

Jan. 20, 1953

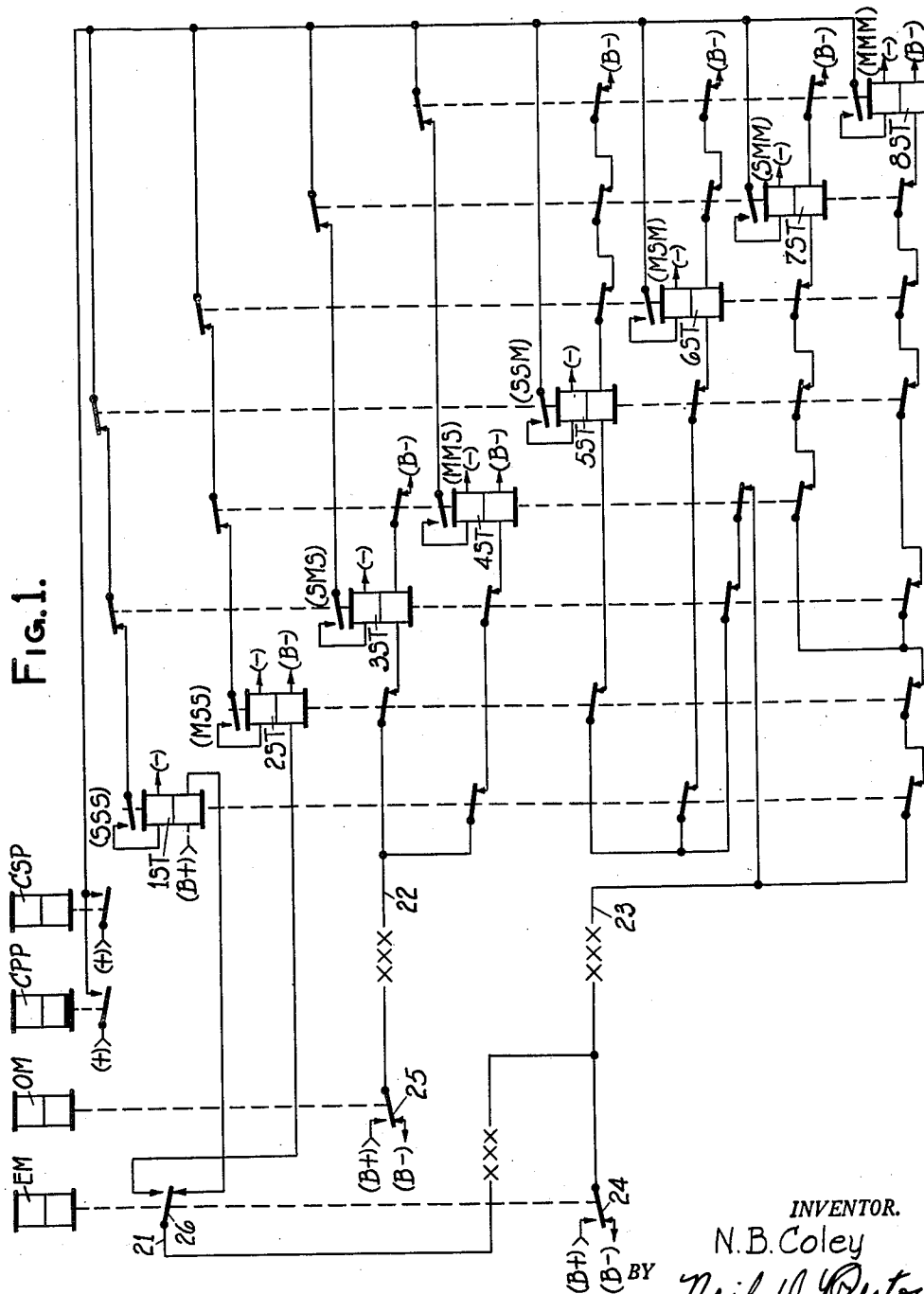
N. B. COLEY
STATION REGISTRATION IN CENTRALIZED TRAFFIC
CONTROL SYSTEM FOR RAILROADS

2,626,383

Filed Aug. 3, 1951

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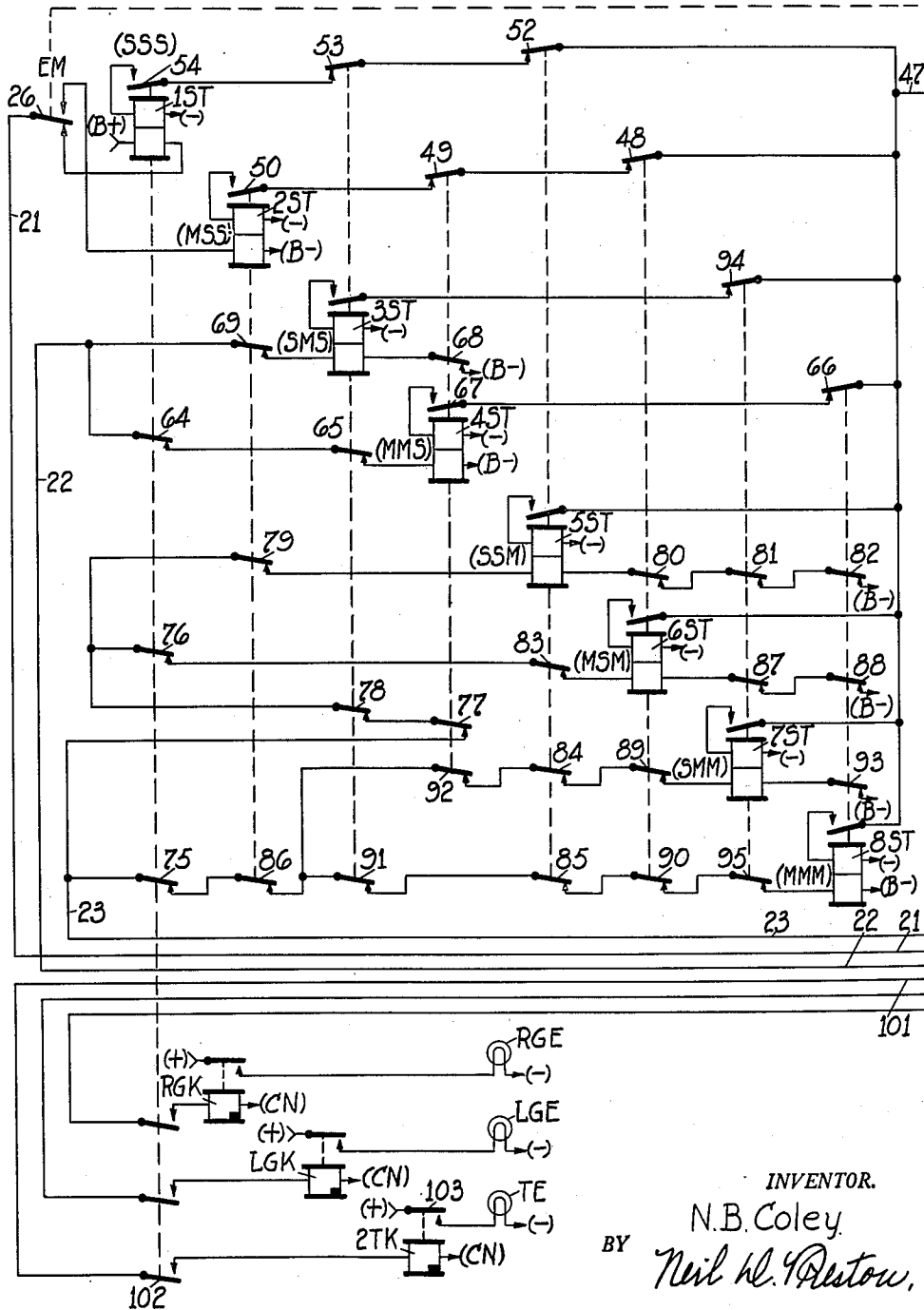
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FIG. 2A.



