd, 5th, 9th, 12th, 15th, and 16th to operate the corresponding indication relays of panel No. 1, and light lamps 132 and 128, thereby indicating that the switch has been reversed and the westbound signal cleared. I will next assume that a train is making the move last provided for, that is, moving west from the siding to the main track, and that the operator wishes to prepare the route for an approaching west bound train, but to hold the latter train at station No. 1. The entrance of the first train into section a-b, has of course caused the transmission of a return code indicating track occupied, switch reversed, and signal at stop, the signal, however being in condition to clear as soon as the train passes point a. The operator now restores lever 1d to normal and moves lever 1f to the middle position, and operates push button OP1 to send a code whose long impulses are the 1st, 2nd, 5th, 11th, 14th, and 16th. This code, at station No. 1, causes contact 9 of relay 1WS to move to the left, and contact 17 of relay 1HS to move to the right. As soon as the first train passes point a, track relay 1TR picks up to energize relay 1K and cause switch 3 to be restored to normal, but the clearing of the signal is now prevented by the open contact 17, so that the following train will be held at signal 1RA. The long impulses of the return indication code in this case will be the 2nd, 5th, 9th, 11th, 14th, and 16th, which code has already been described.

It is evident that there are 6 different codes that can be transmitted from the office to each station; one for each of the three positions of signal lever 1f, with switch lever 1d normal, and one for each of the three positions of signal lever 1f with switch lever 1d reversed, so that every possible train movement at a station can be controlled by the transmission of a single code signal to the station. It is also plain that a return indication of every possible combination of conditions at the remote station can be accomplished with a single code signal.

One important feature of my invention is the use of a single composite code signal to operate all the functions at a selected one of a plurality of stations, or to transmit indications of a plurality of functions from remote stations to a central office by means of a single composite code signal as herein described.

The advantages of the use of a composite code as herein described are threefold; the prime advantage is that a more efficient use of the line circuit is thereby accomplished. In controlling several functions at a station, (in this case, a switch and two opposing signals) the operator is required to send but a single code to perform any or all the operations that he may need to accomplish at one time, without repeating the elements of the code signal which select the particular station. On a busy railroad, if individual codes are used for each function, it may happen that the line is in use constantly, and at times considerable delay in the receipt of return indications may result, particularly if several indications accumulate at each station. By the use of a composite code, the maximum time a station can

monopolize the line to transmit accumulated indications is no greater than the time of transmittal of a single indication, and congestion and delay are thereby avoided. Second, each code sent to a station checks or verifies the position of all devices at the station, and not merely the devices whose position it is desired to change. Likewise, each return indication checks or verifies the position of all indicating devices at the office associated with the station, and not merely the indications that have been changed. A third advantage resides in the elimination of apparatus for storing and sending consecutively a plurality of codes from a station, such as is usually necessary when each code is identified with a particular device or function.

In the apparatus here shown and described I have provided means for checking, or verifying the position of the devices at the remote station without causing the operation of any device at the station. In order to accomplish this result I have provided a recall or check key at the office, designated by the reference character Q. (Fig. 2). When the operator wishes to verify the condition of the apparatus at any station, he first closes the check key Q and then operates the starting push button for the panel corresponding to the station in which he is interested. I will assume, for example, that the operator wishes to verify the condition of apparatus at station No. 1. He therefore operates check key Q and push button OP1. The operation of the push button OP1 picks up relay OH1 and causes the transmission of a code to select station No. 1 and to energize the polarized control relays at that station to agree with the positions of levers 1d and 1f, but in this code the 9th impulse is also a long impulse, a circuit for relay OZ being closed during the 9th impulse from terminal O_z, over front contact 61 of relay OT, front contact 85 of relay OC2, check key Q, front contact 220 of relay OBI, front contact 66 of relay OJ, front contact 67 of relay OX and winding of relay OZ to terminal O_y. Relay OZ therefore becomes energized to prolong the 9th impulse. When the 9th received impulse is prolonged at station No. 1, relay 1J releases to complete a circuit from terminal 1X, over back contact 91 of relay 1J, contact 110 of relay 1C2, contact 111 of relay 1S, contact 221 of relay 1B1, and the lower winding of relay 1H to terminal 1y. This reverses relay 1H to close contact 150 to start the transmission of a return indication code as soon as the pick-up circuit of relay 1T is completed, and this occurs when relays 1KA and 1K close their back contacts at the end of the code being received at station No. 1. This return indication code causes an operating impulse in each of the indication relays of panel No. 1 to put these relays in agreement with the devices at station No. 1.

When a code is being received at either the office or a remote station, the first 15 impulses are used to select the station and the corresponding office panel and to register the functions which are to be performed by that code. The functions are not actually performed, however, until the 16th impulse of the code is received. In effect, therefore, the apparatus counts the total number of impulses in each code and unless this number is equal to 16, the apparatus will not operate. This feature protects the system against errors in the number of impulses in a code, because if the total number of impulses is less than 16 or greater than 16, the final impulse will not cause operation of the apparatus. It

is in order to take advantage of this feature that I have arranged the codes from the office and the remote station to have the same number of impulses, although fewer impulses are actually required in the codes delivered from the office.

If the line circuit remains closed for more than a short interval during the transmission of a code, the receiver is stopped and returns to the starting position. For example, if relay 1R at station No. 1 is energized for more than 0.3 second, relay 1Ka releases, thereby de-energizing all counting relays and placing the apparatus in condition to receive a new code.

If the line circuit remains open for appreciably more than the long open circuit period of the code, the transmission is stopped, and both receiver and sender return to a position ready to start a new when the line is again closed. For example, if relay 1R at station No. 1 remains open 0.2 second relay 1J opens its front contact 91 to de-energize relay 1K, and if the line continues open for say 0.4 second longer, 1K drops to de-energize relay 1T. When the line again closes, 1J and 1K pick up but the circuit of 1T is now open at its front contact 151, therefore 1R remains energized until relays 1Ka and 1K drop consecutively. When 1Ka drops, the apparatus is placed in condition to receive code, and when 1K drops the apparatus is in condition to send code. These features provide protection against the line interference or interruptions, and insure not only against improper operation as the result of line trouble, but also that a correct code signal will be transmitted as soon as a closed line circuit is available, and all stations in condition to receive code.

Another feature of my invention is the arrangement of the apparatus to prevent interference between code signals originating simultaneously at different stations, or at the office and at a station. The first open circuit period of a code signal energizes relays Ka and K at each station, thereby opening the pick-up circuits for relays T at all stations. If the opening of the line is the result of but one T relay picking up, for example, relay 1T at station No. 1, that relay will stick up over its own front contact 151, back contact 94 of relay 1E and the front contacts 95 and 96 of relays 1K and 1Ka, so that station No. 1 will have the exclusive use of the line until its code signal is completed. If the opening of the line is the result of the simultaneous energization of relay 1T at station No. 1 and relay OT at the office, the first impulse will be prolonged and the line held open by the action of relays OZ and OX at the office until relay 1J at station No. 1 drops. This causes relay 1E to be energized, opening at its back contact 94 the stick circuit of relay 1T so that 1T drops. Station No. 1, and likewise any other station on the line, is now in condition to receive code, and since relay OT has not been interfered with, the office has exclusive use of the line until its code signal is completed.

If the opening of the line is the result of the simultaneous energization of the T relays at two stations, the station nearest the office will obtain exclusive use of the line and stop the transmitter of the more remote station until its code signal is completed. For example, when relay 1T picks up, it opens line wire D2 leading to the stations more remote from the office and this portion of the line circuit remains open during the transmission from station No. 1, the portion of the line circuit extending from station No. 1

to the office being completed from line wire D2 through the line relay IR, front contacts 152 and 153, and impedance 154 to portion of the line circuit extending wire D1. The opening of the line to the more remote stations results in stopping either transmission or reception as already described.

If station No. 7 for example, is transmitting, the relays R and the counting relays of any stations between No. 7 and the office will be actuated, but since the first impulse of any code from station No. 7 is short, relays E will not be energized, and hence relay G will not be actuated at any intermediate station.

From the foregoing it is evident that control codes sent from the office take precedence in the use of the line over return indications, as is desirable in view of their relatively greater significance in train operation.

In addition to preventing interference between stations in the use of the line, and in preventing interference between the control levers of an office panel, so that the two levers of a panel may be operated jointly or separately as desired, to transmit a code signal, the apparatus is arranged in such manner as to prevent interference between panels, so that code signals originating simultaneously on several panels will be sent out consecutively and in predetermined order, so that the panel levers may be operated at any time or in any sequence, or several at a time.

Assume for example, that the operator wishes to set up in one operation a route through stations 1, 2, 3, 4, 5, and 6, and that he first operates levers 1d and 1f of panel No. 1 to the desired positions, and immediately follows with the corresponding operation of levers d and f of panels 2, 3, 4, 5, and 6. He then verifies the route set up as he pushes the buttons OP of the six panels so that relays OH1, OH2, OH3, OH4, OH5, and OH6 (Fig. 2) will be picked up. Each of the relays enumerated has a contact 50 in the transmitter starting circuit. The first relay picked up, for example relay OH1, reverses the polarized starting relay OH. This closes contact 51 and energizes relay OT to start the transmission of a code. The starting circuit for relay OH is now open at back contact 49 of relay OT. As already explained, any impulse during which a circuit for relay OZ, or a holding circuit for relay OX, is provided, will be a long impulse, and all other impulses will be short. The first impulse is long, relay OZ pickup up over contact 65 of relay OB1. This picks up relay IE at station No. 1, and the corresponding relay E at all other stations, thereby locking out all master relays except OT. It happens that the second impulse is also long, because when relay OB2 picks up a circuit is closed to hold relay OX energized, over contact 71 of relay OB2, contact 72 of relay OH1 and contact 73 of relay OE. The prolongation of the second impulse picks up the G relays at all stations having jumper 101 connected to the contact of counting relay B2, which is the case at stations 1, 2, 3, and 4 only. At the office, relays OG1 and OL1 pick up and stick. This opens the holding circuit of OE at back contact 59 of relay OL1, and OE drops to de-energize OX to terminate the second impulse. Contact 73 of relay OE is now open and the closed contacts of relays OH1 to OH6 in series therewith are, consequently without effect, so that the 3rd and 4th impulses are short. The selection of group selector relay OG1 at the office, therefore prevents

the selection of any station except one of the four belonging to the same group.

