Sept. 29, 1953 C. E. STAPLES 2,654,081

CODE DETECTING APPARATUS

Filed April 28, 1950

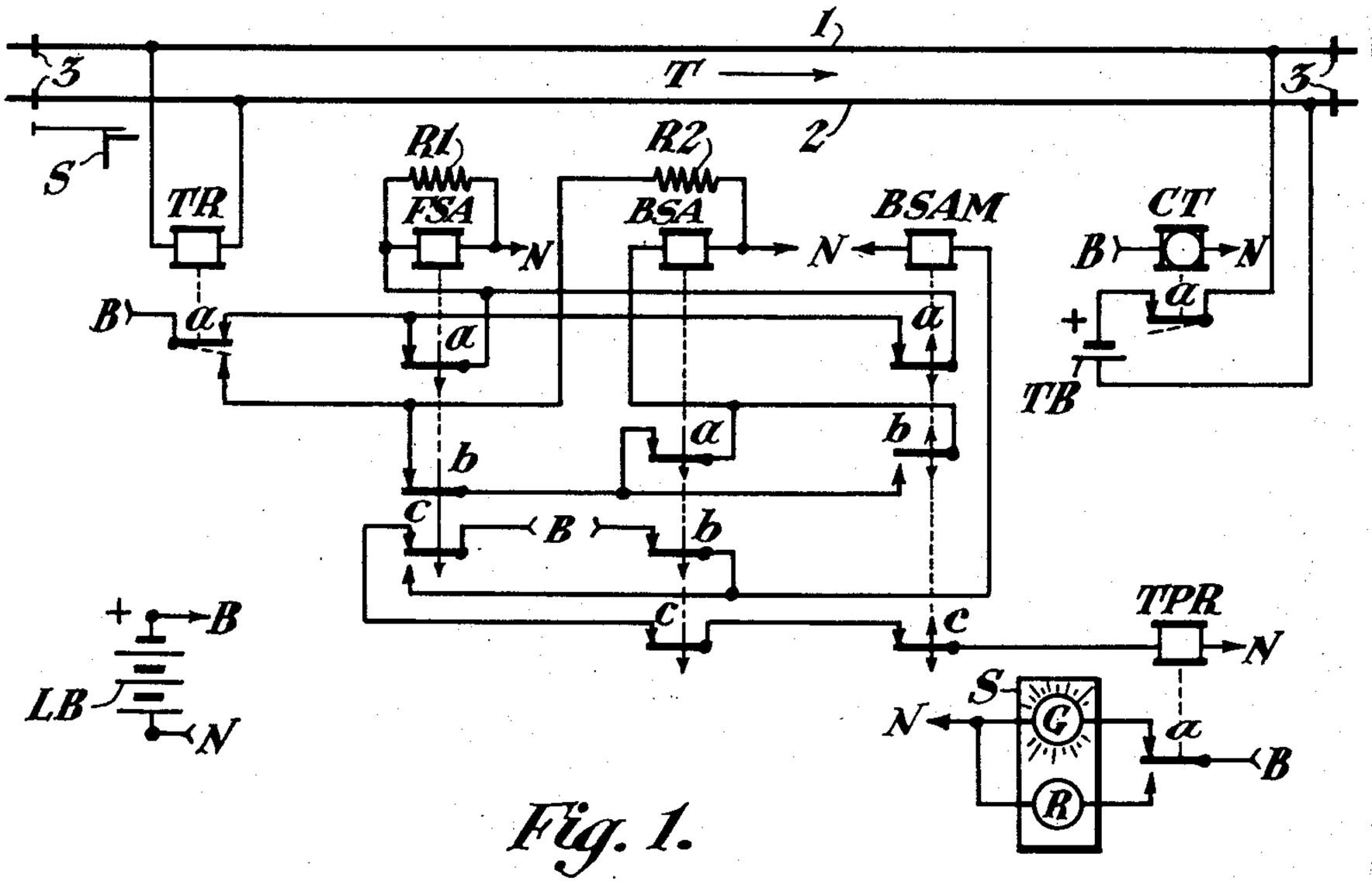

Fig. 1.