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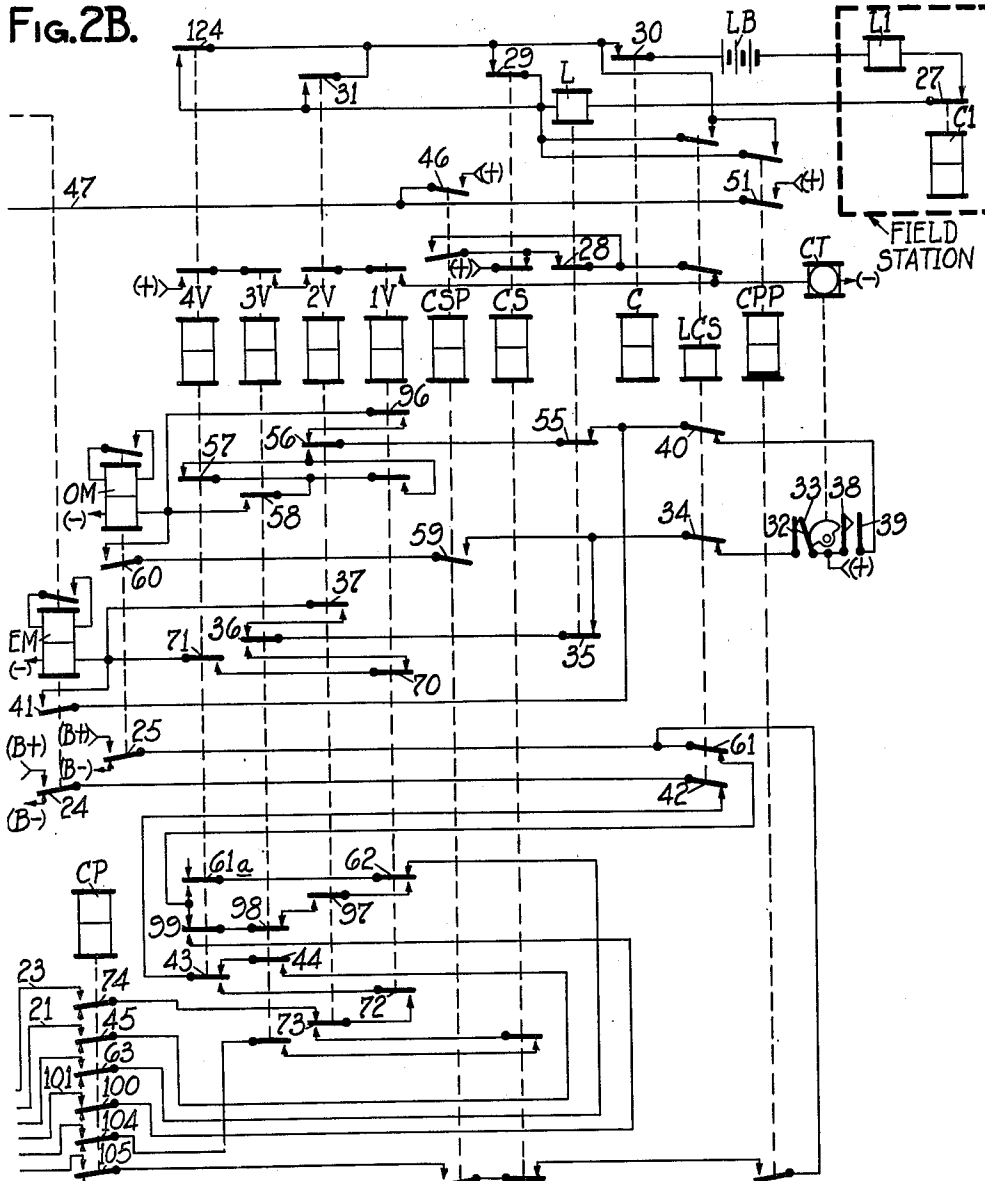
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Fig. 2B.



STATION REGISTRATION CODES			
RELAY	STEP NO. 2	STEP NO. 3	STEP NO. 4
1ST	S	S	S
2ST	M	S	S
3ST	S	M	S
4ST	M	M	S
5ST	S	S	M
6ST	M	S	M
7ST	S	M	M
8ST	M	M	M

Fig. 3.

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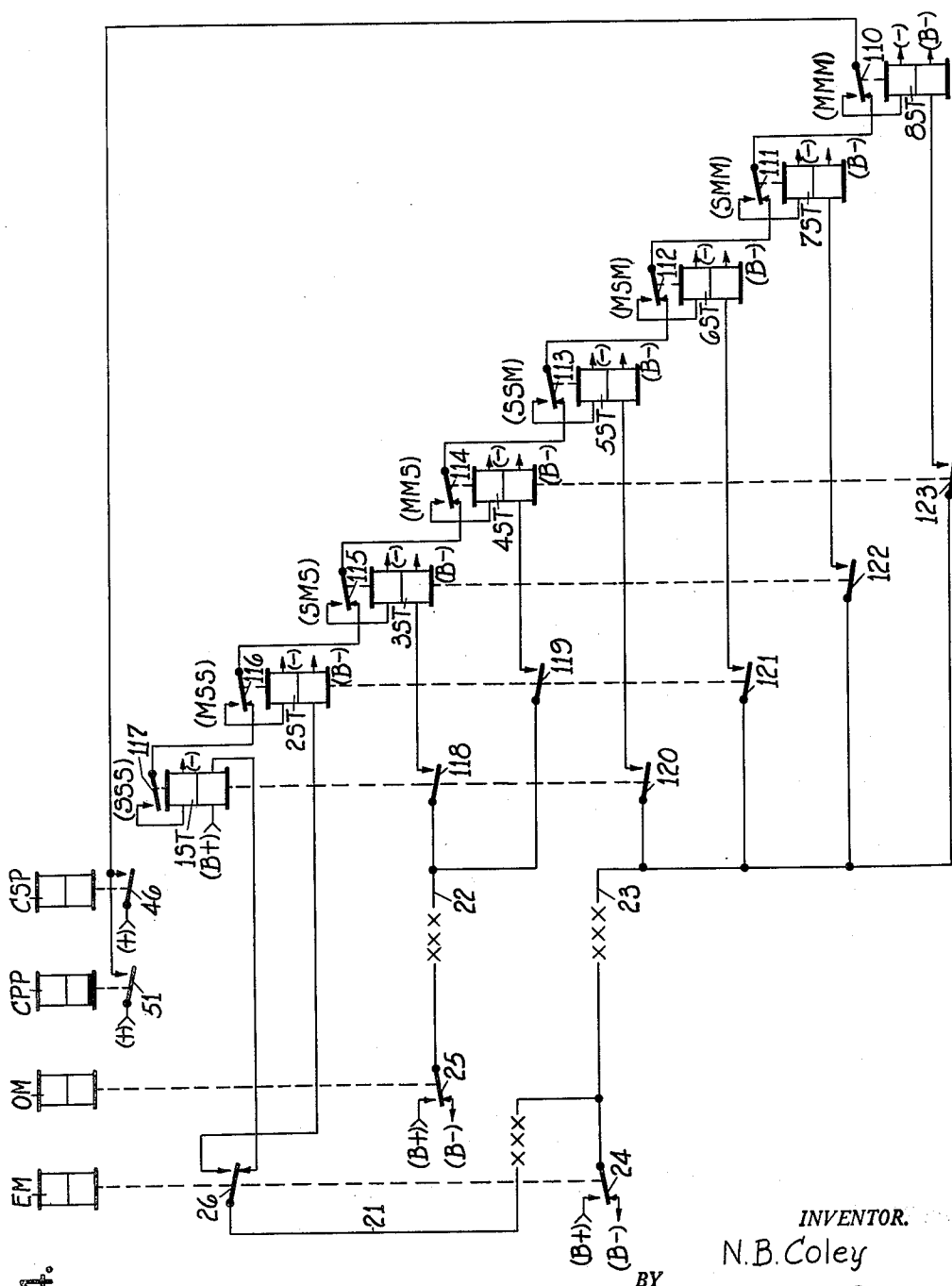


