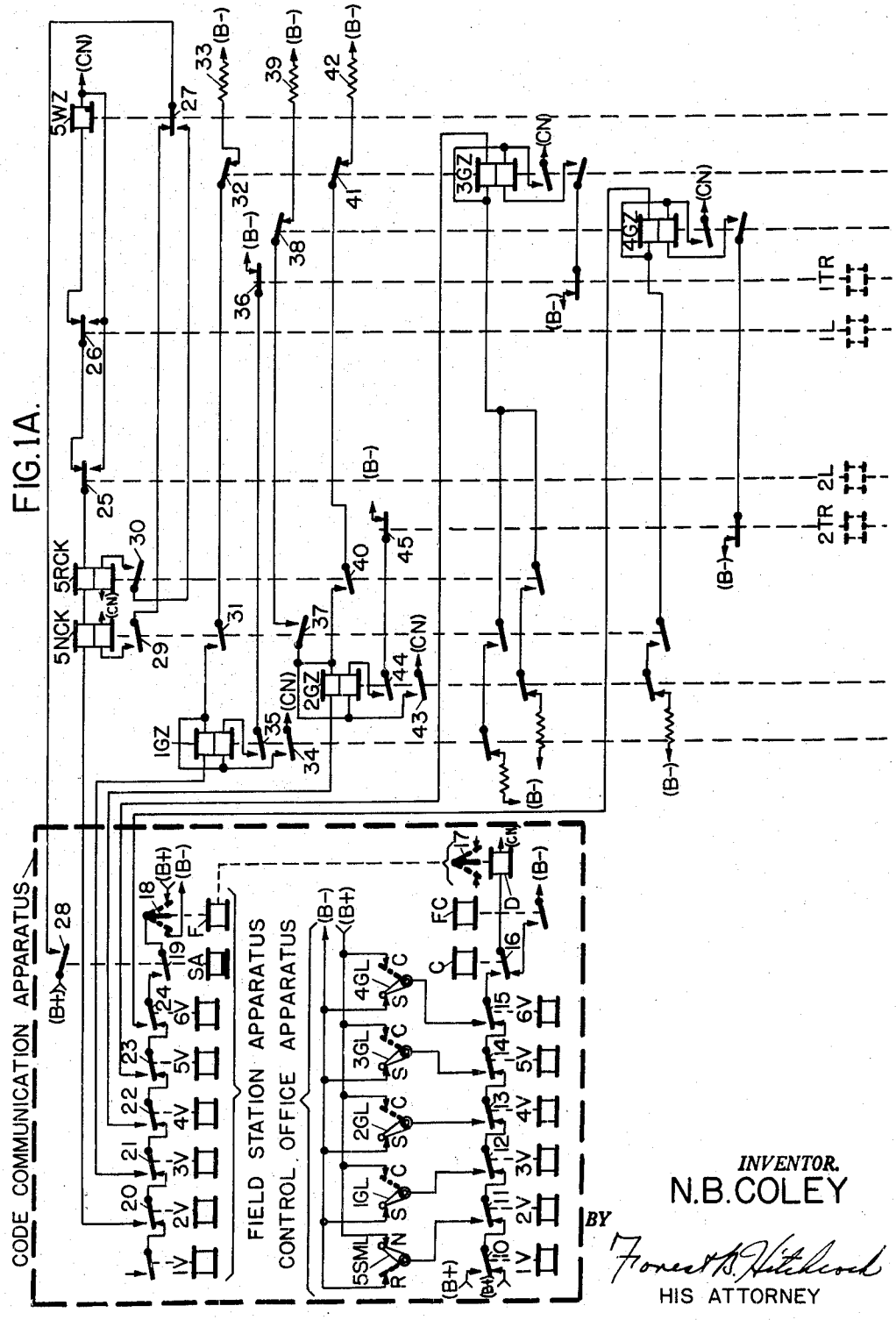
Sept. 8, 1959 N. B. COLEY 2,903,573

SWITCH CONTROL CHECK FOR RAILWAY SIGNALING CODE COMMUNICATION SYSTEMS

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FIG. 1A.