The next long impulse is the 5th, because when OB5 picks up a circuit is closed to hold relay OX energized, over contact 79 of relay OB5, contact 80 of relay OH1 and contact 81 of relay OG1. The prolongation of the 5th impulse picks up the final selector relay S at that station of the first group which has jumper 106 connected to the contact of relay B6, which is, of course, station No. 1. At the office, relay OS1 of panel No. 1 picks up. This picks up relay OL1, which in turn opens the holding circuit of relay OG1, and the latter relay releases to terminate the fifth impulse. Contact 81 of relay OG1 is now open and the closed contacts of relays OH1 to OH6 in series therewith are rendered ineffective. Since the corresponding front contact of relay OG2 is also open, the closed front contacts of OH5 and OH6 are also without effect, so that the 6th, 7th, and 8th impulses are short. The selection of panel relay OS1 at the office therefore prevents the selection of any station except No. 1. With relay OS1 energized, the apparatus in panel No. 1 is now connected to the contacts of relays OB3 to OB7 in series with a contact of OC2 to control impulses 9 to 16 inclusive which govern the operations to be performed at station No. 1. Relay OH1 was de-energized when back contact 47 of relay OS1 opened. During the 16th impulse relay OH is restored to normal to stop the transmission, but as soon as OT drops, relay OH is reversed again, by current over back contact 49 of relay OT and front contacts 50 of relays OH2 to OH6, which are still energized. As soon as relay OKa releases at the end of the code signal, relay OS1 releases, and then relay OK releases to pick up relay OT to start a new transmission in which the station selecting long impulses are determined by relay OH2 and result in the selection of panel No. 2 and station No. 2. This process, manifestly, will continue until all stored code signals have been transmitted in turn to the proper stations.

I will now assume that the operator attempts to send code from panel No. 1 while code is being received and that the sending station happens to be station No. 1. He operates push button OP1 as usual and picks up relay OH1, but if relay OS1 is subsequently energized by the incoming code, it does not drop relay OH1 as is the case when sending, because in this instance the stick circuit of relay OH1 is maintained over the front contact 47 of relay OS1 and back contact 49 of relay OT, so that relay OH1 will be held energized until relay OS1 and relay OT are energized at the same time, that is, until the code signal stored in panel No. 1 is transmitted.

The panel selection just described is an important feature of my invention, not only in the means for selecting but one panel at a time, but particularly in its self checking features whereby the transmission is "locked up" until certain relays drop to insure that the transmitted signal does not contain elements that would permit the selection of more than one station at a time.

In reference to push button OP1, I have shown this as a device entirely separate from levers 1d and 1f, but I do not wish to limit myself to this particular arrangement. Inasmuch as the operation of push button OP1 follows or is coincident with the operation of a lever, its contact may, if preferred, be so arranged that it will be

operated by a lever, preferably in such manner that it will be closed when either lever is moved from any position to any other position. For example, the push button OPI, may be replaced by the usual "lever latch" contact well known in railway signaling, in which case each lever is normally latched in position, and the manual release of the latch preparatory to moving the lever to a new position closes a contact, which contact again opens when the lever is placed in its new position. It is plain that a contact of the type described may be employed for the same purpose as that of push button OPI.

Another advantage of my invention is that most of the contacts on the several relays operate solely as switching contacts, that is, do not break current through a circuit but merely serve to transfer circuits which are afterwards closed and opened by other contacts. The contacts of relays OR, OX, OY, OB, and OJ at the office and corresponding relays at each of the stations are the principal contacts that make and break circuits, and I prefer to connect an asymmetric unit or rectifier, here designated by the reference character *r* in multiple with each relay, in such direction that it offers a high resistance to current flowing from terminal *x* to terminal *y*, and a low resistance to the discharge current of the relay resulting from opening the energizing circuit. These rectifiers prevent arcing at the contact which they protect, and furthermore render the relays across which they are connected somewhat slow acting. One advantage of the use of a rectifier for the purpose of retarding the release of a relay is that the rectifier does not retard the pick-up of the relay but only its release time. For example, the rectifier *r* at the right of relay IJ prevents sparking at the front contact of relay IR due to the discharge of slow release relay IJ and a counting relay Ba in multiple therewith.

Each relay J is designed to have, when energized, a greater inductance than the counting relays, so that when deenergized, its discharge current flows in part through the rectifier and in part through a relay Ba. This effect adds to the release time of relay J, and decreases that of relay Ba which is in accordance with the operating requirements of the circuits.

In explaining my invention, I have assumed a system of a certain size, and a certain arrangement of apparatus, but these features are not essential. For example, to control 20 stations instead of 12, I would employ a counting chain extending from relay B1 to B10, with ten impulses employed for station selection associated in five groups of four stations each, the total number of impulses being 18, or more or less, as convenient. To control a single station having the same number of functions as described, I propose to employ a code of but 9 impulses, eliminating those that I have employed for selection between stations. Furthermore, the B counting chain may for example extend from B1 to B4 and the contacts of each relay be employed in combination with a longer chain of C relays extending from C1 to C4 as in the system of my Patent No. 2,127,691, granted August 23, 1938, to produce the same total of 16 impulses, such variations being possible of accomplishment with facility by changes in relay connections without any change in design or construction of apparatus.

Although I have herein shown and described only one form of remote controlling apparatus embodying my invention, it is understood that

various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. Remote control apparatus comprising two stations connected by a line circuit, means at one station for delivering to said circuit a code signal comprising two groups of impulses of predetermined number, means for selectively controlling certain of said impulses, selecting means at the other station selectively responsive to the relative position of the controlled impulses in one group, a plurality of devices at said other station, and means controlled by the associated selecting means and operating upon the completion of said code signal selectively responsive to the relative position of the controlled impulses in the second group for energizing each of said devices.

2. Railway traffic controlling apparatus comprising a plurality of stations each provided with a plurality of governing devices, a plurality of panels at a control office each comprising indicating devices corresponding to said governing devices, a line circuit connecting said office and all said stations, means effective when the condition of any of said governing devices is changed to transmit to said line circuit a code signal comprising a number of impulses, means responsive to said code for selecting a corresponding panel at the office, and means also responsive to said code for operating each of said indicating devices associated with said selected panel to correspond to the condition of the governing devices.

3. In combination, a central office and a plurality of stations connected by a line circuit, a plurality of panels at the office, one corresponding to each station and each having control levers, a manually controlled starting relay for each panel, means effective when any starting relay is energized to deliver to said line circuit a code signal comprising a number of impulses, certain of which are prolonged depending upon the panel and certain others of which are prolonged depending upon the condition of the levers of such panel, a plurality of devices for each station, selecting mechanism for each station arranged to be operated by certain prolonged impulses in a code originating at the corresponding panel, and means effective when such selecting mechanism is operated, to operate one or more of said devices, depending upon the remaining prolonged impulses in said code.

4. In combination, a central office and a plurality of stations connected by a line circuit, a plurality of governing devices at each station, a plurality of panels at said office one for each station and each having indication devices for registering the condition of the governing devices at the corresponding station, transmitting mechanism for each station, means for setting said mechanism into operation when the condition of any device at such station is changed, means for causing said mechanism to deliver to said line circuit a code signal identifying the condition of all devices at said station, means at the office for registering said code signal, and means for operating each of said indication devices on the corresponding panel in accordance with said code signal.

5. Remote controlling apparatus comprising a plurality of stations each comprising a plurality of devices, a central office provided with a plurality of panels, one for each such station, a

plurality of indication relays for each such panel, a group of registering relays common to all said panels, means responsive to a change in the condition of a device at any station for connecting such station with a corresponding panel at the office, means for subsequently operating said group of registering relays at said office in accordance with the condition of the devices at such station, and means for energizing a plurality of indication relays on such panel in accordance with the position of said registering relays.

6. Remote controlling apparatus comprising a plurality of stations connected by a line circuit, means at one station for delivering to said circuit a code signal comprising impulses of two kinds, a plurality of devices at each station each having two positions, and means operating at one selected station only for simultaneously energizing all of said devices to one position or the other according to the arrangement of said two kinds of impulses in said code signal.

7. Remote controlling apparatus comprising a plurality of stations connected by a line circuit, a plurality of devices at each station, means for delivering to said circuit a code comprising a predetermined number of relatively long and short impulses in two groups, selecting means at each station selectively responsive to a predetermined combination of long and short impulses in the first group, and means at each station effective if the associated selecting means has been operated and actuated by the final impulse of said code for controlling all the devices at such station in accordance with the combination of long and short impulses in the second group.

8. Remote controlling apparatus comprising a plurality of remote stations, a group of devices at each such station, a central office, a plurality of groups of devices at said office, one group for each station, a single line circuit connecting said office with each of said stations, means for transmitting over said line circuit a distinctive code signal to select and actuate one of said groups of remote devices, and means for simultaneously selecting the corresponding office group to cause it to be placed in communication over said line circuit with the group at the selected station.

9. Remote controlling apparatus, comprising a sending station, a receiving station, a line circuit connecting said stations, a plurality of devices at the sending station each having two positions, a plurality of devices at the receiving station each having two positions corresponding to the positions of the associated device at the sending station, and means controlled by a code signal over said line circuit for simultaneously energizing each receiving station device to agree in position with the corresponding station device, each receiving station device being arranged to remain in the selected position when de-energized.

10. A transmitting device for remote control comprising means for transmitting groups of impulses constituting a code signal, means for selecting and modifying one impulse in each group to form the code, and means controlled by each modified impulse to prevent the modification of any additional impulses in the same group.

11. A system of railway traffic route signaling comprising a switch and a plurality of signals at a remote station, a central office, a switch lever and a signal lever at said office, a single line circuit from said office to said station, means for transmitting over said line circuit, a single code signal for clearing or closing a traffic route

over said switch in agreement with the position of said switch lever, in a traffic direction in agreement with said signal lever, and means for transmitting a single code signal for indicating the condition of said route at said office.

12. In combination, a plurality of stations each comprising a railway switch and a plurality of railway signals, a central office, a plurality of panels at said office one for each station and each provided with a switch lever and a signal lever, a single line circuit connecting said office and all said stations, means controlled from each panel for transmitting over said line circuit a single code signal for selecting the corresponding station and for clearing or closing a traffic route over the switch at such selected station in agreement with the position of the corresponding switch lever in a direction in agreement with the position of the corresponding signal lever.

13. In combination, a plurality of stations each comprising a railway switch and a plurality of railway signals, a central office, a plurality of panels at said office one for each station and each provided with a switch lever and a signal lever, a single line circuit connecting said office and all said stations, means controlled from each panel for transmitting over said line circuit a single code signal for selecting the corresponding station and for clearing or closing a traffic route over the switch at such selected station in agreement with the position of the corresponding switch lever in a direction in agreement with the position of the corresponding signal lever, and means at each station for transmitting over said line circuit a single code signal for selecting the corresponding panel at said office and indicating at such panel the condition of the traffic route at such station.

14. Remote controlling apparatus comprising a movable device capable of assuming two positions, a relay having two windings and an armature controlled by such windings and normally in agreement with said device, a line circuit, means operating when said device is moved out of agreement with said armature to transmit a code signal over said line circuit, means responsive to said code signal for energizing a selected winding of said relay to move said armature into agreement with said device, and mechanism controlled by said code signal in accordance with the position of said device.

