

Jan. 21, 1941.

F. H. NICHOLSON

2,229,254

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed March 30, 1938

2 Sheets-Sheet 1

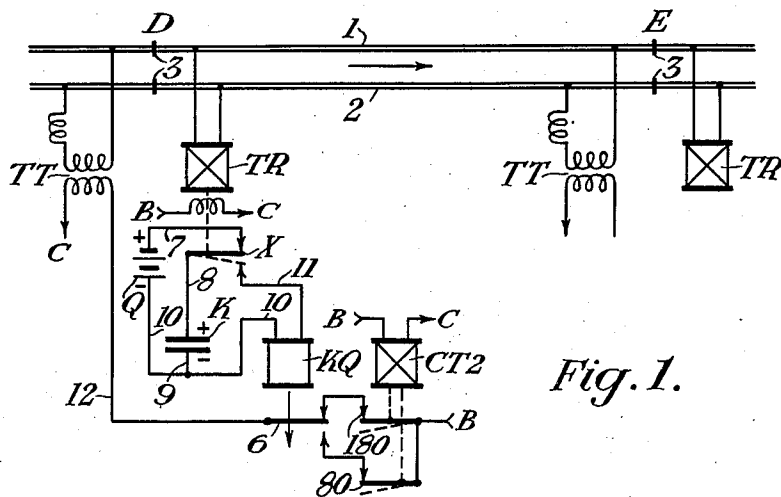


Fig. 1.

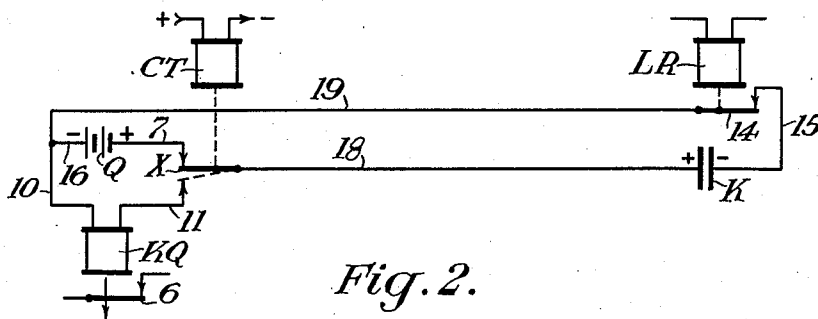


Fig. 2.

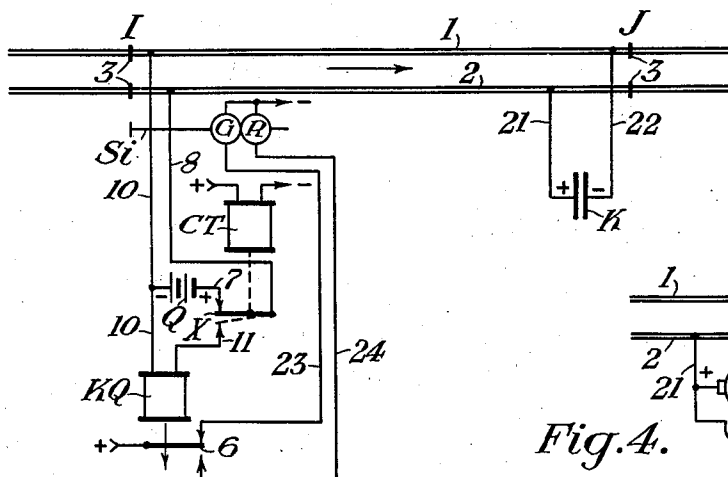


Fig. 3.

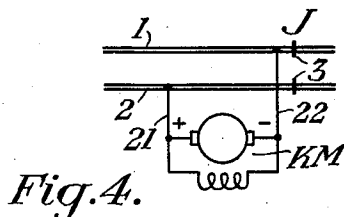


Fig. 4.

INVENTOR
 Frank H. Nicholson.
 BY *Robert*
 HIS ATTORNEY

Jan. 21, 1941.