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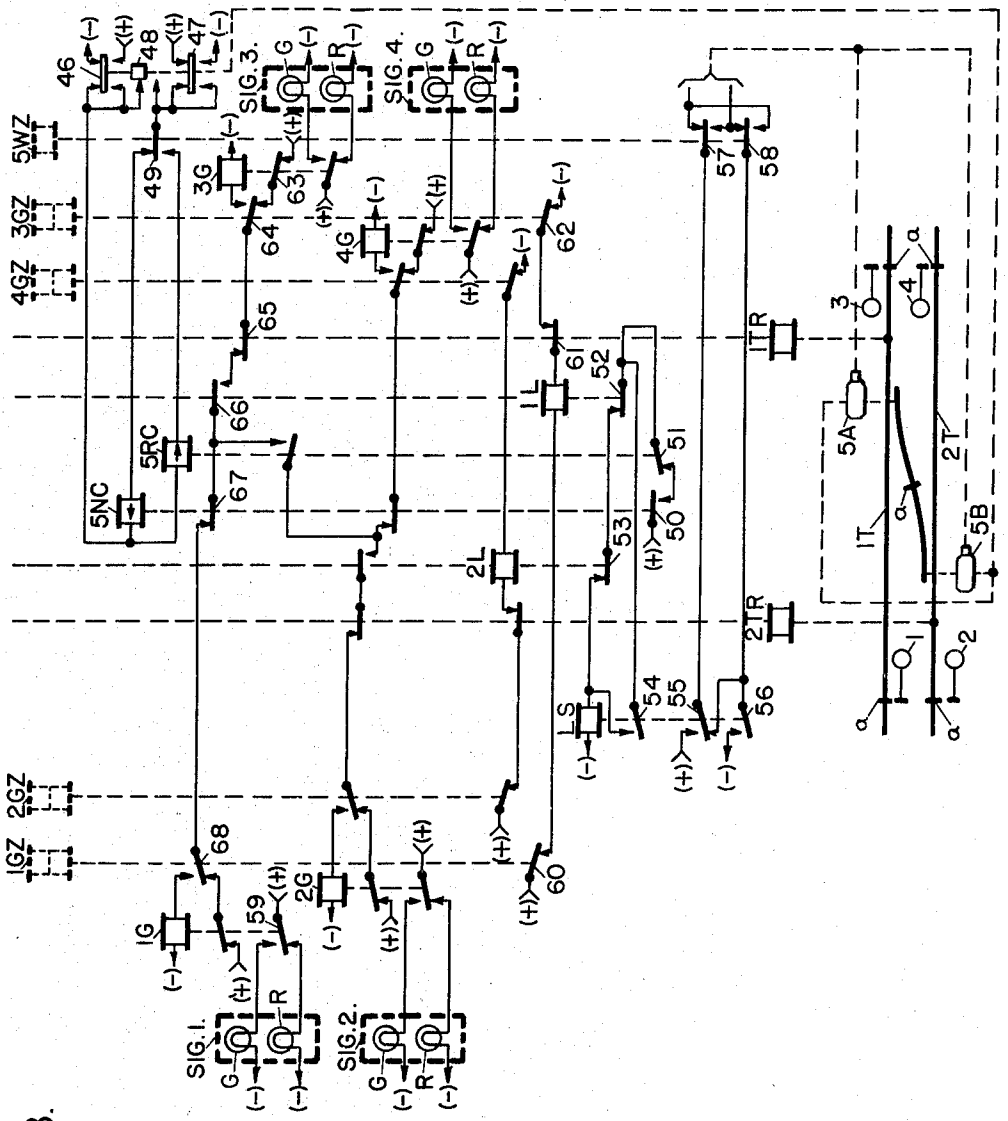


FIG.1B.

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2,903,573

SWITCH CONTROL CHECK FOR RAILWAY SIGNALING CODE COMMUNICATION SYSTEMS

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Application December 28, 1954, Serial No. 478,111

4 Claims. (Cl. 246—3)

This invention relates to railway signaling systems and relates, more particularly, to railway signaling systems of the code communication type.

A current trend in railway signaling practices is to place larger and, consequently, more complex railway interlockings under the jurisdiction of a single operator. As a result, ease and speed of operation of control systems are primary considerations.

It is often desirable to provide a control system which includes a code communication system, permitting the operator to effect the transmission of code cycles which contain selected series of code characters for controlling track switches and signals at remote locations, thus establishing routes for railway traffic. In such a series of code characters, track switch control codes are transmitted first, followed by the transmission of signal clearing control codes. From the standpoint of safety such a mode of operation is permissible because signal clearings cannot be effected unless relevant track switches are locked in either of their operating positions. However, the possibility arises that signals may be cleared for incorrect routes unless a correspondence check is made of actual track switch positions against called-for positions. In other words, if a signal clearing code is received at a time when one or more track switches have not had time to respond to switch control codes, previously established track switch correspondence conditions may still exist. Thus, the safety circuits may permit the clearing of a signal for a route other than that called for by the track switch control codes.

In general practice, signaling systems are arranged to operate in a manner such that track switch control codes are transmitted first. Correspondence checks are made to check actual track switch positions against positions called for by associated control codes to make sure that called for routes are properly aligned. Such correspondence checks are then indicated to the control system before signal clearing codes can be transmitted. Operations of this type are relatively slow because separate control cycles must be transmitted for controlling track switches and for controlling signals. Furthermore, the operating times of track switch throwing devices must be considered in addition to the transmission time of indication code cycles.

In view of the above considerations, it is proposed in this invention to provide a switch control code check means which permits the transmission of track switch and signal control codes for complete routes in a single cycle of operation by a code communication system. More specifically, in one form, the present invention includes a code communication system which when activated transmits selected series of code pulses, each series of code pulses constituting a complete control code cycle. In each control code cycle one code element is assigned for controlling each track switch and respective subsequent elements are assigned for controlling the different signals,

the characters transmitted as the different code elements being selected by manually operable control means.

The present invention includes a code responsive track switch control relay at a field station for each track switch for governing its operation in accordance with the characters of codes received from the control office during an associated control step. Two check relays are provided in conjunction with each track switch control relay, one check relay being associated with operation of the associated track switch to its normal position and the other check relay being associated with operation to the reverse position.

Each track switch control relay and its associated check relays have their windings connected in series in a manner such that the check relays respond to control pulses applied to the associated track switch control relay. If the track switch control relay responds correctly upon reception of a particular code, and assumes its corresponding operating position, the check relay associated with that operating position remains energized for the remainder of the control code cycle. Failure of the track switch control relay to assume an operating position in accordance with a particular control code results in the returning of the associated switch control check relays to their deenergized positions at the end of the associated control step.

When signal clearing control codes are transmitted on subsequent control steps, relevant track switch control check relays are utilized to either permit or prevent the operation of code responsive signal control relays. In other words, signal control relays cannot respond to control codes unless the control relays associated with track switches located in routes governed by the associated signals have responded correctly to previously transmitted control codes. Thus, complete route control codes may be transmitted in one code cycle, protection against the clearing of signals for wrong routes being afforded.

An object of this invention is to provide, at a field station, switch control check means for checking the proper response of track switch control relays to control codes received in a railway signaling code communication system.

Another object of this invention is to utilize switch control check means of the type described above in conjunction with a railway signaling code communication system in a manner such that control codes for both track switches and signals can be transmitted in a single cycle of operation by the code communication system, protection against the clearing of signals for wrong routes being afforded.