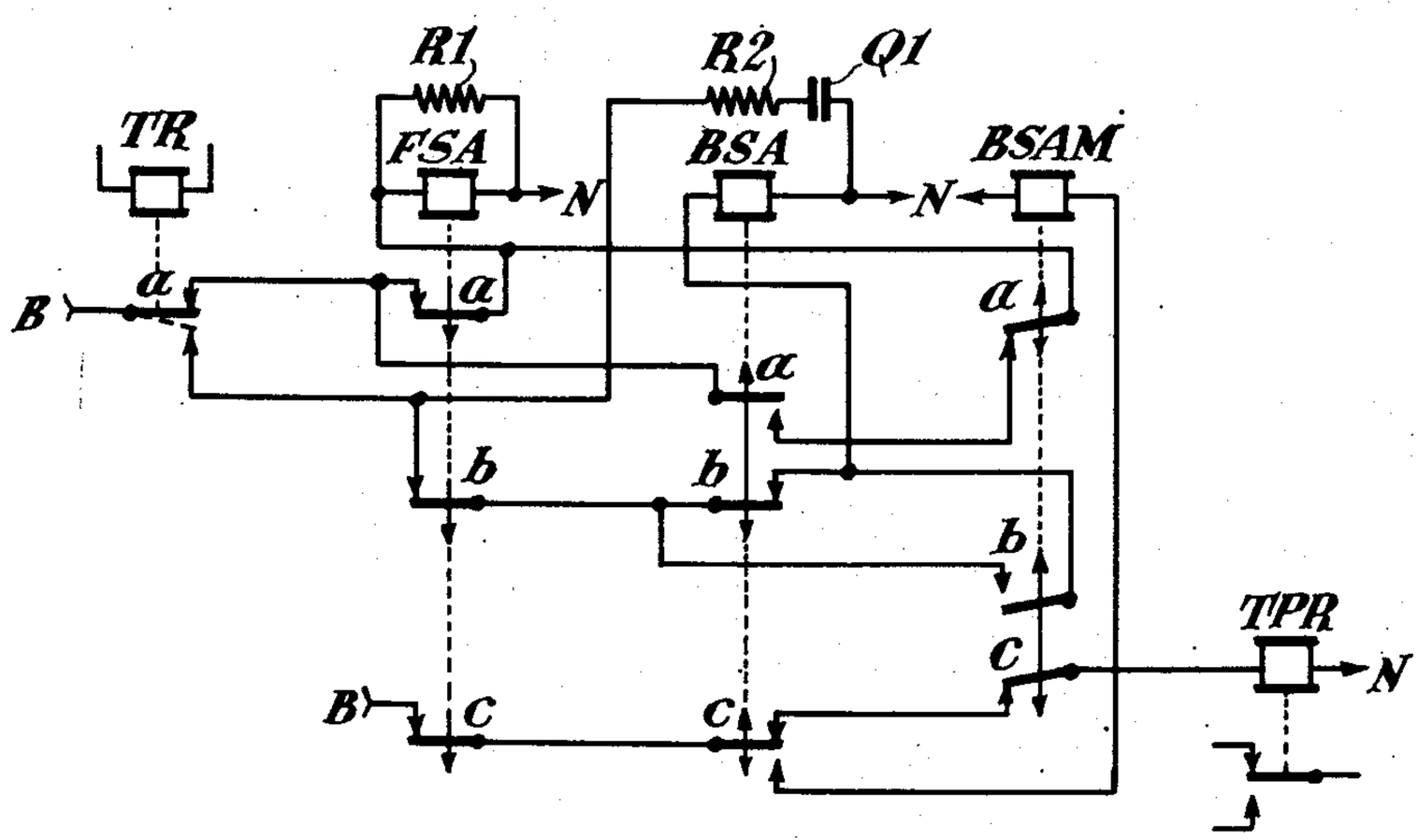

Fig. 2.

INVENTOR.
Crawford E. Staples.
BY
HIS ATTORNEY

Patented Sept. 29, 1953

2,654,081

UNITED STATES PATENT OFFICE

2,654,081

CODE DETECTING APPARATUS

Crawford E. Staples, Turtle Creek, Pa., assignor to Westinghouse Air Brake Company, a corporation of Pennsylvania

Application April 28, 1950, Serial No. 158,710

12 Claims. (Cl. 340—213)

1

My invention relates to code detecting apparatus particularly suitable for use in coded railway signaling systems, and more particularly to code detecting apparatus which provides a high degree of immunity to the defect known as "loss of shunt."

In coded signaling systems, code following operation of a track or other relay having a contact recurrently operated between a first and a second position is frequently detected by means of two slow release relays, the first of which is energized when the code following relay contact occupies its first position, and is known as a front contact repeater relay, and the second of which is energized when the code following relay contact occupies its second position, provided the first slow release relay is picked up, the second relay being known as the back contact repeater relay. It follows that when the code following relay contact is operating recurrently between its two positions in response to the supply of coded energy to the relay winding, the slow release relays will each be periodically energized. The relays are selected so that their release time is longer than the time interval between the pulses of energy so that as long as the code following relay responds to coded energy the contacts of both of the slow release relays are picked up. If the code following relay contact should remain in its first position for a substantially long time interval, the first slow release relay will remain energized and its contacts will remain picked up. However, the supply of energy to the second slow release relay is interrupted by the contact of the code following relay, and after a short time interval, the second slow release relay will release. If the code following relay contact should remain in its second position for a substantial period of time, the supply of energy to the first slow release relay is interrupted by the contact of the code following relay and after a short time interval the contacts of the first slow release relay will release, thereby interrupting the supply of energy to the second slow release relay, and after a short time interval its contacts will release.

Accordingly, the cessation of operation of the contact of the code following relay results in the release of the second slow release relay. Circuits for the control of various functions may be established over contacts of the second slow release relay.

It has been found that under certain conditions, erroneous operation of the code detecting relay occurs, particularly under the condition

2

known as "loss of shunts." This condition exists in a railway track circuit when a train occupying the track circuit fails to properly and continuously shunt the track relay, so that the track relay operates at times as though the track circuit were unoccupied. The loss of shut may be caused, for example, by sand or other non-conducting substance on the surface of the rails, or by light weight vehicles which do not provide a sufficiently low wheel-to-rail resistance. A particularly common cause of loss of shunt is presence of rust on the surface of the rails as found in cases where the track may not be used for long periods of time.