FIG. 4.

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UNITED STATES PATENT OFFICE

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STATION REGISTRATION IN CENTRALIZED
TRAFFIC CONTROL SYSTEM FOR RAIL-
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Application August 3, 1951, Serial No. 240,088

8 Claims. (Cl. 340-147)

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This invention relates to station registration in centralized traffic control systems for railroads, and it more particularly pertains to a system of station registration requiring a minimum number of relays.

It is conventional in most centralized traffic control systems, in the communication of indications from a plurality of indication stations to a control office during separate cycles of operation of a code communication system, to decode the indication registration code at the control office by use of a bank of decoding relays, one decoding relay being used for each character of the indication station registration code.

According to the present invention, however, there is no bank of decoding relays required, but rather the decoding is done accumulatively, so to speak, as the stepping progresses from step to step by a unique circuit organization of the station relays. This circuit organization comprises two station relays assigned to be controlled by the first element of the station registration code, one or the other of these relays being energized, dependent upon the code character that is received. There are also two other station relays assigned to be controlled selectively in response to the second character of the registration code, one or the other of these relays being energized in accordance with whichever relay was energized in response to the preceding character, energization in response to the second element of the registration code being made only provided that a particular predetermined character is received as the second code element. Thus the selection progresses, step by step, each additional step having a number of station relays comparable to the number of station relays that has been associated with all preceding steps, one of these relays being energized as selected by a station relay that may have been energized on a preceding step, but in any case, energization being dependent upon the code element being of said predetermined character. Each time a new station relay is picked up, any prior energized station relay is dropped away, so that there is only one station relay that remains picked up. In this way a single station relay is selected without the use of a bank of decoding relays, irrespective of the number of stations having distinctive registration codes.

An object of the present invention is to reduce the number of relays required for station registration in a centralized traffic control system by eliminating the need for the conventional registration decoding relays that are generally em-

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ployed in centralized traffic control systems at the control office.

Another object of the present invention is to provide a circuit organization for the energization of station registration relays in response to a multiple element code wherein the reception of the code elements in succession is accumulatively effective to determine that the reception of the complete code will result in the sustained energization of only the particular station relay indicative of the particular indication station registration code that is received.

Other objects, purposes, and characteristic features of the present invention will be in part obvious from the accompanying drawings, and in part pointed out as the description of the invention progresses.

In describing the invention in detail, reference is made to the accompanying drawings in which like letter reference characters designate relays having similar functions, preceding numerals being employed in some cases to identify a particular order of association with codes as set forth in a code table, and in which:

Fig. 1 illustrates a simplified organization of station registration relays;

Figs. 2A and 2B when placed side by side illustrate more specifically the organization for station registration according to the system as disclosed in the simplified drawing of Fig. 1;

Fig. 3 is a code table showing the registration codes assigned to the control of respective station relays; and

Fig. 4 illustrates a modified form for control of station relays in response to indication station registration codes.

Conventional schematic diagrams have been used for the disclosure of the system organization in the drawings, such drawings being prepared more particularly to facilitate an understanding of the mode of operation of the system, rather than to attempt to point out the detailed construction and specific arrangement of components that may be provided by those skilled in the art in accordance with the requirements of practice. The symbols (+) and (−) have been used to indicate connections to the respective positive and negative terminals of suitable batteries or other sources of direct current, and the symbols (B+) and (B−) have been used to indicate connections to the respective positive and negative terminals of a suitable split battery, or other source of direct current, having a center tap designated as (CN).

Inasmuch as the present invention is applicable

to different types of code communication systems known in the art, it is considered unnecessary for an understanding of the present invention to disclose the specific code communication apparatus that would be employed in practice for code communication of switch and signal controls from a control office to one or more field stations, and the communication of indications from a plurality of indication stations to the control office. The code communication apparatus can be provided, for example, as disclosed, in the prior application of Coley and Albrighton, Ser. No. 207,253, filed January 23, 1951, as disclosed in my co-pending application, Ser. No. 240,086, filed of even date with the present application, or as disclosed in the Hailes et al. patent, No. 2,399,734, dated May 7, 1946.

The embodiments of the present invention herein disclosed have been particularly adapted for use with the code communication system as disclosed in my co-pending application, Ser. No. 240,086 filed of even date with the present application, and thus the relay contacts of relays identified by letter reference characters but with no circuit shown for the windings of the relays are to be considered as contacts of relays bearing similar letter reference characters in my above mentioned co-pending application, it being considered unnecessary for an understanding of the present invention to show the circuits for all of these relays in this case. Thus the contacts of relays L, CS, CSP, CPP, C, IV, 2V, 3V, 4V, EM, OM, LCS, CP, and the oscillator CT (see Fig. 2B) are of relays provided at the control office having their operations and control circuits substantially the same as specifically described in my above mentioned co-pending application. In addition to these relays which are provided at the control office, the specific circuit organization and functions of the relays C1 and L1 (see Fig. 2B) at the field station are to be assumed as being controlled as fully described in this co-pending application, the relay C1 serving as a transmitter relay for the transmission of indications from the field station to the control office.

The indications to be transmitted from a single field location are assumed to be divided into a plurality of groups, each group being limited to the number of indications that can be transmitted during a single indication cycle of operation of the code communication system. The number of different groups required determines the number of different indication stations that are required to be set up, each indication station having its own distinctive registration code to identify that particular group of indications when received at the control office. Thus there is provided at the control office a station relay ST for each different group of indications, or each different indication station that has been established at the field location for the communication of indications to the control office. The identification of the particular group of indications that is transmitted is by indication station registration code, which comprises as many code characters as are required to distinctively identify all of the different indication stations.