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 present invention in detail, reference is made to the accompanying drawings in which Figs. 1A and 1B, when placed one above the other, show diagrammatically a simple railway interlocking along with a code communication control system for controlling signaling apparatus located at the interlocking.

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

sources of electric current, instead of showing all of the wiring connections to these terminals.

The symbols (+) and (—) are employed to indicate the positive and negative terminals, respectively, of suitable batteries or other sources of direct current; and the circuits with which these symbols are used always have current flowing in the same direction. The symbols (B+) and (B—) indicate connections to the opposite terminals of a suitable battery, or other direct current source which has a central or intermediate tap designated (CN); and the circuits with which these symbols are used may have current flowing in one direction or the other depending upon the particular terminal used in combination with the intermediate tap (CN).

In order to describe the present invention, the present invention is assumed to be applied to the control of track switches and signals in a railway track layout as shown in Fig. 1B. This track layout is assumed to consist of two tracks, including track sections 1T and 2T, respectively, along with a cross-over between the two track sections. The track sections 1T and 2T are assumed to be parts of respective track circuits bounded by insulated rail joints *a*.

Traffic entering the track section 1T is governed in one direction by a signal 1 and in the other direction by a signal 3. Similarly, signals 2 and 4 are provided for governing traffic entering the track section 2T. The signals 1—4 are assumed to be of the color light type and are further assumed to be capable of displaying stop and proceed aspects.

The track switches at the extremities of the cross-over are positioned by power operable switch machines 5A and 5B which may be of any of a number of well-known-types.

The simple interlocking track layout of Fig. 1B may be assumed to be a part of a larger and more complex railway interlocking which includes numerous tracks, track switches and signals. A description of the present invention as applied to the simple interlocking can be made more readily; and it will be evident from this description as set forth as to how the present invention can be applied to large complex interlockings.

Various control devices associated with the signals 1—4 and the switch machines 5A and 5B are assumed to be located at a field station substantially at the interlocking location. Controls for the signaling apparatus are assumed to be initiated in a control office located remotely from the interlocking, and a code communication system is provided for transmitting control codes between the control between the control office and the field station.

Control office equipment is assumed to include a control machine of the well-known type used in centralized traffic control systems, the control machine including a miniature track diagram representing the interlocking track layout for which the system is provided. Control levers GL and SML (see Fig. 1A) for the various signals and track switches respectively are provided on the control machine panel at locations in the track diagram corresponding to the actual locations of associated signaling devices. Various indication lamps and other devices (not shown) may be provided according to usual practice.

It is assumed that two-position signal levers 1GL, 2GL, 3GL and 4GL (see Fig. 1A) are provided for controlling the signals 1—4 respectively. Each lever has a stop S and a clear C control position. Similarly, a switch control lever 5SML having a normal control N position and a reverse control R position is provided for controlling the switch machines 5A and 5B. Selective movements of the various levers serve to condition a code communication system which effects the transmission of selected control codes to the field apparatus.

Although any one of a number of different code communication systems may be used in conjunction with the present invention, it is assumed, for this embodiment of the present invention, that a system similar to that described in the T. J. Judge U.S. Patent No. 2,138,863, dated December 6, 1938, is employed. Relying on the above Judge patent for a complete description of the code communication system, the present disclosure will deal more generally with the mode of operation descriptions, and of the code communication system, those portions of the above Judge system which are necessary to show cooperation with the present invention are shown in block form in Fig. 1A.

In Fig. 1A banks of stepping relays 1V—6V are shown in both the control office and the field station. Six stepping relays are assumed in each bank to provide control code cycles having six steps, this number of steps being adequate for controlling the switches and signaling devices at the interlocking track layout. As described in the above Judge patent, when the code communication system is activated the stepping relays 1V—6V operate in sequence at both the control office and the field station.

A control cycle relay C along with an indication cycle relay FC are shown in Fig. 1A as being included in the code communication apparatus at the control office represented in the control office diagram. As described in the above Judge patent, the control cycle relay C is energized throughout the duration of a control cycle, and the indication cycle relay FC is energized throughout an indication cycle.

A polarity determining relay D is also shown as a part of the code communication apparatus at the control office. As in the above Judge patent the polarity determining relay D is assumed to be of the three-position biased-to-neutral polar type. The relay D selectively pole changes the line circuit in response to polarized energizations of the relay by a circuit network including contacts of the various control levers SML and GL and stepping relays 1V—6V.

At the field station a line relay F which is also of the three-position biased-to-neutral polar type responds to polarized energizations of the control line by the code determining relay D. The relay F in conjunction with the stepping relay network at the field station selectively operates various control devices to be described.

A slow-acting line repeater relay SA is shown in block form with the code communication apparatus provided at the field station. This relay SA functions in the manner described in the above Judge patent so as to be maintained picked up throughout each control cycle.

Signal control relays 1GZ, 2GZ, 3GZ and 4GZ are provided at the field station for controlling the signals 1—4, respectively, in response to control codes and to operations of the field station stepping relay network.

A switch control relay 5WZ is provided at the field station to control the switch machines 5A and 5B in response to control codes and to operations of the field station stepping relay network. The relay 5WZ is assumed to be of the magnetic-stick type which retains its armature in the last operated position.

Two neutral track switch control check relays 5NCK and 5RCK are provided at the field station to check the response of the switch control relay 5WZ to control codes. The track switch control check relays 5NCK and 5RCK are normally deenergized, becoming energized when switch control codes are received. A particular track switch control check relay can remain energized only when the switch control relay 5WZ responds correctly to a particular control code.