It will be seen that the false operation of the track relay under such conditions may cause undesirable effects if the loss of shunt is of sufficient duration to cause the track relay to energize the code detecting relays so that these relays pick up. With the usual type of front and back contact code detecting arrangements as described above, only one or two operations of the track relay contact are required to pick up the code detecting relays. Thus a momentary loss of shunt may cause the relays to indicate an unoccupied track circuit. This may result in the momentary display of a clear signal indication for the stretch of track, which is of course undesirable even for a short time since the engineman on the following train may see a signal change to clear, and thereafter busy himself with duties attendant to the operation of the train, and thus not see the signal return to stop. Another serious consequence resulting from a momentary loss of shunt occurs when a power operated switch is located in the track circuit involved, and is provided with electric detector locking, that is, the control circuits for the switch mechanism are governed by the code detecting relays in such manner that the switch cannot be operated when the track circuit is occupied by a train and the code detecting relays are released. In such a case, if a momentary loss of shunt occurs at the same time that the control circuits are otherwise energized for the switch mechanism, the switch would be operated, and might cause the derailment of the train.

It is evident from the foregoing that the prevention of operation of the code detecting relays during a momentary loss of shunt is of prime importance.

Accordingly, it is an object of my invention to provide apparatus for detecting the recurrent operation of a contact, which apparatus will not be improperly operated when the recurrently

operated contact operates for a short interval after a quiescent period.

Another object of my invention is to provide code detecting apparatus which is arranged so that the code detecting relays when once released must follow a definite cycle in again picking up, and if the cycle is interrupted must begin a new cycle before the circuits governed by the relays are closed.

Other objects of my invention and features of novelty thereof will be apparent from the following description taken in connection with the accompanying drawings.

In practicing my invention, I provide an auxiliary relay in addition to the usual front contact repeater and back contact repeater relays. This auxiliary relay is of the type which is slow acting. The auxiliary relay is governed by circuits including contacts of the front and back contact repeater relays so that the auxiliary relay is required to go through a cycle of operation, that is, either pick up and release, or release and pick up, each time the track relay starts to follow code after having been released. The various control circuits are then governed by contacts of the front and back contact repeater relays and the auxiliary relay, all connected in series, in order to determine that the auxiliary relay starts its cycle from a predetermined position and that the front and back contact repeater relays are both energized.

I shall describe two forms of code detecting apparatus embodying my invention and shall then point out the novel features thereof in claims.

In the accompanying drawings, Fig. 1 is a diagrammatic view of a section of railway track equipped with a signaling system employing code detecting apparatus embodying my invention. Fig. 2 is a fragmentary diagrammatic view of a modification of the apparatus shown in Fig. 1.

Similar reference characters refer to similar parts in each of the two views. In each of the views, the contacts of the slow acting relays are intersected by an arrow, the head of which points downwardly in the case of a slow release relay, and which arrows have a head on each end in the case of a slow release, slow pick-up relay.

Referring to Fig. 1 of the drawings, there is shown therein a section of railway track T having track rails 1 and 2, which are separated from the rails of the adjacent sections by the insulated rail joints 3. Traffic normally moves through this section from left to right, as indicated by the arrow. A signal S, which as shown is of the color-light type having a green lamp G and a red lamp R, is located at the entrance end of the section, and governs the entrance of traffic into the section.

A conventional type of coded track circuit is shown, including a coding device CT having a contact *a* which is recurrently operated between a first and a second position, and a track battery TB for supplying energy to the track section, the battery and coding device being located at the right hand or exit end of the section. At the entrance end of the section, there is provided a code following track relay TR, a front contact repeater relay FSA, a back contact repeater relay BSA, an auxiliary relay BSAM, and a control relay TPR.

In addition, there is provided at each end of the section a source of direct current energy such as the battery LB, whose positive and negative terminals are denoted by the reference characters B and N, respectively.

With the equipment in its normal condition as shown in the drawings, the coding device CT is continuously connected to terminals B and N of the low voltage battery, and as a result its contact *a* is recurrently operated at a selected rate, for instance, 180 times per minute. When contact *a* of coding device CT moves to its closed position, the track relay TR is supplied with energy by the circuit which is traced from the positive terminal of track battery TB, over front contact *a* of coding device CT, over section rail 1, through the winding of track relay TR, and over section rail 2 to the negative terminal of track battery TB. Accordingly, the contact *a* of track relay TR becomes picked up. After a short time interval, the contact *a* of coding device CT moves to its released position, interrupting the supply of energy to the track relay TR over section rails 1 and 2, and as a result contact *a* of relay TR is released.

From the foregoing, it will be seen that normally, with the track section T unoccupied, the track relay TR is supplied with coded energy from the track battery TB over the section rails 1 and 2, and the contact *a* of track relay TR is recurrently operated between its picked up and released position.

Each time front contact *a* of track relay TR closes, energy is supplied to the winding of relay FSA by a stick circuit which may be traced from terminal B, over front contact *a* of relay TR, over front contact *a* of relay FSA and front contact *a* of relay BSAM in multiple, and through the winding of relay FSA to terminal N. The relay FSA is provided with a resistor snub R1, to render the relay slightly slow in releasing. Each time that relay TR releases, a stick circuit is established for supplying energy to relay BSA, which circuit may be traced from terminal B, over back contact *a* of relay TR, over front contact *b* of relay FSA, over front contact *a* of relay BSA, and through the winding of relay BSA to terminal N. Relay BSA is provided with a resistor snub R2, and it will be obvious from the circuits that this snub is connected across the winding of relay BSA only when the contact *b* of relay FSA is picked up. The relays FSA and BSA are rendered sufficiently slow in releasing their contacts by the addition of the resistor snubs R1 and R2, respectively, so that these relays will retain their contacts in their picked up position during the momentary intervals in which energy is not being supplied to their windings, as a result of the code following operation of the track relay TR. Relay BSAM is supplied with energy at this time by a circuit which may be traced from terminal B, over front contact *b* of relay BSA, and through the winding of relay BSAM to terminal N.