For the embodiments of the present invention herein disclosed, it is assumed that eight different indication stations are required for the communication of a full complement of indications from the field location to the control office, and thus eight station relays ST are provided at the control office for indication station reg-

istration. To select one of these relays by a code transmitted from the field location, a registration code of three characters is required to be communicated to the control office.

Each of the indication channels as used in the communication of indications has a magnetic stick relay at the control office such as the relays RGI, LGI, and TTI which are conditioned in accordance with the code characters received through respective channels of the communication system, provided that their associated indication registration code has been received. These relays in turn have associated therewith normally deenergized indicator lamps RGE, LGE, and TE, the energization of which can be rendered effective in accordance with the indications received from the associated field station.

Having thus considered the general organization of the apparatus, consideration will now be given as to the specific circuit organization when considering typical conditions of operation of the system.

Operation

Before considering the circuit organization specifically, consideration will first be given to the general principles of operation.

In an organization of this kind, the station relays at the control office are assigned respective station registration codes according to the code table of Fig. 3 for as many indication stations as there are to be registered at the control office. Then, for the embodiment illustrated in Fig. 1, the station relays are arranged in a circuit network (see Fig. 1) in the same order as their codes appear in the code table of Fig. 3.

According to the embodiment illustrated in Fig. 1, it is assumed that there are eight indication stations to be registered, and thus eight station relays are provided, such eight relays being selectively governed by a three element code. It is immaterial as to what types of elements are used for code communication, but it is assumed for the embodiments of the invention herein disclosed that the elements are communicated as "marks" or "spaces," but it will be readily apparent that the code elements can be characterized as well by polarity, or by "longs" or "shorts" accordingly. It is therefore provided, as will be more readily apparent as the description progresses, that the relay EM is picked up for each even numbered mark that is received, and the relay OM is picked up for each odd numbered mark that is received, and these relays when picked up are maintained energized during the reception of the next following code element, during which time the local circuits selected by their contacts are energized for the control of station relays ST, or the control of indication relays.

For my code communication system upon which the present disclosure is based, the first step is reserved for lockout purposes between control office and field station transmission, and thus the first character of a registration code is transmitted during the second step, and it is during this time that the relay EM is picked up for the first element of the code if the element is a mark. If the element is a space, the relay EM remains dropped away. It is thus similarly provided that the relay OM is picked up if the second character of the station registration code is a mark, but it is dropped away, or maintained in its deenergized position, if the second character of the station registration code is a space. The third character of the station registration

code is transmitted during the fourth step, and thus the relay EM is either energized, or deenergized at this time in accordance with whether a mark or a space is received.

With reference to Fig. 1, the wires 21, 22, and 23 can be considered as respective first, second, and third channel wires for the respective three elements of the indication station registration code. The relays 1ST and 2ST are associated with the first element of the code because they must be energized from wire 21. The relays 3ST and 4ST are associated with the second element of the code because they must be energized from wire 22, and the relays 5ST, 6ST, 7ST, and 8ST are associated with the third element of the station registration code because they must be energized from wire 23.

The organization is such that the relays 1ST and 2ST are selectively energized in accordance with whether the first element of the registration code is respectively a space or a mark. It will be noted that this is in accordance with the first element of the code for which the respective station relays 1ST and 2ST are provided. That is, the relay 1ST requires the first element to be a space, and the relay 2ST requires the first code element to be a mark.

It will be noted that the energization of the respective channel wires 21, 22, and 23 is by a polarized circuit according to the usual practice for the respective channels for the reception of indications, because these same wires are considered as a part of the channel fan which is also used for the actuation of magnetic stick indication relays in accordance with the polarity applied to the circuit. Thus indication magnetic stick relays and station relays to be controlled by code characters received during even steps are energized through contact 24 of relay EM, and magnetic stick and station relays that are to be controlled by code characters received during odd steps are energized through contact 25 of relay OM.

Of the group of station relays ST illustrated in Fig. 1, for example, the relay 1ST is the only station relay that can be picked up in response to the reception of a space as the character for any element of the registration code. This is true because the polarity of energization of the other station relays ST is such that a positive polarity is required to be applied to the respective channel wires 21, 22, and 23 in order to pick up the respective station relays, and this positive polarity of energization can be applied to these wires only provided that marks are received for the respective associated code elements. This being true, it will be readily apparent that if the last two elements of the three element station registration codes are to be both spaces, there can be no energization of station relays ST responsive to the second and third elements of the code, because of the polarity of energization applied to the wires 22 and 23. Therefore, there can be no opening of the stick circuit for either relay 1ST or 2ST because there can be no higher numbered station relay picked up to open such stick circuits. It is by this mode of operation that the relay 1ST or 2ST is permitted to remain energized as being indicative of the particular station that is to be registered, only one or the other of these relays being selected in accordance with whether the relay EM is picked up or dropped away during the reception of the first element of the three element station registration code. It is for this reason that the relays 1ST and 2ST must be asso-

ciated with the first two codes in the order according to the code table of Fig. 3.

Relays 3ST and 4ST which are governed by the second element of the station registration code are necessarily associated with codes having the second elements as marks, because it has been pointed out that the energization of station relays in response to the reception of second and third elements is only in response to the reception of mark characters. Thus the station registration codes with which the relays 3ST and 4ST are associated both have marks as their second characters and spaces as their third characters, because one of these relays can remain energized for the remainder of the cycle, only provided that no other station relay is picked up on a subsequent step. Therefore the subsequent code element (or code elements) would have to be a space. The first element of the code assigned to the station relay 3ST is a space, while the first element assigned to the station relay 4ST is a mark. If the first element of the station registration code has been a space, the relay 3ST is picked up in response to the reception of a mark for the second element, because the circuit for the relay 4ST has been opened by the picking up of the relay 1ST in response to the first element of the code. In other words, the energization of the relay 3ST or the relay 4ST in response to a mark as the second element is selectively governed in accordance with whether a mark or a space was received as the first element as indicated by whether the relay 1ST or the relay 2ST has been picked up. Therefore the energization of relay 3ST or relay 4ST effectively accumulates the character that has been registered in response to the first element, and after this accumulation is done, the particular relay 1ST or 2ST that had been picked up in response to the first element of the code is dropped away.