Two switch correspondence relays 5NC and 5RC are provided to detect correspondence between actual and called-for positions of the track switches associated with the switch machines 5A and 5B. Relay 5NC checks correspondence for normal track switch positions, while the relay RC checks correspondence for reverse track switch positions. Relays 5NC and 5RC are assumed to be of the polar-biased type, being capable of picking up their armatures only when energized by energies of particular polarities.

Two lock relays 1L and 2L are provided to detect

route locking conditions. Relay 1L is associated with routes involving the track section 1T and is assumed to be energized whenever the track section 1T is unoccupied and the signals 1 and 3 are required to display stop aspects. The lock relay 2L operates in a similar manner, reflecting the conditions of the track section 2T and the signals 2 and 4.

A lock stick relay LS is provided to permit or prevent operations of the switch machines 5A and 5B, depending on route locking conditions. The lock stick relay LS is assumed to be normally denergized, becoming energized whenever switch controls calling for changes in track switch positions are received by the switch control relay 5WZ. Energization of the relay LS is also dependent upon lock relays 1L and 2L being energized. Once energized the relay LS assures the operation of the switch machines 5A and 5B once such operations are initiated.

Four signal relays 1G, 2G, 3G and 4G are provided to selectively determine the aspects displayed by signals 1—4 respectively. The signal relays 1G—4G are operated in response to operations of the signal control relays 1GZ—4GZ, respectively, whenever safety circuit conditions permit such operations.

Operation

The code communication system disclosed in the above Judge patent may be generally reviewed and correlated with the block diagram of Fig. 1A. Concurrently, the operation and utility of the present invention in conjunction with the code communication system may be described.

In selectively initiating control code cycles various control levers are first positioned, followed by the activation of the code communication system by a starting push button (not shown). The control cycle relay C is ultimately energized by the actuation of the starting push button and remains energized throughout each complete control cycle.

Control code characters are made distinctive on each step of a control cycle by the polarity of energization of the line circuit connecting the control office and the field station. The selection of the polarities to be applied to the line circuit is accomplished by selectively controlling the polarity determining relay D. At the start of a control cycle the relay D is energized by a pick-up circuit extending from (B+), including back contacts 10—15 of the stepping relays 1V—6V respectively, front contact 16 of relay C and the winding of relay D to (CN). The relay D then closes either its right-hand or left-hand contacts, as indicated by contact 17 of relay D, to apply energy of a particular polarity to the line circuit, resulting in the polarized energization of the line relay F at the field station. As a result, the portion of the code communication system at the field station is activated and operates in synchronism with the control office portion. It is assumed here that the application of (B+) energy to both the relay D and the relay F causes those relays to close their right-hand contacts. Applications of (B—) energy to the relays D and F are assumed to cause the relays to close their left-hand contacts.

At this time, the banks of stepping relays 1V—6V in both the control office and the field station operate in sequence and in synchronism. The energization of each stepping relay demarks a distinct code step.

On the first control step the stepping relay 1V in the control office closes its front contact 10 applying (B+) energy to the pick-up circuit for the relay D. The polarity applied by front contact 10 of relay 1V is arbitrary in this instance. In other words, the first step of the control cycle is not utilized in performing a distinct control function.

On successive steps front contacts 11—15 of relays 2V—6V, respectively, in the control office close, altering the pick-up circuit for the relay D. The polarity applied to the relay D on each step is determined by the position of the control lever associated with each particular step. In other words, on the second step front contact 11 of relay 2V closes establishing a pick-up circuit for the relay D which includes the control lever 5SML. If the lever 5SML is positioned to call for normal track switch positions its normal N contact is closed applying (B+) energy to the pick-up circuit. (B—) energy is applied on the second step whenever the control lever 5SML is positioned to close its reverse R contact.

The signal levers 1GL—4GL function in the same manner as that described for the switch control lever 5SML, and the polarities applied to the pick-up circuit of the relay D are arbitrary. In the present scheme it is assumed that the positioning of any signal control lever to its stop control position closes the stop S contact and applies (B—) energy to the pick-up circuit for the relay D; the positioning of a signal control lever to the clear control position applies (B+) energy to the pick-up circuit through the clear C contact of the lever.

In the above Judge patent one or more code determining relays and contacts thereof are shown in the pick-up circuit for the relay D. Such relays are not necessary in the present disclosure because only one field station is assumed. Therefore, direct connections are shown here between the various control levers and their associated stepping relay contacts.

At the field station energy is applied to various control relays through a network of stepping relay contacts which also includes a contact 18 of the line relay F. Also included in the network is a front contact 19 of relay SA, the relay SA being energized at the start of a control cycle and remaining energized throughout the cycle.

As the stepping operation progresses at the field station front contacts 20—24 of relays 2V—6V, respectively, close in sequence. On the second step, for example, front contact 20 of relay 2V closes establishing a pick-up circuit for the switch control relay 5WZ and the track switch control check relays 5NCK and 5RCK; a more complete description of this pick-up circuit will follow. Similarly, on successive steps pick-up circuits are closed by front contacts 21—24 of relays 3V—6V, respectively, for selectively energizing the signal control relays 1GZ—4GZ, respectively. The pick-up circuits for the various signal control relays will also be described later.

Track switch control codes are received at the field station on the second step of a control cycle. At this time energy is applied to the windings of a switch control relay 5WZ and the switch control check relays 5NCK and 5RCK by a pick-up circuit including contact 18 of relay F, front contact 19 of relay SA, back contact 24 of relay 6V, back contact 23 of relay 5V, back contact 22 of relay 4V, back contact 21 of relay 3V, front contact 20 of relay 2V, the windings of relays 5NCK and 5RCK, front contact 25 of relay 2L, front contact 26 of relay 1L, and the winding of relay 5WZ. The polarity of the energy applied to this pick-up circuit is determined by the polarized energization of the line relay F. If a normal switch call is transmitted it is assumed that the relay F closes its contacts 18 in the right-hand position applying (B+) to the pick-up circuit. A reverse switch call is assumed to cause the line relay F to apply (B—) to the pick-up circuit by closing its contact 18 to the left.

