Nov. 13, 1962 C. JACHINO 3,064,126

CENTRALIZED TRAFFIC CONTROL SYSTEM FOR RAILROADS

Filed May 20, 1957 6 Sheets-Sheet 1

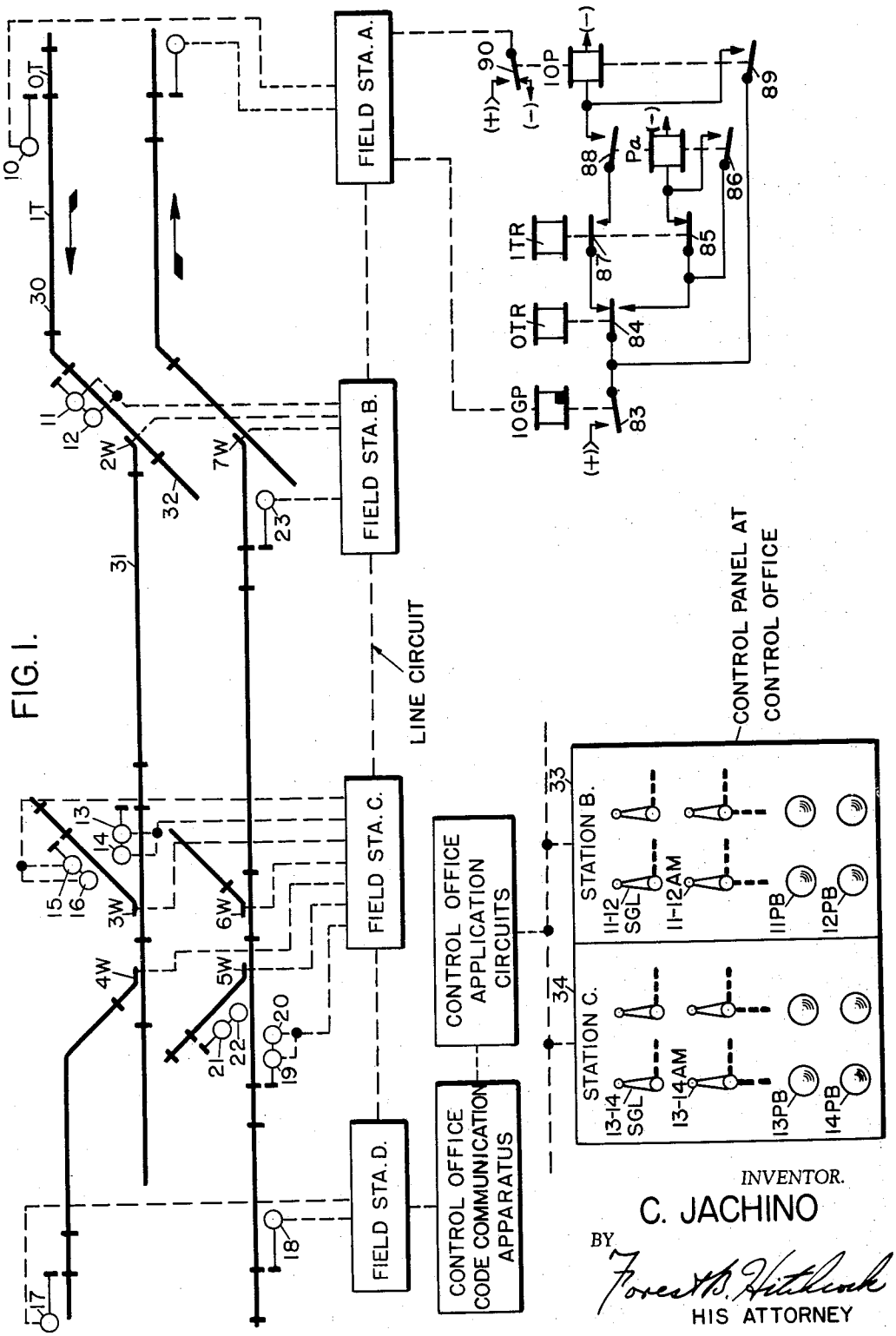



FIG. 1.

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CENTRALIZED TRAFFIC CONTROL SYSTEM FOR RAILROADS

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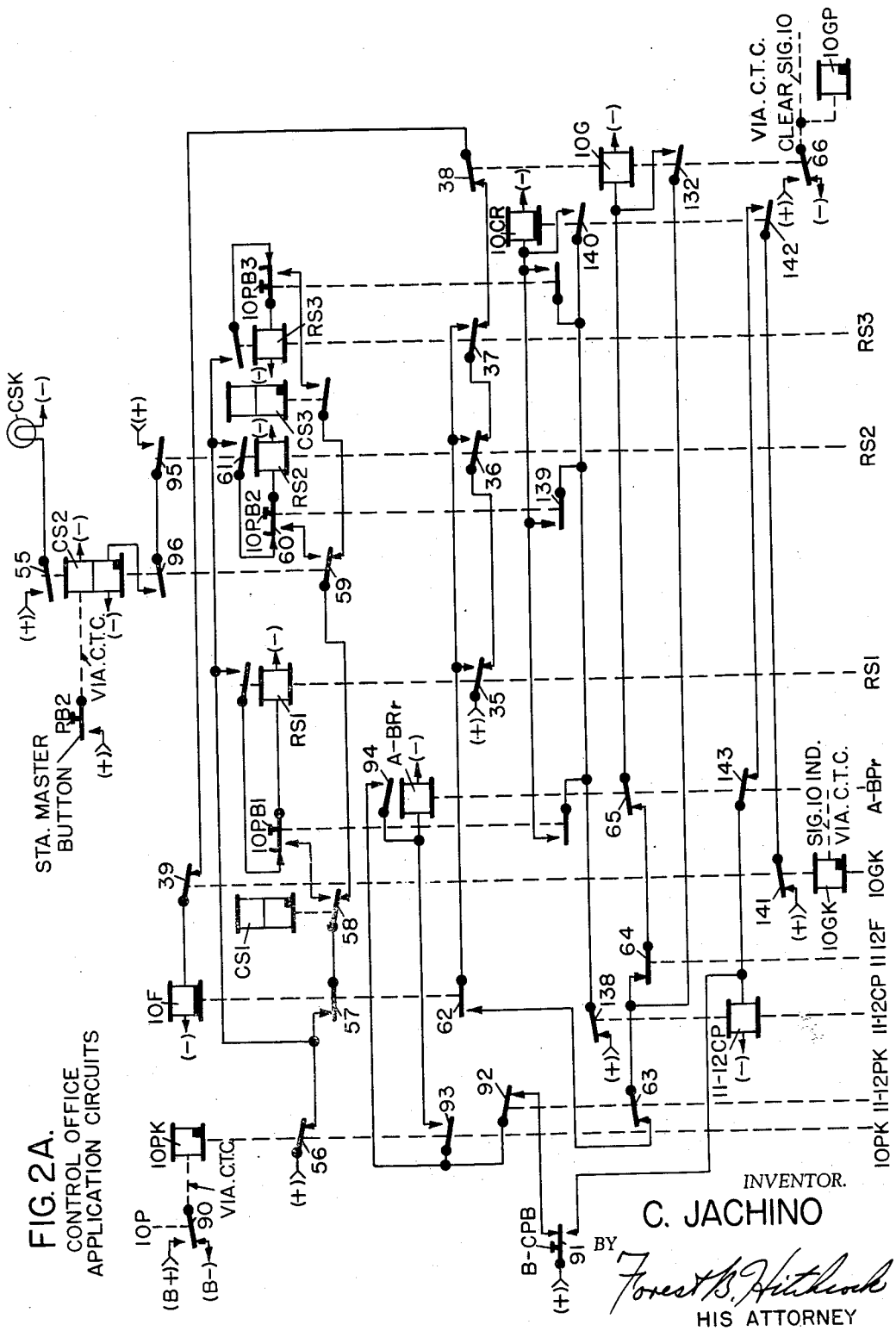