With relays FSA, BSA and BSAM picked up, a circuit is established for supplying energy to the control relay TPR, which circuit may be traced from terminal B, over front contact *c* of relay FSA, over front contact *c* of relay BSA, over front contact *c* of relay BSAM, and through the winding of relay TPR to terminal N. With contact *a* of relay TPR picked up, an obvious circuit is established for supplying energy to the green lamp G of signal S.

From the foregoing, it will be seen that with section T unoccupied, the supply of coded energy from the track battery TB over the section rails 1 and 2 of section T to the track relay TR causes this relay to recurrently operate its contact *a* and this recurrent operation is detected by the code

detecting relays comprising relays FSA, BSA and BSAM. The energization of these relays causes the signal control relay TPR to be picked up, so that it governs the signal S to display a green aspect, denoting a clear stretch of track.

It will now be assumed that a train, moving from left to right, passes signal S and enters track section T. The wheels and axles of the train shunt the supply of energy to the track relay TR, and accordingly relay TR releases its contact *a* and this contact remains released so long as the train shunt continues. When contact *a* remains in its released position, the supply of energy to the winding of relay FSA is interrupted, and after a short time interval the contacts of this relay release. When contact *a* of relay FSA releases it opens the previously traced stick circuit for supplying energy to the winding of relay FSA. When contact *b* of relay FSA opens, the supply of energy to the winding of relay BSA is interrupted and additionally the resistor snub R2 is disconnected from the winding of relay BSA. Accordingly, the resistor R2 is no longer effective to render BSA slow in releasing, and it drops its contacts in a relatively short time after the opening of contact *b* of relay FSA. When contact *c* of relay FSA releases, it interrupts the circuit for supplying energy to relay TPR, and when relay TPR releases its contact *a* interrupts the supply of energy to the green lamp G of signal S and establishes a circuit for supplying energy to the red lamp R of the signal. Accordingly, it will be seen that at this time the signal S will display a red aspect denoting an occupied block.

When relay BSA releases subsequent to the release of relay FSA, its front contact *a* interrupts the stick circuit for supplying energy to the winding of relay BSA, and its front contact *b* interrupts the supply of energy to relay BSAM, but at this time the back contact *c* of relay FSA continues to maintain the supply of energy to relay BSAM. Front contact *c* of relay BSA additionally interrupts the circuit for supplying energy to relay TPR. Accordingly, during the time that the track section T is occupied by a train, the track relay TR will remain deenergized and its contact *a* will be released, and the relays FSA and BSA will be deenergized and their contacts will be released. However, at this time the contacts of relay BSAM are maintained in their picked up position due to the continued supply of energy to the winding of the relay over the circuit including back contact *c* of relay FSA.

When the train proceeds further, and eventually moves out of section T, energy is again supplied from battery TB over the section rails 1 and 2 to track relay TR, and the relay again follows code so that contact *a* of relay TR is recurrently picked up and released. When contact *a* of relay TR picks up for the first time, a pickup circuit is established for supplying energy to the winding of relay FSA, which circuit includes front contact *a* of relay TR and front contact *a* of relay BSAM, so that relay FSA is supplied with energy and its contacts pick up. When front contact *a* of relay FSA picks up, it establishes the previously traced stick circuit for supplying energy to the winding of the relay, which stick circuit includes front contact *a* of relay TR, and front contact *a* of relay FSA. Subsequent operation of contact *a* of relay TR causes energy to be supplied to relay FSA each time contact *a* of relay TR is picked up, and, as previously explained, the resistor R1 renders relay FSA sufficiently slow in releasing so that its contacts remain picked up during the intervals in which no energy is supplied to the relay winding. Relay TPR does not pick up when relay FSA picks up because front contact *c* of relay BSA still interrupts the circuit for supplying energy to relay TPR. The picking up of contact *c* of relay FSA interrupts the supply of energy to the winding of relay BSAM, since front contact *b* of relay BSA is open at this time. The interruption of energy to the winding of relay BSAM will result in the subsequent release of this relay, but the time interval between the deenergization of the relay winding and the release of the contact is relatively long, as determined by the construction of the relay, for example, by the use of heavy copper ferrules on the cores of the magnetic structure.

After a time interval has expired, relay BSAM will release its contacts. When front contact *a* of relay BSAM releases, it opens the pick-up circuit for relay FSA but since relay FSA has been previously picked up by the first operation of contact *a* of relay TR, it remains picked up and is recurrently supplied with energy over the stick circuit including front contact *a* of relay FSA. When contact *b* of relay BSAM releases, it establishes a pick-up circuit for relay BSA, so that on the first release of the track relay TR following the release of BSAM, a circuit for supplying energy to relay BSA is established. This circuit may be traced from terminal B, over back contact *a* of relay TR, over front contact *b* of relay FSA, over back contact *b* of relay BSAM, and through the winding of relay BSA to terminal N. Since front contact *b* of relay FSA is picked up at this time the snubbing resistor R2 is connected across the relay winding, and thus renders the relay BSA slightly slow in releasing. When relay BSA picks up its front contact *a* establishes the previously traced stick circuit for the relay, including front contact *a* of relay BSA, so that the subsequent pick up of contact *b* of relay BSAM will not result in deenergization of relay BSA. The release of contact *c* of relay BSAM further interrupts the circuit for supplying energy to the winding of relay TPR, so that this relay continues to remain deenergized.