15. Remote controlling apparatus comprising a plurality of movable control levers, a starting relay having normal and reverse positions, a line circuit, means operating when said starting relay is moved to its reverse position to transmit over said line circuit a code signal the character of which depends upon the conditions of said levers, means including a push button for moving said starting relay to its reverse position, means operating upon the completion of said code signal to restore said starting relay to its normal position, and means selectively controlled in accordance with the character of said code signal.

16. Remote controlling apparatus comprising a plurality of movable control levers, a starting relay having normal and reverse positions, a line circuit, means operating when said starting relay is moved to its reverse position to transmit over said line circuit a code signal the character of which depends upon the conditions of said levers, an additional relay, means including a push button for energizing said additional relay, means controlled by said additional relay for moving said starting relay to its reverse position, means

for subsequently holding said additional relay energized until the completion of said code signal, means operating upon the completion of said code signal to restore said starting relay to its normal position, and means selectively controlled in accordance with the character of said code signal.

17. A transmitting device for remote controlling apparatus comprising means for transmitting groups of impulses constituting a code signal, means for selecting and modifying one impulse in each group to form the code, a bank of relays corresponding to each said group of code impulses, means responsive to the modified impulse of each group to energize a selected relay of the associated relay bank, and means operating when any such relay is energized to prevent the modification of an additional impulse in the corresponding group.

18. A system of centralized traffic control for railroads comprising an office provided with switch and signal levers, a station having a section of railway track provided with a track switch and the signals for governing the movement of traffic over said section, switch and signal stick relays at said station, means for transmitting code messages from the office to the station, means for determining the character of each of said messages according to the position of said switch and signal levers, means responsive to each said message for positioning said switch and signal stick relays according to the character of the message and independently of traffic conditions in said section, means controlled by said switch stick relay for actuating said switch into agreement therewith provided the signals governing traffic over the switch are at stop and said section is unoccupied, and means controlled by said signal stick relays for clearing one or the other of two opposing signals governing traffic in opposite directions over the route determined by the switch position provided only the position of the switch agrees with the position of the switch stick relay, whereby the receipt at the station of a message which causes the switch stick relay to move out of agreement with the switch may be effective to cause a signal at clear to indicate stop, the switch to reverse and a new signal to clear in a single sequence of operations.

19. A centralized traffic controlling system for railroads comprising an office and a plurality of field stations each provided with a railway switch and a plurality of signals governing traffic over such switch, a normally inactive switch control lever and a normally inactive signal control lever, and a momentary contact starting circuit for each station all located at said office; switch stick and signal stick relays at each station for governing the associated switch and signals, means initiated by the momentary closing of any starting circuit for effecting the control of the switch stick and signal stick relays at the corresponding station only, each in accordance with the position of the associated switch and signal levers whereby the control of both the switch and of the signals governing train movements over said switch may be effected at a particular station only, in a single operation.

20. A centralized traffic controlling system for railroads comprising an office and a plurality of field stations each provided with a railway switch and a plurality of signals governing traffic over such switch, a normally inactive switch control lever and a normally inactive signal control lever, and a momentary contact starting circuit for

each station all located at said office; switch stick and signal stick relays at each station for governing the associated switch and signals, means initiated by the momentary closing of any starting circuit for effecting the control of the switch stick and signal stick relays at the corresponding station only, each in accordance with the position of the associated switch and signal levers whereby the control of both the switch and of the signals governing train movements over said switch may be effected at a particular station only, in a single operation, and continuously active intermittently controlled indication means at said office for indicating the condition of each of said switches and signals and of the track sections containing each of said switches, effective upon a change in condition of a switch, signal, or track section to effect an intermittent control of each of said indicating means to provide a continuing control of the condition of such indication means.

21. Apparatus for the remote control of a plurality of associated movable devices, comprising a pair of independent levers each having at least two positions, normally inactive control contacts controlled by each of said levers and closed in each of said positions respectively, an auxiliary circuit for said pair of levers, means for closing said auxiliary circuit momentarily, means effective when said auxiliary circuit is closed momentarily to complete circuits over the closed contacts of said pair of levers to effect the movement of said devices to positions corresponding to the positions then occupied by said levers.

22. Apparatus for the selective control of a plurality of groups of movable devices, comprising a plurality of pairs of independent levers each having at least two positions, normally inactive control contacts controlled by each of said levers and closed in each of said positions respectively, an auxiliary circuit for each pair of levers, means for closing each auxiliary circuit momentarily, means effective when any auxiliary circuit is closed momentarily to complete circuits over the closed contacts of the corresponding pair of levers to effect the movement of the devices in the associated group to positions corresponding to the positions then occupied by said levers.

23. Apparatus for the transmission of a plurality of code signals comprising a plurality of pairs of independent levers each having at least two positions, normally inactive control contacts controlled by each of said levers and closed in each of said positions respectively, an auxiliary circuit for each pair of levers, means for momentarily closing said auxiliary circuits selectively, and means effective when an auxiliary circuit is closed momentarily to complete circuits over the closed control contacts of the associated levers to effect the transmission of a code signal having a distinctive character corresponding to the positions then occupied by such levers.

24. In a remote control system including an office and a plurality of stations, the combination with code transmitters at said office and at each of said stations for creating a series of code elements of selected character, and a receiver associated with each transmitter selectively responsive to said code elements, of means for imparting a particular character to the first element of each code transmitted by the office transmitter, and a different character to the first element of each code transmitted by the station transmitters, whereby each of said sta-

tion receivers is rendered selectively responsive to a code transmitted by said office transmitter, and non-responsive to a code transmitted by another station transmitter, and other means controlled by each transmitter to render its associated receiver non-responsive to codes transmitted by said transmitter, whereby said office receiver is rendered responsive only to codes transmitted by said station transmitters, and said station receivers are rendered responsive only to codes transmitted by said office transmitter.

25. A remote control system comprising a plurality of code transmitters arranged to deliver code signals of similar character to the same line wires each code signal comprising a fixed number of impulses, means for imparting a selected character to a particular impulse of each code signal delivered by one of said transmitters to indicate the place of origin, and to other impulses in accordance with the functions to be performed, receiving means also connected to said line wires responsive to each of said impulses of selected character to perform said functions only when said one transmitter is the place of origin, and the correct total number of impulses has been received.

26. In a remote control system, a line relay, means comprising a series of impulses of selected characters for repeatedly operating said line relay, a series of contacts closed one at a time in sequence by repeated operation of said line relay, a series of stick register relays one for each of a plurality of said contacts, said relays including a plurality of selector relays, means for energizing each register relay when the corresponding contact is closed but only if the impulse then being received is of a particular character, a plurality of devices, and means effective when the final contact of said series is closed provided all of said selector relays have been energized for controlling said devices selectively in accordance with the condition of the remaining register relays.

27. In a remote control system comprising an office and a plurality of stations, a plurality of control panels at the office one for each station, means for transmitting from the office to all said stations any one of a plurality of multiple impulse codes all having the same number of impulses certain ones of which are of selected character, a group of register relays including a station selector relay at each station, a group of register relays at the office including a selector relay individual to each panel, means responsive to the first impulse of said selected character in a code to selectively operate the first register relay at each station, and means responsive to each subsequent impulse of said selected character in the code to selectively operate a register relay at the office and at progressively smaller numbers of stations, the last of said certain impulses in the code causing operation of the station selector relay at one station only and the panel selector relay for the corresponding panel only.

28. In a remote control system comprising an office and a series of stations connected by a line circuit, a combined transmitter and receiver at the office for delivering multiple impulse code signals to said line circuit for operating movable devices at said stations and for receiving code signals from said stations, a combined transmitter and receiver at each station comprising a line relay included in said line circuit, a series

of contacts closed in sequence by consecutive operations of said line relay, a series of register relays controlled by said contacts, a master relay, a transmitter relay, means selectively operated by said register relays when said line relay is operated by a code signal having a first impulse of selected character to operate said movable devices at said station; a pick-up circuit for said master relay including a contact controlled by said line relay, and closed only when said line relay is steadily energized for a predetermined time interval greater than any occurring during the transmission of a code; a holding circuit for said master relay including its own front contact and a back contact of the first register relay of said series; means controlled by said master relay and including said contacts closed in sequence for actuating said transmitter relay to produce code signals in the portion of said line circuit extending from said station to said office; and means controlled by said master relay for producing an impulse of said selected character in the portion of said line circuit extending in the opposite direction to stations more remote from said office; whereby the transmission of a code signal by any more remote station is stopped provided it is started at substantially the same time as the transmission of a code by said first named station.

29. A selector of the counting relay type comprising a line relay, a series of counting relays and a slow release relay, a pick-up circuit for the first counting relay including a reverse contact of the line relay, and a back contact of the slow release relay, a pick-up circuit for the slow release relay including a reverse contact of the line relay and a front contact of the first counting relay, a holding circuit for the slow release relay including a reverse contact of the line relay, and its own front contact; a pick-up circuit for the second counting relay including a normal contact of the line relay, a front contact of said slow release relay and a front contact of the first counting relay; and a pick-up circuit for the third counting relay including a reverse contact of the line relay, a front contact of said slow release relay and a front contact of the second counting relay.

30. A selector of the counting relay type for closing a large number of circuits in sequence, comprising a closed chain of counting relays connected for consecutive operation through repeated cycles in response to the repeated alternate closing of a pair of control contacts, in combination with an open chain of counting relays stepped by the same means as said first chain, different relays of said second chain being maintained energized during each operating cycle of the first chain, and a series of circuits rendered available to be closed consecutively and arranged in groups, each group including all of the contacts of the relays of the first series that are closed consecutively in a complete cycle of operation, each being connected in series with a single contact of the relay of the second group that is energized during said cycle.

31. A code transmitter comprising a transmitter relay having a line contact, a series of contacts closed in sequence in response to repeated operations of said contact to register a sequence of line interruptions comprising a code, a master relay, a device having two positions, a two-position polar stick relay of the permanent magnet type having two windings, a normal and a reverse contact closed in the normal and re-

verse positions of said relay respectively, a normal and a reverse contact closed in the normal and reverse positions of said device respectively, a starting circuit closed over one of said relay contacts and one of said device contacts when said relay and said device disagree in position for energizing said master relay; means controlled by said master relay for energizing said transmitter relay intermittently to interrupt said line; and a code sending circuit including the closed contact of said device, one winding of said polar relay, and a selected one of said series of contacts for selectively modifying the corresponding code element and to simultaneously operate said polar relay into agreement with said device to open said starting circuit, and to prepare an alternate starting circuit to become closed when said device is moved out of agreement with said polar relay.