FIG. 2A.
CONTROL OFFICE APPLICATION CIRCUITS

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CENTRALIZED TRAFFIC CONTROL SYSTEM FOR RAILROADS

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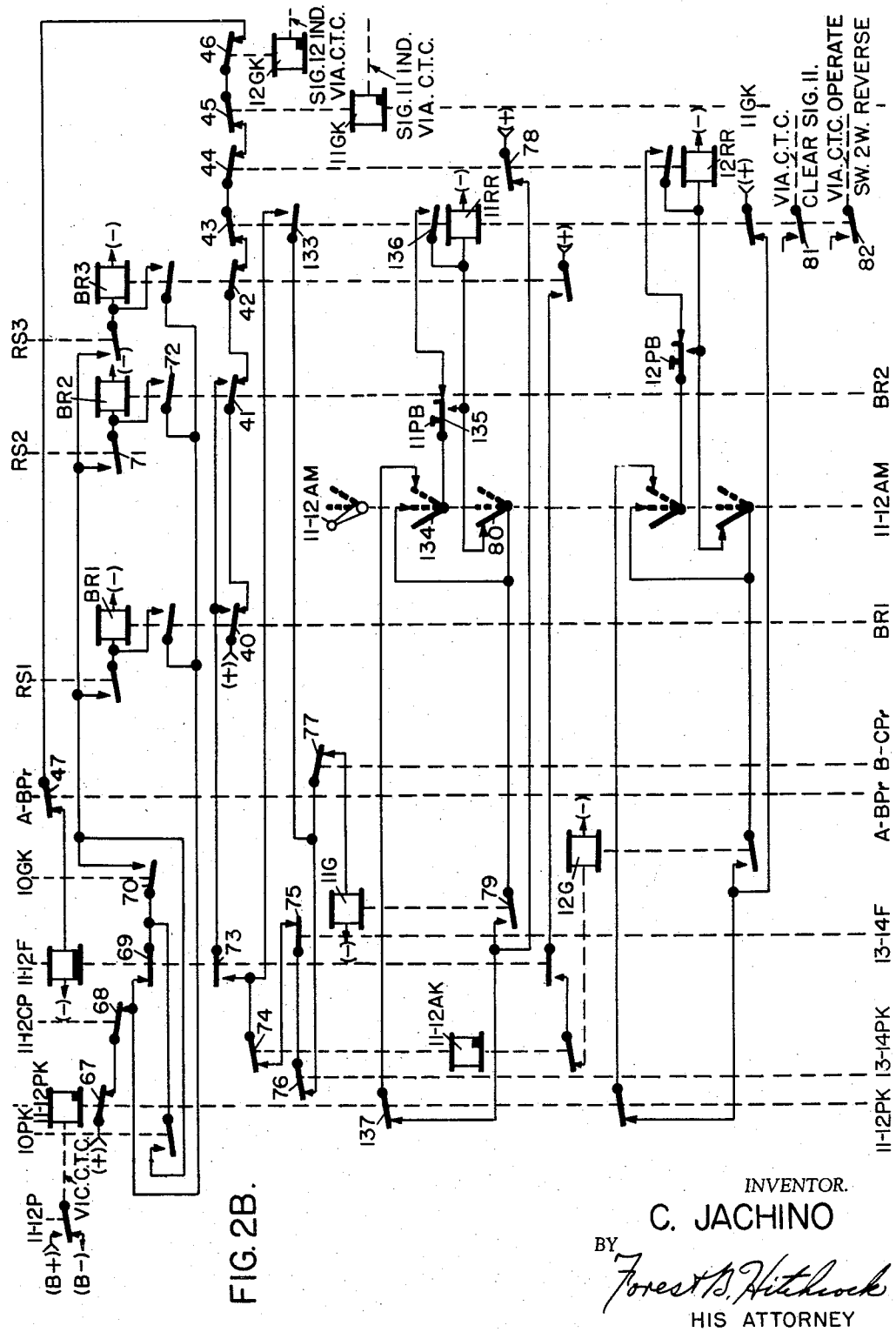



FIG. 2B.

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CENTRALIZED TRAFFIC CONTROL SYSTEM FOR RAILROADS

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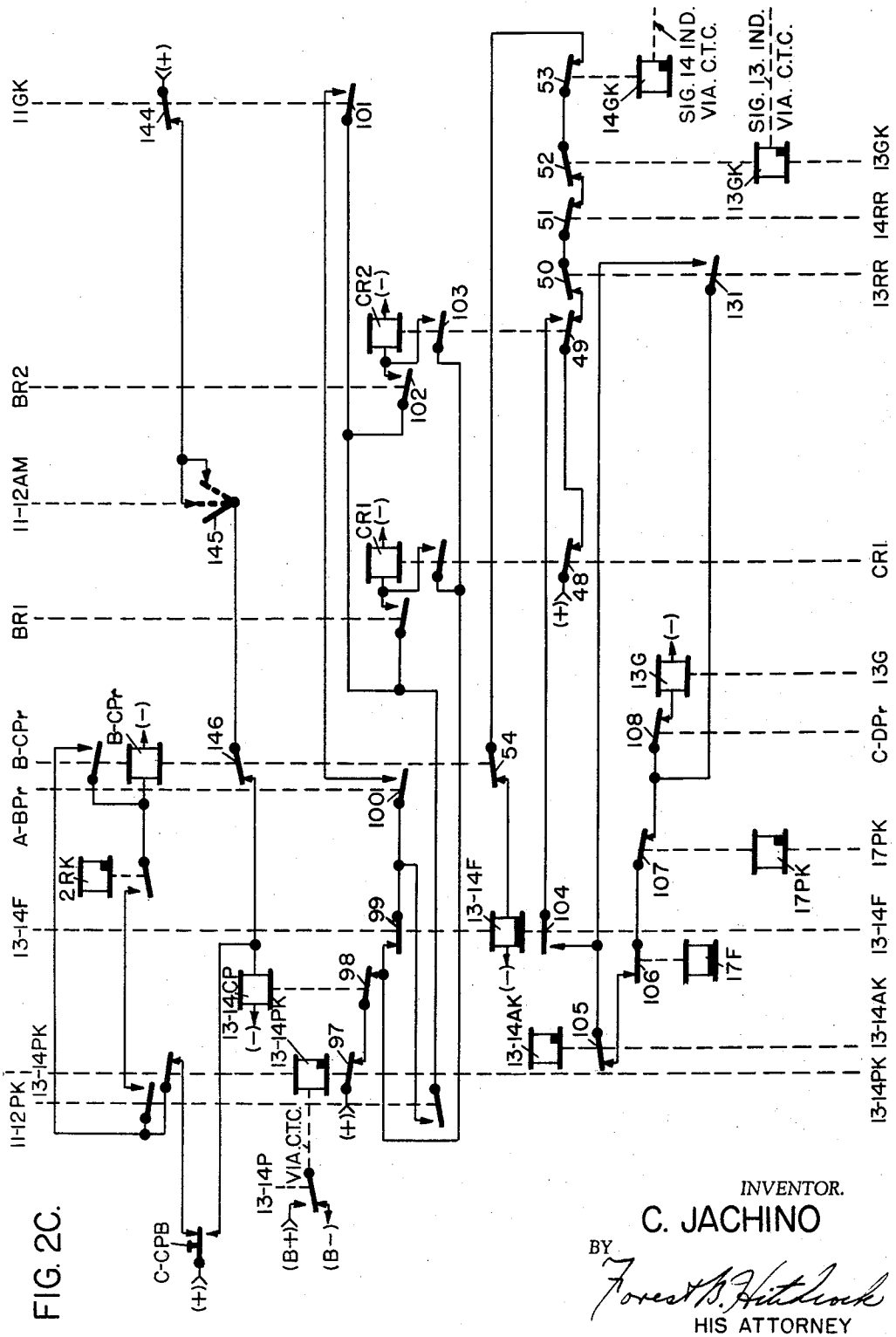



FIG. 2C.