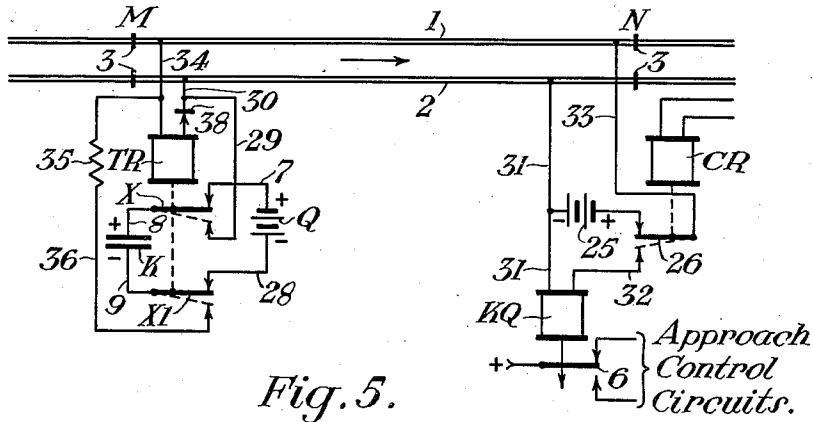
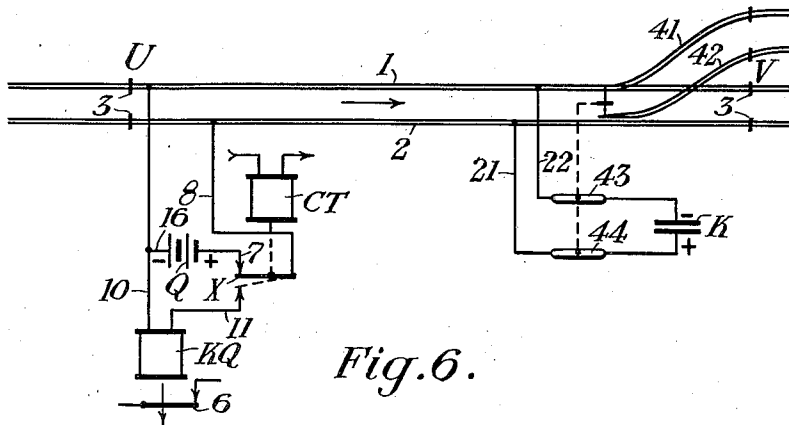
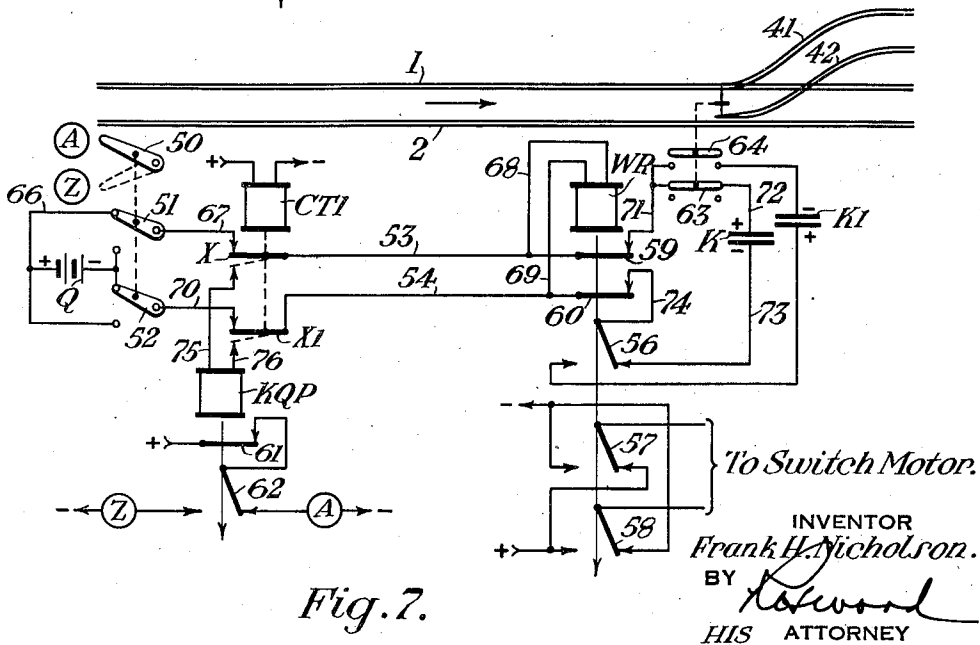
F. H. NICHOLSON

2,229,254

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed March 30, 1938

2 Sheets-Sheet 2



INVENTOR
Frank H. Nicholson.
BY *Kelwood*
HIS ATTORNEY

UNITED STATES PATENT OFFICE

2,229,254

RAILWAY TRAFFIC CONTROLLING
APPARATUS

Frank H. Nicholson, Penn Township, Allegheny
County, Pa., assignor to The Union Switch &
Signal Company, Swissvale, Pa., a corporation
of Pennsylvania

Application March 30, 1938, Serial No. 198,935

7 Claims. (Cl. 246—34)

My invention relates to railway traffic controlling apparatus and it has special reference to the organization of such apparatus into systems wherein various circuits are controlled in accordance with the presence or absence of repeatedly recurring pulses of coded energy.

One object of my invention is to provide a new and improved form of such organization.

Another object is to simplify the equipment needed to register the operation of a periodically actuated contact such as that of a code-following relay.

An additional object is to provide improved means for controlling a relay from a distant point when no primary source of power is available at that point.

A further object is to increase the shunting sensitivity of continuously coded track circuits.

A still further object is to facilitate the provision of approach energization without the use of line conductors.

A still additional object is to provide for the control and indication of the operation of a railway switch through the medium of but two line conductors between the switch and its control lever.

In practicing my invention I attain the above and other objects and advantages by using an energy-storage device, such as a capacitor, as a secondary source of power for a relay which is arranged to register an operating effect of a coding or other periodically movable contact. Under the control of this contact the secondary storage device is repeatedly connected first to a charging source and then to a discharging circuit which includes the winding of the operation-registering relay. That relay releases with sufficient slowness as to bridge the periods between the successive energizing pulses which result and thus it responds to the presence or absence of the desired operating effect of the periodically movable contact referred to above.

I shall describe six forms of railway traffic controlling apparatus embodying my invention and shall then point out the novel features thereof in claims. These embodiments are disclosed by the accompanying drawings in which:

Fig. 1 is a diagrammatic representation of my improved code-registering means incorporated in a coded train-control system;

Fig. 2 is a diagrammatic view of an application of the code-registering means to a system which includes a line-wire control circuit;

Figs. 3 and 4 show applications of my code-

registering means to track circuits for the purpose of improving their shunting sensitivity;

Fig. 5 is a diagrammatic representation of my improved apparatus applied to a coded track circuit in a manner to provide approach control without the use of line wires;

Fig. 6 shows the apparatus of the preceding figures applied to operate in conjunction with a combined track circuit and switch-detector circuit; and

Fig. 7 is a showing of my improved equipment organized into a system for controlling and indicating the operation of a railway switch over a single pair of line-circuit conductors.

In the several views of the drawings, like reference characters designate corresponding parts. Referring first to Fig. 1, character X designates a contact which is adapted to move back and forth between two positions and character KQ designates a relay for responding to this back-and-forth contact movement when such is regularly repeated. Each time that contact X occupies its picked-up position (shown heavy) it completes a circuit through which a direct-current source, shown in the form of a battery Q, supplies charging current to an energy-storage device, shown in the form of a capacitor K. Similarly, each time that the contact X occupies its released position (shown dotted) it completes a circuit through which the capacitor K dissipates its stored energy by circulating discharging current through the winding of relay KQ.