The pick-up circuit for relay BSA having been established, and the relay having picked up on the following release of the track relay TR, a circuit will be established for again supplying energy to the winding of relay BSAM over front contact *b* of relay BSA. Relay BSAM, in addition to being constructed in such manner that its contacts are relatively slow in releasing, is also constructed and arranged so that its contacts are relatively slow in picking up after the application of energy to the relay winding. Such operation may be obtained by proper proportioning of the magnetic structure and by properly selecting the energy levels required for operation of the relay. Accordingly, there will be a substantial time interval between the time that front contact *b* of relay BSA is closed, thus establishing a circuit for supplying energy to the winding of relay BSAM, and the time at which the contacts of relay BSAM move to their picked up position. When the contacts of relay BSAM pick up, front contact *c* establishes the circuit for supplying energy to the winding of relay TPR, since the front contacts *c* of relays FSA and BSA were previously picked up, and as a result energy is again supplied to the winding of relay TPR and it picks up its contact *a* to establish the circuit for supplying energy to the green lamp G of signal S and to interrupt the supply of energy to the red lamp R. Thus the signal displays a green aspect

denoting an unoccupied block. The equipment is now restored to its normal condition as shown on the drawings.

From the foregoing, it will be seen that at any time the track relay TR stops following code, so that its contact *a* releases, relay FSA will drop out in a very short time, and when front contact *b* of relay FSA releases, the relay BSA will be deenergized and since the resistor snub R2 for this relay is disconnected by this action, relay BSA will release very shortly. If the track relay TR commences to follow code once more, it is necessary that relay BSAM release its contacts and subsequently pick up before relay TPR can again be energized. Thus, it will be seen that the periods during which the shut may be lost without clearing out the track circuit depends upon the release time and subsequent pick up time of relay BSAM which may be, for example, four seconds. Thus, if track relay TR should be shunted so that its contact releases momentarily and then again starts following code, it will take a period of approximately four seconds before relay TPR can again pick up. Moreover, it will be seen that if during the cycle of operation, the relay FSA should drop momentarily after relay BSAM is down, energy will be supplied to relay BSAM over back contact *c* of relay FSA, so that relay BSAM will again pick up and the cycle must be started anew in order to pick up relay BSA to complete the cycle to close the circuit for supplying energy to relay TPR.

To summarize, the arrangement shown in Fig. 1 and embodying my invention provides, in a code detecting arrangement of the conventional FSA—BSA type, an auxiliary relay which must operate its contacts through a predetermined cycle between the picking up of relay FSA and the picking up of relay BSA, and all three relays must pick up and remain picked up in order to energize the signal control relay TPR, to thereby indicate a clear track circuit.

In Fig. 2 there is shown a modification of the arrangement shown in Fig. 1, in which the relay BSAM is normally deenergized, and the cycle of operation includes the pick up and release of relay BSAM before the circuit for supplying energy to relay TPR is completed. The circuit for supplying energy to the relay BSAM includes a front contact *c* of relay FSA and a back contact *c* of relay BSA. Thus, relay BSAM will be energized only when the contacts of relay FSA are picked up and the contacts of relay BSA are released.

The apparatus is shown in its normal condition, with the contact *a* of relay TR being recurrently operated by impulses of energy supplied to the winding of the relay. At this time, energy is supplied to the winding of relay FSA over a stick circuit which may be traced from terminal B, over front contact *a* of relay TR, over front contact *a* of relay FSA, and through the winding of relay FSA to terminal N. Relay BSA is supplied with energy at this time by a stick circuit which may be traced from terminal B, over back contact *a* of relay TR, over front contact *b* of relay FSA, over front contact *b* of relay BSA, and through the winding of relay BSA to terminal N.

The resistor R1 connected across the winding of relay FSA renders this relay sufficiently slow in releasing that its contacts will remain in their picked up position during the intervals between the supply of energy to the relay winding. The relay BSA is provided with a snub comprising the resistor R2 and a condenser Q1, which is connected across the winding of relay BSA when relay FSA and relay BSA are both picked up. The condenser Q1 renders the relay much longer in releasing than the resistor R2 alone. Additionally, the relay BSA is constructed and arranged in such manner that its contacts are relatively slow in picking up when energy is supplied to the winding of the relay, for purposes which will be subsequently explained.

At this time, relay FSA and relay BSA are picked up and as a result, the circuit for supplying energy to the relay BSAM is open at back contact *c* of relay BSA. The relay TPR is supplied with energy by a circuit which may be traced from terminal B, over front contact *c* of relay FSA, over front contact *c* of relay BSA, over back contact *c* of relay BSAM, and through the winding of relay TPR to terminal N. Thus, with the apparatus in its normal condition as shown, the relay TR is operating its contact *a* recurrently between its front and back positions, the relays FSA and BSA are both energized, and relay BSAM is released. With these conditions established, energy is supplied to the winding of control relay TPR, and its contacts are picked up to establish a circuit such as those shown in Fig. 1 for governing the signal S.