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CENTRALIZED TRAFFIC CONTROL SYSTEM FOR RAILROADS

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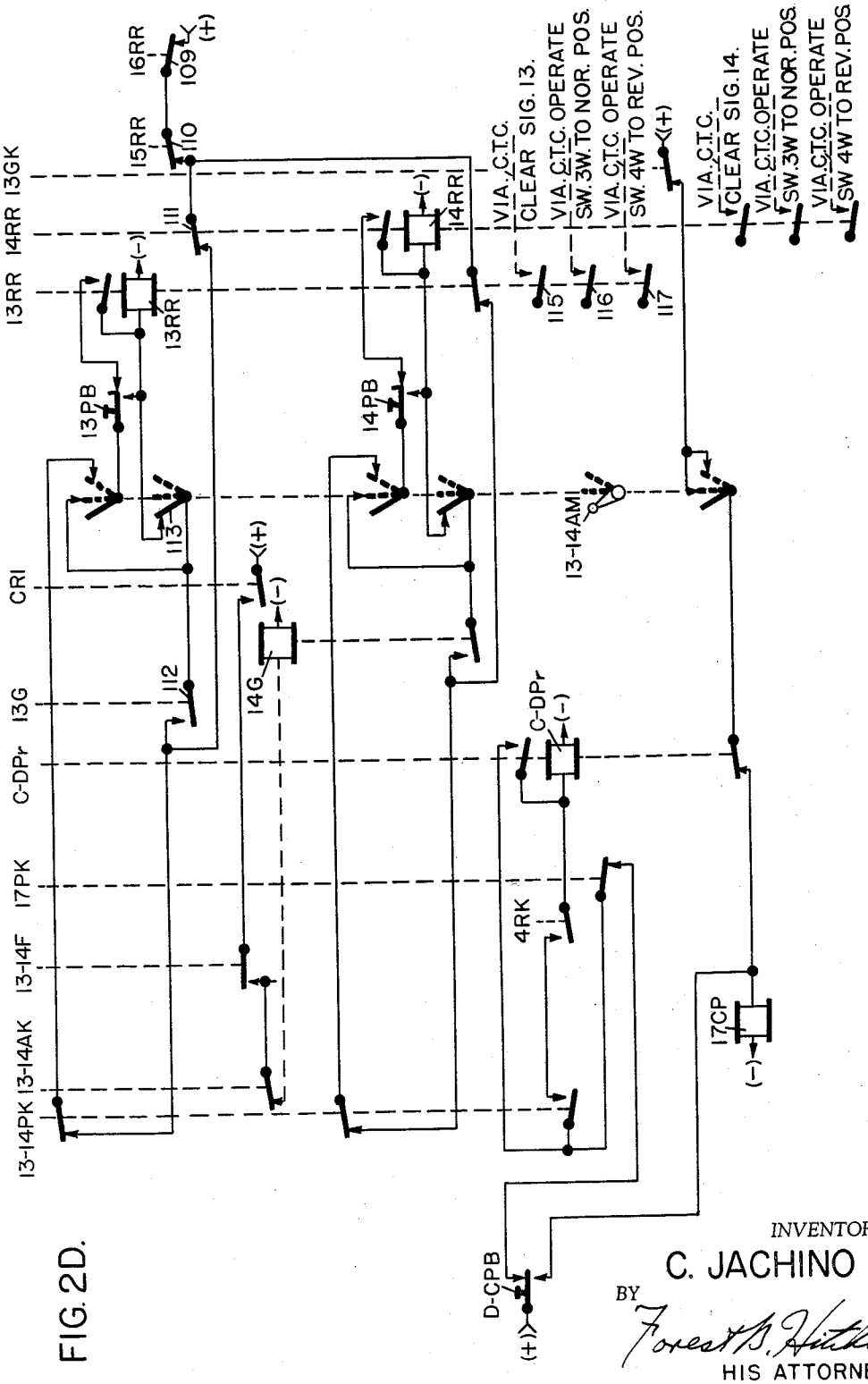



FIG. 2D.

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CENTRALIZED TRAFFIC CONTROL SYSTEM FOR RAILROADS

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FIG. 4.

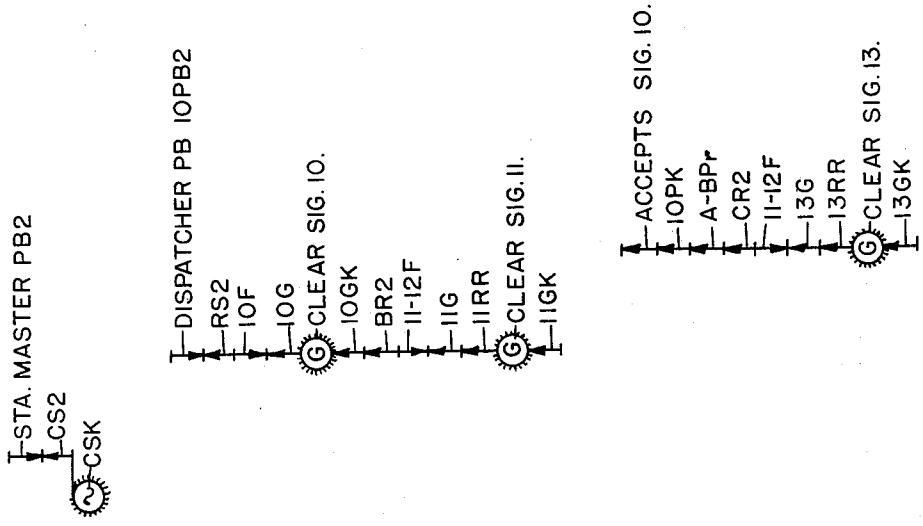
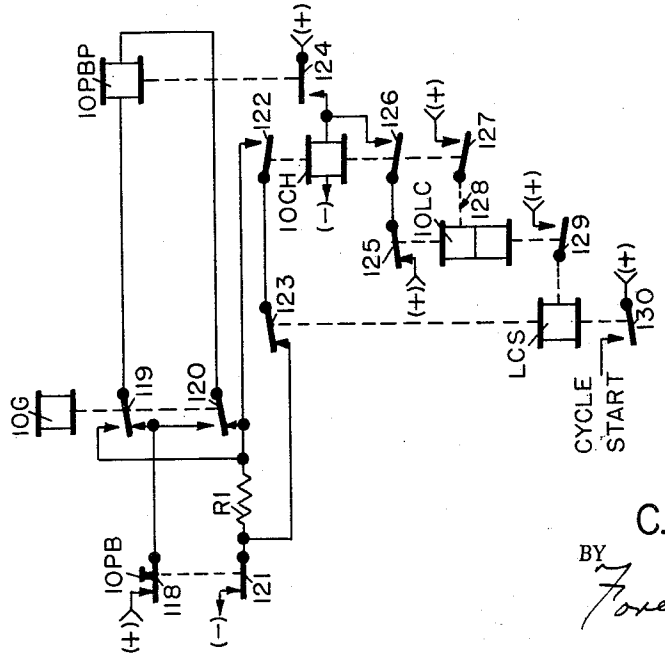



FIG. 3.




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United States Patent Office 3,064,126 Patented Nov. 13, 1962



3,064,126

# CENTRALIZED TRAFFIC CONTROL SYSTEM FOR RAILROADS

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Filed May 20, 1957, Ser. No. 660,153
9 Claims. (Cl. 246—5)

This invention relates to centralized traffic control systems for railroads, and more particularly pertains to centralized control systems wherein track switches and signals at spaced intermediate stations may be controlled manually from a remote control office, or they may be controlled automatically through the control office upon the approach of a train.

In general, the route of a train through a particular extended section of trackway may be determined upon entrance of the train into the centralized traffic control (generally known as CTC) territory, particularly on double track railroads. Thus, if the point of entrance to the CTC territory and the point of departure from the territory are designated, it should be unnecessary for an operator to designate the positioning of track switches and the clearing of signals at intermediate points, except as may be required in accordance with local conditions that may occur at the intermediate interlockings during progress of a train through the territory. It is therefore necessary that an operator be able to control manually the track switches and signals at intermediate interlockings in a centralized traffic control system, but it is also desirable to be able to permit the establishment of routes automatically where there are no unusual conditions calling for manual route designation.

Generally speaking, and without attempting to define the scope of the present invention, the system according to the present invention provides in a CTC system, for the setting up of partial routes automatically and progressively in advance of a train as the train progresses through the CTC territory. Thus no operation is required on the part of an operator to establish a route for a train through intermediate interlockings within the CTC territory.