In response to the reception of a mark as the third element of the station registration code, a similar mode of operation is accomplished to that which has been described with respect to the operation of the relays 3ST and 4ST, in that one of a group of relays is picked up as selected in accordance with whichever station relay ST has been picked up in response to a preceding element of the code. The circuit organization is such as to permit the energization of only one of the relays 5ST, 6ST, 7ST or 8ST in accordance with the energization of the wire 23. This group of station relays ST must necessarily be associated with station registration codes which have a mark as the third character because these relays can only be energized upon the reception of mark as the third character. The first two elements of the codes assigned to the relays 5ST, 6ST, 7ST, and 8ST will be recognized as being the same as the first two elements of the relays 1ST, 2ST, 3ST, and 4ST, respectively. Thus, the only difference in the codes for the last four station relays ST as compared to the codes of the first four relays ST is that of the last element which is always a space for the first four station relays, is always a mark for the last four station relays. The picking up of any one of the last four station relays is effective to deenergize the particular station relay which would have been energized in response to the reception of a preceding code element, and the deenergization of this relay would leave the particular relay of the last group of four relays energized as the particular relay belonging to the station identified for the reception of indications. It will be noted that there will always be

one of the first four relays picked up prior to the application of energy to the wire 23 in response to the third element of the code, because there is a relay in the first group of four relays which is assigned to each possible code that could have been transmitted as the preceding code elements.

Having thus considered the general mode of operation with reference to the simplified drawing of Fig. 1, consideration will now be given as to the specific circuit organization for providing the above described mode of operation. In describing the specific circuit organization, reference will be made to Figs. 2A and 2B which show specifically the manner in which the organization of station relays ST as shown in Fig. 1 are governed by the code communication system provided according to my co-pending application, Ser. No. 240,086, filed of even date with this application.

With reference to Fig. 2B, the transmission of indication codes during an indication communication cycle from the field station is accomplished by the selective pulsing of the line circuit by the relay C! so as to cause the transmission of selected marks and spaces by the pulsing of contact 27 in the line circuit. The initial opening of the contact 27 causes the release of the line relay L at the control office, and dropping away of this relay initiates the operation of the code oscillator CT by the opening of front contact 23. Thus the operation of the oscillator CT is initiated, which in turn initiates the operation of the stepping relays which are dropped away in turn from their normally energized positions in numerical order. The dropping away of relay 3V to form the third step causes the picking up again of relay 1V so that it can be used over again to form the fifth step. Similarly, the relay 2V is picked up in response to the dropping of relay 4V, and relay 3V is picked up in response to the dropping of relay 1V for the second time, so that there is a partial repeat of the dropping away of the stepping relays in numerical order in order to form the steps 5, 6, and 7 by the dropping away for the second time of the relays 1V, 2V, and 3V.

The control office opens the line circuit upon initiation of an indication cycle by the field station in accordance with the dropping away of the relay CS to open front contact 29. The line circuit is subsequently maintained open until the initiation of the second step, provided that a mark is transmitted as the first character of the indication station registration code. Thus if the relay C! is picked up at this time for the transmission of a mark, the line circuit becomes energized through a circuit extending from the positive terminal of the line battery LB, including front contact 36 of relay C, back contact 31 of relay 2V, winding of relay L, front contact 27 of relay C!, and winding of relay L! to the negative terminal of the line battery LB. Back contact 124 of relay 4V is connected in multiple with back contact 31 of relay 2V to insure continuity of the line circuit through the stepping.

In accordance with the reception of a mark as the first character of the station registration code during the second step, the even step mark relay EM is picked up by the energization of a circuit extending from (+), including contact fingers 32 and 33 of oscillator CT, back contact 34 of relay LCS, front contact 35 of relay L, front contact 36 of relay 3V, back contact 37 of relay 2V, and lower winding of relay EM, to (-). The circuit just described for the relay EM is opened by the opening of front contact 36 of relay 3V

upon initiation of the third step, but the relay EM is maintained picked up by its stick circuit during the third step because this is the time during which energy is applied to the back of station relays ST in accordance with the reception of the first element of the station registration code. This stick circuit extends from (+), including contact fingers 38 and 39 of oscillator CT, back contact 40 of relay LCS, front contact 41 of relay EM, and lower winding of relay EM, to (-).

Because of the relay 2ST (see Fig. 2A) having a mark as the first element of its assigned code, this relay is energized in accordance with the reception of a mark as the first element of the station registration code during the third step of the code communication system. The circuit for the energization of the relay 2ST under these conditions extends from (B+), including front contact 24 of relay EM, back contact 42 of relay LCS, front contact 43 of relay 4V, back contact 44 of relay 3V, front contact 45 of relay CP, wire 21, front contact 26 of relay EM, and lower winding of the station relay 2ST, to (B-).

Relay 2ST when picked up is maintained energized by a stick circuit extending from (+), including front contact 46 of relay CSP, wire 47, back contact 48 of relay SST, back contact 49 of relay 4ST, front contact 50 of relay 2ST, and upper winding of relay 2ST, to (-). The front contact 46 of relay CSP applies energy to this circuit in accordance with that relay having been picked up upon initiation of the cycle as fully described in my above mentioned co-pending application. Relay CSP is maintained picked up throughout the cycle except for a momentary deenergization at the mid-point of the cycle, at which time energy is applied to the stick circuit bus 47 through front contact 51 of relay CPP.

If the first element of the station registration code is a space rather than a mark, the line relay L will be in its dropped away position at the time for energization of the relay EM as has been described, and thus the circuit for the energization of relay EM is open at front contact 35 of relay L so that the relay EM is not picked up. Thus the application of energy to the wire 21 during the third step is through back contact 24 of relay EM, and negative energy is applied to the wire 21 and through back contact 25 of relay EM to the lower winding of relay 1ST. Relay 1ST when picked up is maintained energized from the stick bus 47 through back contact 52 of relay SST, back contact 53 of relay 3ST and front contact 54 of relay 1ST. It will therefore be seen from the circuits that have been described that the relay 1ST is energized upon the reception of a space as the first element of the station registration code as selected by the relay EM being deenergized, and the relay 2ST is picked up in response to the first element of the indication station registration code if such element is a mark so as to cause the relay EM to be picked up.

If the second element of the station registration code is a mark, the relay OM is picked up during the third step of the code communication system by the energization of a circuit extending from (+), including contact fingers 38 and 39 of oscillator CT, back contact 40 of relay LCS, front contact 55 of relay L, back contact 56 of relay 2V, front contact 57 of relay 4V, back contact 58 of relay 3V, and lower winding of relay OM, to (-). Relay OM, when picked up during the third step, is maintained energized during the

fourth step subsequent to the opening of its pick-up circuit at front contact 57 of relay 4V, by a stick circuit extending from (+), including contact fingers 32 and 33 of oscillator CT, back contact 34 of relay LCS, front contact 59 of relay CSP, front contact 69 of relay OM, and lower winding of relay OM, to (-).

In accordance with the relay OM being in its picked up position during the fourth step, energy of a positive polarity is applied to the wire 22 through front contact 25 of relay OM, back contact 61 of relay LCS, back contact 61a of relay 4V, front contact 62 of relay IV and front contact 63 of relay CP. If the relay 2ST (see Fig. 2A) has been picked up because of there being a mark as the first element of the code, the circuit for relay 3ST is open at this time at back contact 69, and thus the relay 4ST is picked up in response to the application of positive energy to the wire 22 through back contact 64 of relay 1ST and back contact 65 of relay 3ST. The picking up of relay 4ST under these conditions establishes a stick circuit providing stick energy from the bus 47 through back contact 66 of relay 8ST and front contact 67 of relay 4ST. The relay 4ST in picking up is effective to cause the release of the relay 2ST by opening its stick circuit at back contact 49, but the closure of back contact 69 of relay 2ST in the circuit for relay 3ST cannot permit the energization of that relay because the circuit for relay 3ST is open at that time at back contact 66 of relay 4ST. Thus it will be seen that the relay 4ST is picked up in response to the transmission of a mark as the second character of the station registration code, provided that the preceding character has been a mark, and the relay 2ST is released as a result of the energization of the relay 4ST having accumulated, so to speak, the information with respect to the first element of the code.