32. Means for controlling a code transmitter comprising; a plurality of devices each having normal and reverse positions and a pair of contacts one closed in each of said positions, a two-position polar stick relay for each device each having contacts closed in each position, a circuit for starting said transmitter having a plurality of branches, each branch including a device contact and a polar relay contact in series and adapted to be closed to start said transmitter when said device and said relay are in non-agreeing positions, means effective when said transmitter is started to produce a series of code elements, code sending circuits each including the closed contact of one of said pairs and a winding of the corresponding polar relay for operating such relay and for causing a particular element of said code to be of a selected character, thereby identifying the position of each device by the character of the code elements, and at the same time registering said transmission by the movement of each of said relays to a position in agreement to that of the related device, to open said starting circuits.

33. Means for closing a series of contacts consecutively in response to the repeated operation of a control relay having a pair of contacts closed alternately, comprising a series of quick acting counting relays, a pick-up circuit for each of said counting relays all including a contact of the control relay and all except the first including a front contact of the next preceding counting relay; a holding circuit for each counting relay including its own front contact and an asymmetric resistance unit connected in such direction as to provide a low resistance discharge path whereby the current in said relay is caused to continue to flow to maintain such relay energized for a predetermined time after said pick-up circuit is opened; means for closing said pick-up circuits consecutively, and means for closing the pick-up circuit of the first relay effective only during the first operation of said circuit closing means.

34. A selector of the counting relay type comprising a line relay and a series of counting relays, a pick-up circuit for each alternate counting relay each including a contact of the line relay closed when it assumes one position and each except the first including a contact of the next preceding counting relay, a pick-up circuit for each intervening counting relay each including a contact of the line relay closed when it assumes another position and a contact of the next preceding counting relay, and a stick circuit for each counting relay including an asymmetric

resistance unit connected in such direction as to provide a low resistance discharge path whereby the current flowing in said relay continues to flow after the energizing circuit for the relay is opened to hold the relay picked up until the next counting relay is picked up but to release the relay before the second succeeding counting relay picks up.

35. A selector of the counting relay type comprising a line relay and a series of counting relays, an auxiliary relay controlled by said line relay, a pickup circuit for the first counting relay including a contact of the line relay and a contact of the auxiliary relay and arranged to be closed only during the first operation of the line relay, a pick-up circuit for each counting relay except the first each including a contact of the line relay and a contact of the next preceding counting relay, and means for holding each counting relay picked up until the next succeeding counting relay picks up, comprising means for permitting the continued flow of current through the relay due to its inductance after its pick-up circuit is opened.

36. Spark arresting means for a series of relays arranged to be operated in sequence by the alternate closing of a single pair of contacts comprising a single discharge circuit for the inductive energy of alternate relays of said series connected to a front contact of each of said alternate relays, a second discharge circuit for the inductive energy of the intervening relays connected to a front contact of each of said intervening relays, and means for completing one or the other of said circuits through the windings of each of said relays in turn as said relays are energized in sequence.

37. A code receiver comprising a line relay, a series of contacts closed one at a time in sequence by repeated operations of said line relay; a series of register relays for registering selected code elements, comprising a first register relay, a series of group register relays, each controlled by a particular one of said series of contacts in a first group following said first contact and a plurality of series of station register relays, one series for each group register relay, corresponding relays of each series being adapted to be controlled by a particular one of said series of contacts in a second group following said first group; means for energizing and holding said first register relay energized when the first of said series of contacts is closed; means for energizing a group register relay when the corresponding code element is of a selected character and the first register relay is energized, means effective when any group register relay becomes energized to hold such group register relay energized and to release said first register relay to open the pick-up circuits of all group register relays, means for energizing a station register relay when the corresponding code element is of a selected character and the corresponding group register relay is energized; means effective when any station register relay becomes energized to hold such station register relay energized and to release the corresponding group register relay; whereby the pick-up circuits of all station register relays of the same group are opened.

38. A code receiver comprising a line relay, a series of contacts controlled thereby and adapted to be closed one at a time in sequence to register consecutive elements of a code, a series of register relays to register code elements

of selected character, and including a first relay invariably picked up when the first of said series of contacts is closed, a pick-up circuit for each of said register relays, except the first, including
 5 a front contact of a preceding register relay, a holding circuit for each register relay, and means effective when the holding circuit of any register relay, except the first, is closed, for releasing the
 10 preceding relay, whereby each register relay is released, in turn, when the next register relay selected becomes energized.

39. A code transmitter for selectively generating in a line circuit any one of a plurality of codes each consisting of a plurality of groups of
 15 elements, a transmitter relay for repeatedly interrupting said line circuit to produce a series of code elements, means for controlling said transmitter to cause certain elements to be of selected character and for locking said transmitter to
 20 prevent further operation when each of said selected elements is transmitted; associated line receiving means for registering each of said selected code elements; means controlled by said
 25 last named means, and effective when each selected code element is registered to release said locking means to permit said transmitter relay to continue its operation, and to prevent any
 30 additional elements of the same group from having said selected character, and means also controlled by said registering means for determining in part, which element of the next succeeding group shall have said selected character.

40. Code transmitting means for delivering successive code elements to the line wires of a
 35 remote control system comprising a transmitter relay for controlling said line wires, means for operating said transmitter relay intermittently to deliver code elements to said line wires; a plurality of code selecting relays, each of which
 40 when energized is adapted to control said transmitter relay to impart a selected character to certain of said elements, receiving apparatus selectively responsive to the character of each code element, and means controlled by said receiving
 45 apparatus for permitting the transmitter to terminate a code element to which a selected character has been imparted by one of said code selecting relays, provided the code element received corresponds to the code element determined by said code selecting relay, and means
 50 also controlled by said receiving apparatus for preventing the subsequent transmission of any code elements of selected character not agreeing with the code of which said transmitted element of selected character forms a part.

41. Code transmitting means comprising a transmitter for forming code signals comprising groups of impulses, means for causing one impulse in each of a plurality of groups to be of a
 60 particular character, code receiving means associated with said transmitter and operated by said impulses, registering means controlled by said code receiving means for registering each impulse of said particular character, and means
 65 controlled by said registering means when operated by any impulse of a group for preventing any succeeding impulse of the same group from having said particular character.

42. A code transmitter for transmitting selectively any one of a plurality of code signals over
 70 a line circuit, comprising a transmitter for repeatedly interrupting said line circuit, a line relay in said line circuit, a series of contacts closed in sequence by repeated operations of said line relay
 75 to count the consecutive elements of the code, a

plurality of code sending relays one for each code to be transmitted; means including a front contact of any energized code sending relay for starting operation of said transmitter; means including front contacts of each code sending relay
 5 to complete code selecting circuits over certain of said series of contacts to select certain code elements in a particular combination individual to each code sending relay; means acting when any one of said code selecting circuits becomes closed
 10 to stop said transmitter on the corresponding code element; a series of register relays also controlled by said series of contacts, each adapted to register a particular code element; means for actuating one of said register relays selectively
 15 when said transmitter is stopped on its particular code element, means controlled by any register relay when energized to release said transmitter to permit it to resume operation; and means controlled by the final register relay when selectively
 20 energized to complete the code, to release the code sending relay.

43. In combination with a railway switch, a polar stick relay for operating said switch to different positions, a line circuit, means for supplying control codes to said line circuit to govern said
 25 switch, two register relays adapted to be selectively energized in accordance with the characteristics of said codes, a delivery contact adapted to be closed at the conclusion of each code, and a
 30 circuit for operating said polar stick relay in one direction or the other when said delivery contact is closed, said circuit including said delivery contact and a front contact of one or the other of said register relays.

44. In combination, a plurality of railway signals, a plurality of polar stick relays adapted to be operated to different positions to clear said signals selectively, or to cause all of said signals to indicate stop, a line circuit, means for supplying control codes to said line circuit to govern said
 40 signals, a plurality of register relays adapted to be selectively energized in accordance with the characteristics of said codes, a delivery contact adapted to be closed at the conclusion of each code, and circuits for operating each of said polar stick relays in one direction or the other when said delivery contact is closed, the circuit for each of said polar relays including said delivery contact and a front contact of a different one of said register relays.

45. In combination with a line circuit, means for supplying different control codes to said line circuit, a series of stick register relays arranged to be selectively energized in accordance with the characteristics of the control code supplied to said line circuit, a plurality of polar stick relays, a circuit for operating each of said polar stick relays in one direction or the other at the conclusion of each received code, the circuits for each of said polar relays including a front contact of a different one of said register relays and a delivery contact closed only at the conclusion of a complete code, and a plurality of devices selectively controlled by said polar stick relays.

46. In combination, a two position movable device, a control lever for the control of said device, means for indicating the position of said device including a two position polar stick relay adapted to be moved to one position or the other in response to the movement of said device to one position or another, control means for operating said device including said lever and a second two position polar stick relay adapted to be moved to one position or the other in response to the con-
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trol of said device by said lever to cause said device to move to one position or another, an indication lamp energized when both said first and second polar stick relays occupy said one position, and a second indication lamp energized when both of said relays occupy said other position.

47. A code transmitter for transmitting a plurality of codes over a line circuit comprising a line transmitter and receiver, a series of starting relays, one for each code to be transmitted, a series of selector relays one for each starting relay, movable control levers associated with each selector relay, a pick-up circuit for each starting relay including a manually operable key, a holding circuit for each starting relay including a back contact of the corresponding selector relay, means controlled by each starting relay for actuating said transmitter to transmit a distinctive code to said line circuit having selected elements determined by said starting relay, means controlled by said line receiver when actuated by said code to selectively actuate said selector relay to release said starting relay, and means controlled by said selector relay for selectively operating devices at a remote station in accordance with the positions of the control levers associated with such selector relay.

48. In a centralized traffic controlling system for railways, means for selectively transmitting a plurality of code signals over a line circuit comprising a series of manually operable keys, one for each code to be transmitted, a starting relay for each key, means for starting transmission of a code when any starting relay is actuated and the line is clear, means controlled by each starting relay when actuated for selecting a particular code for transmission so arranged that the codes corresponding to a plurality of starting relays actuated simultaneously are transmitted consecutively in predetermined order, a circuit for actuating each starting relay when the corresponding key is operated, line controlled means for registering each transmitted code, and means controlled by such line controlled means for releasing each starting relay at the completion of the transmission of the code determined by such starting relay.

49. A remote control system for transmitting distinctive messages from an office to a station comprising a plurality of similar control panels at said office, each provided with a plurality of control levers, each of said levers having at least two control positions in each of which a distinctive control contact is closed, a key associated with each panel and effective when actuated momentarily to initiate the transmission to said station of a code message having certain characteristics identifying the particular panel containing the operated key, and having other characteristics determined by the closed control contacts of each of the levers of the corresponding panel.

50. In combination, a railway switch, a switch machine for operating said switch, a plurality of signals for governing train movements over said switch, switch control and signal control means adjacent said switch and manually operable from a remote office independently of traffic conditions at said switch, a pair of switch operating relays, circuits for energizing one or the other of said switch operating relays by said switch control means when said signals indicate stop, circuits controlled by each said switch operating relay when energized to operate said switch machine to a position in agreement with said switch control means, a plurality

of signal relays, one for each signal, circuits for energizing one or another of said signal relays by said signal control means and according to the position of said switch when said switch agrees in position with said switch control means, and circuits controlled by each of said signal relays when energized to clear the corresponding signal.