It is provided, however, that the operator can take over semi-manual control of intermediate interlockings involved in the route of a train so as to hold a train as required to give priority to certain conflicting routes. This can be done on the basis of semi-automatic operation in that, with a selector lever positioned for semi-automatic control, partial routes are selected automatically as in full automatic operation, but manual designation must be made to execute the partial route controls for the different stations, rather than having this done automatically upon the passage of a train through certain track sections. By this organization there is no possibility of the CTC operator aligning the wrong route for a train as the route is determined automatically in accordance with a prior designation of a point of departure from the CTC territory, and no different route may be established.

Full manual control irrespective of a predetermined point of departure for a train may be had by operating the selector lever to a full manual position. With the selector lever in this position, the system is operable according to conventional CTC operating principles.

An object of the present invention is provided for the automatic operation of track switches and signals that are subject to CTC control at several intermediate stations in accordance with the designation of arrival and departure points in the territory governed by CTC.

Another object of the present invention is to provide for the automatic establishment of partial routes in advance of a train as the train progresses.

Another object of the present invention is to provide for semi-automatic operation in a CTC system wherein



the route that may be established is automatically determined, but its actual establishment requires manual designation.

Another object of the present invention is to select, when desired, full manual control of track switches and signals like in a conventional CTC system as compared to automatic or semi-automatic operation.

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 corresponding parts in the several figures of the drawings are identified by similar reference characters, in which parts having similar functions are designated by similar letter reference characters, and in which:

FIG. 1 is an illustration particularly by block diagram of the CTC system provided by the present invention as applied to a specific track layout;

FIGS. 2A, 2B, 2C, and 2D when arranged one above the other respectively illustrate a circuit organization for apparatus that is mostly at a control office for the selection of track switch and signal controls for communication to respective field stations;

FIG. 3 illustrates a typical circuit for the automatic or manual initiation of CTC code communication apparatus into a cycle of operation;

FIG. 4 is a sequence chart illustrating the sequence of operation of certain relays upon passage of a train over a particular route when the CTC system is made subject to automatic control.

For the purpose of simplifying the illustrations and facilitating in the explanation thereof, the various parts and circuits constituting this embodiment of the present invention have been shown diagrammatically, and certain conventional illustrations have been employed, the drawings having been made more for the purpose of facilitating the disclosure of the present invention as to its principles and mode of operation rather than for the purpose of illustrating the specific construction and arrangement of parts that would be employed in practice. Thus, the circuits are shown schematically and symbols are used to indicate connections to the terminals of batteries or other sources of electric current. The symbols (+) and (−) are employed to indicate connection to the positive and negative terminals respectively of suitable batteries or other sources of direct current, and the symbols (B+) and (B−) are used to indicate connections to the opposite terminals of a suitable battery or other direct current source which has a center or intermediate connection designated as (C).

It is to be understood that the system provided by the present invention is applicable to the control of power track switches and signals in various different types of track layouts, and that the control of the track switches and signals illustrated in this embodiment of the present invention is to be considered as typical of the manner in which control can be provided for different combinations of track switches and signals that may be provided in different track layouts to be encountered in practice.

For the purpose of disclosure of this embodiment of the present invention, however, it is assumed that the system is applied to the control of switches and signals disposed along a typical portion or territory of a railroad as illustrated in FIG. 1 that is governed by a CTC control system. The track layout illustrated in FIG. 1 provides for double track operation, the upper track being provided for traffic from right to left, or westbound traffic, and the lower track in the track diagram being provided for governing traffic to the right, or eastbound traffic.

An entering signal **10** is provided for governing westbound traffic into the westbound track **30**, this signal being at field station A and being subject to CTC control from the control office.

Spaced some distance from the signal **10** are lower and upper arm signals **11** and **12** governing traffic over a track switch **2W** into tracks **31** and **32** respectively. These track switches and signals are at field station B and are subject to control by CTC from the control office. Included in the stretch of track **31** is a group of track switches and signals for governing westbound traffic at field station C. This group includes the track switches **3W** and **4W** and signals **13**, **14**, **15**, and **16**. A signal **17** is provided for governing westbound traffic upon leaving the CTC control territory illustrated in FIG. 1. This signal **17** is controlled through field station D in the centralized traffic control system.

Although only CTC control signals are illustrated, it is to be understood that suitable automatic block signaling is provided along the trackway between the various field stations as required. It is to be understood that a similar track layout is provided for the passage of east bound traffic, and inasmuch as the mode of operation over the eastbound track would be comparable to that for the westbound track, for the purpose of simplification of the disclosure of the present invention, the disclosure has been made more particularly relative to the control of signals for westbound traffic, and it is to be understood that similar apparatus, and a similar mode of operation is effective in the setting up of routes for eastbound traffic.

The code communication apparatus provided for transmitting track switch and signal controls from the control office to the several field stations and for transmitting indications to the control office as to the conditions of apparatus at the field stations can be of any suitable type, such, for example, as by the code communication system disclosed in the U.S. patent of W.D. Hailes et al. No. 2,399,734, dated May 7, 1946. It is therefore believed unnecessary to describe in detail the operation of the code communication apparatus as reference can be made to the Hailes et al. Patent No. 2,399,734 for a complete disclosure of the structure and mode of operation of the system.

The CTC control machine for designating controls to be communicated to the respective field stations according to the present invention is, however, different from that disclosed in the above mentioned Hailes et al. Patent No. 2,399,734, and typical sections of the control panel are illustrated in FIG. 1 wherein panel section **33** is provided for the designation of controls for field station B and the panel section **34** is provided for the designation of controls for field station C. It is to be understood that additional panel sections are provided as required for the control of track switches and signals at other field stations.

The panel section **33**, for example, has a 3-position automatic-manual selector switch **11–12AM** for use in the designation of controls for station B for governing westbound traffic. These three positions are provided respectively for automatic control, semi-automatic control, and manual control in the setting up of routes. Route buttons **11PB** and **12PB** are provided for the designation of routes governed by the signals **11** and **12** respectively at field station B. A 2-position lever **11–12SGL** is provided on panel section **33** as a means for manually designating a control for putting a signal to stop. With reference to FIGS. 2A, 2B, 2C, and 2D, magnetic stick indication relays GK, PK, AK, RK, and CS are illustrated as being subject to control by the code communication apparatus, and thus these relays are all provided at the control office and are controlled by the code communication apparatus to indicate conditions of apparatus in the field.

Route description storage relays RS, BR, and CR are provided at the control office for storing route descriptions used in controlling track switches and signals at the different field stations.



A relay F is associated with each of the banks of storage relays RS, BR, and CR for the purpose of permitting only one route description storage to be entered into the associated storage bank at one time.

A partial route control relay P*r* is provided at the control office for each of the intermediate field stations for the registration in the automatic control apparatus of a condition where a partial route is established.

Relays G are provided for the respective signals, and these relays check as to when conditions are right for the clearing of a signal.

Route relays RR are provided for causing the transmission of route controls to the respective field stations for setting up the partial routes as they are called for through the several field stations in accordance with the progress of a train.

Having thus considered the general organization of the apparatus employed in this embodiment of the present invention, further description of the system will be set forth upon consideration of the mode of operation of the system under typical operating conditions.

## OPERATION

### *Normal Conditions*

In describing the mode of operation of the system consideration will first be given as to the normal conditions of the system with no trains present and with no routes established. Under these conditions, most of the relays illustrated in FIGS. 2A, 2B, 2C, and 2D are in their dropped away positions. The relays F, however, are normally energized to indicate that no route is established through the associated station. Relay **10F** (see FIG. 2A) is normally energized by a circuit extending from (+), including back contacts **35**, **36**, **37**, **38**, and **39** of relays RS1, RS2, RS3, **10G** and **10GK** respectively and winding of relay **10F**, to (−). This relay must be energized in order that a route description may be set up which can eventually cause the clearing of signal **10**. Similarly associated with field station B, the relay **11–12F** is normally energized by a circuit extending from (+), including back contacts **40**, **41**, **42**, **43**, **44**, **45**, **46**, and **47** of relays BR1, BR2, BR3, **11RR**, **12RR**, **11GK**, **12GK**, and A–BP*r*, and winding of relay **11–12F**, to (−). The relay **13–14F** which is associated with field station C is normally energized by a circuit extending from (+) including back contacts **48**, **49**, **50**, **51**, **52**, **53**, and **54** of relay CR1, CR2, **13RR**, **14RR**, **13GK**, **14GK**, and B–CP*r*, and winding of relay **13–14F**, to (−).