This relay KQ is provided with a contact 6 which is picked up in response to each pulse of capacitor discharge current and which is sufficiently slow in releasing as to bridge the intervals between consecutive pulses when contact X is repeatedly shifted at normal code-pulse rate between the two positions just described. In consequence, relay KQ holds its contact continuously picked up as long as contact X continues to oscillate between the picked-up and released positions. When, however, this recurring movement is discontinued the resultant interruption of the capacitor discharge pulses causes relay KQ continuously to be deenergized and allows contact 6 thereof to drop to the released position. This is true whether the contact X be stalled in the picked-up or in the released position.

In the former event, the capacitor-charging circuit is continuously completed and the winding of relay KQ is continuously disconnected from the capacitor K. The referred to charg-

ing circuit may be traced from the positive terminal of battery Q through conductor 7, front contact X, conductor 8, the capacitor K and conductors 9 and 10 back to the negative terminal of battery Q. In the latter event, the capacitor is continuously connected to the winding of relay KQ and continuously disconnected from its source of charging current. The referred to discharge circuit extends from the upper or positively chargeable plate of the capacitor K through conductor 8, back contact X, conductor 11, the winding of relay KQ and conductors 10 and 9 back to the lower or negatively chargeable plate of the capacitor.

In practice it is found that a capacitor of comparatively large energy-storage capacity is needed to effect the described operation of relay KQ under code-following conditions on the part of contact X, and for this reason a device of the electrolytic type will in many instances be found preferable because of its comparatively smaller physical dimensions for a given energy-storage rating. When, however, the charging and discharging circuits are of the simple and relatively direct type represented in Fig. 1, other types of capacitors may be made satisfactorily to serve the purpose by employing a charging source Q of comparatively high voltage and thereby taking advantage of the squared ratio which the stored energy bears to the magnitude of the charging voltage.

In the particular application of my improved code-registering means which is represented in Fig. 1, the contact X forms a part of a code-following track relay TR which is operated by energy received from the rails 1 and 2 of a section of railway track included between insulated joints 3 at locations D and E. The mentioned energy is supplied to the rails of the section D—E from a suitable alternating-current source, designated by the terminals B and C, through a circuit which includes the usual track transformer TT and one or another of the contacts 180 and 80 of a coding device CT2. Selection of which of these two coding contacts is included in the primary circuit of the track transformer is made by contact 6 of the previously described slow-release relay KQ.

The particular organization of circuits shown in Fig. 1 is intended for a cab-signalling system of the three-indication coded track-circuit type in which wayside signals are not required. As long as section D—E is vacant the rails 1 and 2 thereof transmit, from the track transformer TT at location E, energy coded by one of the two contacts of an associated device CT2 (not shown at location E but a duplicate of device CT2 at location D) at a rate assumed for purposes of explanation to produce a code made up either of 180 energy pulses per minute or of 80 pulses per minute. Selection, of course, is dependent in the usual manner upon the condition of the track section immediately beyond location E in the direction of the traffic-moving arrow.

In responding to this energy received from the trackway, track relay TR repeatedly picks up and releases contact X at a corresponding rate and thereby causes capacitor K repeatedly to be charged from source Q and discharged through the winding of relay KQ. In consequence, contact 6 of that relay is held picked up and the rails of the track section to the rear of location D receive energy of the 180 coding over a circuit which extends from the terminal B of the alternating-current supply source through coding

contact 180 of device CT2, front contact 6 of relay KQ, conductor 12 and the primary winding of track transformer TT back to the terminal C of the alternating-current source.

In the event, now, that a train enters track section D—E, the rail-shunting action of its wheels and axles deenergizes track relay TR and causes contact X thereof continuously to occupy the released position. As soon as capacitor K has dissipated its charge through the now completed discharge circuit, no further energy is supplied to the winding of relay KQ and contact 6 of the relay is accordingly dropped to its released position. Under this condition, the rails of the track section to the rear of location D receive energy of the 80 coding over a circuit which may be traced from the supply terminal B through coding contact 80 of device CT2, back contact 6 of relay KQ, conductor 12 and the primary of transformer TT back to the supply terminal C.

From the foregoing it will be seen that as long as the track relay TR at location D receives trackway energy of either the 180 or 80 coding the rails of the track section to the rear of location D are supplied with energy of the 180 coding and that when contact X of device TR is stalled in either position (as when a train occupies section D—E or the rails thereof transmit steady energy from facilities not shown to the track relay), relay KQ is deenergized and the rails of the track section to the rear of location D then receive energy of the 80 coding.

From an examination of the code-registering circuits of Fig. 1, it will be apparent that instead of arranging, as there shown, the capacitor-charging circuit to be completed when contact X is picked up and the capacitor-discharging circuit to be completed when the contact is released, equivalent results may be obtained by modifying the arrangement in such manner that the capacitor K receives charging current from source Q when contact X is released and supplies discharging current to the winding of relay KQ when the contact is picked up. In either arrangement, the winding of relay KQ receives recurring pulses of energizing current in response to code-following operation on the part of contact X and is continuously deenergized in the event that contact X is stalled in either the picked-up or the released position.

Referring next to Fig. 2, the application of my inventive improvements there shown again makes use of the energy-storage device K, the source of charging current Q, the slow-release relay KQ included in the discharging circuit of the capacitor K, and the contact X which is repeatedly shifted between its picked-up and released positions.