When relay TR stops following code, as may be caused by the entrance of a train into the track circuit, contact *a* of relay TR will release and remain released. Accordingly, the supply of energy to relay FSA over front contact *a* of the relay is interrupted, and after a short time interval, the contacts of relay FSA will release. When contact *c* of relay FSA releases, it interrupts the supply of energy to the winding of relay TPR, and this relay releases to thereby interrupt the circuits governed thereby. When contact *b* of relay FSA releases, it interrupts the supply of energy to the winding of relay BSA and additionally disconnects the relay snubbing circuit, so that relay BSA releases relatively quickly. Since the stick circuit for supplying energy to the winding of relay FSA becomes opened when front contact *a* of relay FSA opened, relay FSA cannot again pick up, except by the closing of a pick-up circuit including back contact *a* of relay BSA and back contact *a* of relay BSAM.

When relay BSA releases, its back contact *a* closes in the pick-up circuit for relay FSA, but since contact *a* of relay TR is released at this time, no energy is supplied to the winding of relay FSA. When front contact *b* of relay BSA is open, the stick circuit for relay BSA is interrupted, and relay BSA can thereafter pick up only if front contact *b* of relay BSAM is closed. When contact *c* of relay BSA releases, it further interrupts the circuit for supplying energy to relay TPR. Although contact *c* of relay BSA is released, the circuit for supplying energy to relay TPR is interrupted by contact *c* of relay FSA, so that relay BSAM remains released.

From the foregoing, it will be seen that when the relay TR stops following code, the relays FSA and BSA are deenergized and release comparatively quickly to thereby deenergize the relay TPR. During the time that the track relay TR remains released, relays FSA, BSA, BSAM and TPR all remain released.

When impulses of energy are again supplied to relay TR, and its contact *a* recurrently picks up and releases, a pick up circuit is established for supplying energy to relay FSA which may be traced from terminal B, over front contact *a* of relay TR, over back contact *a* of relay BSA, over back contact *a* of relay BSAM, and through the

winding of relay FSA to terminal N. Accordingly, relay FSA will pick up, and its front contact *a* will establish the previously traced stick circuit for supplying energy to the relay FSA each time that contact *a* of relay TR picks up. When contact *c* of relay FSA picks up, a circuit is established for supplying energy to the winding of relay BSAM. This circuit may be traced from terminal B, over front contact *c* of relay FSA, over back contact *c* of relay BSA, and through the winding of relay BSAM to terminal N. Relay BSAM is constructed and arranged so that its contacts are slow in picking up after the application of energy to the relay winding, so that after a time interval the contacts of relay BSAM pick up. When contact *b* of relay BSAM picks up, a pick-up circuit is established for supplying energy to the winding of relay BSA each time that contact *a* of relay TR is released. This circuit may be traced from terminal B, over back contact *a* of relay TR, over front contact *b* of relay FSA, which is already picked up, over front contact *b* of relay BSAM, and through the winding of relay BSA to terminal N. As previously pointed out, the relay BSA is slow in picking up, so that the previously traced circuit for supplying energy to the winding of relay BSAM is maintained sufficiently long to insure the full energization of relay BSAM, and thus secure the maximum slow release time of relay BSAM. When relay BSA picks up, its front contact *b* establishes the previously traced stick circuit for supplying energy to the relay winding, and in addition, the circuit for the resistor-condenser snub of relay BSA is now completed over front contact *b* of relay FSA and front contact *b* of relay BSA, so that relay BSA will remain picked up during the intervals between the supply of energy to its winding. When relay BSA picks up, its front contact *c* interrupts the supply of energy to the winding of relay BSAM. At this time, relay BSAM is picked up and its back contact *c* interrupts the circuit for supplying energy to relay TPR, so that even though front contacts *c* of relays FSA and BSA are picked up, no energy is supplied to the winding of relay TPR. The relay BSAM is slow in releasing its contacts, so that after a predetermined time interval the contacts of relay BSAM will release, and when contact *c* of relay BSAM releases the circuit including back contact *c* of relay BSAM and front contacts *c* of relays FSA and BSA for supplying energy to the winding of relay TPR is again established. Energy is now supplied to the winding of relay TPR and it picks up, to thereby establish the circuits controlled over its contacts, such as those shown for signal S of Fig. 1.

From the foregoing, it will be seen that when the relay TR starts to follow code after having been at rest, it is necessary that the relay BSAM pick up and again release before relay TPR can be energized. By suitable selection of the relays and proper proportioning of the parts, it is possible to provide a circuit which is immune to a loss of shunt varying in time from approximately 3 to 8 seconds, for example, depending on battery voltage and other extraneous factors.

During the pick up cycle, if the contact *a* of relay TR should remain released momentarily for a sufficient time to cause relay FSA to open its contacts, the stick circuit for relay FSA governed by front contact *a* of that relay is interrupted, and relay FSA cannot again pick up until contact *a* of relays BSA and BSAM are both released and contact *a* of relay TR is picked up. Accordingly,

it will be seen that at any time that the relay FSA becomes released during the pick up cycle of the relays, the entire cycles must start over again before all of the relays can pick up to clear the signal. Thus, in any event, a certain time period must elapse between the initiation of the code following operation of relay TR and the picking up of the control relay TPR.

As evident from the foregoing description, the modification of my invention shown in Fig. 2 provides, in a code detecting arrangement of the conventional FSA-BSA type, an auxiliary relay which must operate its contacts through a predetermined cycle in order to energize the control relay, and additionally, the FSA and BSA relays must be energized and remain energized to keep the control relay energized. It will be apparent to those skilled in the art that the relay BSA may be of the ordinary acting type, rather than the slow pick-up type, but the slow pick-up type is preferable, since it increases the length of the operating cycle necessary to pick-up relay TPR, and also it insures that relay BSAM will be energized sufficiently long to insure obtaining the maximum release time of relay BSAM.