Other relays that are normally energized include the track relays TR which are energized according to usual practice and are subject to being dropped away upon the shunting of the track rails of an associated track section T by a train. Track relays **0TR** and **1TR** illustrated in FIG. 1 are associated with the track sections **0T** and **1T** and are normally energized. These relays are typical of track relays provided at various points along the trackway according to usual practice.

### *Automatic Operation*

To consider the mode of operation of the system under automatic operation, a typical mode of operation will be described for the passage of a westbound train through the CTC territory illustrated in FIG. 1. The route to be specifically considered will be the route for a train entering at signal **10** and leaving the CTC territory at signal **17**. It will be considered that designation of the approach of a westbound train to the CTC territory is made by a station master, or by other suitable means, which can be effected by the actuation of the push button PB2 of FIG. 2A for purpose of illustration. This push button PB2 may be located at a station platform,

for example, where it may be actuated when a train is prepared to leave that station. The actuation of this push button PB2 is effective over the code communication apparatus to actuate a magnetic stick relay CS2 at the control office to its picked-up position. Relay CS2 is particularly indicative of the above described route through the CTC territory, and similar relays CS1 and CS3 are also provided at the control office to be responsive to the actuation of similar push buttons PB (not shown) by a station master for the designation of routes through the track layout other than the above mentioned route that will be considered in detail.

The picking up of relay CS2 closes a circuit at front contact 55 for the energization of an indicator lamp CSK to call to the attention of the operator of the machine at the control office that a route has been designated through the CTC territory for the train entering at signal 10 to leave the territory at signal 17. Thus, if the operator of the control machine is willing to let the route be automatically established through the CTC territory he actuates the push button 10PB2 on his control panel. The actuation of this push button 10PB2 causes the picking up of relay RS2 by the energization of a circuit extending from (+), including back contact 56 of relay 10PK, front contact 57 of relay 10F, back contact 58 of relay CS1, front contact 59 of relay CS2, contact 60 of button 10PB2 in its depressed position and winding of relay RS2, to (−). Relay RS2 is maintained energized by a stick circuit extending from (+), including back contact 56 of relay 10PK, front contact 61 of relay RS2, contact 60 of button 10PB2 in its normal position and winding of relay RS2, to (−). Contact 60 of button 10PB2 is preferably a make before break contact so that the stick circuit for relay RS2 is established upon the picking up of that relay and is maintained when the button is restored to its normal position so that there is no momentary deenergization of relay RS2 upon the restoration of the push button 10PB2 to its normal position. The picking up of relay RS2 causes the restoration of relay CS2 to its dropped away position by the energization of a drive-down winding through front contact 95 of relay RS2 and front contact 96 of relay CS2.

The picking up of relay RS2 opens the stick circuit that has been described for the relay 10F at back contact 36, and thus causes the relay 10F to be dropped away. Upon the dropping away of relay 10F, the relay 10G, which is associated with the selection of a control for clearing signal 10, becomes picked up by the energization of a circuit extending from (+), including back contact 35 of relay RS1, front contact 36 of relay RS2, back contact 62 of relay 10F, back contact 63 of relay 11–12PK, front contact 64 of relay 11–12F, back contact 65 of relay A–BP*r* and winding of relay 10G, to (−). Upon the picking up of relay 10G, a stick circuit is closed for that relay at front contact 132 shunting front contact 64 of relay 11–12F and back contact 65 of relay A–BP*r* out of the pick-up circuit just described. The picking up of relay 10G is effective to automatically initiate the code communication apparatus into a cycle of operation for transmission of controls to field station A, and because of the closure of its front contact 66, a code is selected for transmission to field station A for the clearing of signal 10. The reception of this control at station A causes the signal 10 to be cleared subject to the usual track circuit safety circuits that are employed in the field. This signal control when received in the field causes the picking up of the magnetic stick relay 10GP which is used to provide an indication when a train accepts signal 10 as will be hereinafter considered.

A typical system that may be employed for automatically initiating the code communication apparatus into a cycle of operation in carrying out the mode of operation described above is found in FIG. 3, wherein a normally energized start relay 10PBP is provided for the initiation of the system. This relay is subject either to manual or automatic start control. Relay 10PBP is normally energized by a circuit extending from (+), including normally closed contact 118 of push button 10PB, back contact 119 of relay 10G, winding of relay 10PBP, back contact 120 of relay 10G, resistor R1 and normally closed contact 121 of push button 10PB, to (−).

It will be noted that contacts 119 and 120 of relay 10G are connected in pole changing relationship, so that the shifting of relay 10G either to its picked up or its dropped away position causes the pole changing of the relay 10PBP so as to drive the relay down. Because of the inclusion of the resistor R1 in the circuit for relay 10PBP, the relay PBP does not receive sufficient energy on reversed polarity to become picked up until the resistor R1 is shunted by front contact 122 of relay 10CH connected in series with back contact 123 of relay LCS. In other words, it is insured that the relay 10CH has time to become picked up before the relay 10PBP is restored to its normally energized condition, after an automatic start has been initiated. When the relay 10PBP is dropped away, the closure of its back contact 124 causes the picking up of relay 10CH by the energization of an obvious circuit. Relay 10CH when picked up is maintained energized by a stick circuit extending through back contact 125 of relay 10LC and front contact 126 of relay 10CH.

Relay 10CH is effective when picked up to pick up relay 10LC by the closure of its front contact 127. This circuit is indicated by a dotted line 128 to show that other circuit connections are provided according to the above mentioned Hailes et al. patent for the purpose of permitting only a single start to be effective at one time. Thus, in actual practice, the circuits for the relays LC for the several stations are provided as a chain circuit network to permit only a single relay LC to be picked up at one time. In response to the picking up of a relay LC, such as the picking up of relay 10LC, a system relay LCS is picked up as by the closure of front contact 129 of relay 10LC, and the picking up of this relay, as disclosed in the above mentioned Hailes et al. Patent No. 2,399,734 sets the system into operation for the transmission of the selected controls to the particular field station for which the start has been rendered effective as is indicated in FIG. 3 by the closure of front contact 130. It will be readily apparent that this same circuit organization is effective upon the dropping away of the relay 10G upon cancellation of the route established to initiate the code communication apparatus by pole changing the relay 10PBP so as to transmit a signal stop control to restore the signal control apparatus to its normal condition. The initiation of the system manually for transmission of controls to field station A can be effected by the actuation of the start push button 10PB which will cause the dropping away of the start relay 10PBP by opening its circuit at normally closed push button contacts 118 and 121. The restoration of the push button 10PB to its normal position conditions the circuit for relay 10PBP so that it can be restored to its normally energized condition.

The relay 10LC is effective during a cycle to select the transmission of a station call code for field station A and to render the transmission of a signal control code selected by relay 10G effective.

When signal 10 has been cleared, an indication that the signal has been cleared is transmitted to the control office by the code communication apparatus, and thus the signal clear magnetic stick indication relay 10GK becomes picked up at the control office.

The picking up of relay 10GK provides for the transfer of the route description storage into the storage relays BR, and inasmuch as the relay RS2 has been assumed to have been energized for the typical route being considered, the relay BR2 becomes energized when the signal clear indication is received. Thus the relay BR2 becomes picked up by the energization of a circuit extending

from (+), including back contact 67 of relay 11–12PK, back contact 68 of relay 11–12CP, front contact 69 of relay 11–12F, front contact 70 of relay 10GK, front contact 71 of relay RS2, and winding of relay BR2, to (−). This relay when picked up is maintained energized by a stick circuit extending from (+), including back contact 67 of relay 11–12PK, back contact 68 of relay 11–12CP, front contact 72 of relay BR2 and winding of relay BR2, to (−).