Instead, however, of forming a part of a code-following track relay, as in the embodiment of Fig. 1, this contact X of Fig. 2 is included in a constantly operating coding device CT. At all times, therefore, contact X of Fig. 2 is operated between its picked-up and released positions by a motor or other suitable mechanism (not shown) of device CT. To facilitate explanation, it may be assumed that the rate of this contact operation is 180 movement cycles per minute and that the release period of relay KQ is adequate to bridge the intervals between successive contact operations.

The arrangement of Fig. 2 also differs from that of Fig. 1 in that the charging circuit of the capacitor K includes a contact 14 of a line-control

relay LR. This relay may readily be installed at a point distantly removed from the location of the capacitor-fed relay KQ and the primary energizing source Q. In that event, the conductors 18 and 19 will take the form of a pair of line wires which interconnect the contact 14 of the relay LR with the apparatus, including relay KQ, which it controls. Although the capacitor K is shown at the remote location of relay LR, it may, of course, be located at any other point in the circuit of which line conductors 18 and 19 form a part.

In operation of the apparatus shown in Fig. 2, relay KQ maintains its contact 6 continuously picked up as long as contact 14 of the line-control relay LR remains closed. Under this condition, each pick-up operation on the part of contact X of the continuously operating coding device CT completes a capacitor-charging circuit which extends from the positive terminal of the primary source Q through conductor 7, front contact X, line conductor 18, the capacitor K, conductor 15, front contact 14 of relay LR, line conductor 19 and conductor 16 back to the negative terminal of battery Q. Likewise, each time that the contact X occupies its released position, capacitor K dissipates its stored energy through the winding of relay KQ by way of a circuit which may be traced from the left or positively charged plate of the capacitor through line conductor 18, back contact X of device CT, conductor 11, the winding of relay KQ, conductor 10, line conductor 19, front contact 14 of relay LR and conductor 15 back to the right or negatively charged plate of capacitor K. In this manner the operation stated at the beginning of the paragraph is effected.

In the event, however, that contact 14 of line control relay LR is released, the winding of relay KQ becomes continuously deenergized and contact 6 thereof is allowed to drop to its released position. This is due to the fact that both the charging and the discharging circuits for the capacitor K are now interrupted continuously at contact 14 and the battery Q neither supplies charging current to the capacitor nor does the capacitor supply discharging current to the winding of the slow-release relay KQ.

When the contact 14 of relay LR is again picked up, the two circuits just referred to are both periodically completed under the action of constantly operating contact X of device CT and the winding of relay KQ once more receives recurring pulses of energizing current which are effective to pick up contact 6 of that relay and hold the contact continuously in the picked-up position.

It will thus be apparent that my improved arrangement of Fig. 2 provides a very practical means for operating the controlled relay KQ through the contact 14 of a distantly located line relay LR and that in effecting this control the source of primary power Q may conveniently be located, as shown, close to the controlled relay KQ and distantly removed from the controlling line relay LR. The disclosed arrangement also provides desirable features of inherent safety. For example, should the two line conductors 18 and 19 become crossed or otherwise interconnected, or should either one of them become broken, then the winding of the controlled relay KQ would be continuously deenergized.

Referring now to Fig. 3, the application there shown employs the rails 1 and 2 of a track section I—J as conductors in the charging and dis-

charging circuit for the energy-storage device K. As in Fig. 2, the capacitor-charging current originates in battery Q and the discharging current is normally passed through a circuit which includes the winding of relay KQ, which relay has release characteristics sufficiently slow to bridge the intervals between successive operations of contact X of the constantly operating coding device CT. Contact 6 of this relay is shown as selectively controlling the lamps G and R of a wayside signal S which is positioned at the entrance of the associated track section in the usual manner.

As long as this track section I—J remains vacant, contact X repeatedly connects the capacitor K first with the battery Q and then with the winding of relay KQ. The charging circuit may be traced from the positive terminal of source Q through conductor 7, front contact X of device CT, conductor 8, track rail 2, conductor 21, the capacitor K, conductor 22, track rail 1 and conductor 10 back to the negative terminal of source Q. The referred to discharging circuit extends from the left or positively charged plate of capacitor K through conductor 21, track rail 2, conductor 8, back contact X of device CT, conductor 11, the winding of relay KQ, conductor 10, track rail 1 and conductor 22 back to the right or negatively charged plate of the capacitor.

Under the stated condition of track section vacancy, relay KQ thus receives recurring pulses of energizing current which maintain its contact 6 continuously picked up. In consequence, lamp G of wayside signal S now receives lighting current over a circuit which may be traced from the positive terminal of a suitable supply source through front contact 6 of relay KQ, conductor 23 and the lamp G back to the negative terminal of the supply source. The resulting aspect of a green light indicates that the entire length of the track section I—J is clear.

In the event, now, that a train enters the track section I—J, the shunting action of its wheels and axles provides a by-pass or short circuit of both the charging and the discharging circuits for the capacitor K. This, of course, produces a continuous deenergization on the part of relay KQ which causes it to drop its contact 6 to the released position. Under this condition, the controlled wayside signal S displays the red or "stop" indication as a result of lamp R receiving lighting current over a circuit which extends from the positive supply terminal through back contact 6 of relay KQ, conductor 24 and the lamp R back to the negative supply terminal.

As soon as the track section is again vacated, the accompanying removal of the shunting path between the track rails 1 and 2 allows pulses of charging current again to be transmitted to the capacitor K and pulses of discharging current to be transmitted from this capacitor to the winding of relay KQ. In responding in the manner already explained, this relay causes the controlled wayside signal S again to display the green or "clear" indication.