Although I have herein shown and described only two forms of code detecting apparatus embodying my invention, it is to be 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 combination, a code following contact recurrently operated at times between a first position and a second position, a first slow release relay, a first circuit for supplying energy to a winding of said first slow release relay when said code following contact is in its first position, a second slow release relay, a second circuit for supplying energy to a winding of said second slow release relay when said code following contact is in its second position and said first slow release relay is picked up, an auxiliary relay having slow operating characteristics, a third circuit for supplying energy to said auxiliary relay when said first slow release relay is released or said second slow release relay is picked up, said auxiliary relay having contacts interposed in said first and second circuits, and a circuit governed by contacts of said first and said second slow release relays and said auxiliary relay in series.

2. In combination, a code following contact recurrently operated at times between a first position and a second position, a first slow release relay, a first circuit for supplying energy to a winding of said first slow release relay when said code following contact is in its first position, a second slow release relay, a second circuit for supplying energy to a winding of said second slow release relay when said code following contact is in its second position, and said first slow release relay is picked up, an auxiliary relay having slow operating characteristics, a third circuit for supplying energy to said auxiliary relay when said first relay is picked up and said second relay is released, said auxiliary relay having contacts interposed in said first and second circuits, and a circuit governed by contacts of said first and second slow release relays and said auxiliary relay in series.

3. In combination, a code following contact recurrently operated at times between a first position and a second position, a first slow release

relay, a second slow release relay, and an auxiliary slow pick-up-slow-release relay; a pick-up circuit for said first slow release relay including said code following contact closed in its first position and a front contact of said auxiliary relay, a stick circuit for said first slow release relay including said code following contact closed in its first position and a front contact of said first slow release relay; a pick-up circuit for said second slow release relay including said code following contact closed in its second position, a front contact of said first slow release relay, and a back contact of said auxiliary relay; a stick circuit for said second slow release relay including said code following contact closed in its second position, a front contact of said first slow release relay and a front contact of said second slow release relay; a circuit for supplying energy to a winding of said auxiliary relay including a back contact of said first slow release relay and a front contact of said second slow release relay; and a circuit governed by front contacts of said first and said second slow release relays and said auxiliary relay connected in series.

4. In combination, a code following contact recurrently operated at times between a first position and a second position, a first slow release relay, a second slow release relay, and an auxiliary slow pick-up-slow-release relay; a pick up circuit for said first slow release relay including said code following contact closed in its first position, a back contact of said second slow release relay and a back contact of said auxiliary relay; a stick circuit for said first slow release relay including said code following contact closed in its first position and a front contact of said first slow release relay; a pick up circuit for said second slow release relay including said code following contact closed in its second position, a front contact of said first slow release relay, and a front contact of said second slow release relay; a circuit for supplying energy to a winding of said auxiliary relay including a front contact of said first slow release relay and a back contact of said second slow release relay; and a circuit governed by a front contact of said first and said second slow release relays and a back contact of said auxiliary relay connected in series.

5. In combination, a code following contact recurrently operated at times between a first position and a second position, a first slow release relay, a second slow release relay, and an auxiliary slow pick-up-slow-release relay, a pick up circuit for said first slow release relay including said code following contact closed in its first position and a front contact of said auxiliary relay, a stick circuit for said first slow release relay including said code following contact closed in its first position and a front contact of said first slow release relay; a pick up circuit for said second slow release relay including said code following contact closed in its second position, a front contact of said first slow release relay, and a back contact of said auxiliary relay; a stick circuit for said second slow release relay including said code following contact closed in its second position, a front contact of said first slow release relay and a front contact of said second slow release relay; a circuit for supplying energy to a winding of said auxiliary relay including a back contact of said first slow release relay and a front contact of said second slow release relay; a control relay, and a circuit for governing said control relay including a front contact of said first and said second slow release relays and said auxiliary relay connected in series.

6. In combination, a code following contact recurrently operated at times between a first position and a second position, a first slow release relay, and a second slow release relay, and an auxiliary slow pick-up-slow-release relay; a pick up circuit for said first slow release relay including said code following contact closed in its first position, a back contact of said second slow release relay and a back contact of said auxiliary relay; a stick circuit for said first slow release relay including said code following contact closed in its first postion and a front contact of said first slow release relay; a pick up circuit for said second slow release relay including said code following contact closed in its second position, a front contact of said first slow release relay, and a front contact of said auxiliary relay; a stick circuit for said second slow release relay including said code following contact closed in its second position, a front contact of said first slow release relay, and a front contact of said second slow release relay; a circuit for supplying energy to a winding of said auxiliary relay including a front contact of said first slow release relay and a back contact of said second slow release relay, a control relay, and a circuit for governing said control relay including a front contact of said first and said second slow release relays and a back contact of said auxiliary relay connected in series.