Had the first element of the code been a space, upon the reception of a mark as the second element, the relay 3ST would have been energized in preference to the relay 4ST, because the circuit for the relay 4ST would have been open at back contact 64 of relay 1ST, and the picking up of relay 3ST would have been effective to cause the release of the relay 1ST by opening its stick circuit at back contact 53, but the dropping away of the relay 1ST to close back contact 64 could not effect the picking up of relay 4ST because of the opening of the circuit for relay 4ST at back contact 65 of relay 3ST.

If the third element of the station registration code is a mark, the relay EM is picked up during the fourth step by the energization of a circuit extending from (+), including contact fingers 32 and 33 of oscillator CT, back contact 34 of relay LCS, front contact 35 of relay L, back contact 36 of relay 3V, front contact 70 of relay IV, back contact 71 of relay 4V, and lower winding of relay EM, to (-). Upon the picking up of this relay, a stick circuit is established which has been described, effective to maintain relay EM energized during the fifth step. Thus energy of positive polarity is applied to the wire 23 during the fifth step through front contact 24 of relay EM, back contact 42 of relay LCS, back contact 43 of relay 4V, back contact 72 of relay IV, front contact 73 of relay 2V, and front contact 74 of relay CP. Wire 23 when energized with positive polarity as has been described applies energy to a selected one of the relays 5ST, 6ST, 7ST, or 8ST, in accordance with whichever one of the first four station relays ST remains in its picked

up position after having received the first two elements of the station registration code. If it is the relay 1ST that has been picked up in accordance with the first two elements of the code, the circuit for the relays 7ST and 8ST is open at back contact 75 of relay 1ST, and the circuit for the relay 6ST is open at back contact 76 of relay 1ST; therefore the relay 5ST is the only relay that can be energized under the assumed conditions by the application of positive energization to the wire 23, relay 5ST being energized from wire 23 through back contacts 77, 78, 79, 80, 81, and 82 of relays 4ST, 3ST, 2ST, 6ST, 7ST, and 8ST, respectively. The picking up of relay 5ST under the assumed conditions would cause the dropping away of relay 1ST by opening its stick circuit at back contact 52. The closure of the back contacts 75 and 76 of relay 1ST could not be effective to cause the energization of relays 6ST, 7ST, and 8ST as the circuits for these respective relays have been opened at back contacts 83, 84, and 85, respectively, of relay 5ST.

In a similar manner, if it is the relay 2ST that remains picked up after the first two elements of the registration code have been received, the positive energization of the wire 23 cannot cause the energization of relays 7ST and 8ST because of back contact 86 of relay 2ST being open, and the relay 5ST cannot be picked up because of the back contact 79 of relay 2ST being opened. Thus under these conditions it would be the relay 6ST that would be picked up, this relay being energized by energy feeding from wire 23 through back contacts 77, 78, 76, 83, 87, and 88 of relays 4ST, 3ST, 1ST, 5ST, 7ST, and 8ST, respectively. Relay 6ST in picking up opens the stick circuit for relay 2ST at back contact 48 to cause relay 2ST to be dropped away. Relay 6ST in picking up opens the circuits for the relays 5ST, 7ST, and 8ST at back contacts 80, 89, and 90 respectively so that these relays cannot be energized upon the dropping away of the relay 2ST.

If it is assumed that the relay 3ST is in its picked up position as the result of the reception of the first two elements of the station registration code, the positive energization of the wire 23 cannot apply energy to the relays 5ST and 6ST because of the opening of back contact 78 of relay 3ST, and the relay 8ST cannot be energized because of its circuit being open at back contact 91 of relay 3ST. The relay 7ST, however, would be energized under this condition by energy feeding from wire 23 through back contacts 75, 86, 92, 84, 89, and 93 of relays 1ST, 2ST, 4ST, 5ST, 6ST, and 8ST, respectively. The picking up of relay 7ST opens the stick circuit for relay 3ST at back contact 94, and thus the relay 3ST would be dropped away, but the closure of its back contacts 91 and 78 could not cause the energization of either of the relays 5ST, 6ST, or 8ST because of the circuits for these relays being open respectively at back contacts 81, 87, and 95.

If the first two elements of the station registration code are such as to cause the relay 4ST to be picked up, the energization of the wire 23 with positive polarity in response to the third element of the code being a mark cannot apply energy to the windings of relays 5ST, 6ST, and 7ST because of the back contacts 77 and 92 of relay 4ST being open. Relay 8ST can be energized, however, under these conditions by energy feeding from the wire 23 through back contacts 75, 86, 91, 85, 90, and 95 of relays 1ST, 2ST, 3ST, 5ST, 6ST and 7ST, respectively. The picking up of this

relay opens the stick circuit for relay 4ST at back contact 66, but the closure of back contacts 77 and 92 of relay 4ST cannot cause the energization of any other station relays of the group associated with energization from wire 23 because of the back contacts 82, 88, and 93 of relay 8ST being opened.

Having thus described how any particular one of the eight station relays ST can be selected in response to its assigned station registration code, it should be readily understood by those familiar with the art how various indications associated with the station relays selected can be registered by the selective energization of magnetic stick relays with one polarity or another, dependent upon the particular code character that is received for the associated indication. For a simplification of the drawings for the disclosure of the present invention, only typical magnetic stick indication relays have been shown as being associated with the station relay 1ST, it being considered that it should be readily understood by those familiar with the art that other magnetic stick relays can be controlled in a similar manner by other contacts of relay 1ST and during additional steps of the code communication system in accordance with the number of distinctive indications to be communicated for that particular indication station. Similarly, other banks of indication relays are controlled through front contacts of the respective other station relays according to the requirements of practice.

To consider specifically the reception of a particular indication associated with the station relay 1ST, it will be assumed that a mark is received during the fifth step for the energization of the magnetic stick signal indication relay 2TK with a positive polarity. Thus the relay OM is picked up during the fifth step by the energization of a circuit extending from (+), including contact fingers 38 and 39 of oscillator CT, back contact 40 of relay LCS, front contact 55 of relay L, front contact 56 of relay 2V, back contact 96 of relay 1V, and lower winding of relay OM, to (-). This relay when picked up is maintained energized by a stick circuit that has been described during the sixth step, during which time energy is applied of a positive polarity to control the magnetic stick relay 2TK. The circuit for the energization of relay 2TK under these conditions extends from (B+), including front contact 25 of relay OM, back contact 61 of relay LCS, back contact 61a of relay 4V, back contact 62 of relay 1V (back contact 97 of relay 2V, front contact 98 of relay 3V, back contact 99 of relay 4V, front contact 100 of relay CP, wire 101, front contact 102 of relay 1ST, and winding of the magnetic stick relay 2TK, to (CN). It is assumed that energization of relay 2TK with positive polarity is effective to cause that relay to remain picked up, but if the code element for the control of relay 2TK had been a space, rather than a mark, energy would have been applied through the back contact 25 of relay OM of negative polarity, and the contacts of relay 2TK would have been actuated to their dropped away positions, in which the closure of back contact 103 would have been effective to cause the energization of the track occupancy indicator lamp TE.