By employing the arrangement of Fig. 3, I have discovered that the sensitivity of track-circuit shunting may be substantially increased. This is because of the fact that whenever a shunt is placed across the rails 1 and 2 not only is the energy which battery Q supplies to the capacitor K by-passed but also the discharge current from this capacitor is also circulated through the shunting path. This means that at the moment of initial shunting, energy from both directions

is available for breaking down the high resistance film between the running surfaces of the rails 1 and 2 and the contacting surfaces of the train wheels. By virtue of this dual-direction supply the action just referred to is made more positive and rapid and in this manner the shunting sensitivity of the track circuit is substantially increased.

A capacitor of the type shown at K in Fig. 3 is not the only energy-storage device which may be employed for the purpose stated. If desired, use may also be made of a direct-current shunt-wound motor arranged as shown at KM in Fig. 4. When supplied through rails 1 and 2 with the recurring pulses of energizing current from direct-current source Q at location I (not shown in Fig. 4) such a motor may be designed to rotate at a substantial rate of speed. Preferably, the armature or rotating member thereof should be arranged, as by the use of a fly wheel, to have a relatively high value of rotative inertia in order that the speed may be sustained during the "off" periods of motor supply current.

On the occasion of each of these periods, this stored rotative energy causes the machine KM to operate as a generator and supply current in the opposite direction through the rails 1 and 2 back to the winding of relay KQ at location I. Thus it will be seen that the motor-energizing circuit is identical with the capacitor-charging circuit represented in Fig. 3 and that the circuit through which current generated by machine KM passes during intervening periods is identical with the discharging circuit for the capacitor K of Fig. 3.

The modified arrangement of Fig. 4 is, therefore, effective to increase the sensitivity of track-circuit shunting in the same manner as does the arrangement of Fig. 3. That is, when the train wheels and axles first by-pass the rails 1 and 2 of track section I—J, the machine KM at the exit end of the section supplies generated current to the point of wheel contact which aids the current from battery Q in breaking down the initial resistance between the running surfaces of the rails and the contacting surfaces of the train wheels.

Referring now to Fig. 5, the improved facilities of my invention are there shown as being applied to a scheme for effecting approach control without the use of the usual line conductors. The track circuit associated with section M—N receives at the exit end thereof coded energy from a source 25 under the control of a contact 26 of a code-repeating relay CR. This relay is operated by the customary code transmitter contacts (not shown) through the usual selecting means (also not shown).

At the opposite or traffic entering end of the section use is made of a code-following track relay TR which carries the previously described contact X together with a companion contact X1. These contacts control the connection of an energy-storage device, again shown in the form of a capacitor K, with a charging source Q and also with the winding of a slow-release relay KQ at the opposite or exit end of the track section.

The capacitor-charging circuit is completed each time that the track relay TR receives an energy pulse from the rails 1 and 2 and may be traced from the positive terminal of source Q through conductor 7, front contact X of relay TR, conductor 8, the capacitor K, conductor 9, front contact X1 of relay TR and conductor 23 back to the negative terminal of battery Q. The capacitor-discharge circuit is completed during

each "energy-off" period of the referred to track-way code and it extends from the upper or positively charged plate of the capacitor K through conductor 8, back contact X of relay TR, conductors 29 and 30, track rail 2, conductor 31, the winding of relay KQ, conductor 32, back contact 26 of code-repeating relay CR, conductor 33, the track rail 1, conductor 34, a resistor 35, conductor 36, back contact X1 of relay TR and conductor 9 back to the lower or negatively charged plate of the capacitor K.

From the foregoing it will be seen that when the code-following track relay TR is picked up, the capacitor K is charged over the front contact points of this relay from the local battery Q and that when the track relay releases and closes its back contacts, this capacitor discharges into the track circuit and energy is at that time connected to the slow-release relay KQ at the opposite or exit end of the section through the back contact 26 of the code-repeater relay CR.

When, now, the code-repeater relay again closes its front contact, the track battery 25 again picks up the track relay TR over a circuit which may be traced from the positive terminal of battery 25 through front contact 26 of relay TR, conductor 33, track rail 1, conductor 34, the winding of relay TR, a rectifier 38, conductor 30, track rail 2 and conductor 31 back to the negative terminal of battery 25. This causes the capacitor K at the entrance end of the block to be recharged and so the cycle just described repeats itself. Because of its slow-releasing characteristics relay KQ maintains its contact 6 in the picked-up position during each open circuit interval while the back contact of code-repeater CR is open.

The rectifier 38 is included in the manner shown in the winding circuit for the track relay TR for the purpose of preventing the capacitor K from discharging its energy through the winding of that relay. The function of the resistor 35 in the discharge circuit of the capacitor K is to prevent the normal track-circuit energy from flowing in objectionable quantity into the capacitor when the contact 26 of the code-repeater relay CR at location N is picked up and before the contact X of the code-following track relay TR has been picked up in response to energy received from the track circuit.

In the particular application shown in Fig. 5, relay KQ performs the function of the usual approach-control device and its contact 6 serves, for example, to control circuits (not shown) by which facilities for energizing the lighting circuits for a wayside signal (again not shown) at location N may be brought into operation.

In operation of the approach-control system shown in Fig. 5, the approach relay KQ at the exit end of section M—N maintains its contact 6 continuously picked up as long as the track section to the rear of location N remains vacant. This is the result of the before explained code-following operation on the part of contact 26 of relay CR and on the part of contacts X of relay TR at the opposite or entrance end of the section. As has been seen, capacitor K at location M is, under these conditions, repeatedly charged from battery Q and then discharged through the winding of relay KQ by way of a circuit which includes the track rails 1 and 2.

In the event, now, that a train comes into section M—N, the interconnection by its wheels and axles of the rails 1 and 2 deprives the winding of relay KQ of the energizing pulses from capaci-

tor K at the entrance end of the section and causes the relay to release. As long as any part of the train remains within the section this condition, of course, is continued. However, upon the subsequent vacation of the section by the train, the rails 1 and 2 again become effective for transmitting coded energy from track battery 25 to the winding of relay TR and discharge current from the capacitor K to the winding of approach relay KQ. In consequence, that relay again picks up its contact 6 and restores the circuits controlled thereby to the normal or unoccupied-section condition.