7. In combination, a code following contact recurrently operated at times between a first and a second position, a first relay having contacts which are slow in releasing, a second relay having contacts which are slow in picking up and slow in releasing, and an auxiliary relay having contacts which are slow in picking up and slow in releasing; a pick-up circuit for said first relay including said code following contact closed in its first position; a back contact of said second relay and a back contact of said auxiliary relay; a stick circuit for said first relay including said code following contact closed in its first position and a front contact of said first relay; a pick up circuit for said second relay including said code following contact closed in its second position, a front contact of said first relay, and a front contact of said auxiliary relay; a stick circuit for said second relay including said code following contact closed in its second position, a front contact of said first relay, and a front contact of said second relay; a circuit for supplying energy to a winding of said auxiliary relay including a front contact of said first relay and a back contact of said second relay, and a circuit governed by a front contact of said first and second relays and a back contact of said auxiliary relay connected in series.

8. In combination, a code following contact recurrently operated at times between a first and a second position, a first relay having contacts which are slow in releasing, a second relay having contacts which are slow in picking up and slow in releasing, and an auxiliary relay having contacts which are slow in picking up and slow in releasing; a pick-up circuit for said first relay including said code following contact closed in its first position; a back contact of said second relay and a back contact of said auxiliary relay;

a stick circuit for said first relay including said code following contact closed in its first position and a front contact of said first relay; a pick up circuit for said second relay including said code following contact closed in its second position, a front contact of said first relay, and a front contact of said auxiliary relay; a stick circuit for said second relay including said code following contact closed in its second position, a front contact of said first relay, and a front contact of said second relay; a circuit for supplying energy to a winding of said auxiliary relay including a front contact of said first relay and a back contact of said second relay, a control relay, and a circuit for governing said control relay including a front contact of said first and said second relay and said auxiliary relay connected in series.

9. In combination, a code following contact recurrently operated at times between a first position and a second position, a first relay having contacts which are slow in releasing, a second relay having contacts which are slow in releasing and slow in picking up, and an auxiliary relay having contacts which are slow in releasing and slow in picking up; a pick up circuit for said first relay including said code following contact closed in its first position, a back contact of said second relay and a back contact of said auxiliary relay; a stick circuit for said first relay including said code following contact closed in its first position and a front contact of said first relay; a pick up circuit for said second relay including said code following contact closed in its second position, a front contact of said first relay, and a front contact of said auxiliary relay; a stick circuit for said second relay including said code following contact closed in its second position, a front contact of said first relay and a front contact of said second relay; a circuit for supplying energy to a winding of said auxiliary relay including a front contact of said first relay and a back contact of said second relay, a control relay, and a circuit for governing said control relay including a front contact of said first and said second relay and said auxiliary relay connected in series.

10. In combination, a code following contact recurrently operated at times between a first position and a second position, a first relay having contacts which are slow in releasing, a second relay having contacts which are slow in picking up, and an auxiliary relay having contacts which are slow in releasing and slow in picking up; a pick up circuit for said first relay including said code following contact closed in its first position, a back contact of said second relay and a back contact of said auxiliary relay; a stick circuit for said first relay including said code following contact closed in its first position and a front contact of said first relay; a pick up circuit for said second relay including said code following contact closed in its second position, a front contact of said first relay, and a front contact of said auxiliary relay; a stick circuit for said second relay including said code following contact closed in its second position, a front contact of said first relay and a front contact of said second relay; means for rendering said second relay slow in releasing when and only when said first relay is picked up; a circuit for supplying energy to a winding of said auxiliary relay including a front contact of said first relay and a back contact of said second relay, a control relay, and a circuit for governing said control relay including a front contact of said first and said second relays and a back contact of said auxiliary relay connected in series.

11. In combination, a code following contact recurrently operated at times between a first position and a second position, a first relay having contacts which are slow in releasing, a second relay having contacts which are slow in picking up, and an auxiliary relay having contacts which are slow in releasing and slow in picking up; a pick up circuit for said first relay including said code following contact closed in its first position, a back contact of said auxiliary relay; a stick circuit for said first relay including said code following contact closed in its first position and a front contact of said first relay; a pick up circuit for said second relay including said code following contact closed in its second position, a front contact of said first relay, and a front contact of said auxiliary relay; a stick circuit for said second relay including said code following contact closed in its second position, a front contact of said first relay and a front contact of said second relay; means for rendering said second relay slow in releasing when and only when said first relay is picked up comprising a condenser and a circuit including a front contact of said first relay for connecting said condenser across a winding of said second relay; a circuit for supplying energy to a winding of said auxiliary relay including a front contact of said first relay and a back contact of said second relay, a control relay, and a circuit for governing said control relay including a front contact of said first and said second relays and a back contact of said auxiliary relay connected in series.

12. In combination, a code following contact recurrently operated at times between a first position and a second position, a first slow release relay, a second relay which is slow in releasing its contacts, an auxiliary slow pick-up slow-release relay, said auxiliary relay having contacts which are operable between a first and a second position; a pick-up circuit for said first relay including said code following contact closed in its first position and a contact of said auxiliary relay closed in its said first position; a stick circuit for said first relay including said code following contact closed in its first position and a front contact of said first relay; a pick-up circuit for said second relay including said code following contact closed in its second position, a front contact of said first relay, and a contact of said auxiliary relay closed in its said second position; a stick circuit for said second relay including said code following contact closed in its second position, a front contact of said first relay, and a front contact of said second relay; a circuit including contacts of said first and said second relays for governing said auxiliary relay; and a circuit governed by front contacts of said first and said second relays and a contact of said auxiliary relay, connected in series.

CRAWFORD E. STAPLES.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,082,465	Preston	June 1, 1937
2,243,725	Allison	May 27, 1941
2,350,657	Wynn	June 6, 1944