Having thus described specifically the mode of operation for the reception of a typical indication assigned to a particular indication station, it should be readily apparent to those skilled in the art that a similar mode of operation is effective for the communication of other indications for

the same and for other indication stations. In accordance with the code communication system of my above mentioned co-pending application, additional indication communication channels are made available by repeating the operation of the stepping relay bank for the second half of the indication cycle, and in accordance with this operation, the relay CP (see Fig. 2B) is dropped away at substantially the midpoint in the cycle, and the shifting of its contacts 74, 45, 63, 100, 104, and 105 connects a new set of indication channel wires to the indication circuit fan so as to cause the operation of a different set of indication relays (not shown), the station relay that was selected during the first half of the indication cycle being maintained picked up for the second half of the indication cycle by the stick circuit that has been described. Thus the respective steps of the second half of the indication cycle can be used exclusively for the communication of respective distinctive indications.

With reference to Fig. 4, another embodiment of the present invention is illustrated for the control of a group of eight station relays ST to which codes are assigned in the same relative order as has been specifically described for the bank of station relays as illustrated in Fig. 1 and in Fig. 2A. The principal difference in the banks of station relays of Figs. 1 and 4 is that the selected energization of the station relays for the respective second and third elements of the station registration code is by front contact selection of the station relays for preceding code elements, rather than by the back contact selections as has been heretofore described. It is further provided that the stick circuits for the station relays ST of Fig. 4 are organized in a chain circuit manner so that the picking up of a higher number station relay is effective to open the stick circuits for all lower numbered station relays. Thus the stick circuit for the station relay 1ST of Fig. 4, for example, is fed by the front contacts 46 and 51 of relays CSP and CFP respectively connected in multiple, and through back contacts 110, 111, 112, 113, 114, 115, and 116 of relays 8ST, 7ST, 6ST, 5ST, 4ST, 3ST, and 2ST, respectively, and through front contact 117 of relay 1ST. Thus it will be seen that the picking up of any one of the relays 2ST to 8ST inclusive, is effective to open the stick circuit for the relay 1ST.

It will be readily apparent that the pickup circuits for the relays 1ST and 2ST of Fig. 4 are the same as has been described for the corresponding relays of Fig. 1 and Fig. 2A, energy being fed through the contacts 24 and 26 of relay EM, and through contact selections indicated in Fig. 4 by "XXX" as corresponding to omitted selections which are shown and have been described with reference to Figs. 2A and 2B.

If the second element of the station registration code is a mark, the wire 22 of the circuit organization of Fig. 4 is energized with positive polarity comparable to the energization of wire 22 of Figs. 2A and 2B, energization being applied through the front contact 25 of relay OM. With positive energy applied to the wire 22, relay 3ST is picked up, if the relay 1ST has been energized to close front contact 112, or relay 4ST is picked up, if the relay 2ST has been energized to close front contact 113. The principles of operation in the selection of these relays will be readily recognized as being substantially the same as that which has been specifically pointed out with respect to the embodiment illustrated in Figs. 1 and 2A.

Similarly, if energy is applied through contact 24 of relay EM to the wire 23 upon the reception of the third element of the registration code, according to the circuit organization of Fig. 4, a selected one of the station relays 5ST, 6ST, 7ST, or 8ST is picked up in accordance with the closure of one or the other of the front contacts 120, 121, 122, or 123 of the relays 1ST, 2ST, 3ST or 4ST respectively. It will be noted that the picking up of any one of the station relays 5ST, 6ST, 7ST or 8ST is effective to cause the dropping away of the prior energized station relay ST by the opening of the chain stick circuit that has been described.

In order to ensure proper pickup of the respective station relays ST, it is desirable that the station relays ST for the embodiment illustrated in Fig. 4 have sufficiently slow dropping away characteristics as to ensure the full picking up of a station relay ST through a front contact of a relay ST to be dropped away as a result of the operation. For example, it is desirable that the relay 7ST of Fig. 4, in opening its back contact 111 when picked up through the front contact 122 of relay 3ST, should not cause the dropping away of the relay 3ST so quickly as to open the pickup circuit for relay 7ST at front contact 122 before the stick circuit for relay 7ST has time to become established through the front contact 111. For this mode of operation, the relays ST of Fig. 4 may not be required to have slow acting characteristics other than the normal operating characteristics of some particular average types of relays that could be used for this purpose.

Having thus described two specific embodiments of the present invention as applied to the control of respective typical groups of station relays, it is to be understood that these forms of the present invention have been described more particularly to disclose the general principles of operation than to limit the number of forms that the present invention may assume; and it is to be further understood that various adaptations, alterations, and modifications may be made to the specific forms shown in accordance with the requirements of practice without departing from the spirit or scope of the present invention, except as limited by the appending claims.

What I claim is:

1. A centralized traffic control system for the code communication to a control office of indications belonging to respective indication stations comprising in combination, normally at rest code communication apparatus including a line circuit connecting the indication stations and the control office and effective when initiated by an indication station to communicate indication codes to the control office, the code formed by the first group of elements transmitted comprising an indication station registration code identifying the particular indication station that is transmitting, a bank of station registration relays at the control office, one station relay being provided for each of the indication stations, and circuit means for selectively energizing said bank of indication station registration relays in accordance with the respective elements of a multiple element station registration code as such elements are received, said circuit means being effective in response to the first element to energize a selected one of a predetermined group of two station relays in accordance with the particular code character that is received, said

circuit means being effective in response to each subsequent element to energize a selected one of a predetermined group of station relays belonging to the associated code element, the selection of the relay to be energized being by a station relay that has been picked up in response to a prior element of the station registration code, and the energization of any station relay in response to an element of the code other than the first being effective only in response to the reception of a particular predetermined character as that element, and said circuit means being effective upon the energization of a station relay to cause the dropping away of any station relay which has been energized in response to a preceding element of the station registration code, whereby the only station relay which remains energized after the reception of the complete station registration code is the relay to which that code is assigned.

2. In a centralized traffic control system for the code communication of indications from a plurality of indication stations respectively to a control office, normally at rest code communication apparatus for communicating indications from the respective indication stations to the control office, the indication codes communicated comprising a first group of elements constituting a selected distinctive station registration code identifying the particular indication station from which indications are to be communicated, a bank of station relays, one station relay for each of said indication stations, a circuit network for the selective energization of the station relays in response to the indication station codes respectively belonging to the associated station, said circuit means being effective to selectively energize one station relay or another of two predetermined station relays in response to the first element of the indication station code in accordance with the code character received as the first element of the station code, said circuit means being effective to energize another indication station relay in response to an element other than the first element of the station registration code, only provided that a particular predetermined character is received as the associated element, the relay energized being selected in accordance with whichever relay has been energized in response to the reception of a preceding element of the station registration code, and stick circuit means for each of the station relays effective to maintain that relay energized until the end of an indication cycle only provided that there is no other station relay picked up in response to a subsequent element of the station registration code.