Referring to Fig. 6, a fifth application of the improvements of my invention is there shown in connection with a combined track circuit and switch-detector circuit. The track circuit includes the rails 1 and 2 between locations U and V and the track switch is associated with the rails of a branch line track 41—42.

Again use is made of the energy-storage device K bridged across the rails 1 and 2 of the track section, a source of charging current Q periodically connected to the rails by contact X of a constantly operating coding device CT and a slow-release relay KQ arranged to receive discharging current from capacitor K over contact X when in the released position. In addition, use also is made of contacts 43 and 44 of the usual switch circuit controller for the purpose of interrupting the connection of the capacitor K with the track rails each time that the points of the switch are shifted from the normal position in which traffic moving in the direction of the arrow continues along the main line rails 1 and 2 to the reversed position in which the traffic is diverted to the branch track rails 41—42.

The slow-release relay KQ serves the dual purpose of indicating whether the track section U—V is occupied and also of whether the points of the referred to track switch occupy the reversed or traffic-diverting position. As long as neither of these conditions obtains, the contact 6 of relay KQ occupies the picked-up position shown. When, however, either of the two stated conditions becomes effective, the relay contact is dropped to its released position.

The above comes about in the following manner. With the track section vacant and the track switch in the normal position, each pick-up operation on the part of the constantly operating contact X of device CT completes for energy-storage device K a charging circuit which may be traced from the positive supply terminal of battery Q, through conductor 7, front contact X of device CT, conductor 8, the track rail 2, conductor 21, switch-controller contact 44, the capacitor K, switch-controller contact 43, conductor 22, track rail 1 and conductors 10 and 16 back to the negative terminal of battery Q. Likewise, each releasing operation of coding contact X completes a circuit through which capacitor K circulates its discharge current through the winding of relay KQ. This circuit may be traced from the lower or positively charged plate of storage device K through switch-controller contact 44, conductor 21, track rail 2, conductor 8, back contact X of device CT, conductor 11, the winding of relay KQ, conductor 10, track rail 1, conductor 22 and switch-controller contact 43 back to the upper or negatively charged plate of the capacitor.

Under the stated conditions of vacant track section and normal switch position, relay KQ

thus receives repeated pulses of energizing current which cause this slow-releasing device to maintain its contact 6 continuously picked up.

In the event, now, that a train comes into the section U—V, the shunting action of its wheels and axles by-passes the rails 1 and 2 and thus discontinues the supply of energizing pulses to relay KQ. In consequence, it drops its contact 6 to the released position. Likewise, with the track section U—V vacant, when the points of the switch associated with the branch-track rails 41 and 42 are shifted to the traffic-diverting position, switch-controller contacts 43 and 44 disconnect the capacitor K from the rails 1 and 2 and thus also discontinue the supply of energizing pulses to the relay KQ. Under this second condition, therefore, that relay also releases its contact.

Referring to Fig. 7, the improved code-registering apparatus of my invention is there shown as being applied to a system for controlling and indicating the operation of a railway switch through the medium of but two line conductors 53 and 54 between the switch and its control lever. As in the case of Fig. 6, the switch to be controlled is associated with the rails 41 and 42 of a branch track which at times diverts traffic from the main line rails 1 and 2. At a point remote from the switch is a control lever 50 which is movable between two positions A and Z, respectively identified with the normal position of the track switch and the reversed or traffic-diverting position thereof.

Through the medium of blades 51 and 52 of an associated device, this track switch-control lever 50 controls the polarity of the energy which the source of control current Q supplies to the referred to conductors 53 and 54 of a line circuit which terminates in a switch-control relay WR and a pair of energy-storage devices shown in the form of capacitors K and K1. Interposed between polarity-selecting blades 51 and 52 and the line conductors 53 and 54 are the contacts X and X1 of a continuously operating coding device CT1 and connected to the back points of these contacts is the winding of an indication relay KQP.

Line circuit 53—54 serves the dual purpose of transmitting energy for operating the switch-control relay WR and charging one or the other of the capacitors K and K1 and also of transmitting in the opposite direction discharge current from the active capacitor. This discharge current is used to energize the winding of the mentioned indication relay KQP which is installed at the location of switch lever 50.

The particular switch-control relay shown at WR is provided with polar contacts 56, 57 and 58 which respond to the polarity of the energy applied to the relay winding in advance of the time that neutral contacts 59 and 60 of the relay pick up in response to applied energy of either polarity. When switch control lever 50 is in the uppermost or normal position designated by character A, the polarity of the energizing pulses supplied over contact X of device CT to the winding of relay WR is such as to move the polar contacts to the right position represented. When, however, the switch lever 50 is moved to the lowermost or reversed position identified with the character Z, the reversed polarity of the supplied energy causes the polar contacts of relay WR to be shifted to the left-hand position.

In addition to the response characteristics just described, relay WR is of the delayed-release

type and is designed to hold both its polar and neutral contacts continuously in the operated position when the winding thereof receives spaced energizing pulses of the recurring-frequency character determined by the coding device CTI. Polar contacts 57 and 58 of relay WR control the circuits of a motor (not shown) which is employed in the usual manner to operate points of the track switch with which the branch-track rails 41 and 42 are associated. When these contacts occupy the right position shown, the motor receives normal polarity energizing current and operates the switch to the normal position in which traffic moving in the direction of the arrow continues along the main line rails 1 and 2. When the contacts 57 and 58 of relay WR occupy the left-hand position, the switch-operating motor then runs in the reverse direction and shifts the switch points into positions in which the traffic is diverted to the branch-line rails 41 and 42.