The picking up of relay BR2 opens the circuit that has been described for relay 11–12F at back contact 41 and causes this relay to be dropped away. Upon the dropping away of relay 11–12F a circuit is closed for the energization of relay 11G extending from (+), including back contact 40 of relay BR1, front contact 41 of relay BR2, back contact 73 of relay 11–12F, back contact 74 of relay 11–12AK, front contact 75 of relay 13–14F, back contact 76 of relay 13–14PK, back contact 77 of relay B–CP*r* and winding of relay 11G, to (−). It will be noted that relay 11G is selected in preference to the relay 12G because of the relay BR2 being in its energized condition rather than the relay BR3. In other words, the route through the CTC territory from end to end is stored by the relay BR that is energized, and the relay BR2 has selected the energization of relay 11G rather than relay 12G because it is the clearing of signal 11 that is required for fulfillment of the through route that has been designated for the train.

Upon the picking up of relay 11G, the route relay 11RR becomes picked up by the energization of a circuit extending from (+), including back contact 78 of relay 12RR, front contact 79 of relay 11G, contact 80 of lever 11–12AM in its left-hand position, and winding of relay 11RR, to (−). This relay when picked up causes the transmission of a signal clearing code for the clearing of signal 11 by the closure of its front contact 81, and the closure of its front contact 82 provides for the transmission of a switch control to field station B for operating the track switch 2W to its reverse position. Upon the clearing of signal 11, an indication is received over the code communication apparatus to cause the picking up of the signal clear magnetic stick relay 11GK at the control office.

No further propagation of partial route establishment is effective until a westbound train actually accepts the signal 10 because it is desirable to leave field station C free for the establishment of conflicting routes such as a route governed by signal 15 or signal 16. It is considered, however, that after a train has passed signal 10, the route for the train should then be extended through field station C, and the automatic establishment of the partial route through this field station is thus initiated.

With reference to FIG. 1, the relay 10P becomes energized after a train has accepted signal 10, and after the track section 0T has become unoccupied in the rear of the train. An indication of the energized condition of this relay is then transmitted to the control office to initiate the establishment of the partial route through field station C. It has been pointed out that the magnetic stick relay 10GP has been picked up in accordance with the transmission of a ocntrol for the clearing of signal 10, and thus upon entrance of the westbound train into the track section 0T in approach of signal 10, the dropping away of relay 0TR establishes a pick-up circuit for the relay P*a* extending from (+), including front contact 83 of relay 10GP, back contact 84 of relay 0TR, front contact 85 of relay 1TR and winding of relay P*a*, to (−). This relay when picked up closes its stick contact 86 to shunt front contact 85 of relay 1TR out of the circuit just described.

With the relay P*a* in its picked-up condition, a circuit is conditioned for the energization of relay 10P so that this relay can be picked up as soon as the train has accepted signal 10 and the track section 0T has become unoccupied in the rear of the train. The picking up of relay 0TR causes the picking up of relay 10P by the closure of a circuit for the energization of relay 10P extended from (+), including front contact 83 of relay 10GP, front contact 84 of relay 0TR, back contact 87 of relay 1TR, front contact 88 of relay P*a*, and winding of relay 10P to (−). The picking up of this relay closes a stick circuit at front contact 89 shunting the track contacts out of the circuit just described. The closure of front contact 90 of relay 10P causes the transmission to the control office of an indication that the relay 10P has become picked up and this indication is effective to initiate establishment of a route through field station C for the westbound train.

It will be noted that the control of relay 10P is such as to insure the presence of a train as compared to conditions causing momentary dropping of a track relay as by the accidental shunting of the track rails by a maintenance workman. Thus the track section 0T must be shunted first, and then the track section 1T must be maintained shunted after the train has left the track section 0T It is to be understood, however, that other types of train presence detecting means, such as treadles and the like, may be employed in accordance with the requirements of practice.

With reference to FIG. 2A, the magnetic stick relay 10PK at the control office is actuated to its picked-up position in response to the picking up of relay 10P at field station A, and the picking up of this relay causes the picking up of the partial route relay A–BP*r*. The circuit by which relay A–BP*r* is picked up extends from (+), including normally closed contact 91 of the cancel button B–CPB, back contact 92 of relay 11–12PK, front contact 93 of relay 10PK and winding of relay A–BP*r*, to (−). The picking up of this relay closes a stick circuit at front contact 94 to shunt front contact 93 of relay 10PK out of the circuit just described.

The picking up of relay 10PK causes the dropping away of relay 10G by the opening of its circuit at back contact 63, and the dropping away of this relay transmits a signal stop control in accordance with the closure of its back contact 66 to field station A to cause the dropping away of relay 10GP.

Upon the picking up of relay A–BP*r*, relay CR2 becomes picked up in accordance with the extension of the route through field station C. The circuit by which relay CR2 is energized extends from (+), including back contact 97 of relay 13–14PK, back contact 98 of relay 13–14CP, front contact 99 of relay 13–14F, front contact 100 of relay A–BP*r*, front contact 101 of relay 11GK, front contact 102 of relay BR2 and winding of relay CR2, to (−). A stick circuit is established for this relay extending from (+), including back contact 97 of relay 13–14PK, back contact 98 of relay 13–14CP, front contact 103 of relay CR2 and winding of relay CR2, to (−).

The picking up of relay CR2 causes the dropping away of the relay 13–14F by the opening of its circuit at back contact 49. Inasmuch as the energization of relay CR2 is indicative of a through route with an exit point at signal 17, the energization of this relay causes the energization of relay 13G which is associated with the clearing of signal 13 which in turn governs the partial route to be established through field station C over track switch 4W in the reverse position. Thus, the relay 13G becomes picked up upon the energization of relay CR2 by the energization of a circuit extending from (+), including back contact 48 of relay CR1, front contact 49 of relay CR2, back contact 104 of relay 13–14F, back contact 105 of relay 13–14AK, front contact 106 of relay 17F, back contact 107 of relay 17PK, back contact 108 of relay C–DP*r* and winding of relay 13G, to (−).

Relay 13G when picked up causes the picking up of the partial route relay 13RR by the closure of a circuit for this relay extending from (+), including back contact 109 of relay 16RR, back contact 110 of relay 15RR, back contact 111 of relay 14RR, front contact 112 of

relay 13G, contact 113 of lever 13–14AM in its left-hand position and winding of relay 13RR, to (—). The picking up of this relay closes a circuit for relay 13G at front contact 131, shunting contacts 105, 106 and 107 of relays 13–14AK, 17F and 17PK out of the picked up circuit for the relay 13G.

The picking up of relay 13RR is effective by the closure of its front contact 115 to cause the transmission of a signal clearing code to field station C for the clearing of signal 13. A switch control is also transmitted in accordance with the closure of front contact 116 of relay 13RR to operate the track switch 3W to its normal position. The closure of front contact 117 of relay 13RR causes the transmission to field station C of a control for operating track switch 4W to its reverse position. Thus, the route becomes established through track switch 3W in its normal position and over track switch 4W in its reverse position, and the signal 13 becomes clear to establish a route for the westbound train to leave the CTC territory at signal 17. Upon the clearing of signal 13, an indication is transmitted to the control office that the signal has been cleared, and accordingly the magnetic stick relay 13GK at the control office becomes picked up.

Having thus considered the mode of operating upon establishment of the through route, consideration will now be given as to the mode of operation in the restoration of the apparatus to normal conditions after the passage of a westbound train over the route extending from signal 10 to signal 17.

It has been pointed out that the relay 10PK (see FIG. 2A) is picked up after passage of the train past the signal 10. This relay when picked up causes the dropping away of the through route description storage relay RS2 by the opening of its circuit at back contact 56. Signal 10 is restored to stop automatically in the field according to usual practice, and an indication that the signal has been restored to stop is transmitted to the control office, and is effective to actuate the magnetic stick relay 10GK to its dropped away position.