3. A centralized traffic control system for the code communication of indications from a plurality of indication stations respectively to a control office comprising in combination, normally at rest code communication apparatus effective when rendered active to communicate indications by code from the respective indication stations to the control office during respective indication cycles of operation, the indication codes communicated comprising a first group of elements constituting a selected distinctive station registration code identifying the particular indication station from which indications are to be communicated, a bank of indication station relays, one relay being provided for each indication station, circuit means for energizing each of the indication station re-

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lays in response to an assigned distinctive registration code, said circuit means being effective upon the reception of the first element of a multiple element station registration code to energize one or the other of two of said station registration relays during the following step as selected in accordance with the code character that has been received as the first element, said circuit means being effective upon the reception of the second element of a multiple element station registration code to energize one or the other of another two station relays during the following step as selected in accordance with the particular station relay that has been energized during the next prior step, such energization in response to the second element being effective only provided that the second element is of a particular predetermined character, and stick circuit means for the energization of the station relays effective to maintain each relay energized until the end of an indication cycle only provided that there is no other station relay picked up in response to a subsequent element of the station registration code.

4. In a centralized traffic control system for the code communication of indications of the conditions of various devices from a plurality of indication stations respectively to a control office, normally at rest code communication apparatus effective when rendered active to communicate during respective complete cycles of operation indications indicative of the conditions of various devices associated with respective indication stations, the codes communicated comprising a first group of elements constituting a selected distinctive station registration code identifying the particular indication station from which indication codes are to be communicated during the remainder of the indication cycle, a bank of indication station relays, one indication station relay being provided for each indication station, circuit means for energizing each of the indication station relays in response to an assigned distinctive registration code, said circuit means being effective upon reception of the first element of a multiple station registration code to energize one or the other of two station registration relays during the following step as selected in accordance with the code character that has been received as the first code element, said circuit means being effective upon reception of the second element of the multiple element station registration code to energize one or the other of another two station relays during the following step as selected in accordance with the particular station relay that has been energized during the next prior step, such energization in response to the second element being effective only provided that the second element is of a particular predetermined code character, said circuit means being effective upon the reception of the third element of the multiple station registration code to energize one of a group of four other station relays during the following step as selected in accordance with the particular one of four relays which remains energized in accordance with having been energized in response to a preceding code element, such energization in response to the third element being effective only provided that the third element is of said particular predetermined code character, and stick circuit means for maintaining each of said station relays energized until the end of the indication cycle, only provided that there is no other station relay picked up in response to

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a subsequent element of the station registration code.

5. A centralized traffic control system for the code communication of indications respectively from a plurality of indication stations to a control office comprising in combination, normally at rest code communication apparatus for communication of indications from the respective indication stations to the control office, said code communication apparatus being effective to communicate indication codes preceded by respective multiple element station registration codes identifying the respective indication stations from which the indications are transmitted, odd and even step receiving relays at the control office distinctively conditioned in accordance with the particular code character received during their associated respective odd and even steps, a bank of station relays, one station relay being provided for each of the distinctive indication stations, circuit means for energization of the respective station relays in response to the reception of indication station registration codes respectively belonging to the associated relays, said circuit means being effective to select the energization of one of two relays in response to the first element of the station registration code, dependent upon whether said code receiving relay for the associated step is respectively in its picked up or dropped away position, said circuit means being effective to energize another indication station relay in response to the reception of another element of the station registration code, only provided that said indication receiving relay for the associated step is in a predetermined position, the relay selected for energization being in accordance with whichever one of said station relays has been energized in response to the preceding element of the station registration code, and circuit means for maintaining each of said station relays energized until the end of an indication cycle, only provided that there is no indication station relay picked up upon the reception of a subsequent element of the station registration code.

6. A centralized traffic control system for the code communication of indications respectively from a plurality of indication stations to a control office comprising in combination, normally at rest code communication apparatus effective when initiated into a cycle of operation for the transmission of indications by one of said indication stations to transmit a series of elements forming an indication station registration code identifying the particular indication station from which indications are to be transmitted, an indication station relay for each of the indication stations, circuit means for energization of the respective station relays in response to the reception of indication station registration codes respectively belonging to the associated relays, said circuit means being effective upon the reception of the first element of a station registration code to energize one or the other of a first two station registration relays during the following step as selected in accordance with the code character that has been received as the first code element, said circuit means being effective upon reception of the second element of the multiple element station registration code to energize one or the other of the second two station relays as selected by one of said first two station relays, said circuit means being effective upon the reception of the third element of the multiple element station registration code to energize one of four other sta-

tion relays as selected by whichever one of said first two or said second two station relays is picked up, and a chain stick circuit organization of front and back contacts effective to provide stick circuit energization for said station relays in such a manner as to open the stick circuits upon the picking up of any given station relay for the station relays associated with energization in response to preceding code elements.

7. A centralized traffic control system for the communication of indications of conditions of devices from a plurality of indication stations respectively to a control office, normally at rest code communication apparatus effective when initiated into a cycle of operation for the transmission of indications by one of said indication stations to transmit a series of elements forming an indication station code identifying the station that is transmitting, followed by a series of elements characteristic of the conditions of the devices associated with a particular indication station that is identified by the station registration code transmitted, an indication station relay at the control office for each of the indication stations, circuit means for selectively energizing the respective station relays in accordance with the reception of the distinctive station registration codes for their associated stations, said circuit means being effective upon the reception of the first element of each multiple element station registration code to energize one or the other of the first two station registration relays during the following step as selected in accordance with the code character that has been received as the first element of the station registration code, said circuit means being effective upon reception of the second element of the multiple element station registration code to energize one or the other of a second two station relays as selected by the opening of a back contact of one of said first two station relays in the pickup circuit of one of the second two station relays, and stick circuit means for the respective station relays effective to maintain such station relays energized only until another station relay is picked up, or until the end of the cycle of operation of the code communication apparatus.

8. In a centralized traffic control system for the

code communication of indications of conditions of devices associated with respective indication stations to a control office, normally at rest code communication apparatus effective when initiated into a cycle of operation for the transmission of indications by one of said indication stations to transmit a series of code elements forming an indication registration code identifying the particular indication station that is transmitting followed by a series of elements characteristic of the conditions of devices associated with the particular station identified by the station registration code, an indication station relay at the control office for each of the indication stations, circuit means for selectively energizing the respective station relays in accordance with the reception of the distinctive station registration codes for their associated stations, said circuit means being effective upon the reception of the first element of each multiple station registration code to energize one or the other of a first two station relays during the following step as selected in accordance with the particular code character that has been received as the first code element, said circuit means being effective upon reception of the second element of the multiple element station registration code to energize one or the other of a second two station relays as selected by the closure of a front contact of one of said first two station relays in the pickup circuit of one of the second two station relays, and stick circuit means effective to maintain each of said station relays energized when picked up for the remainder of the cycle of operation of the code communication system provided that no other station registration relay is picked up during a subsequent step of the same cycle of operation of the code communication system.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,074,423	Peterman	Mar. 23, 1937