The indication relay shown at KQP also is of a polarized delayed-release type. It has a neutral contact 61 which remains continuously picked up as long as the winding of the relay receives spaced pulses of energizing current at a frequency determined by the rate of movement of the coding device contacts X. It also has a polar contact 62 which occupies the right position when the polarity of the winding energy is "normal" and the left position when the polarity of this energy is "reversed." This contact selectively completes the lighting circuits of a pair of indicating lamps A and Z which are identified with the normal and reversed positions of the referred to track switch.

Only one of the energy-storage capacitors K and KI is active at any given time, the selection being effected by means of a pair of contacts 63 and 64 which are included in the usual switch controller and which respond to the position of the track switch points. When, as shown, these switch points occupy the normal position, contact 63 completes the circuit for capacitor K. When, however, the points occupy the reversed or traffic-diverting position, contact 64 completes the circuit for the companion capacitor KI.

The operation of the switch-control and indication equipment of Fig. 7 will now be explained. When the switch-control lever 50 is in the normal position A, control-supply source Q is connected with the line conductors 53 and 54 in a manner that conductor 53 is positive with respect to conductor 54 and the winding of relay WR then receives periodically interrupted energizing current over a circuit which extends from the positive terminal of battery Q through conductor 66, switch blade 51, conductor 67, front contact X of coding device CTI, line conductor 53, conductor 68, the winding of switch-control relay WR, conductor 69, line conductor 54, front contact XI of device CTI, conductor 70 and switch blade 52, back to the negative terminal of battery Q. This causes the contacts of relay WR to occupy the positions represented in Fig. 7 and, in consequence, the switch-operating motor (not shown) causes the track switch points to occupy the normal positions represented in full lines.

At the same time, capacitor K receives charging current in the form of recurring pulses determined by the operation of contact X of the coding device CTI over a circuit which extends from line conductor 53 through front contact 59 of relay WR, conductor 71, switch-controller contact 63, conductor 72, the capacitor K, conductor

73, right contact 56 of relay WR, conductor 74 and front contact 60 of relay WR back to the line conductor 54.

Each time that the contacts X of the coding device CTI occupy the released position, the line conductors 53 and 54 are disconnected from the battery supply wires 67 and 70 and connected with the winding of the indication relay KQP. During each of these periods, therefore, the capacitor K circulates discharging current through this relay winding over a circuit which may be traced from the upper or positively charged plate of the capacitor through conductor 72, switch-controller contact 63, conductor 71, front contact 59 of relay WR, line conductor 53, back contact X of device CTI, conductor 75, the winding of relay KQP, conductor 76, back contact XI of coding device CTI, line conductor 54, front contact 60 of relay WR, conductor 74, right contact 56 of relay WR and conductor 73 back to the lower or negatively charged plate of the capacitor.

Under the influence of these recurring pulses of normal-polarity current from the capacitor K, relay KQP maintains its contacts in the positions represented and completes for lamp A a lighting circuit which extends from the positive terminal of a suitable supply source through front contact 61 of relay KQP, right contact 62 of the relay and the lamp A back to the negative terminal of the supply source. This lamp now lights to indicate that the track switch points associated with rails 41 and 42 occupy the normal position.

Assume now that it is desired to shift these switch points to the reversed or traffic-diverting position. Switch-control lever 50 is moved downwardly to position Z in which blades 51 and 52 reverse the connections of supply battery Q with conductors 67 and 70. The energy now supplied over coding contacts X to line conductors 53 and 54 is of a corresponding reversed polarity which causes switch-control relay WR to shift its polar contacts 56, 57 and 58 to the left-hand position. Contact 56 now includes the second capacitor KI in the active circuit while contacts 57 and 58 cause the switch-operating motor to shift the track switch points from the normal or represented position to the reversed or traffic-diverting position. When this shift is completed, contact 64 of the switch controller completes the before-referred to active circuit for the second capacitor KI and thus allows it to receive pulses of charging current from the line conductors 53 and 54.

Because of the reversed polarity of these pulses the lower plate of capacitor KI is positively charged with respect to the upper plate, a relation which is reversed with respect to that of the charging of the plates of the first capacitor K. Each time that the coding-device contacts X are in the lowermost or released position, the winding of the indication relay KQP receives from capacitor KI this reversed polarity charging current. In consequence, it shifts contact 62 to the left position in which indication lamp Z lights to show that the switch movement initiated by lever 50 has been completed.

When it is later desired to return the switch points to the normal position, control lever 50 is moved upwardly to position A. Blades 51 and 52 now connect the supply battery Q in normal-polarity relation with the line conductors 53 and 54. Switch-control relay WR responds by returning its polar contacts to the right position

in which the first capacitor K is included in the active circuit and the second capacitor K1 is disconnected. As the switch motor moves the switch points to the normal positions, switch-controller contact 63 completes the capacitor circuit just referred to and allows energy-storage device K to be periodically charged with normal-polarity energy over the coding-device contacts X. In connecting this capacitor with the winding of relay KQP during the intervals which separate the charging periods these contacts cause the winding of the mentioned indication relay again to receive normal-polarity pulses of indicating energy. In response to these pulses relay KQP completes the lighting circuit for indicating lamp A which shows that the switch movement initiated by lever 50 has been completed.

From the foregoing it will be apparent that were the coding device CT1 at the switch lever location to be provided with a larger number of contacts, a correspondingly increased number of indication circuits including relays corresponding to device KQP might be operated under the control of the single coder.

From the preceding description of the six different applications of the code-registering means of my invention, it will be seen that in all of these use has been made of an energy-storage device K, a source of charging current Q therefor, a slow-release relay KQ which is included in a discharge circuit for the storage device, and a device provided with a contact X which periodically moves between a first and a second position respectively to complete the charging and the discharging circuit for the storage device.