51. In a remote control system, a line relay, means for deenergizing said line relay repeatedly in accordance with a code, receiving means effective when operated to respond selectively to said code; a first slow release relay arranged to be energized when said line relay is deenergized, a second slow release relay arranged to be energized when said line relay is energized; means responsive to the first element of a code and controlled by a back contact of the second slow release relay for initiating the operation of said receiving means, and means controlled by the front contacts of both said slow release relays for completing the operation of said receiving means.

52. A centralized traffic control system for railroads comprising mechanism for the transmission of a plurality of code signals and including a plurality of pairs of independent control levers, each having at least two operative positions, normally inactive control contacts controlled by each of said levers and closed in each of said positions respectively, a manually controlled starting relay for each pair of levers, means effective when said relay is operated for completing a series of code transmitting circuits selectively controlled by the closed contacts of said levers to thereby effect the transmission of a code signal containing a group of elements determined by the position of each of the two levers of the corresponding pair.

53. In combination with a group of four signals for governing train movements in either direction over a two position track switch, a signal control relay for each of said four signals, a series of two position stick relays each adapted to be moved to one position or the other by a momentary impulse and to remain in the position last moved when deenergized, code signaling means for momentarily energizing said stick relays each in accordance with the character of a selecting element of said code and for completing the circuit of a selected one of said signal relays, said circuit including the contacts of all of said stick relays in series, and means effective when such signal relay is energized for clearing the corresponding signal.

54. Code signaling apparatus comprising a transmitter for delivering a series of impulses certain of which are of particular character to a line circuit, stepping means comprising a series of contacts adapted to be closed in sequence to prepare a series of circuits, one for each impulse of said series, a plurality of adjustable circuit connectors each adapted to be included in a selected one of said circuits, means controlled by said circuits for causing said transmitter to deliver impulses of particular character in accordance with the adjustable arrangement of said connectors to produce any one of a plurality of code signals each having a pattern a first portion of which is determined by the particular contact to which each connector is attached, a plurality of movable devices, a second group of circuits each including a contact controlled by at least one of said devices and prepared sequentially by the contacts of said series for caus-

ing said transmitter to deliver impulses of particular character in accordance with the positions of said devices to produce any one of a plurality of codes each having a pattern the second portion of which is determined by the position of each of said devices.

55. Remote controlling apparatus comprising a line circuit, means for delivering a code to said line circuit, a first chain of relays, means responsive to said code for repeatedly energizing the relays of said first chain in succession, a second chain of relays, means controlled by the relays of said first chain for successively energizing the relays of the second chain, different relays of the second chain being energized during different cycles of operation of the first chain, and other relays selectively controlled by the relays of said first and second chains.

56. Remote controlling apparatus comprising a line circuit, a first chain of relays, means for repeatedly energizing the relays of said first chain in succession, a second chain of relays, means controlled by the relays of said first chain for successively energizing the relays of the second chain, different relays of the second chain being energized during different cycles of operation of the first chain, and means controlled by the relays of said two chains for delivering a code to said line circuit.

57. In combination with a line circuit connecting an office with a plurality of stations, a plurality of panels at said office one for each station, a manually controlled lever for each panel, starting means for each panel for initiating the delivery to the line circuit of a control code having a first group of elements which are controlled to select a corresponding station and also having a second group of elements controlled in accordance with the condition of the lever on said panel, a chain of counting relays at each station arranged to be energized in sequence by the impulses of a code supplied to said line circuit, governing means at each station, switching apparatus at each station cooperating with the counting relays at such station for placing the governing means at such station under the control of the second group of impulses of the control code when the impulses of the first group of the code have predetermined characteristics, means set into operation at each such station and controlled by said switching apparatus for delivering to the office an indication code having a first group of impulses identical with the first group of a control code to which such station responds and a second group of impulses controlled in accordance with the condition of said governing means, and means for each panel selectively controlled by the second group of impulses in an indication code if the first group of impulses in such indication code corresponds to the first group of impulses in a control code originating at such panel.

58. In combination with an office and a remote station, governing means at such station, manually controlled means at said office for delivering different control codes to said station for selectively controlling said governing means, a relay at such station arranged to become energized at the conclusion of each such control code, means set into operation when said relay becomes energized to deliver an indication code to said office in accordance with the condition of said governing means, and a stick circuit for

said relay arranged to be interrupted at the conclusion of said indication code.

59. In combination, a chain of relays, means for energizing and deenergizing the relays of said chain one at a time in order through repeated cycles, a first auxiliary relay, means for energizing said first auxiliary relay when the first relay of the chain is first energized, a second auxiliary relay arranged to be energized when the last relay of the chain is energized provided said first auxiliary relay is energized, a third auxiliary relay arranged to be energized after said second auxiliary relay picks up, a stick circuit for said third auxiliary relay arranged to be interrupted after the completion of the second cycle of operation of said chain, and selecting means controlled by the relays of said chain and by said auxiliary relays.

60. Remote controlling apparatus comprising a plurality of stations connected by a normally closed line circuit, means for periodically opening said line circuit to produce a code, a chain of counting relays at each station, means responsive to the first interruption of said line circuit for energizing the first relay in each said chain, means for energizing the second relay in each chain provided the first relay in the corresponding chain is energized and for deenergizing such first relay in each chain when the line circuit is next closed, means operating upon each successive opening or closing of the line circuit to energize a succeeding relay in each chain providing the next preceding relay in such chain is energized, each relay in every chain being deenergized when the succeeding relay in the chain becomes energized.

61. Remote controlling apparatus comprising a line circuit connecting an office and a station, a section of railway track at the station, two signals one for governing traffic in each direction over said section, means for controlling said signals selectively from said office over said line circuit, means effective upon a change in conditions at said station for delivering to said line circuit an indication code having a plurality of impulses certain of which are controlled in accordance with the condition of said section and said signals, and means at the office operated by the final impulse of said code to indicate the condition of each signal and the condition of said track section in accordance with the characteristics of said certain impulses.

62. In a system of remote control, two spaced stations, transmitting means at each station for producing distinctive codes each having a locking element of a character depending upon the station of origin of the code and other elements having their characters determined by conditions at the transmitting station, receiving means at each station selectively responsive to a code from the other station, and means at one station for preventing operation of the associated receiving means if the locking element of the received code does not correspond with the station of its origin.

63. In a system of remote control, two spaced stations, transmitting means at each station for producing distinctive impulse codes each having a locking impulse of a character depending upon the station of origin of the code and other impulses having their characters determined by conditions at the transmitting station, receiving means at each station selectively responsive to a code from the other station, and locking means

at one station for preventing operation of the associated receiving means if the locking impulse of a received code is of the character normally occurring in codes originating at such one station.

64. In a system of remote control, two spaced stations, transmitting means at each station for producing distinctive codes each having a locking element of a character depending upon the station of origin of the code and other elements having their characters determined by conditions at the transmitting station, receiving means at each station selectively responsive to a code from the other station, a locking relay at one said station, means for operating said locking relay only in response to a locking element of the character corresponding to the other said station, and means at said one station controlled by said locking relay for permitting the response of the associated receiving means to a received code.

65. In a remote control system comprising an office and a plurality of stations a line circuit extending from said office through all said stations, a transmitting contact at each station, transmitting apparatus at each station including means for at times shunting the line circuit at such station through the associated transmitting contact and for delivering a single impulse to the portion of the line circuit extending to stations more remote from the office, means for subsequently operating the transmitting contact at such station to deliver to the office over the remaining portion of said line circuit an indication code, comprising a series of code impulses, means at the office for supplying multiple impulse control codes to said line circuit, a locking relay at each station controlled by the first impulse of each control code and also by said single impulse, and means controlled by each locking relay for at times preventing operation of the associated transmitting apparatus.

66. A train dispatching system comprising, a dispatcher's office, a plurality of way stations, a pair of wires connecting said dispatcher's office and said way stations, distinctive code transmitting means at said dispatcher's office, code responsive means at each way station each responsive to a particular code transmitted over said pair of wires from said dispatcher's office, and means controlled by codes originating in said dispatcher's office for at times controlling a traffic controlling device located at a particular way station and at other times controlling an indicator in said office in accordance with traffic conditions at another way station over said pair of line wires.

67. In a control system for power-operated switches, the combination with a power-operated switch, of a control relay for governing its operation, a detector track circuit adjacent the switch, a single line circuit for governing said control relay from a distant point, and means for independently indicating over said line circuit occupancy of said detector track circuit and lack of correspondence between the position of the switch and its control relay.

68. In an interlocking system for railroads, a track switch, a switch machine for operating said track switch, means for controlling said switch machine, signals governing traffic over said track switch, means for manually clearing said signals, means causing said signals to give most restrictive indications upon operation of said means for controlling said switch machine irrespective of said means for manually clearing said signals, means requiring said signals to give most restric-

tive indications before said switch machine can be controlled by said means for controlling said switch machine, and means preventing operation of said means for controlling said switch machine during the passage of traffic over said track switch.

69. In a dispatching system for railroads, a dispatcher's office, a way station, a track switch and signals at said station, control relays at the station for governing said switch and signals to set up different routes over said switch, a stepping circuit connecting the dispatcher's office and the station, a plurality of stepping relays at the station operated sequentially by a series of impulses applied to said stepping circuit, means in the dispatcher's office for changing the character of certain impulses in said series to provide different code combinations of impulses, and means controlled by said stepping relays for selectively governing said control relays in accordance with said different code combinations of impulses.

70. In a dispatching system, a dispatcher's office, a plurality of stations, traffic controlling devices at each station, control means at each station responsive to different code combinations of the same number of current impulses for governing said traffic controlling devices at that station, station selecting means at each station for rendering said control means at that station effective, and means for transmitting from the dispatcher's office to the several stations first a group of current impulses for operating said station selecting means at a particular selected station and thereafter a selected code combination of impulses for controlling the control means at that selected station.

71. In a dispatching system, a dispatcher's office, a way station, a track switch and signals at said station controllable to set up different routes for train movements, a stepping circuit, manually controllable means in the dispatcher's office for applying to said stepping circuit different code combinations of impulses one for each route, and a plurality of control relays at the station selectively responsive to each said code combination of impulses for governing the position of said switch and the indications of said signals to set up the one route corresponding to such code combination.

72. In an operating circuit for a single coil relay having an armature, a source of direct current energy and a circuit closing device, and an electronic valve also in circuit with said relay coil for maintaining said armature in operated position when said circuit is intermittently closed.