As shown, the previously described circuit assumes that the switch control relay 5WZ has previously responded to a normal switch call resulting in the closing of front contact 27 of relay 5WZ. Since relay 5WZ is of the polar-stick type it retains its armature in the last operated position. If a normal switch call code is received on the second step under these conditions (B+) energy is applied to the pick-up circuit for relay 5WZ, resulting in the energization of the switch control check relays 5NCK and 5RCK. A stick circuit is then estab-

lished for the normal switch control check relay 5NCK which includes front contact 28 of relay SA, front contact 27 of relay 5WZ and front contact 29 of relay 5NCK. In this manner relay 5NCK is energized by an energy pulse and is held energized by a stick circuit which remains closed throughout the remainder of the control cycle. It should be noted that the direction of current in both the pick-up and stick circuits for relay 5NCK is the same. Since the switch control relay 5WZ is already in its normal control position the application of (B+) energy produces no operation of the relay.

If a reverse switch call is transmitted at this time on the second step of a control cycle, (B—) is applied to the pick-up circuit for relay 5WZ by the closing of contact 18 of relay F to the left. Under this condition, energy flows from right to left in the pick-up circuit, driving down the armature of relay 5WZ and causing the closing of back contact 27 of relay 5WZ. Simultaneously, the switch control check relays 5NCK and 5RCK are energized. A stick circuit is established for the reverse switch control check relay 5RCK, including front contact 28 of relay SA, back contact 27 of relay 5WZ, and front contact 30 of relay 5RCK. In this instance, the direction of current in both the pick-up and stick circuits for relay 5RCK is the same. Relay 5RCK is therefore energized by an energy pulse and is maintained energized by its stick circuit for the duration of the control cycle.

Whenever route locking is in effect, either or both front contacts 25 and 26 of relays 2L and 1L, respectively, are open. The reception of a switch control code is therefore ineffective insofar as further operations of the switch control relay 5WZ is concerned. However, the switch control check relays 5NCK and 5RCK become energized but cannot remain energized unless the control code polarity is in agreement with the last operated position of contact 27 of relay 5WZ. For example, assume that front contact 27 of relay 5WZ is closed and that back contact 25 of relay 2L is closed. Under such conditons, the last switch call was for normal track switch alignment; and the closed condition of back contact 25 of relay 2L indicates that route locking is in effect. In other words, a signal has been cleared for a route through the track setcion 2T. If at this time a reverse switch call is made (B—) energy is applied to the pick-up circuit for the switch control check relays 5NCK and 5RCK through the back contact 25 of relay 2L which by-passes the winding of relay 5WZ. The reverse switch control check relay 5RCK cannot remain energized for the duration of the control cycle because its stick circuit is open at contact 27 of relay 5WZ. The normal switch control check relay 5NCK does receive energy through its stick circuit, but the direction of current in the stick circuit is opposite to that in the pick-up circuit. Therefore, the flux produced in one winding neutralizes that produced by the other resulting in the dropping away of the armature of relay 5NCK. Thus, a positive switch control check is provided by the circuits described. The switch control check relays 5NCK and 5RCK check the reception of control energy by the switch control relay 5WZ because their respective windings are in series with the winding of relay 5WZ. Further check is provided in that the stick circuits for the relays 5NCK and 5RCK are effective only when the relay 5WZ responds (or has responded) correctly to particular control codes.

The upper, or pick-up windings of relays 5NCK and 5RCK may be connected either in series or in parallel. However, the pick-up winding of each relay must be in series with the winding of relay 5WZ.

It should be noted that the pick-up windings of relays 5NCK and 5RCK are energized by energy pulses having durations limited by the length of time allotted to the second control step by the stepping relay system. The pick-up and stick windings of each of the relays 5NCK and 5RCK must be aligned in a manner such that when energy is removed from a pick-up winding at the end of a code step the magnetic flux produced in the lower, or stick winding opposes the flux produced in the pick-up winding, causing the release of the relay armature when the currents flowing in the respective windings are in opposition.

On the third step of the control cycle controls for signal 1 are transmitted. At the field station the opening of back contact 21 and the closing of front contact 21 of relay 3V opens the previously described pick-up circuit for the switch control relay 5WZ and closes a pick-up circuit for the signal control relay 1GZ. The pick-up circuit for signal control relay 1GZ includes contact 18 of relay F, front contact 19 of relay SA, back contact 24 of relay 6V, back contact 23 of relay 5V, back contact 22 of relay 4V, front contact 21 of relay 3V, the upper winding of relay 1GZ, front contact 31 of relay 5NCK, back contact 32 of relay 3GZ, and a resistor 33. The polarity of energy applied to relay 1GZ is determined by the position assumed by contact 18 of relay F. Signal clearing controls arbitrarily require the closing of contact 18 of relay F to the right applying (B+) energy. Stop signal controls require applications of (B—) energy to the pick-up circuit through the closing of contact 18 of relay F to the left. It is evident that the application of (B—) to the pick-up circuit will not energize the pick-up winding of relay 1GZ since the other extremity of the pick-up circuit is also connected to (B—).

The energization of relay 1GZ is dependent upon the normal switch control check relay 5NCK being energized and also upon a deenergized state of relay 3GZ. In other words, signal 1 governs traffic entering the interlocking on track section 1T and moving from left to right. The track switch associated with the switch machine 5A must lie in its normal position to permit a clearing of signal 1. It is obvious that signal 3 cannot be cleared in opposition to signal 1. Therefore, a check of track switch and opposing signal controls is made in the pick-up circuit for relay 1GZ.