In applications such as that shown in Fig. 1 this novel combination of instrumentalities greatly simplifies the equipment needed to detect the presence or absence of code-following operation on the part of a track or master relay which receives energy from the trackway. In other applications such as shown in Fig. 2, my new organization facilitates the remote control of relay KQ over line wire circuits. When applied as shown in Figs. 3 and 4, it provides a ready means for increasing the sensitivity of track circuit shunting. When organized as shown in Fig. 5, it makes possible a simple and practical scheme for effecting approach energization without the use of line wires when applied in a manner shown in Figs. 6 and 7, it facilitates the control and indication of the operation of railway track switches.

Although I have herein shown and described only six forms of railway traffic controlling apparatus embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In a railway signalling system, the combination of a section of track, means at the exit end of said section for supplying coded energy to the rails thereof and for connecting the winding of an approach-control relay across said rails during each off code period, a code-following track relay at the entrance end of the section operated by energy received from said rails, a capacitor, a source of charging current therefor, and a contact carried by said track relay and arranged to connect said capacitor to said source during each on period of the received code and

to connect said capacitor across said rails during each off period of the received code.

2. In combination, a section of railway track, a slow-release approach-control relay at the exit end of said section, means also at said exit end for supplying coded energy to the rails of the section and for connecting the winding of said approach-control relay across said rails during each off period of the supply-energy code, a code-following track relay at the entrance end of the section operated by energy received from said rails, a capacitor, a source of charging current therefor, and means controlled by said track relay for connecting said capacitor to said source during each on period of the received code and for connecting said capacitor across said rails during each off period of that code.

3. In a system for effecting approach energization without the use of line wires, the combination with a section of railway track of a code-following track relay connected to the rails thereof at the entrance end, a capacitor, a source of charging current therefor, a contact carried by said track relay and arranged to connect said capacitor to said source during each on period of the received code and to connect the capacitor across said rails during each off period of that code, and a rectifier included in the circuit of the relay winding to prevent energy from said capacitor from flowing therethrough.

4. In combination with a section of railway track, means at the exit end of said section for supplying recurring pulses of coded energy to the rails thereof, a code-following track relay at the entrance end of said section receiving said coded energy from said rails and responding to each pulse of that received energy, a capacitor at said section entrance, a source of charging current for said capacitor, a circuit connecting said capacitor in energy-receiving relation with said source when and only when said track relay is picked up, another circuit connecting said rails in energy receiving relation with said capacitor when and only when said track relay is released, and a slow-release traffic controlling relay at said section exit connected with said rails to receive thereover recurring pulses of discharge energy from said capacitor whereby to be maintained picked up as long as the section remains vacant and to release in response to the entry of a train into said section.

5. In combination with a section of railway track, a source of trackway energy and an approach control relay at the exit end of said section, a coding contact which repeatedly connects the rails of said section first to said energy source and then to the winding of said approach relay and thereby produces a trackway code made up of recurring "on" period energy pulses which are separated by "off" period intervals that coincide with said rail to relay winding connections, a track relay at the entrance end of said section connected in energy receiving relation with said rails and having a contact which picks up during each "on" period of the said coded energy that is received from those rails and which releases during each "off" period of the received code, a capacitor also at said section entrance, a source of charging current for said capacitor, a first circuit controlled by said track relay contact for connecting said capacitor in energy receiving relation with said charging source each time that said contact is picked up, and a second circuit controlled by said track relay contact for connecting said capacitor with said section rails

each time that said contact is released whereby the capacitor supplies discharge energy to those rails during each "off" period of the said received trackway code and thereby causes those rails to
5 transmit recurring pulses of exciting current to said exit end approach control relay as long as said section remains vacant.

6. In combination with a section of railway track, means at the exit end of said section for
10 supplying recurring pulses of coded energy to the rails thereof, a code following track relay at the entrance end of said section receiving said coded energy from said rails and responding to each pulse of that received energy, a capacitor at said
15 section entrance, a source of charging current for said capacitor, a first circuit controlled by said track relay for connecting said capacitor in energy receiving relation with said source each time that the track relay is picked up, a second
20 circuit controlled by said track relay for connecting said capacitor with said section rails each time that the track relay is released whereby the capacitor then supplies discharge energy to those rails, a train detecting relay at the exit end
25 of said section connected with said rails whereby to receive said capacitor discharge energy as long as said section remains vacant and to be continuously deenergized when a train comes into the section and by-passes the rails thereof,
30 and traffic governing apparatus controlled by said detecting relay and distinctively responsive according as that relay is or is not receiving said discharge energy.

7. In a system of railway signaling, the combination of a control circuit that includes a pair of conductors which normally are capable of transmitting energy between the two ends of the circuit but which at times are rendered incapable
5 of such transmission, means at a given end of said circuit for supplying said conductors with coded energy in the form of recurring "on" period pulses that are separated by "off" period intervals, a code following relay at the opposite circuit end operated by and only by the "on" period
10 pulses of said coded energy which are there received, an energy-storage device also at said opposite circuit end, a source of charging current for said device, means controlled by said code
15 following relay for connecting said device with said charging source during each "on" period of said received code and with said circuit conductors during each "off" period of that code whereby under said normal energy-transmitting conditions of said circuit the device supplies those
20 conductors with discharge energy in the form of recurring pulses that coincide with said "off" code periods, a detecting relay installed at said given circuit end and energized by and only by
25 the said recurring pulses of device discharge energy which said circuit conductors transmit to that given end, and traffic governing apparatus controlled by said detecting relay and distinctively responsive according as that relay is or is
30 not receiving said discharge energy.

FRANK H. NICHOLSON.