73. In an impulsing circuit, a relay, a pair of conductors extending from said relay, a battery, one of said conductors extending to one terminal of said battery; a pair of contacts for intermittently supplying current by way of the other conductor from said battery to the other terminal of said relay to operate the same, and an electronic valve in bridge of said conductors preventing the deenergization of said relay while said contacts are momentarily opened irrespective of the number of times said contacts are opened so long as any period of opening does not exceed the maximum first period which they could have been opened without changing the position of the relay.

74. In combination with a single coil relay, a circuit through the relay coil including a source of operating energy, means for intermittently

closing said circuit, and means for modifying the influence of the intermittently closed circuit on said relay comprising an electronic valve connected across the terminals of said coil.

75. In a relay control arrangement, a relay, an operating circuit for said relay comprising a source of current and a device for producing series of interruptions in said circuit, and auxiliary means permanently connected across the terminals of said relay having a high resistance to the current flow in its operating circuit and a low resistance to current induced in said relay flowing when the operating circuit is interrupted for holding said relay operated during such period.

76. In a train dispatching system, the combination with a dispatcher's office, a station, and a switch and plurality of signals at the station, of relays at the station individually controlling both the operation of the switch and the indications of the signals, a stepping line circuit, means for applying a code of impulses to the stepping line circuit, and means at the station for operating said relays selectively in accordance with the code pattern of the impulses applied to the stepping line circuit.

77. In a train dispatching system, a track circuit, a switch, and a plurality of signals, all located at a station; a plurality of neutral relays at the station; a stepping line circuit; means for applying impulses to said stepping line circuit for energizing said relays sequentially; channel circuits respectively including contacts closed by the energization of different relays of said plurality for indicating the condition of said track circuit, position of the switch, and indications of said signals; and other relays controlled selectively by said neutral relays for controlling the operation of said switch and indications of said signals in accordance with the duration of the respective impulses on the stepping line circuit operating said relays.

78. In a dispatching system for railroads, a dispatcher's office, traffic controlling devices located at a distant station, control levers in the dispatcher's office for governing said traffic controlling devices, a stepping circuit connecting the dispatcher's office and said station, means governed by said control levers for impressing on said stepping circuit any one of a plurality of different code combinations of the same number of current impulses, stepping relays at the station operated sequentially by any one of said code combination of impulses, and control means for the traffic controlling devices at the station including a plurality of control relays having energizing circuits selectively governed by said stepping relays, each control relay being operated differently in accordance with the character of a particular impulse in the code combination of impulses then being applied to said stepping circuit.

79. In a dispatching system, a dispatcher's office, traffic controlling devices located at intervals along the track, a line circuit, means for transmitting over said line circuit alone different code combinations of the same number of impulses, code responsive means at each station for governing the operated conditions of said traffic controlling devices, said traffic controlling devices at different stations along the track being responsive to the same code combinations, and means for selecting the code responsive means at said stations one at a time to respond to the code

combinations then being transmitted over said line circuit.

80. In a dispatching system, a dispatcher's office, a way station, a track switch and signals at said station controllable to set up different routes for train movements, a plurality of control relays at the station each operable to govern both the position of said switch and the indications of said signals to set up only one of said routes, and means for governing said control relays selectively from the dispatcher's office.

81. In a dispatching system, a dispatcher's office, a track switch and signals at a distant point, control levers in the dispatcher's office having different positions for the different positions of said switch and the indications of said signals, a stepping circuit extending from the dispatcher's office to said distant point, means in the dispatcher's office for impressing on said stepping circuit any one of a plurality of different series of current impulses each of said series being determined in accordance with the relative positions of said control levers, a control relay at said distant point for each different series, each control relay corresponding to a route over said track switch, and means governed by each control relay for clearing the one of said signals corresponding to the route to which that control relay is assigned, only when said track switch is aligned for the corresponding route.

82. In a dispatching system for railroads, a dispatcher's office, a way station, a track switch and signals for governing traffic thereover at said way station, a stepping circuit connecting the dispatcher's office and said way station, manually governable means in the dispatcher's office for impressing on said stepping circuit any one of a plurality of different series of current impulses, code responsive means at the field station including a plurality of relays each individually governed in accordance with the character of a particular impulse of each series, and means controlled by each of said relays for operating said track switch and for clearing a signal for a particular route over said track switch.

83. In combination, a control office and a remote station connected by a line circuit; a group of four signals for governing train movements in either direction over a two position track switch, and a signal relay for each of said signals at said station; a switch lever having normal and reverse positions, and a signal lever having left, right, and stop positions at said office; means at said office for transmitting to said station over said circuit a code signal comprising a group of elements controlled in part by the position of said switch lever and in part by the position of said signal lever; means at said station responsive to a code signal from said office for completing the circuit of a selected one of said signal relays; means effective when a signal relay is energized to clear the corresponding signal to permit a train movement over a route through said switch which has been determined by the position of said switch lever in a direction determined by the position of said signal lever.

84. In a train dispatching system of the character described, a dispatcher's office, a plurality of stations, a station selector in the dispatcher's office normally at rest, control levers in the dispatcher's office, a starting relay at each of the several stations, means for automatically initiating the operation of said station selector upon movement of any number of said control levers to a new operated position and also upon opera-

tion of any of said starting relays to a new condition, and means for storing the changed condition of the several operated control levers and the several operated starting relays.

5 85. In a centralized traffic control system for railroads, in combination, a central office, a plurality of stations along the trackway, communication means between the central office and the stations, means for establishing communication
10 between the central office and each one of the way stations in sequence, at least one function control device at each station, means for at times selectively energizing the function control devices at a station after having established communication with such station, and means at the
15 central office for arresting the sequential communication between the central office and each way station at any desired way station and causing repeated sequential energization of the function control devices at such desired way station.

20 86. In a dispatching system for railroads, a dispatcher's office, a plurality of stations, a plurality of traffic controlling devices at each station, control means in the dispatcher's office for the traffic controlling devices at each station, a communication system for establishing operative connections between the traffic controlling devices at the several stations only one station at a time and the corresponding control means in the dispatcher's office, and manually operable
30 means in the dispatcher's office for each station effective so long as operated to maintain such communication between the dispatcher's office and a particular selected station.

35 87. In a system for establishing an operative connection between control levers in a dispatcher's office and control devices located at intervals along the track at a plurality of stations, a stick relay in the dispatcher's office associated with the control levers for each station, communication
40 means normally at rest for operatively connecting the traffic controlling devices at said stations with the corresponding control levers only one station at a time, means for energizing each stick relay, and means for maintaining each stick relay energized until communication has been established between its associated control levers and the traffic controlling devices at the corresponding station irrespective of the number
45 of said stick relays that are energized at any one time.

50 88. In a dispatching system for railroads, a dispatcher's office, a plurality of way stations, control means in the dispatcher's office for each station, including control levers, a starting relay, and a manually operable circuit controller for energizing said relay; station selecting means for establishing communication between the dispatcher's office and the several stations one at a time; and means governed by said station selecting means for maintaining the starting relay for each station energized until that station is selected.

55 89. In a centralized traffic control system for railroads, a dispatcher's office, a plurality of way stations, a selector type communication system for establishing communication between said dispatcher's office and said way stations one station at a time, a starting relay for each way station
60 for causing said selector type communication system to establish communication between the dispatcher's office and its corresponding way station, manually governable means to energize each of said starting relays, and a stick circuit for each of said starting relays closed only until its cor-

responding station has been selected subsequent to its initial energization by said manually governable means, whereby several of said way stations may be selected one at a time and successively upon simultaneous energization of the corresponding starting relays.

90. In a centralized traffic control system for railroads, a dispatcher's office having a plurality of way stations, a selector type communication system for establishing communication between
10 said dispatcher's office and said way stations one station at a time and a group of control levers in the dispatcher's office for each field station, the combination which comprises a starting relay corresponding to each of said groups of levers for initiating said system to select the station corresponding to that group, a manually controlled pickup circuit for each of said starting relays, and a stick circuit for each of said starting relays closed until the corresponding station has been selected.

91. In a centralized traffic control system for railroads, the combination with a plurality of way stations of a control office, a line circuit connecting said control office with said way stations, a plurality of control levers divided into groups corresponding to the stations, and means for selectively rendering said groups of control levers effective one group at a time to determine the character of a plurality of impulses placed on said line circuit, said means including a starting relay, a manually controlled pickup circuit for each of said starting relays, and a stick circuit for each of said starting relays closed only until its corresponding group of control levers have determined the character of a plurality of impulses placed on said line circuit, and means at said way stations responsive to said series of impulses placed upon said line circuit.

92. A selector of the relay type comprising a control relay, a plurality of counting relays arranged in order, a pickup circuit for each counting relay, means controlled by said control relay for closing said pickup circuits in order, a stick circuit for each counting relay controlled by said control relay, and a low resistance snubbing circuit for each counting relay including an asymmetric unit for gradually decreasing the energy in such relay after the opening of the corresponding stick circuit.

93. In a remote control system of the code type, a starting relay, means for energizing said starting relay, code transmitting means set into operation when said starting relay is energized, a second relay controlled by said starting relay and by said code transmitting means, a preliminary stick circuit for said starting relay controlled by said second relay, and another stick circuit for said starting relay controlled by said transmitting means.

94. In a remote control system of the code type, a starting relay, means for energizing said starting relay, code transmitting means set into operation when said starting relay is energized, a second relay arranged to be energized during the operation of said transmitting means, a preliminary stick circuit for said starting relay including a back contact of said second relay, and another stick circuit for said starting relay including a front contact of said second relay and controlled by said transmitting means.

95. In combination with a normally closed line circuit including a line relay, a slow releasing checking relay provided with a circuit including a back contact of said line relay, a chain of count-

ing relays, means requiring said checking relay to be picked up for operating the relays of said chain progressively, and means controlled by said counting chain for repeatedly opening said line circuit to produce a code.

96. In combination with a normally closed line circuit including a line relay, means for repeatedly opening said line circuit to produce a distinctive code, a slow releasing checking relay arranged to be energized each time said line relay is deenergized, a chain of counting relays, means controlled by said line relay in response to said code and effective only if said checking relay remains picked up to operate the relays of said counting chain progressively, and receiving means controlled by said counting chain and selectively responsive to said code.

97. In a centralized traffic controlling system, a control office, a plurality of field stations, a line circuit extending from the control office through the field stations, a plurality of movable devices at each field station, a plurality of stepping relays at each field station operated over said line circuit to control the selection of a particular one of said field stations, and means for again operating said stepping relays at the selected station to control the transmission to the control office over said line circuit of indications of the positions of all of the devices at that station.

98. In a communication system of the synchronous selector type, a control office, a plurality of field stations, step-by-step means at the control office and at each station operated synchronously, station selecting means at each station operated over circuits sequentially closed by said step-by-step means, station registering means at the control office operated over circuits sequentially closed by said step-by-step means, means at the control office and at each station for initiating said step-by-step means, automatic means at each station actuating said station selecting means to select that station and actuating said station registering means to register that station, and lock-out means at each station preventing said automatic means from being effective when some geographically preceding station is being registered in said control office.