As the train progresses further in the route so as to have passed the signal 11G which is associated with station B, relay 11–12PK is picked up at the control office by control means (not shown) similar to the control means that has been described in detail for the energization of the relay 10PK which is controlled from station A. The picking up of relay 11–12PK at the control office causes the dropping away of relay 10G by the opening of its circuit at back contact 63, and the dropping away of relay 10G closes a circuit at its back contact 38 that has been described when considering the normal conditions of the system for restoring the relay 10F to its normally energized position. The relay 10G in dropping away is effective to initiate the code communication system into a cycle of operation to transmit a control which is indicated by a dotted circuit associated with contact 66 to field station A to cause the dropping away of the magnetic stick relay 10GP at that station. With reference to FIG. 1, the dropping away of relay 10GP causes the dropping away of relay 10P at field station A by the opening of front contact 83. Relay 10P when dropped away closes its back contact 90 which is effective to cause the transmission of an indication to the control office that relay 10P has been dropped away, which upon reception at the control office causes the relay 10PK to be actuated to its dropped away position. This completes the restoration to normal conditions of the apparatus associated with field station A.

A similar mode of operation is effective for restoring the apparatus to normal at field station B wherein the picking up of relay 11–12PK opens the circuit for the through route description storage relay BR2 at back contact 67 so as to cause that relay to be dropped away. The dropping away of relay BR2 causes the dropping away of relay 11G by the opening of its circuit at front contact 41. The circuit by which the relay 11G has been maintained picked up prior to this time extends from (+), including back contact 40 of relay BR1, front contact 41 of relay BR2, back contact 73 of relay 11–12F, front contact 133 of relay 11RR, back contact 77 of relay B–CPr and winding of relay 11G, to (—). Upon the dropping away of relay 11G, the route relay 11RR becomes dropped away by the opening of its circuit at front contact 79 of relay 11G. When relay 11RR becomes dropped away, it initiates the transmission of a control to field station B automatically for restoration of the signal control apparatus at that field station to its normal conditions according to a mode of operation similar to that which has been specifically described for the restoration of normal conditions of the apparatus associated with field station A. Such mode of operation causes the transmission of an indication from field station B to the control office to restore the relay 11–12PK to its dropped away position. When the signals at field station B are at stop, and the route designating means is restored to its normal condition as has been described, the relay 11–12F becomes picked up to complete the restoration to normal conditions of the control apparatus associated with field station B.

When the westbound train has passed signal 13 so as to cause the picking up of relay 13–14PK by a mode of operation similar to that which has been described in detail for the picking up of a similar relay 10PK at field sation A, the through route description storage relay CR2 becomes dropped away by the opening of back contact 97 of relay 13–14PK, and the dropping away of that relay causes the dropping away of the relay 13G by the opening of front contact 49. Relay 13G in dropping away causes the dropping away of route relay 13RR by the opening of front contact 112, and the dropping away of relay 13RR is effective to automatically initiate the code communication apparatus into a cycle of operation for restoring relays in the field at field station C by a mode of operation comparable to that which has been described as being effective for field station A in accordance with the dropping away of the relay 10G. An indication is received at the control office from field station C causing the restoration of the relay 13–14PK to its dropped away position, and the relay 13–14F becomes picked up by the energization of a circuit that has been described when considering the normal conditions of the system.

The automatic route control apparatus at the control office has thus been restored to its normal conditions, and is thus conditioned station by station as the route is released in the rear of a westbound train so that another route may be set up for a following westbound train according to a mode of operation similar to that which has been heretofore described.

*Semi-Automatic Operation*

Under semi-automatic operation, the selector lever AM for the associated station is operated to its center position. With the lever AM for a station in its center position, operation is effective as has been described when considering full automatic operation up to the point of picking up the particular route relay RR that has been selected by the automatic circuits. The picking up of the route relay RR requires manual actuation of an associated route push button for the particular route that has been selected. In other words, under semi-automatic operation, only partial routes corresponding to the through route description may be established. This provides a check on the manipulation of the buttons by the control machine operator to prevent him from setting up the wrong route by inadvertently actuating the wrong route button. On the other hand, the semi-automatic operation gives the operator of the control machine an opportunity to control the propagation of the establishment of partial routes so as to permit the manual designation of preference where two conflicting routes

through a field station are called for at substantially the same time.

To consider the circuit organization more specifically for the energization of a route relay RR under semi-automatic operation, it will be assumed that a through route description has been set up as has been heretofore described for the passage of a westbound train from signal 10 to signal 17, and that the control has been effective to apply energy to the control circuit for the route relay 11RR. Under normal operation, the relay 11RR is picked up by a circuit including contact 80 of lever 11–12AM in its lefthand position, but with this lever in its center position for semi-automatic operation, contact 80 of lever 11–12AM is open. If the route push button 11PB is actuated to its depressed position, however, the relay 11RR becomes picked up because of shunting around the contact 80 of lever 11–12AM by contact 134 of lever 11–12AM in its center position being connected in series with contact 135 of button 11PB in its depressed position. When relay 11RR is picked up upon actuation of the route push button 11PB, it is maintained energized through stick contact 136, which is connected through contact 135 of the push button 11PB in its normal position. This contact 135 is preferably provided with a make-before-break adjustment so that the stick circuit is maintained established during the restoration of the button 11PB to its normal position from its depressed position. The transmission of the controls for establishment of the route upon the picking up of relay 11RR is provided according to the same mode of operation that has been heretofore described relative to full automatic operation of the system. It will be noted that a similar organization of contacts of the lever 11–12AM are included in the circuit for the control of the route relay 12RR which is associated with the clearing of signal 12, and it is to be understood that a similar mode of operation is provided in the picking up of this route relay.

*Full Manual Control*

For operation under full manual control at any station, the selector lever AM at that station is operated to its righthand position. With the lever AM in its right-hand position the route relays RR are subject to energization when their associated push buttons are actuated, irrespective of any through route description that may have been set up.

More specifically, for example, if the lever 11–12AM is operated to its full right-hand position, the pick up circuit for the route relay 11RR is no longer dependent upon the closure of front contact 79 of relay 11G, and thus the picking up of relay 11RR can be rendered effective independent of the storage of a through route description. Thus, upon actuation of the route push button 11PB to its depressed position when the lever 11–12AM is in its right-hand position, relay 11RR becomes picked up by the energization of a circuit extending from (+), including back contact 78 of relay 12RR, back contact 137 of relay 11–12PK, contact 134 of lever 11–12AM in its right-hand position, contact 135 of button 11PB in its depressed position and winding of relay 11RR, to (—). This relay, when picked up, closes a stick circuit at front contact 136 to maintain the relay picked up after restoration of the push button 11PB to its normal position. Relay 11RR when picked up initiates the code communication system into a cycle of operation for the transmission of track switch and signal controls to establish the route governed by signal 11 by a mode of operation that has been heretofore described.

*Manual Cancellation*

After a through route description has been set up by the energization of a relay RS, such route description can be cancelled by the pulling out of the push button PB that is associated with the control of that relay. Thus, if it is desired to cancel the route description that has been set up by the picking up of the relay RS2, for example, the pulling out of the push button 10PB2 causes the picking up of the cancel relay 10CR by the energization of a circuit extending from (+), including back contact 138 of relay 11–12CP, contact 139 of button 10PB2 in its pulled-out position and winding of slow drop away relay 10CR, to (—). The picking up of this relay closes a stick circuit through contact 140 to shunt the push button contact 139 of the circuit just described.

The picking up of relay 10CR causes the picking up of the cancel relay 11–12CP which is associated with station B by the energization of a circuit extending from a (+), including back contact 141 of relay 10GK, front contact 142 of relay 10CR, back contact 143 of relay A–BP*r* and winding of relay 11–12CP, to (—). This relay when picked up causes the dropping away of the corresponding through route description relay BR2 which is associated with station B by the opening of its circuit at back contact 68, and the opening of back contact 138 in the circuit for relay 10CR causes relay 10CR to be restored to its normally deenergized condition. This in turn causes the dropping away of relay 11–12CP by the opening of front contact 142 of relay 10CR.

The above described route description storage cancellation is effective provided that there has been no route actually established, and provided that the route for which cancellation is attempted is not occupied by a train. Under such conditions, emergency cancellation means is provided by the push button CPB for the several field stations, but these push buttons are normally sealed, and there is little occasion for their actuation.