Once energized, relay 1GZ is held energized by a stick circuit extending from (CN) including front contact 34 of relay 1GZ, the lower winding of relay 1GZ, front contact 35 of relay 1GZ, and front contact 36 of relay 1TR to (B—). The closing of front contact 34 of relay 1GZ provides a parallel current path which includes front contact 31 of relay 5NCK, back contact 32 of relay 3GZ and resistor 33. The resistor 33 is assumed to have a resistance high enough to preclude the shunting of the stick winding of relay 1GZ by the previously described parallel circuit.

Relay 1GZ is maintained energized until the stick circuit is opened by front contact 36 of relay 1TR when traffic enters the track section 1T. However, relay 1GZ may be deenergized during a subsequent control cycle in which a signal stop control is transmitted on the third step. In the latter instance, (B—) energy is applied to the pick-up circuit for relay 1GZ by contact 18 of relay F. Current then flows (CN) through front contact 34 of relay 1GZ and the upper winding of relay 1GZ. The direction of current in the upper winding is opposite to the direction of current in the stick winding of the relay, resulting in the releasing of the relay armature. It should be noted that precautions are taken to preclude the possibility of having relay 1GZ release its armature and subsequently pick up its armature during an abnormally long pulse of (B—) energy. In other words, front contact 35 of relay 1GZ serves as a stick contact while front contact 34 serves as a cutoff contact which prevents erroneous deenergization of the relay which might occur if contact 34 were omitted from the circuit.

On the fourth control step the signal control relay 2GZ is controlled by the stepping relay network in a

manner similar to that described for relay 1GZ. However, signal 2 governs traffic over two routes which are dependent upon the position of the cross-over. One pick-up circuit includes front contact 37 of relay 5NCK, back contact 38 of relay 4GZ and a resistor 39. The other pick-up circuit includes front contact 40 of relay 5RCK, back contact 41 of relay 3GZ and a resistor 42. In either case energy is applied to the pick-up circuits by the closing of front contact 22 of relay 4V which also opens the previously described pick-up circuit for relay 1GZ.

The pick-up circuits for relay 2GZ are dependent upon the energized state of one or the other of the switch control check relays 5NCK or 5RCK and the deenergized state of the corresponding opposing signal control relay 3GZ or 4GZ.

Once energized relay 2GZ is held energized by a stick circuit including front contacts 43 and 44 of relay 2GZ, the lower winding of relay 2GZ, and front contact 45 of relay 2TR. Relay 2GZ may be deenergized either by track occupancy or by a subsequent stop control in the manner described above for relay 1GZ.

Relay 3GZ is operated on the fifth control step in a manner similar to that described above for relay 2GZ. By the same token relay 4GZ is controlled on the sixth step in a manner similar to that described for relay 1GZ.

It can be seen from the preceding description that during a control cycle controls for the track switches 5A and 5B are transmitted on the second step and a check is made that the switch control relay 5WZ responds to the control code. The switch check relays 5NCK and 5RCK check the valid reception of switch control codes and permit subsequent energizations of the various signal control relays. In this manner, the possibility of clearing a signal for an incorrect route is prevented while allowing the transmission of complete route controls in a single control cycle.

When a switch control is received on the second step of a control cycle the switch correspondence relays 5NC and 5RC are operated in accordance with the operated position of the switch control relay 5WZ and the actual positions assumed by the track switches 5A and 5B. Track switch position is detected by point detector mechanisms in the switch machines 5A and 5B. The point detection mechanisms may be of the type described in C. S. Bushnell Patent No. 1,517,236, dated November 25, 1924 and are shown here in a simplified form. In Fig. 1B the point detection mechanisms are represented by movable contacts 46, 47 and 48. It is assumed that when the track switches lie in their normal positions contacts 46 and 47 are moved upward to close one set of stationary contacts. Contacts 46 and 47 are moved downward to close second sets of stationary contacts when the track switches lie in their reverse positions. When the track switches are in transit between their normal and reverse positions the movable contacts 46 and 47 do not make contact with either sets of stationary contacts. The contact 48, however, closes a circuit through a third set of horizontally disposed stationary contacts when the track switches lie in intermediate positions.

When the switch control relay 5WZ is operated for normal switch controls front contact 49 of relay 5WZ closes. If the track switches lie in their normal positions a pick-up circuit for the normal correspondence relay 5NC is established through contacts 46 and 47 of the point detector and front contact 49 of relay 5WZ. If correspondence does not exist between switch position and switch call the pick-up circuit for relay 5NC is open at contacts 46 and 47 of the point detector. A similar pick-up circuit for the reverse correspondence relay 5RC includes contacts 46 and 47 of the point detector and back contact 49 of relay 5WZ.

More specifically, when the switch control relay 5WZ is operated to its normal switch control position and the track switches 5A and 5B lie in their normal positions the normal correspondence relay 5NC is energized by a circuit extending from (B+), including contact 47 of the point detector, front contact 49 of relay 5WZ, the relay winding 5NC, and contact 46 of the point detector, to (−). The relay 5NC is assumed to be of the polar-biased type and is capable of picking up its armature only when current flows in the direction of the arrow. In the previously discussed pick-up circuit the polarity of the applied energy is such that current does flow in the proper direction.

Assume now that a reverse switch control is received by the switch control relay 5WZ. Relay 5WZ releases its armature closing its back contact 49. The pick-up circuit for the normal correspondence relay 5NC is opened. A pick-up circuit is subsequently established for the reverse correspondence relay 5RC. However, relay 5RC cannot pickup its armature because of the polar-biased structure of the relay. In other words, the polarity of energy applied to the pick-up circuit of relay 5RC is incorrect until the movable contacts 46 and 47 of the point detector move to positions which indicate that the track switches have reached their reverse positions. At this time, relay 5RC is energized by a pick-up circuit extending from (+), including contact 46 of the point detector, the relay winding 5RC, back contact 49 of relay 5WZ, and contact 47 of the point detector, to (−).