99. In a centralized traffic controlling system of the station selective code type, a control office and a plurality of field stations connected by a line circuit, relays in said office corresponding to said stations, a manually operated lever in said office associated with each of said relays, a traffic controlling device at each of said stations, means responsive to the actuation of any one of said levers for operating the associated one of said relays, means responsive to the operation of any one of said relays for applying a characteristic series of impulses to said line circuit, means responsive to each of said characteristic series of impulses for effecting selection of a corresponding station, means controlled by the position of the actuated lever for actuating the traffic controlling device at the selected station, and means for effecting only the application of a preferred series of impulses when more than one of said relays are in their operated positions at the same time.

100. In a centralized traffic control system, means for transmitting indications from a field station to a control office over a single line circuit comprising, means at the control office for energizing said line circuit, means at the field station for opening said line circuit repeatedly at times and to vary the duration of its de-energization in accordance with the indications

to be transmitted, a plurality of polar relays in the control office having contacts which stay where put, and means in the control office responsive to the successive energizations of said line circuit for energizing said polar relays each in accordance with the duration of a different preceding de-energization of said line circuit.

101. A communication system for centralized traffic control having indication responsive means comprising a line circuit, a plurality of polar relays having contacts which remain where set by an energization until changed by a subsequent energization of opposite polarity, stepping relays energized sequentially one at a time in response to repeated de-energization of said line circuit irrespective of the duration of such de-energization, energizing circuits for said polar relays prepared successively by the successive energization of said stepping relays, and means including a slow-acting relay for completing said energizing circuits to energize each of said polar relays in one direction or the other dependent upon the duration of a preceding de-energization of said line circuit.

102. A centralized traffic control system for transmitting indications from a plurality of field stations to a control office comprising, a single line circuit energized from a control office, means at the field stations operable to open the line circuit at predetermined times to vary the duration of the de-energization of said line circuit, a plurality of polar indication relays for each station having contacts which stay where put, a station relay in the control office for each station, energizing circuits for said polar indication relays established only when the corresponding station relay is energized, and means including a slow-acting relay for selectively energizing said station relays one at a time in accordance with the duration of certain de-energizations in said line circuit and for subsequently supplying current of one polarity or the other to said energizing circuits for said polar indication relays in accordance with the duration of other successive de-energizations of said line circuit.

103. In a centralized traffic controlling system for railroads, the combination with a stepping circuit connecting a central office and a plurality of way stations, a series of relays in said central office operated successively in response to a particular code impressed on said circuit, means associated with said series of relays for in response to one distinctive impulse of a code on said stepping circuit dictating the character of the next distinctive impulse on said stepping circuit, and code responsive means at a distant way station responsive to the code so dictated.

104. In a centralized traffic control system for railroads; a track switch; a plurality of signals governing traffic over said track switch; a route storing relay for each of said signals; a control office, a code transmitting means at said control office transmitting impulses of different characteristics; a code receiving means at said track switch including a plurality of code receiving relays each being selectively controlled in accordance with the character of a particular impulse in a series of code impulses received from said control office; means governing said route storing relays in accordance with the composite response of said code receiving relays to a series of code impulses; and a circuit for each of said signals including a front contact on its corresponding route storing relay, said circuits being selected in accordance with the position of said track switch.

105. In a centralized traffic control system for railroads; a central office, a plurality of field stations connected to said control office through the medium of a communication system of the coded type; means in the control office for forming a plurality of code combinations for transmission to the several field stations with each of said code combinations having the same number of impulses, each impulse being selectively marked with one of a plurality of distinctive characters and each code combination differing from every other code combination by the character of at least two impulses; and means at each field station responsive only to said code combinations differing by the character of at least two impulses, whereby a single error in any of said plurality of code combinations is ineffective to produce an undesirable control.

106. In a centralized traffic controlling system for railroads; a control office; a field station; traffic controlling devices at said station; a stepping circuit connecting said office and said station; manually governable means in said office for impressing on said stepping circuit any one of a plurality of series of impulses of invariable number, each of said impulses being selectively marked with one of a plurality of distinctive characters and each of said series differing from each other series in the character of at least two impulses; code responsive means at said station including a plurality of relays each selectively responsive to the character of a particular impulse in said series; and storing means governed in accordance with the composite response of said code responsive means to each of said series of impulses for controlling said traffic controlling devices.

107. In a communication system of the multiple impulse type for controlling railway traffic controlling devices at one station in accordance with the condition of a control means at another station, the combination with a control line circuit connecting two stations, step-by-step means at each station operated in synchronism, means at one station for applying an impulse of distinctive duration to said line circuit during a particular step of said step-by-step means in accordance with the condition of control means at said one station, slow-acting means including a contact at the other station which normally assumes one position and for each impulse of long duration assumes another position, a relay having a polar contact, and a circuit for said relay controlled by the contact of said slow-acting means and energized by current of one polarity only if said contact remains in its normal position and energized by current of the reverse polarity if said contact assumes another position during a particular step of said step-by-step means.

108. In a centralized traffic controlling system, a railroad track switch, signals for governing traffic over said track switch, switch control means for governing movement of said track switch, signal control means for governing the condition of said signals, step-by-step selectively controlled means for indicating when said track switch is in correspondence with said switch control means and said signals are in correspondence with said signal control means, and means for indicating when either said track switch or said signals are out of correspondence with their respective control means.

109. In a centralized traffic controlling system, a railroad track switch, signals indicating clear or stop for governing traffic over said switch in

one direction, switch control means for governing operation of said track switch, signal control means for governing operation of said signals, a route indicator lamp, and means for illuminating said indicator lamp only when said switch is in correspondence with said switch control means and said signals are indicating clear in correspondence with said signal control means.

110. In a centralized traffic controlling system, a railroad track switch, a switch machine for operating said track switch, signals indicating clear or stop for governing traffic over said switch in one direction, a switch control lever for governing operation of said switch machine, a signal control lever for governing operation of said signals, a route indicator lamp, and means controlled by said levers in combination for illuminating said lamp only when said switch is in correspondence with said switch control lever and said signals are indicating clear in correspondence with said signal control lever.

111. In a centralized traffic controlling system, a railroad track switch, a switch machine for operating said track switch, signals indicating clear or stop for governing traffic over said switch in either direction, a switch control lever for governing operation of said switch machine, a signal control lever for governing operation of said signals, a first route indicator lamp and a second route indicator lamp, and means controlled by said levers in combination for illuminating one or the other of said lamps when said switch is in correspondence with said switch control lever and said signals are indicating clear in correspondence with said signal control lever.

112. In a centralized traffic control system for railroads, a dispatcher's office and a way station, a plurality of control levers at said dispatcher's office, a track switch and signals governing traffic thereover at said way station, a plurality of stick relays for governing the different routes over said track switch, step-by-step means at the dispatcher's office and at the way station operated synchronously, a circuit connecting said dispatcher's office with said way station, a bank of code responsive relays at the way station governed in accordance with the position of said levers by impulses placed on said line circuit, and means including said code responsive relays for controlling all of said stick relays simultaneously.

113. In combination with a line circuit, a transmitting contact arranged when opened to interrupt said line circuit, means for periodically operating said contact to supply the line circuit with a code made up of a plurality of elements, a first relay arranged to be energized when such code is supplied to the line circuit but to become deenergized if the line circuit is interrupted for a predetermined time, a second relay arranged to be energized only when said first relay is picked up, manually controlled means for at times preventing said contact from closing until said second relay releases, to prolong certain of said code elements, and governing means selectively controlled by the codes supplied to said line circuit.

114. In a centralized traffic control system for railroads, a power-operated switch machine at a field station, a manually operable control lever in a control office governing said switch machine, indication means in the control office, a communication system of the multiple impulse type including line wires extending from the control office to the field station for operatively connecting said switch machine with said control lever

and also said indication means, said communication system acting to operate said indication means to positions in accordance with the locked position of said switch machine, and means in the control office manifesting lack of correspondence between said control lever and said indication means, said manifesting means being initiated upon movement of said control lever and remaining effective until said indication means is again controlled by said communication system.

115. In a centralized traffic controlling system of the normally at-rest code communication type for transmitting controls and indications between a control office and a field station, a plurality of devices at the field station for receiving controls and having indications to transmit, means at the field station effective to automatically initiate the communication system to transmit the indications of all of said devices from the field station when one of said devices changes its condition, and means at the station rendered effective only in response to a particular control received over the communication system to initiate the communication system for the transmission of indications of all of said devices from that particular station.

116. In a centralized traffic controlling system of the normally at-rest code communication multiple impulse type connecting a control office and a field station, a plurality of devices at the field station having indications to transmit to the control office, means at the field station effective to automatically initiate the communication system to transmit the indications when any one of said devices changes its condition, and means at the field station rendered effective only in response to the composite characteristics of a particular combination of impulses received over the communication system to initiate the communication system for the transmission of indications from that particular field station.

117. In a centralized traffic controlling system of the selector type for railroads, the combination with a central office and a plurality of way stations, a selector circuit connecting said office and way stations, a line relay in said selector circuit at said office and at each way station, means in said central office for intermittently energizing said selector circuit to control apparatus at one of said way stations, and a slow acting relay at said office and at each way station held in its energized condition during each intermittent energization of said selector circuit through the medium of the associated line relay and sufficiently slow dropping to remain in its attracted condition until the next energization of said selector circuit, whereby the energized and deenergized condition of said slow acting relays manifest respectively whether or not said selector circuit is intermittently energized.

118. In a centralized traffic controlling system of the selector type for railroads, the combination with a central office and a plurality of way stations, a selector circuit connecting said office and way stations, a line relay in said selector circuit at said office and at each way station, means in said central office for intermittently energizing said selector circuit to control apparatus at one of said way stations, a slow acting relay at said office held in its energized condition during each intermittent energization of said selector circuit through the medium of the line relay at said office and sufficiently slow dropping to remain in its attracted condition until the next energization of said selector circuit,

whereby the energized and deenergized condition of said slow acting relay manifests respectively whether or not said selector circuit is intermittently energized, a series of counting relays at said office, and an initiating circuit for the control of said counting relays including a contact of said slow acting relay.

119. In a centralized traffic controlling system of the selector type for railroads, the combination with a central office and a plurality of way stations, a selector circuit connecting said office and way stations, a line relay in said selector circuit at said office and at each way station, means in said central office for intermittently energizing said selector circuit to control apparatus at one of said way stations, a slow acting relay at said office held in its energized condition during each intermittent energization of said selector circuit through the medium of the line relay at said office and sufficiently slow dropping to remain in its attracted condition until the next energization of said selector circuit, whereby the energized and deenergized condition of said slow acting relay manifests respectively whether or not said selector circuit is intermittently energized, said system being normally at rest, and an initiating circuit for said system including a contact of said slow relay.