To consider the mode of operation under such conditions of cancellation, however, if the seal associated with push button B–CPB, for example, is broken, and that push button is actuated to its depressed position, the cancellation relay 11–12CP is picked up by the energization of an obvious circuit, and the picking up of this relay renders cancellation effective for station B by a mode of operation that has been described.

It is further provided that when an operator actuates the selector lever AM for a particular field station to a semi-manual or full-manual position, the cancellation relay for the associated station is picked up, provided there is no signal clear for governing entrance for a train into the associated field station. Thus, the relay 13–14CP, for example, is picked up upon the actuation of the lever 11–12AM to its semi-manual or full-manual position by the energization of a circuit including back contact 144 of relay 11GK, contact 145 of lever 11–12AM, back contact 146 of relay B–CP*r* and winding of relay 13–14CP, to (—). The picking up of this relay cancels any description that may be set up by a relay CR for the field station C by the opening of circuits governing these relays at back contact 98.

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

What I claim is:

1. A centralized traffic control system for a stretch of railway track having track switches and signals for the establishment of partial routes at several remotely spaced field stations subject to control from a control office comprising, code communication means for two way code communication between the control office and the field stations, indication means including said code communication means for indicating at the control office the presence of a train at the several field stations, a control panel

having route buttons for the several field stations for designation of respective partial routes extending through the associated field stations, said control panel having a manual control switch for each of the field stations having one position for automatic control and another position for semi-automatic control, route description storage means at the control office for storing descriptions of through routes extending from a predetermined entering point through several field stations to different points of departure, and partial route establishing means associated with the several field stations and including said code communication means for setting up respective partial routes and clearing signals governing entrance thereto respectively in advance of a train, said partial route establishing means being rendered effective in response to the actuation of said indication means to establish a partial route conforming to a through route for a train as called for by said storage means provided said lever for the associated field station is in said one position without requiring actuation of one of said route buttons, and said partial route establishing means being effective for a field station having its selector lever in said semi-automatic position in response to the actuation of said indication means only provided a particular one of said route buttons corresponding to the route called for by said storage means is actuated.

2. A centralized traffic control system for a stretch of track having track switches and signals for the establishment of partial routes at several remotely spaced field stations subject to control from a control office comprising, code communication means for two way code communication between the control office and the field stations, indication means including said code communication means for indicating at the control office the presence of a train at the several field stations, a control panel at the control office having route buttons for the several field stations for designation of respective partial routes extending through the associated field stations, said control panel having a manual control switch for each of the field stations having one position for selection of automatic control and having another position for selection of manual control, route description storage means at the control office for storing descriptions of through routes extending from a predetermined point of entrance through several field stations to different points of departure, and partial route establishing means associated with the several field stations and including said code communication means for setting up respective partial routes in advance of a train and clearing a signal, said partial route establishing means being rendered effective in response to the actuation of said indication means to establish a partial route conforming to a through route for a train as called for by said storage means provided that said lever for the associated field station is in said one position, and said partial route establishing means being effective for a field station having its selector lever in said another position only upon the actuation of any one of said route buttons, irrespective of a through route that may be called for by said route description storage means.

3. A centralized traffic control system for a track layout having at least one entrance point and a plurality of points of departure for through routes extending through the track layout and having track switches and signals at several remotely spaced field stations in the routes subject to control from a control office comprising:

(*a*) code communication means for communicating switch and signal control codes from the control office to the field stations and for communicating indication codes from the field stations to the control office indicative of the conditions of devices at the several field stations,

(*b*) route description storage means at the control office for storing the designation of any one of several points of departure from said track layout for a train entering said stretch at one of the entrance points of said track layout,

(*c*) indication means at the control office responsive to indication codes transmitted from the field stations by said code communication means for indicating the presence of a train at each of the field stations,

(*d*) partial route establishing means operable when rendered effective for setting up a partial route and clearing a signal in advance of a train at each field station conforming to the route leading to any one of said points of departure of the train as called for by said route storage means,

(*e*) and means for rendering said partial route establishing means effective for setting up a route and clearing a signal at each field station in response to the actuation of said indicating means for indicating the presence of a train at a point in approach to each respective station.

4. A centralized traffic control system according to claim 3 wherein said route description storage means at the control office includes a bank of storage relays and means for selectively energizing the storage relays in different combinations in accordance with different designated points of departure.

5. A centralized traffic control system according to claim 4 wherein said means for selectively energizing the storage relays is responsive to an indication communicated from one of the field stations by said code communication means.

6. A centralized traffic control system for a track layout having a plurality of through routes extending from an entrance point to a plurality of points of departure respectively and having track switches and signals at several remotely spaced field stations in the routes subject to control from a control office comprising:

(*a*) code communication means for communicating switch and signal control codes from the control office to the field stations and for communicating indication codes from the field station to the control office indicative of conditions of devices and indicative of the presence of trains at the several field stations,

(*b*) a through route description storage means at the control office for each of the several field stations for storing a description indicative of the point of departure of any one of said through routes,

(*c*) indication means at the control office responsive to indication codes transmitted from the field stations by said code communication means for indicating the presence of a train at each of the field stations,

(*d*) route storage transfer means including said code communication means for advancing a through route description storage in said route description storage means from one of said storage means to the next in a predetermined order in response to the reception of a particular indication code by said indication means indicative of the progress of a train,

(*e*) said route storage transfer means being effective upon the transfer of a route storage to initiate said code communication means into operation for the transmission from the control office to the field stations of switch and signal control codes for the establishment of a partial route selected in accordance with the point of departure storage that has been transferred,

(*f*) and means at the field stations for controlling track switches and signals in accordance with the switch and signal control codes communicated by said code communication means from the control office.

7. A centralized traffic control system according to claim 6 wherein manually operable means is provided for controlling said switch and signal control code selecting means and wherein switching means is provided for rendering said switch and signal control code selecting means

selectively responsive to said manually operable means or to said storage means.

8. A centralized traffic control system for a track layout having a plurality of conflicting through routes extending from an entrance point to at least one point of departure, each of the routes having track switches and signals at several remotely spaced field stations in the routes subject to control from a control office comprising:

(*a*) code communication means for communicating switch and signal control codes from the control office to the field stations and for communicating indication codes from the field stations to the control office indicative of conditions of devices and indicative of the presence of trains at the several field stations,

(*b*) through route description storage means at the control office for storing a description of at least one of said through routes that may be designated including track switches and signals at a plurality of field stations, and

(*c*) partial route establishing means for each of the stations operable in response to the reception at the control office of an indication code indicative of the presence of a train at one field station for transmitting selected switch and signal control codes from the control office to only a single field station in advance of the train to establish a partial route corresponding to the description stored by said through route description storage means,

(*d*) whereby a through route corresponding to a designated through route description is set up by partial route establishment, through one field station at a time, as the train progresses.

9. A centralized traffic control system for a track layout having track switches and signals at remotely spaced field stations controlled from a control office for the selective establishment of a plurality of through routes extending between an entrance point and a plurality of points of departure from the track layout comprising:

(*a*) code communication means for communicating switch and signal control codes from the control office to the field stations and for communicating indication codes from the field stations to the control office indicative of conditions of devices and indicative of the presence of trains at each of the field stations,

(*b*) route description storage means at the control office for storing a designated description of a through route extending from the entrance point through several field stations to any one of the points of departure,

(*c*) indication registration means at the control office actuated by an indication code transmitted from one of the field stations by said code communication means in response to the passage of a train for registering an indication at the control office of the presence of the train,

(*d*) partial route establishing means including said code communication means operable in response to the actuation of said registration means for clearing a signal and setting up a partial route in advance of the train conforming to said designated description of a through route,

(*e*) and means for rendering said partial route establishing means effective for setting up a partial route at a given station only provided there is no conflicting route established at that station.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 2,194,353 | Brown | Mar. 19, 1940 |
| 2,223,126 | Phinney | Nov. 26, 1940 |
| 2,399,734 | Hailes | May 7, 1946 |
| 2,439,676 | Seitz | Apr. 13, 1948 |
| 2,443,199 | Schmidt | June 15, 1948 |
| 2,700,728 | Brixner | Jan. 25, 1955 |
| 2,793,287 | Phelps | May 21, 1957 |
| 2,916,612 | Marple | Dec. 8, 1959 |