At times when the track switches are in transit contact 48 of the point detector closes the horizontally disposed stationary contacts of the detector, shunting the winding of one or the other of the switch correspondence relays. In this manner, protection is afforded against the false energization of a switch correspondence relay by stray energy from another source under abnormal conditions.

Track switch controls are effected when a control code is received by relay 5WZ. If correspondence exists between switch call and actual track switch position no controls are transmitted to the switch machines 5A and 5B. If correspondence does not exist actuation of relay 5WZ causes the deenergization of the previously energized correspondence relay 5NC or 5RC. Under these conditions both correspondence relays become deenergized. Switch controls are then effected by the energization of the lock stick relay LS by a pick-up circuit extending from (+) including back contact 50 of relay 5NC, back contact 51 of relay 5RC, front contact 52 of relay 1L, front contact 53 of relay 2L, and the winding of relay LS to (−). The lock stick relay LS is then held energized by a stick circuit including its front contact 54. This stick circuit is maintained until switch correspondence is again attained and either back contact 50 of relay 5NC or back contact 51 of relay 5RC opens.

The closing of front contacts 55 and 56 of relay LS establishes a circuit for energizing the switch machines 5A and 5B. The switch control circuit includes normal and reverse control selections introduced by contacts 57 and 58 of relay 5WZ. It is assumed that normal switch controls are effected when front contacts 57 and 58 of relay 5WZ are closed, reverse controls being effected when back contacts 57 and 58 of relay 5WZ are closed.

Energy is maintained in the switch control circuit by the relay LS until switch correspondence is attained. In other words, subsequent deenergizations of the lock relays 1L or 2L have no effect on the switch control circuit until track switch movements are completed.

The completions of track switch movements in response to control codes result in the energization of a particular correspondence relay 5NC or 5RC. Various signal control circuits are rendered operative as soon as switch correspondence is effected and particular signal control relays 1GZ—4GZ are operated. Controls for signal 1 are selectively applied to the signal lamps by contact 59 of relay 1G. It is obvious that the closing of back contact 59 of relay 1G energizes the red R lamp in signal 1. Similarly, closing of front contact 59 of relay 1G ener-

gizes the green G lamp in signal 1. Comparable circuits are provided for energizing the indication lamps in signals 2, 3 and 4 through the action of signal relays 2G, 3G and 4G, respectively.

Assume that a signal clearing control is received on the third step for signal 1. The signal control relay 1GZ is energized in the manner previously described. The opening of back contact 60 of relay 1GZ opens a pick-up circuit for the lock relay 1L; the pick-up circuit also includes front contact 61 of relay 1TR and back contact 62 of relay 3GZ.

The signal relay 1G is now energized by a pick-up circuit extending from (+), including back contact 63 of relay 3G, back contact 64 of relay 3GZ, front contact 65 of relay 1TR, back contact 66 of relay 1L, front contact 67 of relay 5NC, front contact 68 of relay 1GZ, and the winding of relay 1G to (−). Contact 59 of relay 1G operates as previously described to energize the green G lamp in signal 1.

Signal 1G continues to display a green aspect until the relays 1GZ and 1G are deenergized either by the subsequent reception of a signal stop control code or by the arrival of a train on the track section 1T.

When a train enters the track section 1T the shunting action of the train wheels in the track circuit critically deenergizes the track relay 1TR which opens its front contact 61 in the previously described pick-up circuit for the lock relay 1L, holding relay 1L deenergized. At the same time, front contacts 36 and 65 of relay 1TR open to deenergize relays 1GZ and 1G, respectively. Signal 1 is thus caused to display a red aspect by the closing of back contact 59 of relay 1G.

When the train leaves the track section 1T relay 1TR becomes energized reclosing its various front contacts. The lock relay 1L is then energized by the closing of front contact 61 of relay 1TR.

It is evident from the drawings that similar safety circuits including the lock relay 2L and the track relay 2TR are provided for controlling signal relays 2G, 3G and 4G. Further description is considered unnecessary in view of the above description and in view of the well-known status of such circuits in the art.

Summary of operation

The operation of the present system provides a means for controlling the track switches in a particular route on an early step of a control cycle, resulting in the actuation of the switch control relay 5WZ and the track switch control check relays 5NCK and 5RCK. If a switch control is received and causes the switch control relay 5WZ to operate, one or the other of the track switch control check relays remains energized for the duration of the control cycle.

The subsequent transmission of signal clearing control codes on later steps in the control cycle results in the energization of particular signal control relays if a corresponding track switch control check relay has been previously energized.

Protection against clearing signals for wrong routes is thus provided by the track switch control check relays. Protection insofar as safety is concerned is provided by signal control circuits at the field station.

Thus, complete route control codes may be transmitted and registered at the field station to await execution by the field station apparatus when traffic and safety conditions are favorable.

The switch control check scheme outlined above is applicable to high speed code systems since relay operating times may be adjusted to fit the needs of practice. The quick-acting switch registration means improves the operating times of control systems in which speed and facility of operation are prime considerations. This is especially true when large interlockings are involved.

The present invention is applicable to large interlockings having pluralities of track switches in particular traffic routes. In such instances it is necessary to organize the control system so that particular track switch control codes are transmitted during portions of control cycles which precede portions allotted to the transmission of signal control codes for controlling signals which govern routes including the particular track switches.