120. An impulse absorbing group of relays for centralized traffic controlling systems for railroads for delivering impulses only after a predetermined number of impulses have been received comprising, a series of stepping relays of the first order, a series of stepping relays of a second order, means interconnecting said relays so that all of said relays of the first order will operate successively for each of the relays of the second order operated, and means for always delivering the impulses as they are received only when a predetermined number of impulses have been absorbed.

121. An impulse absorbing group of relays for centralized traffic controlling systems for railroads for delivering impulses only after a predetermined number of impulses have been received comprising, a series of stepping relays of the first order, a series of stepping relays of a second order, means interconnecting said relays so that all of said relays of the first order will operate successively for each of the relays of the second order operated, means for always delivering the impulses as they are received only after a predetermined number of impulses have been absorbed, and means for establishing message circuits by the impulses delivered.

122. In a centralized traffic controlling system for railroads, a dispatcher's control panel, track signals associated with railroad track sections for governing traffic thereover, corresponding indication devices on said panel illuminated in accordance with the operated condition of said track signals, means for transmitting a code to change the operated condition of one of said track signals, means responsive to the transmission of said code for extinguishing the corresponding panel indication, means for operating the corresponding track signal in accordance with the transmitted code, means responsive to the operation of said track signal for transmitting a return code, and means responsive to said return code for illuminating the panel indication device in accordance with the operated condition of the corresponding track signal.

123. In a centralized traffic controlling sys-

tem for railroads, field stations comprising a plurality of railroad track sections and associated track signals for controlling train traffic thereover, a central office panel having a signal lever for each track signal, a code transmitter associated with said panel, means responsive to the operation of any one of said levers for operating said transmitter to transmit a code corresponding to the operated lever, means in said transmitter for prolonging the first impulse of said code, receiving devices in said field stations, means responsive to said prolonged impulse for conditioning said receiving devices to operatively receive the remaining impulses of said transmitted code, and means in one of said field stations operated by the receiving device therein in response to the receipt of the full transmitted code for operating the track signal corresponding to the transmitted code.

124. In a centralized traffic controlling system for railroads, field stations comprising a plurality of track sections and track signals for governing train traffic thereover, a dispatcher's station including a code transmitter, means for operating said transmitter to transmit a code to said field stations corresponding to one of said track signals, means for prolonging the first impulse of the transmitted code, a combined receiving and transmitting device in each field station, means responsive to said prolonged impulse for conditioning said devices to operatively receive the transmitted code, means in one of said field stations operated by the device therein in response to the receipt of the full transmitted code for operating the track signal corresponding to the transmitted code, means responsive to the operation of said track signal for operating said combined receiving and transmitting device in the corresponding field station to transmit a return code to the dispatcher's station, and means in other field stations operated in response to the transmission of said return code for preventing the operation of said combined receiving and transmitting devices in said other field stations as a receiving or transmitting means during the transmission of said return code.

125. In a centralized traffic controlling system for railroads, a dispatcher's station, a plurality of field stations connected in tandem to said dispatcher's station, a combined receiver and transmitter in each of said stations for receiving and transmitting codes of like character, means responsive to codes transmitted from said dispatcher's receiver and transmitter for operating the combined receiver and transmitter in each of said field stations as a receiver, means responsive to codes transmitted from one field station receiver and transmitter for operating the combined receiver and transmitter in the dispatcher's station as a receiver, and means for preventing the operation of the combined receiver and transmitter in the remaining field stations as either a receiver or a transmitter during the transmission of a code from said one field station.

126. In a centralized traffic controlling system for railroads, a dispatcher's station, a field station connected to said dispatcher's station, track signals associated with said field station for governing train traffic over corresponding track sections, coding apparatus in said field station, means for transmitting codes from said dispatcher's station to said field station to operate said signals, a lock out relay in said coding apparatus operated in response to each code from said dispatcher's

station, means controlled by the operation of said lock out relay for conditioning said coding apparatus to receive said transmitted codes, said coding apparatus thereafter being operated in response to said codes for operating the track signals corresponding to said transmitted codes, a master relay in said coding apparatus, means for operating said master relay in response to the operation of any one of said track signals, means controlled by each operation of said master relay for conditioning said coding apparatus to transmit a code, and means for thereafter operating said coding apparatus to transmit a code to the dispatcher's station corresponding to the track signal operated.

127. In a centralized traffic controlling system for railroads, a dispatcher's station, a field station connected to said dispatcher's station, track signals associated with said field station for governing train traffic over corresponding track sections, coding apparatus in said field station, means for transmitting codes from said dispatcher's station to said field station to operate said signals, a lock out relay in said coding apparatus operated in response to each code from said dispatcher's station, means controlled by the operation of said lock out relay for conditioning said coding apparatus to receive said transmitted codes, said coding apparatus thereafter being operated in response to said codes for operating the track signals corresponding to said transmitted codes, a master relay in said coding apparatus, means for operating said master relay in response to the operation of any one of said track signals, means controlled by each operation of said master relay for conditioning said coding apparatus to transmit a code, means for thereafter operating said coding apparatus to transmit a code to the dispatcher's station corresponding to the track signal operated, and means for preventing the operation of either of said relays in case another field station is transmitting a code to the dispatcher's station.

128. In a supervisory control system; a plurality of substations, a central station having a plurality of operating keys, said keys being individual to the substations; a single signalling channel connecting said stations; a relay chain individual to each of said stations; a transmitting relay at each of said stations having contacts connected to said signalling channel; a receiving relay at each of said stations connected to said channel; transmitting relay controlling means at each station for controlling the operation of the transmitting relay thereat, said means being normally non-operative; means responsive to an operation of a key at said central station for rendering said transmitting relay controlling means thereat operative; said transmitting relay controlling means being thereupon responsive in accordance with the operation of the key to operate said transmitting relay for the transmission of code signals over said line individual to a substation; means whereby the receiving relays and relay chain at said central station and said substations receive the said code to select a substation and make a corresponding selection at the central station; and means controlled jointly by said operated key and said relay chain at the said central station for terminating the transmission of said signals and for rendering said transmitting relay controlling means non-operative.

129. In a supervisory control system; a central station having a plurality of operating keys and associated indication devices; a plurality of sub-

stations; a single signalling channel connecting said stations; a relay chain individual to each of said stations; a transmitting relay at each of said stations having contacts connected to said signalling channel; a receiving relay at each of said stations connected to said channel; transmitting relay controlling means at each station for controlling the operation of the transmitting relay thereat, said means being normally non-operative; means responsive to an operation of a key at said central station for rendering said transmitting relay controlling means thereat operative; said transmitting relay controlling means being thereupon responsive in accordance with the operation of the key to operate said transmitting relay for the transmission of code signals over said signalling channel; means whereby the receiving relay and relay chain at said central station and said substations receive the said code; and means controlled jointly by said operated key and said relay chain at the said office for terminating the transmission of said signals and for rendering said transmitting relay controlling means non-operative; and means at a predetermined substation including the receiving relay and relay chain thereat responsive on receipt of a predetermined code for rendering the transmitting relay controlling means thereat operative to control the transmitting relay for the transmission of a predetermined code over said signalling channel to the central station to operate an indication device thereat.

130. In a supervisory control system; a central office having a plurality of operating keys; a plurality of substations; a single signalling channel connecting said central office and said substations; a relay chain individual to each of said stations; a transmitting relay at the central office and at each substation having contacts connected to said signalling channel; a receiving relay at the central office and at each substation connected to said channel; transmitting relay controlling means at each station for controlling the operation of the transmitting relay thereat, said means being normally non-operative; means responsive to an operation of a key at said office for rendering said transmitting relay controlling means operative; said transmitting relay controlling means being thereupon responsive in accordance with the operation of the key to operate said transmitting relay for the transmission of code signals over said line; means whereby the receiving relay and relay chain at said office and said substations receive the said code; means controlled jointly by said operated key and said relay chain at the said office for terminating the transmission of said signals and for rendering said transmitting relay controlling means non-operative; means at a predetermined substation including the receiving relay and relay chain thereat responsive on receipt of a predetermined code for rendering the transmitting relay and controlling means at such substation operative to control the associated transmitting relay for the transmission of a predetermined code over said signalling channel; and means whereby the relay chain at said predetermined substation and said office are operated in response to said last mentioned code.

131. In a train dispatching system, a source of current, an impulse sender, a receiver responsive to a sequence of successive impulses com-

prising a relay energized during one impulse, a second relay energized during the release of the first relay in the succeeding interval between impulses and held closed for the duration of the interval, and a third relay energized over a contact of the second relay during the release of the second relay in the next succeeding impulse.

132. A remote control system comprising a control station and substations connected by a plurality of conductors including means at the control station for transmitting either of two calling codes to each substation, means responsive at a substation to the first code to transmit two supervisory signals, and means responsive at a substation to the second code to receive a control signal indicating a combination of two desired operations.

133. In a remote control system for transmitting distinctive messages from an office to a station and comprising a plurality of similar control panels at said office, each provided with a plurality of control levers, each of said levers having at least two control positions in each of which a distinctive control contact is closed, the improvement which comprises a key associated with each panel and mechanism responsive to momentary actuation of any key for initiating the transmission to said station of a code message having certain characteristics identifying the particular panel containing the operated key, and having other characteristics determined by the closed control contacts of each of the levers of the corresponding panel.

134. In a remote control system of the type employing codes made up of impulses of different characters arranged in distinctive patterns, receiving apparatus characterized by the combination of a plurality of groups of register relays each relay selectively responsive to the character of a different impulse of said code, a plurality of sets of indicators each set containing an indicator for each group of register relays, means responsive to other impulses of said code for selecting for operation a single one of said sets of indicators, means for selectively operating all of the indicators in the selected set each indicator in accordance with the positions occupied by a plurality of the register relays of the group associated with that indicator, and means for maintaining each indicator in its operated condition after the termination of the code, whereby a comparatively small number of register relays may be governed by successive codes to control one set at a time a comparatively large number of indicators.

135. In a remote control system of the type employing codes made up of impulses of different characters arranged in distinctive patterns, receiving apparatus characterized by the combination of a plurality of register relays each relay selectively responsive to the character of a different impulse of said code, a plurality of receiving devices, means responsive to other impulses of said code for selecting for operation certain of said devices, another relay operated by the last impulse of the code, and means responsive to operation of said other relay for controlling a plurality of the selected devices each in accordance with the positions of a plurality of register relays.

LLOYD V. LEWIS.

CERTIFICATE OF CORRECTION.

Patent No. 2,197,130.

April 16, 1940.

LLOYD V. LEWIS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 21, first column, line 24, claim 18, strike out "the" first occurrence; page 26, first column, line 65, claim 58, strike out the word "remote"; page 29, second column, line 8, claim 90, for "railroads, a dispatcher's office having" read --railroads having a dispatcher's office,--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 4th day of June, A. D. 1940.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.