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

What I claim is:

1. In a centralized traffic control system for the control of railway track switches and signals at a field station from a remote control office, a track layout at the field station having a power track switch and a signal governing traffic over the track switch, means at the control office for designating respective normal and reverse controls for said track switch and for designating the clearing of said signal, code communication apparatus connecting the control office and the field station operable when rendered active to transmit a series of selected code pulses from the control office to the field station during a single cycle of operation of the code communication apparatus, said series of code pulses comprising a selected switch control code element for governing operation of said track switch to a designated normal or reverse position followed by a selected signal control code element for clearing said signal, a switch control relay at the field station, two check relays at the field station, one of said check relays being provided for the normal position of said track switch control relay and the other of said check relays being provided for the reverse position of said track switch control relay, pick-up circuit means rendered effective upon the reception of said switch control code element for energizing said switch control relay and said check relays in series, polarized stick circuit means including front contacts of the respective check relays and contacts of said switch control relay for maintaining one or the other of said check relays picked up after termination of the switch control code element only provided that said switch control relay has responded in accordance with the switch position called for by the character of the switch control code element that has been received, and circuit means permitting the clearing of said signal in response to said signal control code element only provided that one or the other of said checking relays is energized.

2. In a system for controlling railway signaling devices including a power operable track switch at a field station from a remote control office, a code communication system linking said control office and field station and being capable when activated of performing control code transmission cycles, each of said cycles comprising a series of code steps containing codes of selected characters, each of said code steps being associated with the controlling of a particular signaling device; a manually operable control selection means at the control office associated with said track switch for determining the characters of control codes transmitted during control code cycles on the code step associated with said track switch, means for activating said code communication system, a track switch control relay, said track switch control relay being of the magnetic-stick type and having two operating positions, each operating position being associated with an operating position of said track switch, said track switch control relay being capable of retaining its armature in the last operated position during times when said relay is not being

controlled, a normal track switch control check relay and a reverse track switch control check relay, each of said track switch control check relays having a pick-up winding and a stick winding, route locking means for indicating previously established controls for signaling devices related to routes which include said track switch, a pick-up circuit means including both of said pick-up windings of the track switch control check relays and the windings of said track switch control relay and the route locking means for operating said track switch control relay in response to transmitted switch control codes said pick-up circuit means being operative only when route locking means indicate the absence of previously established route controls and only for the duration of the associated code step and being polarized in accordance with the characters of said switch control codes, and switch control check relay stick circuit means including the stick winding of said check relay and a contact of said check relay responsive to the correspondence condition of said switch control relay for holding one of said track switch control check relays operative, said stick circuit means for each of said track switch control check relays being polarized with respect to said pick-up circuit means whereby the stick winding of a particular relay is effective to neutralize the flux in the relay whenever the operating position assumed by said track switch control relay is not in accordance with a particular polarization of said pick-up circuit means.

3. In a railway signaling system, a plurality of track switches selectively operable to form routes for railway traffic, a plurality of signals selectively operable to govern traffic over routes formed by said track switches, a control office, a field station located near said track switches and signals, a code communication system linking said control office and field station and being capable when activated of performing control code transmission cycles comprising series of code steps, each of said code steps containing a code of selected character, manually operable route selection means at said control office for activating said code communication system and for selecting the characters of codes to be transmitted for controlling said track switches and signals, said route selection means being aligned in conjunction with said code communication system in a manner such that in each control code cycle code steps associated with said track switches precede code steps associated with said signals, a code responsive track switch control device at said field station associated with each of said track switches, said track switch control device being operable to either of two positions corresponding to the distinctive character of a switch control code, said track switch control devices being capable of remaining in the last operated position, two track switch control check devices at said field station provided for each of said track switch control devices, one of said track switch control check devices being provided for each of two operating positions of the associated track switch control device, an operating circuit means responsive to a particular switch control code for operating a particular track switch control device and each of the associated track switch control check devices, a holding circuit means responsive only to the in-correspondence condition of a designated transmitted switch control code and the operated position of said track switch control device for holding either of said track switch control check devices operative during the remainder of said control cycle, a code responsive signal control device at said field station associated with each of said signals, circuit means responsive to operations of said code communication system and relevant track switch control check devices for selectively operating said signal control device, track switch control means responsive to operations of said track switch control devices for operating said track switches, track switch correspondence means responsive to operations of said track switch control devices and associated track switches for detecting correspondence between actual track switch positions and positions called for by operating positions of associated track switch control devices, and signal control means subject to operations of said track switch correspondence means for selectively controlling said signals in response to operations of said signal control devices.

4. In a control system for a track switch and signals governing routes which include the track switch, control apparatus capable when activated of delivering a pulse of energy of a selected polarity for controlling the track switch, a two-position polarized switch control relay for controlling the track switch, said switch control relay being capable of retaining its armature in the last operated position, two switch control check relays associated, respectively, with the operating positions of said switch control relay, each of said switch control check relays having a pick-up winding and a stick winding, circuit means for connecting the winding of said switch control relay and the pick-up windings of said switch control check relays in series and to said control apparatus so that an energy pulse delivered by said control apparatus operates said switch control check relays to pick-up and operates said switch control relay in accordance with the polarity of the energy pulse, stick circuit means energized by energy of a fixed polarity while said control apparatus is activated and including contacts of said switch control relay for selectively energizing the stick windings of said switch control check relays, said stick circuit means being arranged so that the energization of the stick winding of a particular switch control check relay produces a magnetomotive force which either aids or opposes the magnetomotive force produced by the energization of the pick-up winding of the particular switch control check relay either to hold or to release its armature depending, respectively, upon either the agreement or disagreement between the operated position of said switch control relay and the position called for by the polarity of the energy pulse supplied by said control apparatus.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,903,573 September 8, 1959

Nelson B. Coley

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 14, line 50, after "relay" insert -- , thereby causing the particular switch control check relay --.

Signed and sealed this 20th day of September 1960.

(SEAL)
Attest:
KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents